Economic Policies in Emerging-Market Economies

Festschrift in Honor of Vittorio Corbo

Ricardo J. Caballero
Klaus Schmidt-Hebbel

editors

Central Bank of Chile / Banco Central de Chile

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This Festschrift in honor of Professor Vittorio Corbo assembles frontier research on economic policies in emerging-market economies. This book addresses key policy questions in essays, theoretical models, and empirical research, in the fields of macroeconomics, financial integration, and economic development. The volume's twelve chapters are organized in five major areas. Two essays on development thinking discuss the relation between global trade and growth, and the evolution of development thinking. Three models develop new interpretations of the recent global financial crisis, focusing on financial markets, capital flows, and financial stability. The book's third part is comprised by three chapters on fiscal sustainability and fiscal rules. Monetary policy and the exchange rate are the subject of two subsequent chapters. The volume's final part comprises two chapters on the relation between poverty and economic growth, and between trade liberalization and economic performance.
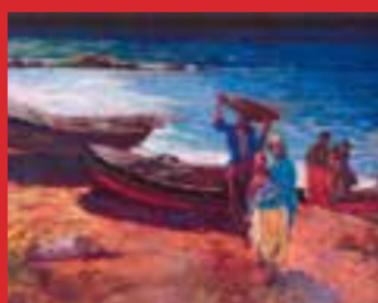
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FESTSCHRIFT IN HONOR OF VITTORIO CORBO

Ricardo J. Caballero
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Editors

Central Bank of Chile / Banco Central de Chile
Santiago, Chile

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Contributors

The articles presented in this volume are revised versions of the papers presented at the Conference in honor of Professor Vittorio Corbo, held in Santiago on 27-28 October, 2011. The list of contributing authors and conference discussants follows.

Contributing Authors

Félix Berríos
Rojas y Asociados
Santiago, Chile

Ricardo J. Caballero
Massachusetts Institute of
Technology
National Bureau of Economic
Research
Cambridge, MA, USA

Guillermo Calvo
Columbia University
New York, NY, USA

Giancarlo Corsetti
University of Cambridge
Cambridge, UK
Università Roma III
Rome, Italy
Centre for Economic Policy
Research
London, UK

José Ignacio Cuesta
University of Chicago
Chicago, IL, USA

William Easterly
New York University
New York, NY, USA
National Bureau of Economic
Research
Cambridge, MA, USA

Sebastián Edwards
University of California at Los
Angeles, CA, USA

Ibrahim Elbadawi
Dubai Economic Council
United Arab Emirates

Francico A. Gallego
Pontificia Universidad Católica
de Chile
Santiago, Chile

Felipe A. González
University of California at
Berkeley
Berkeley, CA, USA

Anne O. Krueger
Johns Hopkins University
Baltimore, MD, USA

Humberto López
World Bank
Washington, DC, USA

Alberto Martin
CREI, Universitat Pompeu
Fabra
Barcelona GSE
Barcelona, Spain

Paolo Pesenti
Federal Reserve Bank of New York
New York, NY, USA
National Bureau of Economic Research
Cambridge, MA, USA
Centre for Economic Policy Research
London, UK

Patricio Rojas
Rojas y Asociados
Santiago, Chile

Francisco Rosende
Pontificia Universidad Católica de Chile
Santiago, Chile

Klaus Schmidt-Hebbel
Pontificia Universidad Católica de Chile
Santiago, Chile

Luis Servén
World Bank
Washington, DC, USA

Raimundo Soto
Pontificia Universidad Católica de Chile

Matías Tapia
Pontificia Universidad Católica de Chile
Santiago, Chile

Jaume Ventura
CREI, Universitat Pompeu Fabra
Barcelona, Spain

Conference Discussants

Rómulo Chumacero
Universidad de Chile
Santiago, Chile

Kevin Cowan
Banco Central de Chile
Santiago, Chile

Jorge Desormeaux
Former Deputy Governor, Banco Central de Chile
Santiago, Chile

J. Rodrigo Fuentes
Pontificia Universidad Católica de Chile
Santiago, Chile

Miguel Kiguel
Econviews
Buenos Aires, Argentina

Felipe Morandé
Former Minister of Transport and Communications
Santiago, Chile

Andrea Repetto
Universidad Adolfo Ibáñez
Santiago, Chile

José Miguel Sánchez
Pontificia Universidad Católica de Chile
Santiago, Chile

José A. Tessada
Pontificia Universidad Católica de Chile
Santiago, Chile

Rodrigo O. Valdés
International Monetary Fund
Washington, DC, USA

Rodrigo Vergara
Banco Central de Chile
Santiago, Chile

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Economic Policies in Emerging-Market Economies: An Overview

Ricardo J. Caballero
Massachusetts Institute of Technology and
National Bureau of Economic Research

Klaus Schmidt-Hebbel
Pontificia Universidad Católica de Chile

Economic policies in emerging-market economies (EMEs) are shaped by the structural features and policy challenges of countries on their road to development. Convergence toward income levels of advanced countries is a difficult and bumpy road—it is even uncertain if and when most developing countries will overcome the middle-income trap—and EMEs differ in their particular conditions and progress toward development. Yet they face common issues and policy challenges that require systematic analysis. This volume addresses a selective number of key policy questions relevant to EMEs in the fields of macroeconomics, financial integration, and economic development.

This volume is a Festschrift that honors the life-long academic and professional achievements of Professor Vittorio Corbo Lioi. It comprises original scientific contributions by scholars, researchers, and friends that reflect their generosity and admiration for Vittorio Corbo. The twelve chapters of this volume are revised versions of the papers presented and discussed at the Conference in honor of Professor Corbo, organized by the Instituto de Economía of Pontificia Universidad Católica de Chile, in Santiago on 27-28 October, 2011.

We thank Pontificia Universidad Católica de Chile for its generous financial and personal support to make this Conference possible. Ignacio Sánchez (University President), Guillermo Marshall

(University Provost), Francisco Rosende (Dean of the School of Economics and Business Administration), and José Miguel Sánchez (Director of the Institute of Economics) gave their support to and participated actively at the Conference. We thank the corporate sponsors of the Conference and their board members and executives —Mauricio Larraín (Banco Santander), Andrés Castro (AFP Capital), and Álvaro Donoso (CorpBanca)—for their personal commitment to the Conference and the generous financial support provided by their corporations. We are also indebted to the Conference's excellent production team comprised by María de los Ángeles Ferrer, Macarena Montiel, and Carolina Gallegos.

Special thanks go to chapter authors that generously gave their intellect and their time to the success of the conference and this Festschrift by contributing excellent original research. We also thank paper discussants, session chairs, and conference participants for their valuable contributions.

We also thank warmly the Board and the staff of the Central Bank of Chile for including this Festschrift volume in the Bank's Book Series on "Central Banking, Analysis, and Economic Policies".

This Festschrift opens with a *Laudatio* in honor of Vittorio Corbo by Klaus Schmidt-Hebbel and closes with Professor Corbo's *Curriculum Vitae.* In between are the research chapters, organized around five major areas that are at the core of Vittorio Corbo's research and professional involvement.

The book's first chapters focus on two key dimensions of development thinking and policy. Anne O. Krueger, in her keynote lecture, derives the implications of rapidly growing EMEs for the world economy. Trade is a major growth engine, as reflected in the rising share of developing countries in both world exports and GDP. However, as argued by the author, the role of developing countries in general (and high-growth EMEs in particular) has oscillated between heterodox criticism, opportunistic silence, and free ridership of industrial countries' efforts toward liberalization of international trade and capital flows. Therefore Krueger calls for a more active and constructive role of EME governments and economists in supporting open markets for goods, services, and capital, attaining international agreements on migration and environmental protection, and strengthening multilateral institutions. This would be both in their interest and that of the world at large.

Sebastian Edwards' contribution on the war of ideas in development reviews the policy debates that have shaped economic thinking and

development policy during the last 50 years. He reviews the dominance of the planning approach to economic development from the 1950s to the 1970s, based on protectionism, forced industrialization, and government control. In the 1970s and 1980s, the planning approach suffered the double blow of its large-scale failures in most developing countries and the intellectual challenge posed by a growing number of economists and policy makers that espoused the market approach to development. The latter became the dominant development paradigm for most developing countries, since the 1980s and to date. A more specialized and still ongoing debate is between the supporters and the critics of foreign aid. Here, and regarding public policies in general, the author favors using randomized control trials to evaluate policy effectiveness, moving current and future policy debates from abstract thinking or aggregate assessment to the reality of field experiments and their statistical evaluation.

The volume's second part develops new interpretations of the recent global financial crisis, focusing on financial markets, capital flows, and financial (in) stability. Ricardo J. Caballero derives a stylized model of the workings of a global economy where one of its key driving factors is economic agents' continuous struggle to find assets in which to park financial resources. This struggle naturally comes with euphoria and disappointments, as many of the "parking lots" are built too quickly, are not of the desired size, or suddenly collapse. There are also global asymmetries, as some countries are endowed with more empty "land" than others, and their growth potential may also differ. The author uses this caricature of the world economy to describe several of the main driving forces behind recent global macroeconomic events, such as the steady decline in real interest rates, the spikes in risk spreads during the subprime crisis, the pattern of global capital flows between EMEs and industrial economies, or the struggles of the European periphery, and to explain the role played by "quantitative" easing-type of policies in this environment of (safe) asset shortages.

Guillermo Calvo shows in the following chapter that liquidity considerations provide a simple rationale for the creation and destruction of bubbles, and related disturbances in credit markets—the fall in collateral values, in particular. He presents a framework in which credit disturbances can explain jobless recoveries and involuntary unemployment. Jobless recovery follows from the assumption that job creation is at a disadvantage with respect to physical capital investment projects, because the latter come with

their own collateral. Involuntary unemployment arises because, due to severe working capital constraints, the full-employment real wage would ravage work ethic to such an extent that firms find it more profitable setting their wages above the full-employment level —even though nominal wages are perfectly downward flexible. The model does neither rely on Keynesian rigidities nor on the absence of a lender of last resort to explain protracted recessions with large involuntary unemployment, such as those following deep financial crises. The key is liquidity creation and meltdown.

Alberto Martin and Jaume Ventura offer new insights on the relation between financial reforms and capital flows. Due to debt enforcement problems, many high-productivity firms in EMEs are unable to pledge sufficient future profits to their creditors and this constrains the funding they are able to obtain. Many argue that, by relaxing these credit constraints, reforms that strengthen enforcement institutions would increase capital flows to EMEs. However, this argument is based on a partial-equilibrium notion, which does not take into account the origin of additional resources that flow to high-productivity firms after the reforms. The authors show that some of these resources do not come from abroad, but instead from domestic low-productivity firms that are driven out of business as a result of the reforms. Indeed, the resources released by these low-productivity firms could exceed those absorbed by highly productive firms so that capital flows to emerging economies might actually decline following successful reforms. This result provides a general-equilibrium perspective on some recent patterns of capital flows in industrial and emerging economies.

The following part of this book is on fiscal policy and fiscal regimes. William Easterly identifies growth slowdowns as one of the important causes of rising debt to GDP ratios and subsequent debt crises, as confirmed by some simple arithmetic borne out by recent experience in the U.S. and Eurozone, in middle-income countries in the 1980s, and in Highly Indebted Poor Countries (HIPCs) in the 1990s. It follows that preventing debt crises requires sound forecasting practices on future growth, such as projecting regression to the mean and making growth forecasts more conservative as the debt ratio to GDP gets higher. Unfortunately, political incentives often result in the opposite forecasting practices. The author provides examples from HIPCs and the U.S. that show growth forecasts getting more rather than less optimistic, perhaps to avoid confronting the need for difficult fiscal choices.

In recent decades a rising number of countries have adopted fiscal rules that constrain policy discretion with the aim of strengthening macroeconomic stability, fiscal sustainability, and resilience to government corruption and private lobbying. Ibrahim Elbadawi, Klaus Schmidt-Hebbel, and Raimundo Soto address empirically the question of why do some countries adopt and stick to fiscal rules while others do not. Their evidence, based on a large cross-country panel dataset, suggests that a dozen variables grouped in five sets of potential factors lead countries to adopt and hold to fiscal rules: more developed political institutions (democracy, federalism, checks and balances, and government stability), more sound fiscal policy conditions, particular monetary and exchange rate regimes (inflation targeting, fixed exchange-rates), financial development, and overall economic development.

Patricio Rojas and Félix Berríos analyze a puzzle related to the behavior of Chile's exchange rate. Adoption of a fiscal rule since 2001, which links government expenditure to long-term prices (and delinks it from current prices), should have reduced the high correlation between the price of copper (Chile's main export) and the exchange rate. However, this has not been observed. The authors address this puzzle by providing new evidence on several fundamentals that determine Chile's nominal and real exchange rates. First, they show that implementation of the fiscal rule has indeed reduced the impact of the copper price on the real exchange rate. Second, they provide evidence of other channels that explain why a higher price of copper appreciates the nominal exchange: higher prices of non-copper exports, improved expectations about global conditions affecting Chile, and higher domestic spending.

Part 4 of this book focuses on monetary policy and the exchange rate. Giancarlo Corsetti and Paolo Pesenti show that a monetary union (or a fixed exchange rate) can be perceived as an optimal policy regime, even if monetary unification does not foster real economic integration and intra-industry trade. In their model, firms choose the optimal degree of exchange rate pass-through as to stabilize markups in the face of real and monetary shocks. Monetary authorities choose optimal policy rules conditional on beliefs about firms' pass-through. Because of the interaction between these choices, there exist two equilibria. In the first, firms preset prices in domestic currency and let prices be determined by the law of one price, while floating exchange rates are optimal. In the second equilibrium, firms preset prices in consumer currency, and a common monetary policy is the optimal policy choice

for all countries, leading to higher business cycle synchronization across countries but not to a superior welfare outcome.

Francisco Rosende and Matías Tapia study Chile's 30-year road to low inflation. They provide evidence that Chile's successful stabilization, in a context of strong domestic growth, reflects both better domestic policies (in terms of objectives and actual policy management) and a favorable global supply shock that reduced inflation everywhere. Using structural break methods, the authors find that the inflation process has changed twice since 1977; both changes coincide approximately with relevant changes in domestic monetary and international conditions. Next they compare the statistical pattern of Chile's disinflation with those exhibited by G7 countries, confirming strong similarities between Chile and industrial countries regarding the timing of disinflation and the breaks in trend inflation and inflation volatility.

The final part of this volume is on economic growth, poverty, and trade policy. Humberto López and Luis Servén provide a direct empirical assessment of the impact of poverty on growth. The paper's strategy involves including poverty indicators among the explanatory variables in an otherwise standard empirical growth equation. Using a large cross-country panel dataset, the results show that poverty has a negative impact on growth that is significant both statistically and economically. This result is robust to a variety of specification changes, including different poverty lines, poverty measures, sets of control variables, and estimation methods, as well as allowing for linear and non-linear effects of inequality on growth. Further, at low levels of financial development, the adverse effect of poverty on growth works through investment. Hence financial market imperfections are a key ingredient of poverty traps.

José I. Cuesta, Francisco A. Gallego, and Felipe A. González assess the local effects of trade opening in Chile, exploiting the fact that municipalities differed strongly in effective rates of protection before the start of trade liberalization that made import tariffs low and uniform. Using a novel dataset from agricultural censuses over a period of 50 years, the authors find that agricultural output and specialization increased more in counties that started with negative effective rates of protection. In turn, average plot size, land concentration, and poverty rates declined in municipalities that had relatively more distorted prices before economic liberalization. Finally, although production declined in counties where effective protection fell, poverty did not increase more in these areas, which suggests that other activities developed there.

LAUDATIO OF VITTORIO CORBO

Klaus Schmidt-Hebbel
Pontificia Universidad Católica de Chile

Vittorio Corbo is one of Latin America's outstanding economists and, like some of his peers in the region, his contributions and his influence includes academia but goes well beyond academia. While academic economists in developed countries tend to focus more narrowly on research and teaching, the diversity of social demands and professional opportunities for first-rate economists is much larger in the developing world. Vittorio's 40 years of post-graduate career span a large range of contributions, commensurate with his broad talents and his enthusiasm for taking up new challenges. Hence I will refer to Vittorio's work and achievements as researcher, teacher, policy maker, and advisor. And obviously I will end by referring to Vittorio as a wonderful human being. But let me start with his early years.

The early years

Vittorio was born in Iquique, a port city in Northern Chile, on March 22, 1943. He is the youngest of five children of Italian parents. His father emigrated from the Basilicata region of Italy to Chile in 1927 and his mother was born in Chile to Italian parents. Vittorio attended public school in Iquique and enrolled in the Economics undergraduate program at University of Chile in Santiago in 1961.

His most influential teacher at University of Chile was Eduardo García d'Acuña, Chile's first Economics Ph.D. graduate from the

Massachusetts Institute of Technology (M.I.T.). As a student, Vittorio joined as a research assistant the first professional team of economists working with a Chilean government: the group comprised by Jorge Cauas, Álvaro Marfán, Eduardo García, and Joaquín Undurraga that advised President Eduardo Frei Montalva on economic matters. Subsequently Joaquín Undurraga and Eduardo García were part of the core group that formed ODEPLAN, the government's planning office, where Alejandro Foxley was a division chief and Jere Behrman a foreign advisor. Vittorio assisted research of this group during 1965-1967, contributing to the development of Chile's first macroeconomic model, a two-gap Keynesian development model, which turned into his first monograph, published in 1966.

Vittorio met Verónica Urzúa at University of Chile, where they studied economics together from day one through graduation. Quick both in his thinking and in seizing key opportunities, Vittorio graduated on July 13, 1967, got married to Verónica on July 14, and both departed Chile on July 15 for the United States to start Vittorio's Ph.D. studies at M.I.T.

The M.I.T. years were key for the Corbos, intellectually and family-wise. Marcello was born to Verónica and Vittorio in April 1968. Vittorio majored in Econometrics and Development Economics. Among his classmates at M.I.T. were Nobel prize recipients Robert Merton and Robert Shiller, as well as Jeremy Siegel and his subsequent co-authors and friends, Stanley Fischer and Hossein Askari. His dissertation on "Inflation in Developing Countries" combined frontier macroeconomics and econometrics and was guided by Ed Kuh, Robert Solow, and Frank Fisher. The two latter professors, as well as professors Paul Samuelson and Franco Modigliani, were his most influential teachers at M.I.T. Three of them are Nobel prize recipients, too.

Vittorio completed his dissertation in February 1971, graduating after three and half years at M.I.T. Then he received a job offer from Franco Modigliani and Robert Solow to be the director of an advisory M.I.T. team to Governor Ferrer of Puerto Rico. But Vittorio and Verónica had already decided to return to Chile. There Vittorio got an offer from Rolf Lüders to start his academic career at the Institute of Economics of Catholic University of Chile, which he accepted. The Corbo family returned to Chile in March 1971, when Vittorio joined as a young assistant professor our Catholic University. Three months later Ximena was born to Verónica and Vittorio.

The researcher

Vittorio's outstanding list of publications comprises until 2011 9 books, 75 journal articles, 67 book chapters, and more than 200 monographs, research reports, and policy assessments. His range of research fields and sub-fields is amazingly broad. Vittorio's work spans microeconomic theory of production functions; econometric theory; industrial organization and competition models of public services (particularly in telecoms); structural reforms in general and trade reform in particular; technical efficiency, productivity, and growth; closed-economy and open-economy macroeconomics; monetary policy, money demand, and inflation; monetary and exchange-rate regimes; fiscal policy; and international financial crises. In many of these fields, Vittorio has conducted theoretical work, empirical analysis, and policy evaluation.

His research is highly influential and very much quoted, as reflected by the almost 4000 citations of his work reported by Google Scholar until late 2011.

Let me describe, somewhat arbitrarily, a few highly quoted publications and areas of stellar research of Vittorio's intellectual output, representing the more than four decades of post-Ph.D. research started in early 1971 at Catholic University of Chile.

First I refer to his 1974 North-Holland/Elsevier book on "Inflation in Developing Countries", published in the prestigious series on "Contributions to Economic Analysis". This book was written in response to an invitation by Dale Jorgenson, the book series editor, to extend Vittorio's Ph.D. dissertation. With a Rockefeller Foundation scholarship for a post-doctorate at M.I.T., Vittorio returned during the Summer of 1972 to his alma mater to finish the aforementioned book. This is an exceptional volume that combines a review of the history of inflation modeling and of inflation in Chile with the development of a large macroeconomic model and the application of frontier econometric techniques to estimate the model on Chilean data. In the book's final chapter the model is put to work by Vittorio to simulate the macroeconomic effects of counter-factual policies that were acutely relevant to policy discussions in developing countries at that time (and are relevant to over-indebted emerging-market and industrial countries today): lower wages, relaxation of foreign resource constraints, and sale of foreign reserves.

Ten years later, in 1985, Vittorio publishes probably his most quoted and influential work in open-economy macroeconomics, namely

his 1985 Review of Economics and Statistics paper on "International Prices, Wages, and Inflation in an Open Economy: A Chilean Model". Paraphrasing and extending the previous Australian and Scandinavian open-economy models in the Salter-Swan-Corden-Bruno-Lindbeck tradition, his "Chilean model" broadens the previous literature in important dimensions that are today still at the core of the New Keynesian DSGE models for open economies: disaggregation of tradable goods into primary and manufactured goods, sector wage inflation rates specified as inflation-augmented Phillips curves, and inflation expectations modeled as partly rational and partly backward-looking. Then he validates the model for Chile, simulating the frequently-observed consequences of exchange-rate based stabilizations, namely real exchange-rate over-appreciation, unsustainable current-account deficits, and currency crises. Vittorio's model provides in this paper the analytical underpinnings of the disastrous Southern-Cone *tablita*-based experiences of the late 1970s and the subsequent likewise disastrous exchange-rate based stabilizations pursued by Argentina and Brazil in the late 1980s and 1990s.

Vittorio's most quoted paper (more than 200 citations according to Google Scholar) is his 1991 Journal of International Economics article on "The Effects of Trade Reforms on Scale and Technical Efficiency", co-authored with Jim de Melo and James Tybout. The authors analyze the change in industrial sector performance that came with Chile's radical trade liberalization of the 1970s. Comparison of pre- and post-liberalization manufacturing census data reveals little aggregate productivity improvement. However, industries undergoing reduction in protection showed improvements in efficiency levels and reductions in cross-plant efficiency dispersion. Why is this an important paper? Because it exploits micro data and applies frontier econometric techniques to address pressing questions about trade reform effects, which previously had been analyzed, in Chile and elsewhere, by using aggregate data.

Vittorio focused much of his research in the 1980s and 1990s on structural reform, macroeconomic adjustment, development strategies, and growth in developing countries—the main topics of his research division at the World Bank. He published 50 papers in these fields between the late 1980s and 2000, including his 3 chapters in North-Holland Handbook series and his AER paper on trade reform. He wrote much about development problems in Latin America. Yet he also shifted his attention beyond this region to address issues on structural reform, adjustment, and growth in Africa, Eastern Europe, and Asia, with a particular focus on Korea.

Just at the turn of the millennium, Vittorio began to work on monetary and exchange-rate regimes, central bank independence, and the conduct of monetary policy. This new research interest matched the spreading of regime shifts toward inflation targeting, flexible exchange rates, and rule-based conduct of monetary policy by newly independent central banks. Among his most original contributions on these issues are the following: his research on the evolution of monetary policy rules in Latin America toward more standard forward-looking Taylor rules as regimes shift toward inflation targeting and exchange-rate floats (the 2002 book chapter on "Monetary Policy in Latin America in the 1990s"), his negative evaluation of dollarization or a common currency for most Latin American countries ("Is it Time for a Common Currency in the Americas?", Journal of Policy Modeling, 2001), and his early and positive empirical assessment of the results of inflation targeting in the region (in half a dozen papers).

Finally I want to refer to a different output, not a scientific paper. I mean the policy report prepared at the request of Finance Minister Felipe Larraín, the 2011 "Report of the Advisory Committee for the Design of a Fiscal Policy of Structural Balance of Second Generation for Chile". While this is a collective work of the seven members of the ad hoc Committee, this volume bears clearly the imprint of the Committee's Chairman, Vittorio Corbo. It takes stock of the world policy frontier in fiscal institutions and fiscal policy rules, identifies the shortcomings of the current fiscal policy framework and fiscal rule, and makes recommendations for their improvement. While the report is on Chile, considering its relevance and its depth makes it very likely that it will influence future fiscal policy reforms in other countries, as already reflected in the recent adoption of a fiscal rule in Colombia.

Beyond his research output, Vittorio's academic career includes presentation of hundreds of seminars world-wide; reception of twenty research grants, awards, and distinctions; and holding many board positions in international professional societies, including the Vice Presidency of the International Economic Association.

The teacher

Vittorio's teaching career spans 41 years. He has taught at Catholic University of Chile, Clark University, Concordia University, Georgetown University, and University of Chile. He is Full Professor of Catholic University of Chile and Extraordinary Professor of

University of Chile, and has been Full Professor at Concordia University. His undergraduate and graduate courses span from econometrics to microeconomics, from macroeconomics to monetary theory, and from development economics to economic policy reform.

Vittorio is an amazing teacher who gets the highest student evaluations. For 12 years Vittorio and I shared teaching of the graduate seminar course on economic policy reform at Catholic University. It was very hard for me to get the same outstanding marks he would regularly get from our students.

Vittorio is a gifted presenter of complex ideas and loves engaging in lively discussion with his audiences of academics, policy makers, CEOs, and students. He is admired and appreciated by hundreds of students in Latin America, who have been taught and mentored by him. In every country in Latin America—and some countries in other regions—that is visited by a Chilean economist, he or she will be asked with keen interest and affection about Vittorio when that economist meets Vittorio's former students, which are typically holding high academic, private, or public sector positions.

Vittorio is enormously supportive of students applying to doctoral programs abroad. He always goes to the last mile in supporting selected applicants, calling up admission committee members to argue for admission of his student—as witnessed by Ricardo Caballero, who now is often on the other end of Vittorio's telephone line.

The policy maker

Inflation and monetary policy take central stage in Vittorio's research agenda. Hence it is not surprising that Vittorio came to serve his country as Governor of the Central Bank of Chile. When President Lagos, at a politically difficult juncture, nominated Vittorio as Board Member of the Central Bank, he said that he had selected "the best of all possible candidates". Vittorio's nomination was approved by a huge majority of Chile's Senators and then President Lagos appointed Vittorio Governor of the Central Bank of Chile, a position he held from May 2003 to December 2007.

Under Vittorio's leadership, the Central Bank of Chile was strengthened very significantly in two key dimensions of its mandate and performance. First, the Bank's policy framework, based on inflation targeting, a floating exchange rate, and careful monitoring of financial stability, was significantly strengthened. Transparency and accountability in the conduct of monetary policy and Central

Bank operations were improved significantly, inflation targets were met closely, and the peso floated freely, as the Bank did not engage in any exchange-rate intervention.

Second, internal efficiency and external accountability were significantly improved during Vittorio's tenure, by streamlining management and procedures of business functions, and improving financial transparency and public accountability.

The advisor

Since the beginning of his career, Vittorio has complemented his academic work with advising governments, central banks, international financial institutions, and, in recent years, private corporations. For example, as research advisor of a Chilean private corporation during 1979-1982, Vittorio mentored the work of half a dozen young economists during or before they attended graduate school in the U.S.

Vittorio, together with Patricio Meller, met Anne Krueger in the first half of the 1970s, when they were invited by Anne to join the famous NBER project on Trade and Employment, a project that led to many publications. One decade later, in the mid-1980s, Anne Krueger, then Senior Vice President of Research and Chief Economist of the World Bank, invited Vittorio to join the Bank as Senior Policy Adviser in the Development Research Department. He accepted her invitation, holding several managerial position in the World Bank's Operations and Research Departments. In these positions, Vittorio displayed intellectual leadership, managerial talents, and a great capacity in attracting young and motivated economists to work on the main development challenges of the day. Many participants and attendants of the 2011 Conference held in Vittorio's honor, including Ricardo Caballero, Giancarlo Corsetti, William Easterly, Ibrahim Elbadawi, Miguel Kiguel, Raúl Labán, Luis Riveros, Patricio Rojas, José Miguel Sánchez, Andrés Solimano, Luis Servén, Jaume Ventura, Rodrigo Vergara, Raimundo Soto, and I, were invited as staff or summer interns to work at Vittorio's Macroeconomic and Growth Division (DECMG). Other participants at the Conference, including Guillermo Calvo, Sebastián Edwards, Felipe Larraín, and Felipe Morandé, visited DECMG for shorter terms or participated actively in DECMG conferences.

Vittorio returned from Washington to academic life at Catholic University of Chile in 1991. Over the last two decades, Vittorio's

complementary role and reputation as highly-sought advisor grew steadily. After his period at the helm of Chile's Central Bank, Vittorio has expanded his portfolio of research, teaching, and advisory activities. Today he serves as Senior Research Associate at the Centro de Estudios Públicos, a leading public policy think tank in Chile. He also chairs or serves as a member of four major private corporate boards and as a member of advisory councils of the IMF and the World Bank. He advises governments and international financial institutions, and gives talks and seminars all over the world.

The human being

Is there a man beyond Vittorio Oeconomicus? Certainly. Among his private passions are reading, cooking, and skiing, preferably in the company of his beloved family. Vittorio is a devout family person. *Per Don Vito la famiglia viene prima di tutto*.

Yet Vittorio's gentleness extends much beyond his family. As countless colleagues, co-authors, and students attest, Vittorio exudes warmth and affection to all people that are lucky enough to meet and come to know him.

As Rick Mishkin says about our common friend: "Vittorio is a *mensch*". This wonderful yiddish noun of German origin, *mensch*, means "a person of integrity and honor". Yes, Vittorio is certainly a person of enormous integrity, honor, and fairness. And he treats with equal respect and gentleness a man on the street or a student, a company CEO or a nation's president. He is simply a gentleman.

Vittorio Corbo—*un uomo di famiglia, un caballero de tomo y lomo*, a true *mensch*. Vittorio is simply an exceptional human being.

Implications of Rapidly Growing Emerging Markets for the World Economy

Anne O. Krueger
Johns Hopkins University

It is an honor and a pleasure participating in this conference in honor of Vittorio Corbo. He has been a major contributor to the thinking on economic theory and policy with respect to development as an academic, as a World Bank official, as a consultant, and as Governor of the Banco Central de Chile. I first met Vittorio in connection with a comparative study that was then about to start analyzing foreign trade regimes and economic development. Vittorio's (with Patricio Meller) enthusiasm for the project and his contributions to it—in addition to those needed for the volume on Chile—were truly impressive. We have known each other as friends and colleagues ever since, including the time he spent at the World Bank, at several conferences, and on other occasions. I consider him as a friend and colleague, and cannot adequately express my esteem. All the praise bestowed upon him here is very well deserved.

My assigned topic is the implications for the international economy of the increasing share of the emerging markets. It is fitting as a topic to honor Vittorio both because of his participation in the emergence of these countries and because of his own support for, and contributions to, the multilateral system. Initially, I thought I would start by considering whether the relative importance of emerging markets will continue to increase over the next half-century or century as it has in the past. There are too many cases in the world of countries growing rapidly for a period of time and then gradually sinking back into relatively low-growth status. Argentina, regarded as one of the richest countries in the world around 1900, comes to mind. But even in more recent times, there have

been many instances of a growth spurt during which optimism about the future abounded, only to be followed by poor performance. Pakistan and the Philippines, each of which was regarded as having much more potential than India, are cases in point. Even those examples pale in comparison to consideration of the sorry state of the economy of Myanmar and of several African countries whose standards of living are below those of a half-century ago.

I do not think we can assume that present trends are guaranteed to continue. The history of economic advance is one in which progress has entailed both advances and new challenges. Those challenges, in turn, must be met if growth is to be sustained. As is all too painfully evident at the present time, the advanced economies themselves must rethink a number of aspects of financial regulation and sovereign debt if they are to resume healthy growth.

But for this talk, however, I will assume that the share of emerging markets will continue to increase, both with above-average growth of those countries already deemed emerging markets, and with the success of some additional countries that are now low income (although it is difficult to say which).

For that rapid growth to persist however, it will require changes in virtually all the dimensions of interdependence between countries that affect trade flows: trade policy itself, capital flows, ideas, international organizations, environment, and migration. I will present the challenges of each of these later, although I will spend most of my time on the first four.

The first question is how smoothly the emerging markets can be integrated into the world trading system as their share of trade and world output increases. To answer that, it is useful to remember how much change has happened in the past half-century, and how it was accommodated. That can give some insight as to the magnitude of changes that can be expected in the future, and their likely impact.

Let me start with trade. In 1950, world exports were US$57 billion, of which industrial countries accounted for US$36 billion. Developing countries' share was 37 percent of total world trade. Over the next two decades (by 1970), their share fell to 22 percent and then rose to 34 percent (primarily because of increases in oil prices) over the next decade before falling to 25 percent in 2000 but rising to 39 percent by 2010. Surely, these numbers conceal a lot: East Asia's share of trade —first Japan and then the so-called "Asian tigers"—was rising after 1960 even as the overall share of developing countries was still falling. Moreover, the composition of emerging and developing countries'

exports has changed with a much higher percentage of manufactured products and a smaller fraction of agricultural commodities.

However, even with those qualifications duly noted, the first observation to be made is that shares have fluctuated considerably across countries and regions while, at the same time, world trade has grown rapidly. Manufactured exports have grown at approximately twice the rate of growth of world GDP.

As such, trade has certainly served as an "engine of growth" of the international economy.

In the late l940s, the United States accounted for almost 30 percent of world exports. By l953, the share had fallen to 21 percent. By 2009, it had fallen to 8.6 percent. What is important to remember is that, during that same time, despite occasional (and deplorable) lapses, the American economy remained fairly open, and tariffs—on manufactures at least—fell from an average of more than 40 percent in the late 1940s to less than 5 percent by the turn of the century.

The ability of emerging markets to access the international market and to open their economies was an important factor enabling their rapid growth. What is less frequently noted is that world markets were increasingly opened during that period by the very countries that were losing share. Surely, there were protectionist pressures, but for the most part, they did not achieve much and trade barriers actually fell in the countries that were losing share (but nonetheless growing fairly rapidly).

When the emerging markets accessed the international economy, they had Europe and Japan as importers, as well as North America. When the next economies begin emerging, they will have all of those areas plus, it is hoped, the currently emerging markets as export destinations. Indeed, if the EMs do not embrace the newcomers, they will be unable to realize their own growth potential and will simultaneously reduce the potential of those countries that have not yet emerged from low-income status.

While Japanese exporters were challenged by those from South Korea and Taiwan, and those from South Korea, Taiwan, Hong Kong and Singapore were challenged by new entrants, especially including China and India, a crucial part of the growth process has been the shifting from lower to higher value-added activities. As comparative advantage has changed, the more advanced economies have shifted away from unskilled labor-intensive activities toward things that use their accumulated human and physical capital. The same now seems

to be starting as Chinese wages rise and factories are beginning to shift to Vietnam, Indonesia, and elsewhere.

If countries are unwilling to contemplate such shifts, they will not only thwart their own growth but that of the remaining low-income countries. Because there are always frictions in such shifts, the role of the World Trade Organization will be more important than ever. But, as I shall discuss below, with the increased importance of the emerging markets, they will need to play a more active and constructive role in the WTO (and other international organizations) than they have in the past, recognizing their stake in a healthy, well-functioning WTO and not only their own short-term self interest.

Capital flows are a second major facet of the international economy. The world economy cannot become increasingly integrated without fairly open capital markets. Capital controls cannot be very binding without beginning to affect trade because there are too many ways in which trade invoices can be adjusted, and the authorities take some time to approve "legitimate" trade transactions.

The challenges of maintaining a sufficiently open international capital market to support world economic growth and simultaneously achieve a regulatory and supervisory framework to strengthen financial stability are daunting. All countries have an interest in finding the appropriate framework, and there are clearly international dimensions: any country that significantly tightens its regulatory and supervisory standards on its own may well find that its financial institutions are at a disadvantage in international competition. There are also issues of cross-border ownership, supervision, and responsibilities for overseas branches and subsidiaries, and much more.

Before concluding that any tightening of supervision and regulation is desirable, it should be borne in mind that the financial system plays a crucial role in any modern, growing economy. Enabling savers' resources to finance the appropriate array of risk-adjusted assets is central to economic growth; many poor countries initially have very low saving rates and need to access international markets in order to raise their investment rates once appropriate macro and microeconomic policies are in place. It is often forgotten that South Korea's net capital inflow averaged around 10 percent of GDP during its first decade of very rapid growth. Its saving rate in 1960 was close to zero; it rose rapidly with growth. But that growth needed financing in its early stages. Interestingly, most of the capital inflow was in the form of debt obligations assumed by the government, but the debt-to-GDP ratio did not rise because growth was sufficiently rapid.

Appropriate changes to oversight of the international financial system are needed and will happen, but it is crucial for the prospects of those countries not yet embarked on rapid growth that they be able to access international capital markets when there are high risk-adjusted return opportunities. Benefits of open capital markets to the emerging markets themselves should not be underestimated.

There are also issues surrounding the possibility of discriminatory capital flows as has already happened in some of the Free Trade Agreements (FTAs). It would be much in the interest of emerging markets to support enhanced purview over capital flows in the multilateral system. It is difficult to envision the consequences of a world economy with truly discriminatory capital control regimes as envisaged in some free trade agreements.

The third area is ideas. It is seldom listed as one of the key ways in which countries are interdependent, yet it is striking how rapidly ideas spread across national borders. Ideas such as inflation targeting are transmitted among countries very quickly and affect policies in many countries. One of the areas where, in my judgment, emerging markets have yet to contribute sufficiently is in the realm of ideas. Too often, contributions to op-ed pages, policy and academic journals, and other fora, have consisted of critiques of the international economic system with little by way of constructive alternatives.

It may be (possibly legitimately) objected to that the industrial countries' influence has been so great that contributions from policy makers, academics, and others in developing countries would have been or were ignored. But even so, as the relative importance of emerging markets in the international economy increases, the world will need a greater participation from emerging markets. It needs to take two forms: new ideas, but also effective communication of the role and interests of emerging markets. To take but one example of the latter, it is striking how often most Americans view most emerging markets as having "graduated," while most in emerging markets view their countries as still struggling to achieve that status. Even with respect to new ideas, the media representation of spokesmen from emerging markets is relatively sparse.

This brings me to the fourth concern: international organizations. Arguably, small countries have a much greater interest in the ability of international organizations to oversee trade, capital flows, and much more, than the large countries do. Yet, from World War II until the end of the century, the industrial countries not only took the lead in the multilateral organizations but were also, generally, their

strongest supporters. Emerging markets and the least developed countries have taken international organizations as given, and been free riders without much regard for the preservation or strengthening of the system as a whole.

When the industrial countries accounted for two thirds or more of world trade and capital flows, a relatively small group of countries could, for all practical purposes, lead those organizations. Moreover, most of the then developing countries generally opted out. They did not actively negotiate tariff reductions and the removal of quantitative restrictions under the GATT/WTO but instead used the balance of payments provisions of the GATT to maintain their inner-oriented regimes. They benefitted enormously from the growing international market and from the reductions of trade barriers among industrial countries (which were done on an Most-Favored Nation basis).

They were generally recipients of IMF support when balance of payments crises arose and, as such, were perhaps not in much of a position then to play a leadership role. Their chief contribution in the realm of policy dialogue was to criticize the status quo rather than to develop feasible constructive proposals for strengthening the system in a manner consistent with their interests.

That has now changed in two important ways. On one hand, the advanced countries no longer hold a dominant share in the international economy. Whether discussing trade, behavior of reserves, or capital flows; emerging markets are important players and the multilateral institutions cannot function effectively without their increased participation and support. On the other hand, emerging markets bear a strong responsibility for assuming a highly supportive role for multilateral solutions and governance.

To date, there has been little more than lip service to the Doha Round as emerging markets have either objected to aspects of possible deals or have been silent. Yet its completion is urgent, even more so in the interests of emerging markets than low-income countries and advanced countries. More generally, emerging markets need to take much more responsibility for protection and support of the open multilateral system.

A number of new issues—preferential trade arrangements, discriminatory capital flows, and the environment—must be addressed. Yet, as long as the Doha Round is not completed, the legitimacy of the WTO is undermined and it does not seem possible to address the new issues. As more and more policy makers give up on the possibility of a successful conclusion of Doha, there is an increasing resort to FTAs. Within a multilateral framework (which should be strengthened),

increased FTAs can be a step toward more open multilateral trade and addressing the new issues. But without that framework, which languishes with the passage of time and no Doha agreement, there are significant risks of economic and political differences emerging from FTAs. Yet the voice of the emerging markets urging the closure of Doha is little heard. Worse yet, NGOs' support of emerging markets and least developed countries continue to believe that open trade is not in the interests of those countries, and there is almost no pushback from policy makers and academics from there.

The last two items, migration and the environment, are also key issues for emerging markets, and other countries. In the case of migration, it is difficult to foresee any significant relaxation of the existing national regimes in the near future. Within the WTO, it should be possible to negotiate temporary work visas for construction and other services, but that awaits the conclusion of the Doha Round. Beyond that, one has to hope that when the rate of world economic growth picks up, the current political climate of hostility toward migration will diminish. Indeed, at least in the United States, there are already signs that some are beginning to recognize the benefits of immigration. With concerns about aging populations and increased ratios of dependents to working-age population, it is likely that stances will soften and perhaps reverse, but for now it is likely that there will be no multilateral regime and no significant changes in the status quo with regard to international migration. But voices from emerging markets could support progress and improved policies on these issues, even if the likelihood of achieving a Pareto-optimal regime is small.

Issues concerning the environment are much more divisive than issues concerning trade and capital flows between emerging markets and advanced economies. Certainly, conflicts between those viewing the stock of pollutants as the basis on which policy should be made and those regarding the flows of emissions being critical and in the interests of all must somehow be resolved. I have little to say about that, except to say that the emerging markets bear responsibility for participating in dialogue and helping reach workable arrangements.

However, in that resolution, there are dangers for the trading system and the international monetary system. It is all too easy for producers in any country to claim that their costs are higher because of environmental taxes or regulations. Sometimes they may be telling the whole truth, but it is tempting to use the environment as a basis for achieving competitive advantage. Some surely do so. It will be important for the global economy that environmental agreements are

reached that avoid enabling the emergence or reemergence of strong protectionist pressures. While environmental issues must surely be addressed, it would be a tragedy if that happened in a way that enabled a reversal of the integration of the international economy, the gains in living standards, and reductions in poverty that that has accomplished. Again, constructive voices and ideas from emerging markets are needed more than ever to assure that environmental objectives can be achieved without undermining the open multilateral trading system.

Let me try to summarize. Forecasts for the future are always hazardous and it is by no means assured that the international economy and individual countries will progress as they did in the past. But the past sixty years have witnessed rising life expectancies, literacy rates, nutrition standards, and other aspects of well-being unprecedented in history. With appropriate policies, these gains can be entrenched while those still left out can be brought into the prosperous world, and emerging markets can achieve further gains.

One forecast puts the share of developing and emerging economies in world trade rising from less than 30 percent in 2006, to just over 70 percent in 2050, while advanced economies' share falls in like amounts. Of that increase, much is expected to come from the very large emerging markets. Trade among emerging markets will increase and the emerging markets will become much larger trading partners of the now poor countries.

With that increase, the role of emerging markets in the international economy and in multilateral institutions must grow. The emerging markets need to take on a larger role and heightened responsibility for the maintenance and preservation of an open multilateral trading system as a whole, a well-functioning international financial system, and even preservation of the environment.

Much has been said to the effect that the emerging markets deserve more representation at the multilateral institutions. That is surely so. But the low-income and advanced countries deserve more support from emerging market countries for preservation and strengthening of multilateral institutions. The advanced countries may have looked after their self-interest disproportionately over the past half-century, but they did maintain the open multilateral trading system with little support from emerging markets, and liberalized their own trade policies enabling the acceleration of growth in emerging markets. Emerging markets can no longer play the *free riders*' role on the system, and need to look not only at their narrow self-interest but also at their interest in the effective functioning of the multilateral system as a whole.

The War of Ideas in Economic Development: A Historical Perspective

Sebastián Edwards
University of California, Los Angeles

In the early1970s, when he had barely turned thirty years old, Vittorio Corbo was already a legend of sorts among development economists. His dissertation at M.I.T. became an instant classic, a work that had to be read by anyone interested in understanding the dynamics of inflation in developing nations. It was published in 1974 by North Holland as "Inflation in Developing Countries: An econometric study of Chilean inflation." In many ways it was a book that stood side by side with the most influential works on the subject, such as Felipe Pazos' celebrated volume on the persistence of inflation in Latin America.

I met Vittorio for the first time in the mid 1970s when he visited Chile and gave a lecture in an econometrics course being taught by Patricio Meller, another giant of Chile's economics profession. It was immediately evident to my classmates and me that Vittorio was a great economist, a rare breed that combined intuition with great rigor and insight. But more important than that, we rapidly realized that he was a generous person, a prominent academic willing to dispense advice to young economists to be. That has been a constant with him: his unselfishness and capacity to mentor and help the younger generations.

In the late 1970s and early 1980s Vittorio Corbo played an important role in helping shape a fundamental change in development economics as a field. His many scholarly contributions on macroeconomic adjustment, exchange rates, inflation and reform had great impact in the academic world, and helped promote a view of economic development

that emphasized trade openness, markets, productivity growth, and macroeconomic stability. From today's perspective all of this seems to be quite evident. However, in the early 1980s espousing those views was still a rarity.

Vittorio, however, was not satisfied with being an "ivory tower" economist. For him economics has always been an applied discipline, one that affects people's wellbeing and contributes to building and strengthening the social fabric of a nation. In 1984 Vittorio accepted an offer from the World Bank and joined a team led by Anne Krueger that helped define the intellectual backbone that guided the Bank's new structural adjustment programs. He later became the Chief in the Bank's Macroeconomic Division, and from that post he put together an influential and ambitious research program on a number of issues related to economic reform and transition. A few years later Vittorio was appointed governor of the Banco Central de Chile, and became instrumental in the consolidation of Chile as a low inflation nation, as a country that would be frequently cited as an example of how to run macroeconomic policy. In 2006 and as recognition of his brilliant work he was named "Central Banker of the Year" by *Global Finance Report Card* magazine.

Vittorio Corbo has been both a witness and a player in many of the intellectual battles of the last four decades: first as a student, then as an academic, later as an official at the World Bank, and more recently as one of the most respected central bankers in the Americas. In this paper I provide a review of these policy debates and I discuss how thinking on economic policy in emerging nations has evolved since the 1950s. The discussions center on three issues: (1) the most important tenets of the "planning approach" that was dominant from the end of World War II until the early 1980s; (2) the ascendancy of the market-oriented and pro-competition view in the 1980s, a view sometimes referred to as "the Washington Consensus." And (3) policy and academic debates on the efficiency of foreign aid to emerging nations.

1. THE PLANNING APPROACH TO ECONOMIC DEVELOPMENT

During the 1960s and 1970s there were competing views on economic development; indeed, it is not an exaggeration to say that there was a "war of ideas." On one hand, a large group of economists didn't trust markets, and believed that in poor countries planning had

to guide resource allocation. According to this view, which was in vogue when Corbo was an undergraduate student in the 1960s, protectionist policies provided the most effective way of fostering industrialization and encouraging growth. Most economists that supported the planning perspective believed that the state should own large firms, banks, and trading companies. Some key representatives of this approach included Ragnar Nurkse, Paul Rosenstein-Rodan, and Albert Hirschman. In Chile, the main representatives of this school of thought were Anibal Pinto and Osvaldo Sunkel.[1] On the other hand, a smaller group of thinkers, including Hungarian-born Peter Bauer and T.W. Schultz from the University of Chicago, believed that market forces and competition provided the best institutional arrangement for developing countries, and that openness and export expansion were essential for achieving rapid productivity gains and sustained growth. In the Latin America of the 1960s some of the very few economists in this camp worked at the Universidad Católica de Chile, the institution where Vittorio would later spend much of his own academic career.

The planning approach became particularly influential in Africa, a continent that during the 1960s was slowly beginning to emerge from a long colonial period. Many of the independence leaders were educated in the United Kingdom and were highly influenced by Fabian Socialist ideas. For example, Julius Nyerere, from Tanganyika, attended the University of Edinburgh; Jomo Kenyatta, from Kenya, and Seewoosagur Ramgoolam, from Mauritius, went to both University College and the London School of Economics; and Kwame Nkrumah, from Ghana, was enrolled in the London School of Economics. However, not all Fabian socialists in Africa were exactly alike; in each country different policies were implemented at different times. In Kenya and Zambia, for example, planning was light and, at least until the late 1970s, market signals were allowed to operate in most sectors. In contrast, and as Ndulu (2008) has pointed out, Tanzania, Mozambique and Ethiopia, followed from early on a more intense form of planning where markets were repressed significantly and the state played a growing role in the productive, investment, and distribution spheres. In these countries most large firms, banks and insurance companies were nationalized.[2]

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1. Of course, there were significant differences among the representatives of what I have called the "planning perspective." This was anything but a uniform group.

2. As Ndulu (2008) points out, Mauritius's Ramgoolam followed a pragmatic path, and never succumbed to the promises of full-fledged planning.

The planning approach was also popular in other parts of the world. In India, Nehru strongly believed that the state should control most decisions regarding production, investment, and distribution. Indian planning efforts were developed by Professor P.C. Mahalanobis, who during the late 1950s became a legend of sorts among development practitioners from around the world. In Latin America, as noted, it saw its heydays during the 1960s. Indeed, after President John F. Kennedy announced the Alliance for Progress in 1961, planning became a fundamental component of policy formulation. In fact, having a well-functioning Department of Planning was a precondition for obtaining aid under the Alliance guidelines. Planning in Latin America, however, was significantly lighter and less intrusive than in Africa and India. Planning was also important in forging economic policies in Sukarno's Indonesia and in Razak's Malaysia.

1.1 Unlimited Supplies of Labor, Market Failures, and Protectionism

At the core of the planning view of development was the notion that the accumulation of physical capital was the main source of economic growth, and that the availability of labor was not a major constraint to economic expansion. These beliefs were based on two theoretical frameworks that had become popular in the 1950s: the Harrod-Domar model that emphasized the roles of the capital-output ratio and the saving rate in determining long-term growth, and the Arthur W. Lewis (1954) unlimited supplies of labor model that assumed that enormous quantities of labor were available at very low (almost zero) wages. According to these models, policies aimed at raising the aggregate saving and investment ratios were fundamental components of any successful development strategy. In countries where domestic saving was very low, it would be supplemented with foreign saving in the form of foreign aid. At the same time, the government would make efforts to generate (or "mobilize") additional resources to finance capital accumulation. These resources, in turn, would come from "surplus" generated by the primary (agricultural, timber, and mining) sectors.

A central assumption of the planning approach was that markets didn't work well, and that if left on their own they would generate undesirable outcomes. These "market failures" were the result of a combination of factors, including the absence of competition

due to the small scale of operation of most firms, consumers' ignorance, incomplete information, politicians that were captured by multinational and large domestic corporations, and the exploitation of poor countries by rich ones. Another key belief of the planning perspective was that poor countries' terms of trade would experience a secular deterioration. According to this view, promoted by Hans Singer and Raul Prebisch, among others, the global demand for developing countries' exports (commodities) had a low income elasticity, while advanced countries exports (manufactured goods) had a high elasticity. As a consequence, the relative prices of poor nations' exports were destined to decline through time. This called for a rapid industrialization process, which had to be encouraged through an array of subsidies, preferential treatments, protective import tariffs, licenses and quotas, outright prohibitions, and mandatory allocation of credit.

Marxist and neo-Marxist thinkers provided a more extreme version of this view that emphasized the fact that poor countries "depended" on rich nations for markets, capital equipment, consumption goods, and financing. Dependency theorists, including Samir Amin and André Gunder Frank, argued that poor countries had to severe economic and commercial ties with rich nations, including, in particular, former colonial powers. This required political will, as well as the implementation of "South-South" trading arrangements. Other dependency theorists, including Fernando Henrique Cardoso and Enzo Faletto in Latin America, stayed away from doctrinal or "vulgar" Marxism, but still emphasized the relations of dependency between the center and the periphery.

Some supporters of the import-substitution strategy—and most notably Albert O. Hirschman—argued that in order for this policy to succeed, two conditions were required. First, protectionist measures had to be temporary, and import tariffs had to be lowered through time. More generally, import tariffs and other restrictions on international trade had to be sufficiently high as to protect the targeted industry, and low enough as to act as a "pressure mechanism" that forced producers to improve productivity. And second, only selected industries should be protected. This recommendation was part of Hirschman's conviction that a healthy and successful growth process was always "unbalanced," and that some industries and sectors were to grow faster than others for prolonged periods of time. Hirschman contrasted his "unbalanced growth" view with the indiscriminate creation of large state-owned manufacturing

firms, and massive and blanket protection. This latter perspective was associated with the "big push" approach to industrialization, supported by Paul Rosenstein-Rodan, an early advocate of large, ambitious, and detailed plans to forge comprehensive development strategies.

According to Hirschman's theory—which became very popular in academic and policy circles—trade restrictions should be used to protect and encourage those sectors with strong "forward and backward linkages." That is, protection should be provided to those industries whose expansion would, at the same time, feed into other promising industries, and demand inputs and materials from deserving sectors. During the 1960s and 1970s steel was usually mentioned as an example of an industry with significant forward and backward linkages. On one hand, steel mills required iron ore and coke coal, and, on the other, the finished product could be used in the manufacturing of white goods, automobiles, trucks and tractors, and in construction. The proper implementation of this model required a remarkable amount of fine tuning and very precise and detailed knowledge of the economy; indeed, it required the type of knowledge that no government official—not even the best trained, most cable and well informed ones—was likely to have, or ever acquire. Which industries had the greatest linkages? By how much should they be protected? And, for how long? What was the combination of import tariffs, quotas and licenses that would provide the adequate "pressure mechanism" to force firms to become efficient? And, more important, how to make sure that policy makers were not captured by lobbyists (either from the private or parastatal sectors) that claimed that their specific sector had extremely high linkages and was utterly deserving of protection? As Columbia University Professor Carlos F. Díaz-Alejandro put it, the problem with Hirschman's linkages approach was that its policy implications were extremely complex and were likely to become "dangerous in the sloppy hands of mediocre followers."[3]

As in turns out, in most poor countries—including Latin American and African nations—protection became general and massive, subsidizing industries with a high degree of linkages, low linkages, and no linkages at all. In many countries it took the private manufacturing sector no time to capture policy makers and

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3. Díaz-Alejandro (1984), p. 113.

to convince them that their particular industry was exceptional, had great promise, contributed to the process of technological transfers from the advanced world, was essential for bettering social conditions, and deserved to be protected by tariffs, quotas and even straight prohibitions. In other countries managers of state-owned enterprises played a similar game, and were able to convince policy makers to erect high protective walls around their specific industries. But that was not all. The maze of regulations became so intricate that it paid to obtain exemptions. Of course, those that managed to become sole importers at low (or zero) import duties made fortunes in very short periods of time. Tariff books throughout the Third World became huge monsters that detailed import duties for tens of thousands of goods, described the extent of restrictions and regulations, presented sliding tariffs' schedules, detailed the coverage of prior licenses and the levels of surcharges, and specified a number of exemptions. In many countries the granting of import duties and tax exemptions led to severe corruption and governance problems.

1.2 Elasticity Pessimism and the Dread of Devaluation

Supporters of the planning perspective assumed that in poor countries producers and consumers' responses to price incentives were limited. In that regard, there was a generalized "elasticity pessimism." A particularly important consequence of this view was the belief that peasants' efforts were not significantly affected by changes in crop prices. This view was particularly prevalent among many development economists that worked in Africa. As a result, it was thought that governments could use marketing boards with monopsony power to pay peasants a low fraction of international prices for their crops, and use the resulting "surplus" to finance the industrialization effort.[4]

Planners were especially skeptical and pessimistic regarding the role of exchange rate changes in the adjustments process. They strongly believed that trade elasticities were low and that the "structure" of the economy was more important than price incentives in foreign trade. According to the Marshall-Lerner condition, if the sum of the price elasticities of demand for imports and of the supply for exports is less than one, currency devaluation would fail

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4. In Africa, marketing boards were a legacy of colonial times.

to improve the balance of trade. Planners' resistance to devaluation was also based on the idea that under certain conditions devaluations could be contractionary, reducing the level of aggregate demand, a point made by Hirschman in 1949, and emphasized with great force by Díaz-Alejandro in 1963.[5]

In addition, supporters of the planning view believed that currency devaluations were passed onto domestic prices rapidly and fully, thus fueling inflation and reducing real wages in the urban sector. The "structuralist" views on exchange rates were in contradiction with those developed at the IMF, where it was thought that a properly implemented devaluation—that is, one accompanied by a reduction in aggregate expenditure or absorption—would succeed in improving the balance of trade. According to the Mundell-Fleming model developed at the IMF, devaluations are expansionary, resulting, under most circumstances, in an increase in aggregate demand. Throughout his career Vittorio Corbo has undertaken a number of research projects related to the general topic of exchange rate adjustment, resource allocation, and inflation. For example, he deals with these issues in chapter 3 of his 1974 book, and again in his celebrated article in the 1985 *Review of Economics and Statistics*.

Economists that subscribed to the planning view had great faith in their models' abilities to calculate accurately the "requirements" —both direct and indirect—for achieving certain development targets. These figures were obtained by manipulating, in different ways, input-output matrices. A byproduct of these exercises was the computation—as the dual to the planners' optimizing problem—of shadow prices. These accounting prices were supposed to reflect the true value of different goods—and, thus, took into account the distortions created by "market failures"—, and were to be used in making investment and other decisions. A serious problem, however, was that in many developing countries (and in particular in Africa), for many years there were no data to construct input-output matrices, and in those countries were they existed they were often outdated, and did not incorporate the latest technological developments in the production process. As a result, calculations in most five-year plans in Africa were made using less sophisticated techniques. This did not imply that these plans were less ambitious or demanding than those elaborated in countries that did have detailed input-output matrices, such as some Latin American nations.

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5. Hirschman (1949), Díaz-Alejandro (1963). See also Edwards (1989).

1.3 Light Planning

Of course, not all enthusiasts of the planning approach were alike; there were many variants of this economic perspective. Some believed that what poor countries needed was "indicative" or "light" planning that would provide broad guidelines to the private sector. This, for example, was the view implicit in the Alliance for Progress in Latin America. According to this approach the economy would be organized around three productive sectors: a small sector comprised of state-owned enterprises, mostly in heavy industries and natural monopolies; a "mixed-sector" where firms would be jointly owned by the state and private investors; and a private sector made up of small and medium size firms, and retail trade. Light planning was also the dominant view in the 1960s, 1970s and 1980s in Kenya. Other economists, however, supported a greater involvement of the public sector, through highly detailed plans and heavy government intervention in the form of price controls, investment licenses, controlled credit, and the imposition of import and export quotas. In this variant the state owned a very large proportion of the means of production, and government officials were largely free to control and regulate economic activities.

One of the most influential supporters of the planning perspective in Africa was René Dumont, a French agriculturalist and development expert that, with time, forged very close relations with most African leaders. His book "A False Start for Africa," originally published in 1962 as "*L'Afrique Noir est mal partie*," and translated into English in 1966 with an introduction by Thomas Balogh, was highly influential. In it he argued against the excessive use of foreign experts, and pointed out that for a poor country to develop, political organization and political will were more important than the technical aspects of the plan. Dumont was also a great supporter of rapid industrialization behind a wall of import tariffs, licenses, quotas and prohibitions. According to him, "[i]ndustrialization is…a symbol of economic progress… Giving priority to agriculture alone is a typically reactionary position… Custom protection on a national level, and later on the creation of the African Common Market, itself protected, will be virtually essential… Accelerated agriculture development will be more of a corollary… to this necessary but difficult industrialization" (Dumont 1966, p. 103-4). With time, however, Dumont became rather disillusioned with the turn of events in Africa and deplored the bureaucratization of economic policy in general, and planning in particular.

2. The Market Approach to Economic Development: From the "Washington Consensus" to the Global Financial Crisis

The war of ideas intensified during the late 1970s, as more and more developing countries in Latin America, Africa and parts of Asia experienced (very) low growth and deteriorating social conditions. This war reached an inflection point in the early 1980s when a growing number of academics—including Vittorio Corbo and some of his coauthors—began to question the dominant planning paradigm. In Latin America the inflection point came with the Mexican crisis of 1982 and the realization that every country in the region had become extremely vulnerable to external shocks. In Africa the early signs that views on development were changing came with the release of the "Berg Report" by the World Bank in 1981 (see the discussion below for details). Political developments in the advanced nations, and in particular the elections of Ronald Reagan in the U.S. and Margaret Thatcher in the U.K., also affected thinking about development. As the 1980s unfolded, views that emphasized the role of openness, competition, export growth, macroeconomic stability, and markets became increasingly influential. Many of these ideas—or more modern variations of them—were the bases for the reforms supported by the multilateral institutions, and in particular by the World Bank, and eventually undertaken in country after country around the globe after 1982. Once again, Vittorio played an important role in this process. This time, however, it was not from the academic trenches, but as a senior World Bank official holding different influential positions in World Bank operations and research departments.

In table 1 I present a schematic comparison of the main beliefs of the planning and market perspectives to economic development. The table covers five policy areas: (1) policies to enhance growth; (2) industrialization; (3) trade policy and openness; (4) incentives and resource allocation; and (5) policies towards alleviating poverty and improving the distribution of income. For each of these broadly defined polices I discuss the most salient proposals within each perspective.

2.1 Openness, Competition, and Growth

Research undertaken by a number of academics on the effects of protectionism on efficiency and economic performance was

particularly influential in helping change the views on development policy. Among these works, books by Little, Scitovsky, and Scottt (1970) and Balassa (1971) led the way by pointing out that protective structures could range from a highly negative degree of protection (mostly in the agricultural sector) to several hundred (and even thousand) percent in some industries. These findings were confirmed and expanded by a large and ambitious National Bureau of Economic Research project on protection and economic performance led by Bhagwati (1978) and Krueger (1978). This multi-country study showed that in most poor countries the tariff configuration generated a severe "anti-export" bias. Further, Bhagwati and Krueger showed that in the presence of quantitative restrictions to trade (import quotas and licenses), a devaluation reduced the anti-export bias significantly. A subsequent project, also directed by Anne Krueger, on the labor market consequences of alternative trade regimes confirmed the results from the NBER studies. Vittorio Corbo, jointly with Patricio Meller, wrote a brilliant paper on the Chilean experience for this effort.

The contrast between successful East Asian "tigers," on one hand, and the Latin America countries, on the other, also influenced the switch in paradigm in development economics. By the late 1970s most nations in Latin America had come to a standstill, and many experts talked about the end of the "easy phase" of import substitution. In most countries productivity growth was extremely low, or even negative. Worse yet, after decades of planning and protectionist policies poverty had not declined and the region's dismal income distribution had not improved. In the early 1980s Mexico was affected by a major external crisis that rapidly spread to the rest of Latin America: the so-called "lost decade" was about to begin. The years that followed were years of sorrow, frustration, and soul searching. As time passed, and more and more countries returned to democratic rule, a broad rethinking of economic strategy took place. By the early 1990s almost every country in Latin America—the main exceptions being Cuba and Haiti—had initiated a reform program that followed the blueprint of what has been called the "Washington Consensus."[6]

6. For a detailed discussion on the policies of the Washington Consensus see Williamson (1990). Edwards (2010) analyzes the results of these reforms and argues that ill conceived exchange rate policies and the lack of proper bank regulation and supervision resulted in deep crises in a number of Latin American countries during the second part of the 1990s and the early 2000s.

Table 1. Main Elements of the "Planning" and "Markets" Approaches to Economic Development in the 1960s

	Planning Approach	Market-Based Approach
(1) Determinants and mechanics of growth	-Based on Harrod-Domar model; capital accumulation as main source of growth. -Emphasis on savings and investment ratios (Nurkse). -Labor availability not an issue; labor is assumed to be in "unlimited supplies" (Lewis, Ranis-Fei). -Foreign aid key to supplement domestic saving. -Competing views on mechanics of growth and takeoff: "big push" (Rosenstein-Rodan) vs. "unbalanced growth" (Hirschman).	-Productivity growth as important as factor accumulation (Solow). -Substitution between capital and labor (Solow). -Labor and "human capital" accumulation important source of growth (Schultz). -Productivity growth not exogenously given; affected by policy; excessive distortions reduce it; rate of innovation (and imitation) tends to be endogenous (Stigler). -Productivity growth and technological progress may be capital saving or labor saving (Viner).
(2) Industrialization and the sector composition of output	-Prices of natural resources-based exports subject to secular decline (Prebisch-Singer); industrialization is fundamental for development; only way to increase income per capita substantially (Kuznets). -Industrialization to be financed through "surplus" generated by primary sectors (agriculture and/or mining) and by foreign aid (Kuznets). This surplus, in turn, is captured by marketing boards that are by law sole buyers of crops. -Private sector unable to "mobilize resources" in the scale needed for industrialization; state has to do it. -Investment tightly controlled by the government at firm level, to avoid "wasteful variety" of goods (Feldman-Mahalanobis). -Sectors with strong "forward and backward linkages" to be promoted (Hirschman).	-Comparative advantage should determine what to produce and export (Viner; Little, Scitovsky, Scott). -Forced industrialization generates distortions and discriminates against exports (Balassa). -"Picking winners" generates dual economy with "protected and unprotected" sectors, and high equilibrium unemployment (Harris-Todaro). -"Financial repression" results in resource misallocation and slower growth (McKinnon, Shaw). -Freely determined prices should be main signal to allocate resources. -International competition and openness provide main antidote against monopoly power (Stigler).

Table 1. (continued)

	Planning Approach	Market-Based Approach
(2) Industrialization and the sectoral composition of output	-Low interest rates encourage investment and industrialization. -Input-output analysis essential for determining capital and other requirements of selected industrial sectors (Leontief). -Food prices to be kept low in urban sector, as a way of reducing manufacturing costs (Sunkel, Singer). -There are two possible constraints to growth, "the two-gap approach": a saving gap and a foreign exchange gap.	
(3) Openness and trade orientation	-Protectionist policies required to shield nascent manufacturing sector; "infant industries" argument (Prebisch). -Protection and South-South agreements needed to deal with poor countries *dependency* on foreign capital and advanced markets (Amin, Sau, and dependency theorists). -Tariff structure to exercise appropriate "competitive pressure" (Hirschman). -In order to avoid dependency from foreign capital and markets, poor countries to aim at "self-reliance" (Amin, Wellerstein). -Exports do not respond to exchange rate changes; "elasticities pessimism" (Singer). -Low currency values in order not to pressure wage good prices (Singer).	-Comparative advantage should guide production and trade (Viner; Little, Scitovsky, Scott, Balassa). -Relative prices matter, especially "tradables to non-tradables" (Salter-Swan). -Trade elasticities high; external sector responds to incentives (Harberger, Laursen, Metzler). -Protectionism generates perverse incentives; usually discriminates against agriculture: effective rates of protection may be negative in some sectors (Corden). -Real exchange rate overvaluation at center of poor trade performance and external imbalances (Bhagwati, Krueger). -Avoiding anti-export bias encourages growth (Bhagwati, Krueger). -Lobbying for protectionism is wasteful, generates "rent seeking," and reduces welfare (Bhagwati, Krueger).

Table 1. (continued)

	Planning Approach	*Market-Based Approach*
(4) Incentives and resource allocation	-"Planning" should be the main mechanism for allocating resources and making investment decisions (Lange, Lerner). -Planners should decide what is produced; this is best way for avoiding "wasteful diversity and variety of goods." -Low response of agricultural sector to price incentives; mostly affected by land property structure (Sunkel). -Smallholders unable to export; marketing boards required to lower costs. -Poor countries plagued by "market failures"; government intervention required to tackle them (Nurkse). -Market prices are distorted; "shadow prices" should guide resource allocation (Little). -If let on their own, markets will result in underinvestment and wasteful production; state ownership of means of production required for effective growth policies. -Agricultural cooperatives provide a good way for reducing costs of farming.	-Resources should be allocated through markets (Hayek). -Firms should produce what consumers want to consume; "consumer sovereignty" is important (Friedman). -Peasants and poor people respond to relative prices and other incentives: elasticities tend to be large (Tax, Schultz). -Market prices tend to provide appropriate signals; if distortions are too high "shadow prices" should be used (Harberger, Little). -Public sector investment projects should be subject to strict evaluation; only those with high "social rate of return" should be implemented. -"Government failure" more pervasive and important than "market failures". -Bureaucracy, excessive regulation and "red tape" stifle growth and productivity (Krueger).
(5) Poverty, social conditions, and income distribution	-Reducing poverty requires direct "anti-poverty" programs; growth is an ineffective way of reducing poverty. -Socialism is the most effective system for reducing poverty, improving social conditions and reducing inequality.	-Informality in labor markets fundamental cause of poverty; informality direct consequence of industrialization policies. -Providing right incentives for agricultural production is one of best ways of reducing poverty. -Human capital accumulation – especially at the primary level – powerful tool for reducing poverty (Mincer).

Table 1. (continued)

	Planning Approach	*Market-Based Approach*
(5) Poverty, social conditions, and income distribution	Land reform reduces inequality and poverty; cooperatives provide a good way of organizing the agricultural sector after the reforms. -The agglomeration of peasants in villages reduces costs of providing social services and reduces poverty. -Since there are "unlimited supplies of labor" in the agricultural sector, the most effective way of increasing wages is through industrialization.	

2.2 New Views on Africa

In 1981 two major and highly influential publications presaged the change in views regarding economic development in Africa: The World Bank's *Accelerated Development in Sub-Saharan Africa: An Agenda for Action*, universally known as "the Berg Report" after its main author, Elliot Berg, and Robert Bates's *Markets and States in Tropical Africa: The Political Basis of Agricultural Policies*. Although very different in terms of their genesis and objectives, these two books made a simple and yet powerful point: the poor performance of the African economies was mostly (but not exclusively) the result of bad policies that put bureaucrats interests ahead of those of the people, and that had stifled incentives for growth, innovation, and productivity improvements. Also, both works pointed out that, in contrast to what planning models assumed, African governments were far from being benign institutions that tried to maximize society's welfare. Bates and Berg argued that government bureaucrats—including the managing echelons of parastatals, marketing boards, and state-owned banks—had captured the state apparatus and were using it for their own benefit as well as for that of their immediate supporters, families, and friends.

Bates's analysis was rooted in the "rational choice" perspective developed by political scientists—sometimes referred to as the "new political economy"—, and concentrated on which interest groups benefited and which ones lost from certain policy options. He pointed out that in Africa government policy taxed farmers through several channels: the low producer prices paid by marketing boards, the overvalued exchange rate, and the high prices of consumer goods that farmers consumed. The latter was the consequence of the protectionist policies aimed at promoting industrialization. At the same time, in many countries government policies tended to help farmers through the subsidization of inputs and capital goods. Bates persuasively argued that the final net effect, however, was significant taxation, and a strong discouragement of agricultural activities.

By looking at the problem from a "rational choice" perspective, Bates went beyond explaining the effects of certain policies, and discussed *why* those policies were undertaken, even if they were detrimental for society as a whole. One of the most important conclusions of the rational choice perspective is that policy decisions are the result of distributional struggles, and reflect the structure of power in a particular country. Learning that certain policies are

technically inferior to other policy options is not enough for changing the course of action. In his concluding chapter Bates argued that the costs of anti-agricultural policies were rapidly climbing. This meant that political support for the ruling coalition was eroding, and that political change looked possible. The nature of this change, however, was uncertain, and depended on the specific characteristics of each country. According to Bates a serious obstacle for deep and meaningful reform was that eliminating the anti-rural bias required major devaluations, which were strongly opposed by urban-based interest groups.

As most World Bank documents, the Berg Report went beyond an evaluation of past performance, and made a number of recommendations for future policy changes. In many ways the reforms undertaken in Tanzania starting in 1986 were (partially) based on the suggestions made in this report. Broadly speaking, it called for drastically reducing the role of the state in economic activities, encouraging private sector participation, reducing protectionism to the industrial sector, eliminating fiscal imbalances, devaluing overvalued currencies and making sure that these stayed in line with fundamentals, encouraging agriculture, introducing new cultivation methods, and reforming (or better yet, dismantling) parastatals. The Report also called for reforming aid. In particular it recommended greater flexibility in terms of funds' use, increased coordination across donors, and a major increase—a doubling—of aid in real terms.

The "Berg Report" generated a strong reaction among African governments and their supporters. There were two fundamental criticisms. First, it was argued that the Bank disassociated itself from the policies undertaken in Africa in the past, pretending that it had played no role in their formulation. In that regard the critics were right, and the Bank's position was, to say the least, disingenuous. For example, for years the World Bank was enthusiastic about Tanzania's development strategy, including its devastating agricultural policies, the cruel villagization process that forcefully moved more than 10 million peasants from their homes, and the reliance on protectionism to encourage industries with forward and backward linkages. Similar stories could be told of other African nations. As Loxley (1983) argued, the Bank should have recognized that two decades of "misguided" policies in Africa were, at least in part, the consequence of its own "misguided" advice.

The second criticism of the Berg Report had to do with its claim that Africa's economic failure was (almost exclusively) due

to policy mismanagement, and that external factors had played a minor role in the continent's dismal performance. In particular, World Bank critics were incensed by the assertion that "trends in the terms of trade cannot explain the slow economic growth in Africa in the 1970s because for most countries… the terms of trade were favorable or neutral."[7] According to the critics this conclusion depended on which years were used as a base to calculate changes in terms of trade. The Berg Report insistence that external factors were unimportant was also at odds with the position espoused by the African nations in the "*Lagos Plan of Action for Economic Development of Africa,*" a document released in 1981 (but signed a year earlier). The *Plan for Action* attributed the region's penuries to the external shocks and the instability of the world economy. This long and all-encompassing document called for African countries to step up efforts for industrialization and self-reliance, and proposed the creation of a common market that would eventually lead to the formation of an African Economic Community. In addition, it stated that former colonial powers were trying to impose their own policies to the African nations: "Africa was directly exploited during the colonial period and for the past two decades; this exploitation has been carried out through neo-colonialist external forces which seek to influence the economic policies and directions of African States."

During the first half of the 1980s these two contrasting views on economic development would coexist and battle with each other. However, as economic conditions deteriorated throughout Sub Saharan Africa, the support for the "planning approach" and the Lagos Plan of Action gradually eroded. By the mid-1980s it was clear that the war of ideas had taken a significant turn, and that the previously unpopular "market approach" was gaining more and more supporters.

2.3 The "Washington Consensus"

The fall of the Berlin Wall in 1989 accelerated the decline in the degree of popularity of planning and generated increased interest among politicians in development strategies based on competition and export expansion. The experience of the East-Asian Tigers with export-led growth attracted considerable attention, and a number of works were penned on the policies followed by those nations. One of

7. World Bank (1981, p.19).

the messages that emerged from these case studies was that avoiding currency overvaluation—and, in some cases, deliberately encouraging undervaluation—had helped develop a vibrant export sector. Of course, that was exactly the opposite of what had happened throughout most of Africa and Latin America where the reluctance to adjust currency values, even in an environment of high domestic inflation, had resulted in significant real exchange rate overvaluation, losses in international competitiveness and eventually in very severe currency crises.

In the late 1980s and early 1990s a move towards economic reform swept through the developing world. This phenomenon had its origins in Latin America, and rapidly spread to other nations, including Central and Eastern Europe, the former Soviet Union, and India. The reform movement also affected Africa, although it moved at a slower pace, and faced stiffer opposition from the elites and those groups that during decades had benefited from the planning approach to development.

The early market-oriented reform agenda became known as the "Washington Consensus," a name that suggests that these policies originated in the multilateral agencies—the World Bank and the IMF—and in the U.S. Department of the Treasury. This, however, was not the case. In Latin America, for example, the reforms were largely homegrown, and were the response to more than ten years of a generalized crisis—the so-called "lost decade"—that had erupted in the early 1980s. An analysis of the relevant documents and archives shows that the Washington institutions were skeptical, and in some cases openly opposed, to some of the most daring reform proposals in many parts of the world, including in many of the Latin American nations. In Argentina, Brazil, Chile, Colombia and Mexico, to mention just a few countries, reform programs were developed by local economists that had acquired significant political power. These economists-turned-politicians were often referred to as "technopols." Also, in many former Warsaw Pact nations local pro-reform technocrats accumulated substantial political power and pushed reform programs that were often at odds with the more tentative agenda of the multilateral institutions. Both in Latin America and in the former Communist countries local economists were often advised by Western academics. Some prominent names among external advisors included Arnold C. Harberger, Rudi Dornbusch, Andrei Shleifer, Stanley Fischer, and Jeffrey Sachs.

In a highly influential article published in 1990, English economist John Williamson summarized the main goals of the Washington Consensus as follows:

• Achieve fiscal balance, as a way of reducing inflationary pressures, and stabilize prices.

• Target public expenditures towards the poorer groups in the population. Priority should be given to government expenditures aimed at improving social conditions and reducing poverty; generalized subsidies, which benefit mostly the middle class, were to be avoided.

• Implement deep tax reforms, in order to reduce evasion, increase government income and eliminate perverse incentives to production and investment.

• Modernize the financial sector. Interest rates had to be market determined, and not set by government officials in an arbitrary fashion. A well functioning capital market would help allocate scarce capital to the most productive uses.

• Avoid artificially strong currencies that discourage exports. By staying away from currency overvaluation the probability of major, and very costly, crises would be greatly reduced. This measure would also encourage production in the agricultural sector.

• Reduce the extent of protectionism and rationalize trade policy. That is, the irrational structure of protectionism that had evolved over half a century—and that was documented above—has to be dismantled and replaced by lower import tariffs.

• Encourage foreign direct investment.

• Privatize inefficient state-owned enterprises.

• Deregulate business transactions including investment decisions. Red tape had to be cut, barriers to entry in key industries eliminated, and competition encouraged.

• Improve legal protection of property rights, as a way of securing higher investment by both foreigners and nationals.

These ten policies—and the name "Washington Consensus" for that matter—acquired a life of their own, and were soon considered to be an official pronouncement of what the countries in the emerging world should do and what they should not do. This was unfortunate, since a number of analysts have evaluated reform efforts through the lenses provided by this list, and, thus, have missed many of the subtleties and complexities of the actual individual country stories.

During the first half of the 1990s different nations emphasized different aspects of the market-oriented reforms. In some countries —and particularly in Latin America—results were quick and impressive. Inflation declined abruptly, exports increased, and real wages recovered at a rapid clip. But in many countries these early accomplishments

hid important weaknesses: privatization of public utilities—including energy, water, sanitation, and telecommunications—was implemented without putting in place proper regulation and competition policies. As a result, in a number of cases state-owned monopolies were replaced by privately-owned monopolies, and in many instances privatization was surrounded by corruption and giveaways, where insiders—including government officials in charge of public enterprises and their sale—ended up buying large blocks of shares at conveniently low prices. At the same time, most countries in every region of the world failed to move forward in the creation of strong and modern institutions that would encourage the rule of law, protect property rights, and reduce the extent of corruption. In many Latin American nations the situation was even worse, as policy makers used fixed (or rigid) exchange rates as a way of controlling inflation. With time, currencies became overvalued—a well-known problem in Africa—and severe external imbalances developed.[8]

During the 1990s and early 2000s a succession of external crises erupted in a number of countries that had either embarked on the reform path and/or were considered as premier examples of outward orientation: Mexico (1994-95); Thailand, Malaysia, Indonesia, the Philippines, and South Korea (1997-98); Russia (1998); Brazil (1999); Turkey (2001); Argentina (2001-02); and Uruguay (2002). These crises resulted in significant income loss, increased poverty, lower wages, and spikes in unemployment. In most countries the crises generated political upheaval, and in some they paved the way to populist politicians that reversed the reforms, nationalized foreign companies, and implemented protectionist measures—Argentina and Venezuela being the most salient examples. The crises also generated an intellectual backlash against the Washington Consensus. Chief critics of the simple version of market orientation and reform included Nobel laureates Joseph Stiglitz and Paul Krugman.[9]

A number of lessons on macroeconomic management emerged from the currency collapses of the 1990s and early 2000s. They included the benefits of having flexible exchange rates, the dangers of short-term speculative capital movements—and, thus, the merits of some controls on capital inflows—, the importance of having a "reasonable" stock of international reserves, and the value of labor market flexibility, openness, and countercyclical fiscal policies. There

8. See for example Edwards (2010).
9. See for example Krugman (1995) and Stiglitz (2003, 2008).

were also important lessons for social policies and governance, including the need to have a safety net to protect the poor and disadvantaged from the vagaries of the global economy. Other lessons referred to the importance of having a modern tax system that raised enough revenue to finance transfers to the poorest groups and to finance social programs.

During the second half of the 2000s most of these lessons were incorporated into specific policies in different countries; the process was gradual and without much fanfare. Many countries took a pragmatic approach towards reforms and modernization, discarded the rigid tenets of the Washington Consensus and moved towards their own versions of market and outward orientation. Overly doctrinaire positions were abandoned and whatever worked—including maintaining (majority) government ownership of some companies, and implementing some controls on capital mobility—was incorporated into the policy framework. In fact, many observers—including the critics of market-orientation and reform—didn't notice the extent to which many emerging countries had improved macroeconomic management. This became evident, however, with the collapse of Lehman Brothers in 2008. This time, things were really different. Instead of being the victims of contagion and crumbling as so many times in the past, the emerging nations as a group continued to grow. Emerging countries in Asia, Latin America, and Africa showed remarkable resilience. These developments were helped by two important factors: high commodity prices, propelled by China's remarkable expansion, and significant liquidity in world financial markets. The latter was the result of the very permissive policies followed by the advanced countries' central banks—including the Federal Reserve's "Quantitative Easing" policies—and contributed to the strengthening of many emerging countries currencies.

3. INTERNATIONAL AID: POLICIES AND CONTROVERSIES

During the last four decades foreign aid has been a central element of the "war of ideas." Interestingly, however, this is a relatively new topic in economics. The classics—Smith, Ricardo, and Stuart Mill—didn't address the subject in any significant way. In fact, if anything, classical economists thought that the colonies would catch up—and

even surpass—the home country quite rapidly.[10] In Chapter VII of "The Wealth of Nations," Adam Smith provides a detailed discussion on the "causes of the prosperity of the new colonies." In many ways this analysis is remarkably modern. Smith argues that the main reason why the English colonies of North America had done significantly better than the Spanish dominions of South America was that "the political *institutions* of the English colonies have been more favorable to the improvement and cultivation of this land than those of the [Spanish colonies]."[11] This, of course, sounds remarkably similar to the ideas developed in the last few decades by Douglas North, Daron Acemouglu, James Robinson, Simon Johnson, and others. Smith goes on to list a number of policies implemented by the British—including tax, inheritance, and trade policies—that, in his view, explain the economic success in what was to become the United States; in parallel, he discusses how poor policies enacted by the Dutch and the Spanish— and to a lesser extent by the French—stifled growth and progress in their dominions. Although this chapter runs for almost 100 pages, there is not even a mild suggestion that the home nation should provide systematic financial assistance to its colonies.

The first legal statute dealing explicitly with official aid was passed by Parliament in the United Kingdom in 1929. The *Colonial Development Act* created the *Colonial Development Fund* with resources of one million pounds sterling per year. Although this Act intended to improve the social conditions in the colonies—especially in the rural sector—, its main objective was to promote British exports at a time when the Great Depression had hit the country particularly hard.[12] Until the passing of this legislation the colonies were supposed to be, largely, self-financing, and any aid was confined to emergencies. In 1940 and 1945 new laws dealing with aid to the colonies were passed in the United Kingdom. These Acts increased

10. The analysis in this section doesn't pretend to be exhaustive. I don't attempt to deal with every aspect of aid-related controversies. Readers interested in the intricacies of international assistance may consult some of the very thorough surveys on the subject, including two comprehensive articles by Radelet (2005, 2006) and the extensive literature cited therein.

11. Smith (1776), Cannan Edition, published by the University of Chicago Press, 1976. Emphasis added.

12. At the time the Act was passed, Sidney Webb—one of the founders of the London School of Economics and a prominent Fabian Socialist—was the Colonial Secretary. During his tenure as Secretary he fought, with limited success, to reinstate the policy of "native paramountcy" in East Africa. See Barder (2005) for a succinct history of foreign aid in the United Kingdom.

the amount of funds available and made commitments for longer periods of time—for up to ten years in the *Colonial Development and Welfare Act of 1945*. More important, the Act of 1945 established that aid plans had to be prepared "*in consultation* with representatives of the local population."[13]

The question of how much to involve recipient governments and populations in designing aid packages would become a recurrent theme in aid policy debates. For example, the issue was of paramount importance in Tanzania. Through time the terms used when referring to local involvement evolved from "consultation," as in the *Colonial Act* of 1945, to "participation," as in the influential Pearson Report in 1969, to "ownership," as in the Helleiner Commission on aid in Tanzania in 1995.[14]

In the United States the first law dealing with foreign assistance came quite late, with the adoption of the Marshall Plan in 1948.[15] In his inaugural speech on January 20th, 1949—the so-called *Point Four Speech*—President Harry Truman put forward, for the first time, the idea that aid to poor nations was an important component of U.S. foreign policy. He said that one of the goals of his administration would be to foster "growth of underdeveloped areas." He then added that "more than half the people of the world are living in conditions approaching misery… For the first time in history, humanity possesses the knowledge and the skill to relieve the suffering of these people."

In spite of Truman's vehement allocution, aid commitments to poor countries were considered temporary. In 1953, when Congress extended the *Mutual Security Act*, it explicitly stated that economic aid to U.S. allies would end in two years; military aid was to come to a halt in three years. In the early 1960s—and largely as a result of the escalation of the Cold War—the United States revised its position regarding bilateral assistance, and, jointly with other advanced countries, founded the Development Assistance Committee (DAC) at the newly formed Organization for Economic Cooperation and

13. Barder (2005, p. 3), emphasis added.
14. The Pearson Commission was appointed in 1967 by George Woods, then World Bank president, "to study the consequences of development assistance." The first section of chapter 1 was titled "Crisis in Aid," indicating that, at least in the minds of some, official aid has been in crisis mode for almost half a century. There were eight commissioners, and the Staff of the Commission added to 27 people. See Pearson (1969).
15. The Marshall Plan, which was announced by U.S. Secretary of State George C. Marshall in a speech at Harvard University on June 5, 1947, played an important role in defining U.S. policy towards foreign aid. Congress, however, was slow in passing the Plan. It was only done in 1948, after the Soviets took over Czechoslovakia.

Development (OECD). The main objective of the DAC was—and continues to be—to coordinate aid to the poorest countries.[16]

During the early post World War II years there were recurrent discussions on whether aid should be allocated, mostly, towards projects geared at accelerating economic growth, or towards programs aimed at improving social conditions and reducing poverty. In the 1960s, and as the neoclassical model of growth developed by Solow made inroads in the economics profession, a greater emphasis was given to the formation of human capital. This decision was also influenced by the increasing evidence that the developing countries lacked the "absorption capacity" required to implement many of the aid projects. Training professionals and improving skills among the indigenous populations was seen as a key contribution to growth itself, as well as a step towards making aid more effective. It was not until the late 1960s and early 1970s that the "basic needs approach" became popular, and the improvement of social conditions became the central goal of the majority of official programs. The World Bank, under the leadership of former U.S. Secretary of Defense Robert S. McNamara, played an important role in the move in this direction.[17]

Since the end of World War II, most donors have followed a two-prong approach to aid. On one hand they have relied on their own bilateral programs, which are run by national bureaucracies that often operate at the ministerial level; on the other hand, they have supported the work of the multilateral organizations, such as the World Bank and the regional development banks. In addition, they have used the OECD's DAC as a mechanism for achieving some level of coordination. This dual mechanism has allowed most advanced nations to be selective (in terms of which countries they assist directly), and, at the same time, to join forces with other donor nations in supporting broader initiatives. The Nordic countries have been particularly active in using this approach: through their own agencies (*Sida*, *Norad*, *Danida, Finida*) they have assisted a small number of countries, while at the same time they have devoted

16. The original name of DAC was Development Assistance Group, while the original name of the OECD was Organization for European Economic Cooperation. In 1946 France created its first aid agency (FIDES), which in 1963 was replaced by the Ministry of Cooperation. The Nordic countries created their own aid agencies in 1962.

17. In some donor countries, however, the objective of alleviating poverty was central from early on. This was the case, for instance, of Sweden, where Proposition 1962:100 explicitly established that the objective of aid was to raise the living standards of the poor.

approximately 50% of their (quite large) foreign aid budget to support the multilateral organizations.[18]

Already in the 1950s and 1960s a number of market-oriented economists—including Milton Friedman and Peter Bauer—argued against the provision of foreign aid beyond humanitarian relief. According to them, official assistance created the wrong incentives, especially when it distorted markets and encouraged protectionism. The response from early supporters of aid, such as W. Arthur Lewis and Paul Rosenstein-Rodan, was that international aid supplemented domestic saving, and allowed poor countries to accumulate capital and develop a key manufacturing sector. In their view, rapid industrialization through import substitution was required in order to achieve sustained growth and reduce poverty. As noted, in the 1980s and early 1990s there was a major shift in the views regarding international assistance in general, and aid to Africa in particular. As a result, aid became more narrowly focused, the number of capital intensive projects was greatly reduced, and social programs were expanded; at the same time, aid was increasingly conditioned on certain actions by the recipient nations, including the adoption of market oriented policies and trade liberalization. During these years a large number of bilateral development agencies—including those in the Nordic countries and Japan—went through thorough evaluations of their programs, and decided that there was a need to be both more selective, in terms of which programs to support, and more demanding with respect to the recipient countries' contribution to their overall development strategy.

In September 2000, the United Nations Assembly adopted the "Millennium Declaration" that set forward a new set of targets—the so-called *Millennium Development Goals (MDG)*—for the development community to be achieved by 2015. These goals included: (1) halving extreme poverty and hunger; (2) achieving universal primary education; (3) promoting gender equality, especially in the educational system; (4) reducing under-five child mortality by two thirds; (5) reducing the maternal mortality ratio by two thirds; (6) halting and reducing by one half the incidence of malaria, as well as halting and reversing the spread of HIV/AIDS; (7) ensuring environmental sustainability; and (h) developing a global partnership

18. To be sure, the Nordic countries not always agreed with the specific policies undertaken by the multilateral organizations. In the early 1970s, for example, the Swedes were particularly critical of the World Bank's support to South Vietnam.

for development.[19] In March 2002, at the *Monterrey Conference* on development, most advanced countries signed a declaration that called for making "concrete efforts towards the goal of 0.7 percent of gross national product (GNP) towards official development assistance."[20] The focus on ownership and performance is mostly aimed at dealing with the "double principal agent" problem that has affected aid since its beginnings in the 1920s (see the discussion in Section III.3.2 below; see, also, Radelet, 2006).

The Millenium Declaration and Monterrey Conference led to a (somewhat) new view on aid policy. This perspective, subscribed by over 100 countries in the Paris Declaration on *Aid Effectiveness* of March 2005, emphasizes the recipient country's "ownership" of programs. There was also a renewed focus on linking aid to both economic performance and the implementation of anti-corruption measures (see Edwards, 2014, for details). This new approach required developing a battery of tools to monitor whether specific projects and programs had "performed appropriately". Since the early 2000s academic economists have made important progress towards developing a methodology for evaluating whether social programs achieve their predetermined goals. Possibly the most important component of this new perspective is the use of "randomized field experiments".[21]

3.1 The Inconclusiveness of Econometric Studies

Trough time, a number of authors—both in academia and in the aid community—have used a battery of econometric methods to analyze whether (or under what circumstances) aid is effective, in the sense of generating higher growth and better economic outcomes.[22] Some of these studies have tried to tackle issues of reversed causality, and have used a series of instruments—some

19. See http://www.un.org/millenniumgoals/

20. See *www.un.org/esa/ffd/monterrey/MonterreyConsensus.pdf*. The UN tracks progress towards achieving the MDGs by following 21 targets and 60 indicators. By mid 2012, and according to a report by the United Nations Secretary General, three of the eight goals—on poverty, water and slums—had been met for the developing world as a whole. At the same time, the data shows that most of MDG's would be missed in Sub-Saharan Africa.

21. For a discussion on the emerging "new aid model" see Bourguignon and Sundberg (2007). On randomized trial experiments see, for example, Banerjee and Duflo (2011).

22. See, for example, Johnson and Subramanian (2005), Rajan and Subramanian (2008), and Bourguignon and Saunders (2007), and the literature cited therein.

more convincing than others—in an attempt to deal with the fact that slower growth (in very poor countries) may attract additional aid. Other works have analyzed whether aid only works under certain conditions, or whether a minimal degree of institutional development is required for international assistance to bear fruit. These studies have considered nonlinear functional forms, and have investigated if there are meaningful interactions between aid and other variables, such as the degree of literacy, the level of corruption, the extent of macroeconomic stability, institutional strength, the quality of overall economic policies, and geography. The majority of these studies has used GDP growth as the performance variable of interest, have relied on cross-country or panel data, and have attempted to distinguish between short- and long-term effects.

Overall, the results from this large body of research have been fragile and inconclusive. Indeed, after analyzing 97 studies, Doucouliagos and Paldam (2005) concluded that, in the best of cases, it was possible to say that there was a small positive, and yet statistically insignificant, relationship between official aid and growth. This conclusion was also reached by Rajan and Subramanian (2008) in an analysis that corrected for potential endogeneity problems, and that considered a comprehensive number of covariates. In particular, according to this study there is no clear relation running from more aid to faster growth; this is true even in countries with better policy environment and stronger institutions.

Bourguignon and Sundberg (2008) have argued that one should not be surprised by the inconclusiveness of studies that rely on aggregate data. According to them, aid affects economic performance, directly and indirectly, through a variety of complex channels. Thus, treating all aid as homogeneous—independently of whether it is emergency assistance, program aid, or project-based aid—is misleading. In their view it is necessary to break open the "black box" of international aid, and deconstruct the causality chain that goes, in intricate and non-obvious ways, from aid to policymakers, to policies, and to country outcomes. This type of analysis would focus on a number of specific ways in which international assistance may impact economic performance. In particular, studies that try to determine the impact of aid on growth should consider issues related to technical assistance, conditionality, level of understanding of the economy in question, and the government ability to implement specific policies.

3.2 The Bitterness of Recent Controversies

In spite of its intensity, the academic debate on the relationship between aid and performance pales in comparison with recent policy controversies on the subject. On one side of recent battles are aid critics such as William Easterly and Dambisa Moyo.[23] On the other side of this divide are Jeffrey D. Sachs—possibly the most vehement supporter of increasing the volume of official aid—and his associates. The level of animosity in this veritable war is illustrated by the following quote from a Sachs' article published in 2009: "Moyo's views [are] cruel and mistaken… [Moyo and Easterly are] trying to pull up the ladder for those still left behind."[24] Easterly's reply, also from 2009, was equally strong: "Jeffrey Sachs [is]… the world's leading apologist and fund-raiser for the aid establishment… Sachs suffers from [an]… acute shortage of truthiness…"[25]

In a number of articles, as well as in a blog and in a bestselling book, Easterly has argued that aid agencies are bureaucracies that, in a typical monopolistic fashion, charge too much and deliver too little services.[26] Worse yet, according to him these agencies have formed a "cartel" that prefers "aid coordination" to "competition." As most monopolies, aid bureaucracies innovate slowly and are overly risk averse. As a result, they have developed safeguards that avoid creative solutions to economic problems; the main goal of these bureaucracies is to steer clear of "failures." But this is not all: according to Easterly and his supporters international assistance also suffers from a "double principal agent problem," where those with the greatest interest in the success of the programs—aid recipients in the poor countries, and tax payers in donor nations—are far from the decision making process. As is often the case when the principal agent problem is severe, officials in donor and receiving countries tend to "capture" the aid organizations, and run them according to their own interests, values, and goals. Worse yet, states Easterly, many of the efforts to tackle this agency problem—including conditionality, consultation, and matching funds—have not worked, and have added to the bureaucracy. Easterly, Moyo, and other aid-skeptics have vehemently argued that the official donor community

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23. Robert Klitgaard's "Tropical Gangsters," published to great acclaim in 1991, provided an early criticism, from the field, of the way in which official aid was provided in Africa.

24. Sachs (2009).

25. Easterly (2009).

26. See, for example, Easterly (2002, 2003, 2006).

uses the wrong yardstick to measure performance and success: instead of focusing on outcomes that are important for the poor, they emphasize the amount of funds spent in particular countries or regions.

Of course, most of the critics recognize that throughout the years the aid community has had some successes, including the improvement of health and education indicators in a large number of countries. But, overall, they believe that aid channeled through bureaucratic and monopolistic government agencies is largely destined to be ineffective and wasteful. At the risk of oversimplifying a bit, the view of aid critics may be summarized with the following quote from Easterly: "[F]oreign aid works for everyone except for those whom it was intended to help, with results such as the aids agencies' calculation that it takes $3,521 in aid to raise a poor person's income by $3.65 a year."[27]

During the last two decades or so, Jeffrey D. Sachs has become one of the most steadfast and vocal defenders of foreign aid channeled through official channels. Other prominent supporters of official assistance include Joseph Stiglitz and Paul Krugman. Their support, however, is not unconditional; as most economists that believe that official assistance funds should increase, they recognize that some reforms in the management of aid programs are in order. For example, Sachs and his colleagues do not defend traditional, top-down, bureaucratic assistance; on the contrary, their view is quite critical of the way in which aid has been dispensed in the past. But, at the same time, they strongly argue that, if properly provided, and if channeled towards combating particular ills—including diseases such as malaria and HIV-AIDS, the lack of potable water, and the inadequate infrastructure that isolates poor communities—, official assistance can help eliminate poverty in a relatively short period of time.

According to Sachs and his supporters—and there are many of them—most aid programs should concentrate on what they have called the "Big Five development interventions": improved agricultural inputs; investment in basic health—including antimalarial bed nets—; investment in education; the provision of power, transport and communication services; and making safe and drinking water available to everyone. When presented on their own, these interventions are unlikely to generate excitement, enthusiasm, or optimism. Indeed, all of them have been fixtures of conventional development assistance for decades. What makes Sachs' view different,

27. Easterly (2002).

however, is the way in which assistance is to be provided. His is a holistic approach that begins with a community-specific diagnosis—what he calls "clinical economics"—, and the formulation of programs that capture the peculiarities of each community. Sachs' most important argument comes from the results obtained in a number of villages across Africa—the *Millennium Villages*—, where a modest amount of aid (about USD 120 per person, per year), coupled with the Big Five interventions have resulted, according to him, in significant improvements in agricultural output, reduced malaria cases, improved health, and better school achievements. However, and not surprisingly, the Millennium Villages Project (MVP) has had its critics. For example, Rich (2007) has argued that although the project has improved a number of indicators in the villages where it has operated, it has not solved some of Africa's most serious problems, including the domination of particular clans or tribes, corruption, dependency, and poor governance. A key question raised by these critics is whether the impact of the MVP will be sustained through time, or whether the communities where it has been active will revert to poverty and destitution once the aid workers leave.

To a large extent, the Easterly-Sachs debate has generated public attention because it has been couched in simple terms. These are, indeed, simple narratives based on ethnographic arguments and specific anecdotes that resonate with large segments of the general public. But behind the different positions there are hundreds of academic studies—most of them based on advanced econometric techniques—that have tried to determine the extent to which foreign aid is effective. The problem, as noted, is that much of this body of empirical work has resulted in fragile and inconclusive evidence.

For an increasing number of economists the issue of aid effectiveness is neither black nor white. Indeed, a number of authors have taken intermediate positions. For example, in an influential book that deals with the plight of the poorest of the poor, Paul Collier from Oxford University, has argued that both critics and staunch supporters of official aid have greatly exaggerated their claims and distorted the empirical and historical records. His analysis is based on a large body of empirical work undertaken by him and a number of his associates. Collier's reading of the evidence is that over the last 30 years official assistance has helped accelerate GDP growth among the poorest nations in the world—most of them in Africa—by approximately 1% per year. This is a nontrivial figure, especially when one considers that during this period the poorest countries have had an aggregate rate of per capita growth of zero. That is, in the absence of official assistance,

the billion people that live in these nations—the so-called "bottom billion"—would have seen their incomes retrogress year after year.

However, and as Collier points out, aid is subject to decreasing returns. Thus, doubling its volume, while maintaining the way in which it is disbursed, would not add another 1% to the squalid rate of growth in this group of countries. In order for additional aid to truly impact the lives of the bottom billion it needs to be reformed. Collier looks at this issue through the lenses of the four poverty traps that, according to him, have hampered development in these nations: the conflict trap, the natural resources trap, the landlocked trap, and the bad governance trap. His empirical results indicate that while additional official assistance can do little to free societies from the first two traps, it can be quite effective in addressing the problems arising from the landlocked and bad governance traps.[28]

Collier, however, believes that in order for this to happen there needs to be a major change in the way aid is disbursed. He is particularly critical of ex-ante conditionality—the type of policies used extensively during the 1980s and early 1990s—, and argues that technical assistance is particularly important in helping countries change course and move towards growth and progress. According to Collier's empirical analysis, aid is more effective when it is provided at the beginning (during the first four years) of a reform process leading to an economic turnaround. Also, official assistance would become much more effective if a larger proportion is devoted towards improving the skills of the local population, including those of government officials involved in the implementation of development programs. Collier also calls for creative solutions, such as aid agencies teaming up with civil society and NGOs to build parallel institutions to provide basic services such as education and health.

In a recent book, Banerjee and Duflo (2011) have argued that there is need for a "radical rethinking of the way to fight poverty." In their view, the acrimonious debate between the Easterly and Sachs factions has missed the boat. Banerjee and Duflo join a growing group of researchers in arguing that this controversy cannot be solved in the abstract, by using aggregate data and cross-country regressions. The evidence, in their view, is quite simple: some projects financed by official aid work and are effective in reducing poverty and moving the domestic populations towards self-sufficiency and prosperity,

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28. He does argue, however, that aid can be very effective in helping countries in the post-civil conflict period. See his discussion in pages 105-107.

while other projects (and programs) fail miserably. The question is not how aggregate aid programs have fared in the past, but how to evaluate whether specific programs are effective.

Like Bourguignon and Sundberg (2008), Banerjee and Duflo urge economists and other social scientists to "think in terms of concrete problems that can have specific answers, rather than foreign assistance in general." They go on saying that "the lack of a grand universal answer might sound vaguely disappointing." This doesn't mean, however, that particular and circumstance-specific answers are not useful. In fact they are. Taking the lessons from concrete policies seriously would go a long way towards improving aid programs; it would help millions of people to get out of their poverty traps. Banerjee and Duflo have been among a group of economists that in recent years have introduced "randomized control trials" as a way of evaluating the effectiveness of different policy interventions.[29] In these experiments randomly selected individuals are subject to a treatment—they receive anti-malaria nets, for example—, while other randomly selected individuals conform the control group. A comparison of the outcome of this intervention provides evidence on whether the treatment is effective, and on the magnitude of the effects.

According to Banerjee and Duflo (2011) and Deaton (2010), among others, randomized control trials provide valuable information that can guide reforms and aid programs at the margin. Overall, their view is that details matter. Poverty and underdevelopment are not so much the result of geography, politics or grand conspiracies that resulted in failed "institutions," as they are consequences of policies that go wrong due to their complexity, incomplete information, and missing markets. Official assistance, if properly provided, can make a huge difference; "small changes can have big effects." The key is to know how to dispense official aid properly. In Banerjee and Duflo's world, evidence from randomized control trials is an essential tool for obtaining that knowledge, for using aid funds wisely, and, thus, for moving forward in the quest for reducing poverty.

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29. The Poverty Action Lab at M.I.T. , founded in 2003 by Banjeree and Duflo, has been on the forefront of the random trial experiment work. See for example Banerjee and Dufflo (2009) and the survey by Deaton (2010), and the works cited there.

REFERENCES

Amin, S. 1977. *Imperialism and Unequal Development.* New York, NY: Monthly Review Press.

Balassa, B. 1971. *The Structure of Protection in Developing Countries*. Baltimore, MD: Johns Hopkins University Press.

Banerjee, A., E. Duflo, R. Glennerster, and C. Kinnan. 2009. "The Miracle of Microfinance?: Evidence from a Randomized Evaluation." Working Paper 31, Centre for Micro Finance-IFMR Research.

Banerjee, A. and E. Duflo. 2011. *Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty*. New York, NY: PublicAffairs.

Bates, R. 1981a. "Food Policy in Africa: Political Causes and Social Effects." *Food Policy* 6(3): 147–57.

————. 1981b. "Some Core Assumptions in Development Economics." Working Paper 399, California Institute of Technology.

————. 2005. *Markets and States in Tropical Africa: The Political Basis of Agricultural Policies*. 2nd edition. Berkeley, CA: University of California Press.

Bates, R. and A. Krueger. 1993. *Political and Economic Interactions in Economic Policy Reform*. Oxford: Blackwell.

Bhagwati, J. 1978. *Anatomy and Consequences of Exchange Control Regimes*. Cambridge, MA: Ballinger.

Bourguignon, F. and M. Sundberg. 2007. "Aid Effectiveness: Opening the Black Box." *American Economic Review* 97(2): 316–21.

Cardoso, F. and E. Faletto. 1979. *Dependency and Development in Latin America*. Berkeley, CA: University of California Press.

Collier, P. 2007. *The Bottom Billion: Why the Poorest Countries Are Failing and What Can Be Done about It*. Oxford: Oxford University Press.

Corbo, V. 1974. *Inflation in Developing Countries: An Econometric Study of Chilean Inflation*. Amsterdam, North Holland.

————. 1985. "International Prices, Wages and Inflation in an Open Economy: A Chilean Model." *Review of Economics and Statistics* 67(4): 564–73.

Corbo, V. and P. Meller. 1981. "Chile, Alternative Trade Strategies and Employment Growth" In *Trade and Employment in Developing Countries, vol. 1, Individual Studies*, edited by Anne O. Krueger and others. Chicago, IL: University of Chicago Press.

Corden, W. 1966. "The Structure of a Tariff System and the Effective Protective Rate." *Journal of Political Economy* 74(3): 221–37.

Deaton, A. 2010. "Instruments, Randomization, and Learning about Development." *Journal of Economic Literature* 48(2): 424–55.

Development Assistance Committee (DAC). 1991. *Principles for Evaluation of Development Assistance*. Paris: Organization for Economic Co-operation and Development (OECD).

Díaz-Alejandro, C. 1963. "A Note on the Impact of Devaluation and the Redistributive Effect." *Journal of Political Economy* 71: 577–80.

———. 1984 "Comment." In *Pioneers in Development*, edited by G. Meier and D. Seers. Oxford: Oxford University Press.

Doucoliagos, H. and M. Paldam. 2005. "Conditional Aid Effectiveness. A Meta Study." Working Paper 14, Department of Economics, University of Aarhus.

Dumont, R. 1966. *False Start in Africa*. New York: Praeger.

———. 1983. *Stranglehold on Africa*. London: A. Deutsch.

———. 1986. *Pour L'Afrique, J'accuse: Journal d'un Agronome au Sahel en Voie de Destruction*. Paris: Édition Terre Humaine.

Easterly, W. 2002. *The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics*. Cambridge, MA: MIT Press.

———. 2003. "Can Foreign Aid Buy Growth?" *Journal of Economic Perspectives* 17(3): 23–48.

———. 2006. *The White Man's Burden: Why the West's Efforts to Aid the Rest Have Done So Much Ill and So Little Good*. New York: Penguin Books.

———. 2009. "Sachs Ironies: Why Critics are Better for Foreign Aid than Apologists." In *Huffington Post*. May 25. http://www.huffingtonpost.com/william-easterly/sachs-ironies why-critics_b_207331.html.

Edwards, S. 1986. "Are Devaluations Contractionary?" *Review of Economics and Statistics* 68(3): 501–08.

———. 1989. "Exchange Rate Misalignment in Developing Countries." *The World Bank Research Observer* 4(1): 3–21.

———. 2010. *Left Behind: Latin America and the False Promise of Populism*. Chicago, IL: University of Chicago Press.

———. 2014. *Toxic Aid: Economic Collapse and Recovery in Tanzania*. Oxford: Oxford University Press.

Harberger, A. 1950. "Currency Depreciation, Income, and the Balance of Trade." *Journal of Political Economy* 58(1): 47–60.

———. 1983. "The Cost-Benefit Approach to Development Economics." *World Development* 11(10): 863–73.

Helleiner, G. 2002. "Local Ownership and Donor Performance Monitoring: New Aid Relationships in Tanzania?" *Journal of Human Development* 3(2): 251–61.

Hirschman, A. 1949. "Devaluation and the Trade Balance: A Note." *Review of Economics and Statistics* 31(1): 50–3.

————. 1958. *The Strategy of Economic Development*. New Haven, CT: Yale University Press.

————. 1963. *Journeys Toward Progress: Studies of Economic Policy-Making in Latin America*. New York: Twentieth Century Fund.

Krueger, A. 1978. *Liberalization Attempts and Consequences*." Cambridge, MA: Ballinger.

Krugman, P. 1995. "Dutch Tulips and Emerging Markets." *Foreign Affairs* 74(4): 28–44.

Lal, D. 1987. "The Political Economy of Economic Liberalization." *World Bank Economic Review* 1(2): 273–99.

Leontief, W. 1974. "Structure of the World Economy: Outline of a Simple Input-Output Formulation." *American Economic Review* 64(6): 823–34.

Lewis, W. 1954. "Economic Development with Unlimited Supplies of Labour." *The Manchester School* 22(2): 139–91.

Little, I. and M. Scott. 1976. *Using Shadow Prices*. London: Heinemann Educational.

Little, I., T. Scitovsky, and M. Scott. 1970. *Industry and Trade in Some Developing Countries: A Comparative Study*. London: Oxford University Press.

Loxley, J. 1983. "The Berg Report and the Model of Accumulation in Sub-Saharan Africa." *Review of African Political Economy* 27/28: 197–204.

McKinnon, R. and E. Shaw. 1973. *Financial Deepening in Economic Development*. Washington DC: Brookings Institution.

Moyo, D. 2010. "*Dead Aid: Why Aid Makes Things Worse and How There Is Another Way for Africa*." London: Penguin Books.

Ndulu, B. (ed.). 2008. *The Political Economy of Economic Growth in Africa: 1960 2000, volume 2: Country Case Studies*. Cambridge, MA: Cambridge University Press.

Prebisch, R. 1950. *The Economic Development of Latin America and Its Principal Problems*. New York: United Nations Dept. of Economic Affairs.

Radelet, S. 2006. "A Primer on Aid Allocation." Working Paper 92, Center for Global Development.

Radelet, S., M. Clemens, and R. Bhavnani. 2005. "Aid and Growth: The Current Debate and Some New Evidence." In *Macroeconomic Management of Foreign Aid: Opportunities and Pitfalls,* edited by P. Isard and others. Washington, DC: International Monetary Fund.

Raikes, P. 1986. "Eating the Carrot and Wielding the Stick: The Agricultural Sector in Tanzania." In *Tanzania: Crisis and Struggle for Survival*, edited by J. Boesen and others. Uppsala, Sweden: Scandinavian Institute of African Studies.

Rajan, R. and A. Subramanian. 2008. "Aid and Growth: What Does the Cross Country Evidence Really Show?" *Review of Economics and Statistics* 90(4): 643–65.

Ranis, G. and J. Fei. 1961. "A Theory of Economic Development." *American Economic Review* 51(4): 533–65.

Rich, S. 2007. "Africa's Village of Dreams." *Wilson Quarterly* 31(2): 14–23.

Rodrik, D. 1994. "The Rush to Free Trade in the Developing World: Why so late? Why now? Will it last?" In *Voting for Reform: Democracy, Political Liberalization, and Economic Adjustment*, edited by S. Haggard and S. Webb: 61–8. New York, NY: Oxford University Press.

Rosenstein-Rodan, P. 1957. "Notes on the Theory of the 'Big Push.'" Unpublished manuscript, Center for International Studies, Massachusetts Institute of Technology.

Sachs, J. 2005. *The End of Poverty: Economic Possibilities for Our Time*. New York: Penguin Press.

————. 2009. "Aid Ironies." *Huffington Post*. May 24. http://www.huffingtonpost.com/jeffrey sachs/aid-ironies_b_207181.html.

Schultz, T. 1956. "Reflections on Agricultural Production, Output and Supply." *Journal of Farm Economics* 38(3): 748–62.

————. 1961. "Investment in Human Capital." *American Economic Review* 51(1): 1–17.

Serra, N. and J. Stiglitz. 2008. *The Washington Consensus Reconsidered: Towards a New Global Governance*. Oxford: Oxford University Press.

Singer, H. 1950. "The Distribution of Gains between Investing and Borrowing Countries." *American Economic Review* 40(2): 473–85.

Smith, A. 1976. *An Inquiry into the Nature and Causes of the Wealth of Nations*. Chicago, IL: University of Chicago Press.

Solow, R. 1956. "A Contribution to the Theory of Economic Growth." *Quarterly Journal of Economics* 70(1): 65–94.

Srinivasan, T. 1994. "Data Base for Development Analysis: An Overview." *Journal of Development Economics* 44(1): 3–27.

Stigler, G. 1982. "The Economists and the Problem of Monopoly." *American Economic Review* 72(2): 1–11.

———. 1975. "The Goals of Economic Policy." *Journal of Law and Economics* 18(2): 283–92.

Sunkel, O. 1969. "National Development Policy and External Dependence in Latin America." *Journal of Development Studies* 6(1): 23–48.

Truman, H. 1949. "Inaugural Address." Accessed June 20, 2013. http://www.bartleby.com/124/pres53.html.

Viner, J. 1940. "The Short View and the Long in Economic Policy." *American Economic Review* 30(1): 1–15.

Wallerstein, I. 1979. *The Capitalist World-Economy*. Cambridge, MA: Cambridge University Press.

Williamson, J. 1990. "What Washington Means by Policy Reform." In *Latin American Adjustment: How Much Has Happened?* Washington, DC: Institute for International Economics.

World Bank. 1981. *Accelerated Development in Sub-Saharan Africa: An Agenda for Action*. Washington, DC: World Bank.

A Caricature (Model)
of the World Economy

Ricardo J. Caballero
Massachusetts Institute of Technology
National Bureau of Economic Research

This paper provides an extremely stylized model of the workings of a global economy where one of its key driving factors is economic agents' continuous struggle to find assets to park financial resources. This struggle naturally comes with euphoria and disappointments, as many of the "parking lots" are built too quickly, are not of the desired size, or suddenly collapse. There are also global asymmetries, as some countries are endowed with more empty "land" than others, and their growth potential may also differ. I use this caricature of the world economy to describe several of the main driving forces behind recent global macroeconomic events and to discuss suitable economic policy. I also make a series of conjectures about some of the uncertainties and trends that may emerge in the near future.

This *macroeconomics of asset shortages* perspective has been at the core of much of my research and policy proposals over the last decade (see Caballero (2006) for a short paper presented at the ECB with that title). As such, I do not pretend that this is a fully balanced view of the recent events in the world economy.

Also note that much of what I say here has a formal "micro-founded" model in the background (see, in particular, Caballero and Krishnamurthy (2006; 2008a, b; 2009) and Caballero and others (2008a, b) but I do not make any major effort to draw those connections here. Instead, I indulge in the liberating experience of simply writing down equations that roughly capture things I believe in. (Warning: this should not be done without proper supervision or if you need to get tenure).

1. THE GLOBAL ECONOMY

In this section I build a stylized model of the world economy, attempt to capture some of the main recent macroeconomic forces and trends, and conjecture upon some of the pending risks and patterns that are likely to emerge in the near future. My emphasis throughout is on financial markets implications, however it goes without saying that there is an extensive literature that describes the many connections between developments in financial markets and real activity (and their feedbacks).

1.1 A (Caricature) Model

I begin by outlining a model which serves as the backbone for the conjectures I make in the rest of the paper. There are four assumptions and equations on which the analysis builds: aggregate consumption, portfolio demand, goods production, and asset supply.

Time is continuous. At each instant, (the rate of) aggregate consumption, C_t, is proportional to aggregate wealth, W_t:

$$C_t = \theta W_t. \tag{1}$$

There are two assets, A and B, in which to store wealth. Agents want to hold a share α^D of wealth in asset A and $(1-\alpha^D)$ in asset B. In the model there is no real distinction between these assets in terms of payoffs since there is no explicit modeling of risk, so all differences stem from agent's tastes. However, this is just a "catch all" reduced form for the many factors that determine portfolio decisions in reality, that are not purely return-driven (more on this later). Let x^i, for $i=\{A,B\}$, denote the units of each asset held by economic agents and p^i their respective prices. We then have:

$$W_t = p_t^A x_t^A + p_t^B x_t^B. \tag{2}$$

Aggregate output is exogenous and grows at rate g:

$$Y_t = Y_0 e^{gt}. \tag{3}$$

A fraction δ of this output is pledgable (i.e., its present value can be used to back up assets) and the rest is not (think of the latter as

part of labor income, but it could include other non-pledgable incomes such as small firms' profits). There are α^s assets of type A and $1-\alpha^s$ of type B, each of which entitles the owner to corresponding shares of the pledgable output (i.e., a fraction α^s of the pledgable income is of type A while $(1-\alpha^s)$ is of type B).

We are now ready to characterize some basic properties of this (world) economy. Equilibrium in goods and financial markets require that:

$$C_t = Y_t$$

$$\frac{p_t^A}{p_t^B} \frac{\alpha_S}{1-\alpha_S} = \frac{\alpha^D}{1-\alpha^D}.$$

Henceforth I will assume that asset A is in *relatively short supply*. That is, $\alpha^D > \alpha^S$, to imply:

$$p_t^A = \frac{\alpha^D}{\alpha^S} \frac{1-\alpha^S}{1-\alpha^D} p_t^B > p_t^B. \tag{4}$$

Replacing this expression back into the portfolio equation and using the consumption function and equilibrium condition in goods markets, we can solve for the equilibrium asset prices in terms of the consumption good (the numeraire):

$$p_t^A = \frac{\alpha^D}{\alpha^S} \frac{Y_t}{\theta} \tag{5}$$

$$p_t^B = \frac{1-\alpha^D}{1-\alpha^S} \frac{Y_t}{\theta}.$$

Finally, we can find the implicit interest rates, r^A and r^B, that are consistent with these asset prices and the standard arbitrage condition:

$$r_t^i = \frac{\delta Y_t + p_t^i}{p_t^i}.$$

to imply:[1]

$$r_t^A = g + \delta\theta\frac{\alpha^S}{\alpha^D} \tag{6}$$

$$r_t^B = r_t^A + \lambda_t \, ,$$

for a scarcity premium (or convenience yield) of asset A over asset B:

$$\lambda_t \equiv \delta\theta\frac{\alpha^D - \alpha^S}{\alpha^D(1 - \alpha^D)} > 0 \, . \tag{7}$$

These equations fully characterize equilibrium and allow us to do comparative statics.

1.2 Discussion and Apology

Before exploring the effects of different "shocks", it is important to provide some context to the distinction between type A and type B assets. This assumption attempts to capture the fact that at any given time there are assets that seem scarcer than others. The reasons for these scarcities are varied, complex, and change over time.

For example, during the years between the Nasdaq crash and the recent financial crisis, type A assets were almost any AAA bond or tranche. The reasons for the enormous demand for these assets were, among others, the rise in the relative importance of sovereign savers and a variety of regulatory requirements on financial institutions. Things changed when the crisis hit; suddenly only AAA-bonds issued by sovereigns, especially the U.S., made the type A cut.

At times, type A assets are not limited to ultra-safe fixed income ones. Commodities, real estate, or the Nasdaq may become the hot asset. That is, economic investors coordination can raise the status of almost any particular asset. We can also think about the sovereign yield curve in terms of A and B assets, with the short end of the curve as the former and the long end as the latter, although there are times when the entire curve seems to be perceived as type A.

Also, policy actions can have very significant effects on asset supply composition. Sometimes this is a deliberate decision, as in

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1. For simplicity, I have assumed that all future pledgable income is embodied in existing assets. A more realistic setup has new assets emerging over time, in which case the effect of growth on interest rates is reduced. In fact, in the extreme case where the stock of assets grows at the rate of g, this rate drops out of the interest rate expressions.

some quantitative easing policies, but in others it is an unintended consequence. For example, the recent Swiss franc peg (or lower bound) against the euro, significantly reduced the availability of type A assets in foreign exchange markets. I will return to these issues later on in the paper.

I am fully aware that I am asking the reader to be far more flexible in its interpretation than is the norm in academic papers. In fact, all the examples in this section have some concept of risk in the background while the model has none. Still, I think this stretch is useful in order to isolate the idea that sometimes economic agents are collectively willing to put large amounts of resources into a few assets, almost regardless of price (this feature takes an extreme form in the model since the assets are identical, *except* for the price!). As it will be apparent in the next sections, this simple idea has something to say about a wide variety of macroeconomic phenomena.

2. MAJOR RECENT GLOBAL MACROECONOMIC FORCES

Let's use this model to capture some aspects of the main global forces driving recent macroeconomic and financial market events.

2.1 Force 1: Gradual Decline in Global $\delta\theta$

An important characteristic of the world economy is the sharp rise in the relative income of the largest emerging market economies and commodity producers, coupled with their enormous desire to save for a "rainy day". In general, these are economies that have limited capacity to produce financial instruments (low δ) and have a higher propensity to save than developed economies (low θ).

In terms of the simple parameters of the model, this trend amounts to a decline in the global (income-weighted) δ and θ. In the model these parameters enter multiplicatively in the numerator of (possibly shadow) interest rates, and hence this force depresses interest rates and, correspondingly, raises equilibrium asset prices (note that in general equilibrium only the decline θ in matters for asset prices, since the negative direct effect of the decline in δ is exactly offset by the asset price boosting effect of lower equilibrium interest rates).[2]

2. More precisely, when θ falls, there are more savings looking for a fixed amount of assets so prices have to rise. When δ falls there is a similar effect in that now the supply for assets shrinks relative to given savings. However, this effect is offset by the fact that now each unit of the asset has a lower dividend.

This pattern is consistent with the continuous emergence of asset "bubbles" and with the so called Greenspan's conundrum (when the Fed tried to raise interest rates but the market kept putting downward pressure on the longer end of the yield curve). This idea was developed formally in Caballero and others (2008a, b), and the θ component also captures the so called savings glut hypothesis (Bernanke, (2005)).

A popular criticism of the latter is that measured global saving did not rise during the period it was supposed to apply to. However, the model here illustrated that this is not a meaningful rejection since equilibrium prices change to offset the savings glut force, and hence the adjustment may reflect entirely in prices rather than in quantities (in fact, in the model global saving is zero at all times).

Note also that the scarcity (risk?) premium λ is linear with respect to $\delta\theta$ and hence it also drops as $\delta\theta$ falls:

$$\frac{\partial \lambda}{\partial(\delta\theta)} = \frac{\lambda}{\delta\theta} > 0 \ ,$$

which is consistent with the risk-compression observed through much of the recent decade prior to the financial crisis.

In the model, r^B declines more than r^A because as $\delta\theta$ falls, there is more scarcity of assets in general, not just of the "safest" assets. That is, it is a proportional shift in demand for *all* assets which dilutes the *relative* scarcity premium of assets type A.

2.2 Force 2: Gradual Rise in α^D

Not only has the net demand for assets risen over time but also, especially after the Nasdaq crash in the early 2000s, this rise has been concentrated on AAA-assets (the type A assets of this episode). This is again due primarily to the role played by sovereigns in global saving and by a series of regulatory requirements on financial institutions favoring these assets. In the model, the direct effect of a rise in α^D is an increase in the price of assets type A and a decrease in the price of assets of type B.

The combination of forces 1 and 2 through this period led to a generalized rise in the capitalization value of both fixed (type A in that period) and variable income, but with a much stronger rise in the former. For example, U.S. financial assets grew from less than 160 percent of GDP in 1980 to almost 480 percent in the third quarter of 2007, and

almost the entire growth from the early 2000s was due to a rise in debt instruments (primarily that issued by the financial system).

The next force describes the supply side reaction to the rise in demand.

2.3 Force 3: Temporary (Artificial?) Rises in α^S

Forces 1 and 2 led to either spontaneous (coordination-based) or deliberate attempts to "arbitrage" λ by transforming B into A assets (and partly to transform non-pledgable assets into pledgable ones). During much of the 1990s artificial assets were created in emerging markets until the sequence of crises starting with the Asian crisis destroyed a large share of these assets. The pressure then moved to U.S. assets, and the Nasdaq in particular, which also culminated with a crash; to then be followed by the financial system's rapid rise in the production of AAA tranches from the securitization of lower quality loans. This also came to an abrupt end during the so called "subprime" crisis.

By 2001, as the demand for safe assets began to rise above what the U.S. corporate world and safe-mortgage-borrowers naturally could provide, financial institutions began to search for mechanisms to generate triple-A assets from previously untapped and riskier sources. Subprime borrowers were next in line, but in order to produce safe assets from their loans, "banks" had to create complex instruments and conduits that relied on the law of large numbers and tranching of their liabilities. Similar instruments were created from securitization of all sorts of payment streams, ranging from auto to student loans (see Gorton and Souleles (2006)). Along the way, and reflecting the value associated with creating financial instruments from them, the price of real estate and other assets in short supply rose sharply. A positive feedback loop was created, as the rapid appreciation of the underlying assets seemed to justify a large triple-A tranche for derivative CDOs and related products. Credit rating agencies contributed to this loop, and so did greed and misguided homeownership policies, but most likely they were not the main structural causes behind the boom and bust that followed.

2.4 Force 4: Spikes in α^D/α^S (Flight to Quality)

From a systematic point of view, this new-found source of triple-A assets was much riskier than the traditional single-name highly

rated bond. As Coval and others (2009) demonstrate, for a given unconditional probability of default, a highly rated tranche made of lower quality underlying assets will tend to default, in fact it can (nearly) only default, during a systematic event. This means that, even if correctly rated as triple-A, the correlation between these complex assets distress and systemic distress is much higher than for simpler single-name bonds of equivalent rating.

The systemic fragility of these instruments became a source of systemic risk in itself once a significant share of them was kept within the financial system rather than sold to final investors. Banks and their SPVs, attracted by the low capital requirement provided by the senior and super senior tranches of structured products, kept them in their books (and issued short-term triple-A liabilities to fund them), sometimes passing their (perceived) infinitesimal risk onto the monolines and insurance companies (AIG, in particular).[3] The recipe was copied by the main European financial centers (Acharya and Schnabl (2009)). Through this process, the core of the financial system became interconnected in increasingly complex ways and, as such, it developed vulnerability to a systemic event.

The triggering event was the crash in the real estate "bubble" and the rise in subprime mortgage defaults that followed it. Almost instantaneously, confidence vanished and the complexity which made possible the "multiplication of bread" during the boom, turned into a source of counterparty risk, both real and imaginary. Eventually, even senior and super-senior tranches were no longer perceived as invulnerable (previously A assets turned into B assets).

Along the way, the underlying structural deficit of safe assets that was behind the whole cycle worsened as the newly found source of triple-A assets from the securitization industry dried up (α^S declined), and the spike in perceived uncertainty further increased demand for these assets (α^D increased). In terms of the model, these dynamics are captured by a sudden rise in α^D/α^S. Consistent with our simple equations, during this episode safe interest rates plummeted to record low levels and all forms of risk-premia (λ_S) skyrocketed.

Initially, the flight to quality was a boon for money market funds, which suddenly found themselves facing a herd of new clients. In order to capture a large share of this expansion in demand from these new clients that had a higher risk-tolerance than their usual

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3. See Gennaioli and others (2001) for a "local thinking" model of disappointment with financial innovation.

clients, some money market funds began to invest in short-term commercial paper issued by the investment banks in distress (that is, they found their own temporary mechanism to transform B into A assets). This strategy backfired after Lehman's collapse, when the Reserve Primary Fund "broke-the-buck" as a result of its losses associated with Lehman's bankruptcy. Perceived complexity reached a new level as even the supposedly safest private funds were no longer immune to contagion. Widespread panic ensued and were it not for the massive and concerted intervention taken by governments around the world, the financial system would have imploded.

In terms of the model, the panic phase corresponded to an even more extreme rise in α^D / α^S, and the policy interventions are attempts to both lower α^D and raise perceived α^S by issuing public guarantees which are aimed at limiting the sudden transformation of A assets into B assets.

Another recent example is the Swiss franc peg (lower bound) against the euro which sharply reduced the α^S in foreign exchange markets. One of the unintended consequences of this policy was a sharp depreciation of type B currencies (emerging markets, in particular) relative to the remaining type A currencies (U.S. dollar and yen in particular).

3. REGIONS

There are limits to how far we can go without referring to the heterogeneity, both ex-crisis and post-crisis, in the world economy. Here I highlight some of these differences, pointing to their broad implications rather than focusing on the mechanics of global equilibrium.

3.1 Force 5: Asymmetric δθ

One of the key differences between emerging and developed economies is the institutional development supporting financial markets and contracts. That is, δ is higher in developed economies than in emerging markets. This is the point we made formally in Caballero and others (2008b) to explain why capital was flowing from emerging markets to developed economies during the period starting after the Asian crisis. This effect was reinforced by the high propensity to save (low θ) of some emerging markets, in particular from Asia and some commodity producing economies.

As is apparent in the model, these forces lead to lower pledgable return in the "South" than in the "North", and hence justify the seemingly paradoxical direction of net capital flows from emerging markets to developed economies in recent years (it is a paradox because the standard neoclassical implication is that capital should flow from capital rich developed economies to capital poor developing economies).

3.2 Force 6: Asymmetric α^D/α^S

The relative weakness in financial development of emerging market economies is particularly severe in the production of type A assets. Other things equal, this asymmetry in α^D/α^S means that r^A is higher in developed economies while r^B is higher in emerging markets.

Given net flows, this mechanism helps to explain why the typical gross capital flows pattern is one in which emerging markets buy "safe" assets from developed economies, while the latter buy "risky" assets from emerging markets (Gourinchas and Rey (2007) very lucidly describe this phenomenon as the venture capitalist behavior of U.S. investors in the international context).

The many adjustments they made in response to their own crisis in previous decades paid off. The solid macroeconomic performance of emerging markets during the crisis has reduced the perceived α^D/α^S asymmetry, which is gradually turning type B emerging market assets into type A assets.

3.3 Force 7: Asymmetric *g*

While emerging markets typically grow at a faster pace than developed economies, this gap has become very pronounced in the post-crisis phase. From the point of view of our model, this effect increases the expected return of all emerging market assets over those in developed economies. This is probably a key factor behind the surge in capital flows to emerging markets that preceded the very recent spike in risk aversion following the problems in the Euro area. While developed economies are still mired in double-dip concerns, most non-Eastern European emerging market economies were until recently struggling to cool down capital inflows and their expansionary consequences.

As I said earlier, these new pattern of capital flows is partly due to growth differential, but it is also a result of the weakening of force 6.

3.4 Force 8: Transitions

In this new environment of extreme safe assets scarcity, it makes a great difference to countries whether they are perceived as primarily type A or type B asset producers. Perhaps more importantly, the transition from one to other category can have devastating or exhilarating consequences depending on the direction of the shift. The PIIGS have seen the consequence of the bad transition, from A to B, while many emerging markets, such as Indonesia or Chile, are on the other side of the spectrum (of course this is a relative statement that reflects the direction of marginal changes, not the relative level of investors' appeal of these regions).

Perceived relative growth potential can have similar effects, which explains why some Eastern European economies are having a particularly hard time during the recovery as they face a combination of weak growth potential and institutional development.

These transitions, when involving a large group of countries, have global equilibrium consequences. In fact, the recent appreciations of the Swiss franc and Japanese yen do not owe to any particular domestic strength (especially the latter), but to the fall in expected return in other developed economies' returns (the connection between exchange rates and returns differential follows from the interest parity condition). On the other side of the spectrum, the (until recent) surge in capital flows to many emerging markets were not exclusively due to new strengths in them, but also due to the relative weakness of much of the developed world. These general equilibrium sources of capital flows are important to keep in mind for understanding the strength and weaknesses of particular recoveries.

4. QUANTITATIVE EASING

This simple framework is useful for understanding the essence of the financial implications of quantitative easing policies (QE). Presumably, the ultimate financial goal of such a policy is to reduce r^B, as most private sector produced assets (borrowing by corporations and households) have a large component of type B assets. In the early stages of QE, r^B was targeted directly through the purchase

of MBS and other distressed assets. This "credit-easing" policy was instrumental in stabilizing the economy, but as the recovery took hold, a series of political constraints and concerns brought that unorthodox strategy to an end. The recent faltering in the recovery is not yet severe enough to make it politically feasible to go back to credit-easing policies, which has left the Fed and other central banks with the second best policy of lowering r^A (Treasury rates) and hoping that this will indirectly reduce r^B. One, indirect, mechanism by which the latter may occur, is simply by the "psychological" effect of the policy in boosting the perception that the central bank is willing to put a floor on the economy. That is, this indirect channel acts through reducing α^D. I suspect this is the most powerful aspect of the policy, as the direct channel faces an uphill battle with investors asset demands and has some unintended consequences, as I argue below. I turn to this direct channel next.

Let $\alpha^S \Delta$ denote the purchases of type A assets by the Fed, which reduces the net supply of these assets faced by the private sector from α^S to $\alpha^S (1-\Delta)$. The Fed's earned returns on these holdings are transferred to the Treasury, which in turn gives it back to households.

It is easy to see in the stark model that QE targeted at assets type A have no effect on r^B. Since the share of income invested in assets type B is constant and the net supply of assets type B is not changed by QE, there is no effect of the policy on the price and return of this asset. Instead, all that happens is that p^A rises by (approximately)Δ percent, and r^A drops correspondingly:

$$p_t^{A,QE} = \frac{\alpha^D}{\alpha^S (1-\Delta)} \frac{Y_t}{\theta} \approx (1+\Delta) p_t^A, \tag{8}$$

$$r_t^{A,QE} - r_t^A = -\delta\theta \frac{\alpha^S}{\alpha^D} \Delta. \tag{9}$$

Thus, in order for QE to have an effect on r^B, there needs to be a leak out of demand for assets of type A. This is unlikely to happen during a severe flight to quality episode, but it is more likely during a recovery (and in this sense it is reasonable to shift from a policy targeting B directly to one targeting A once one considers the political costs of the former). As r^A drops to extremely low levels, it triggers a search for yield process that lowers r^B. This is one of the main mechanisms by which emerging markets were initially flooded by capital as QE took place in the U.S.

Let us introduce a minimal modification in the model to capture this search for yield effect and assume that the minimum return investors are willing to accept for assets type A is $r^{A,min}$. It immediately follows from expression (9) that there is a maximum QE, Δ^{max}, such that any further increase in QE leaks entirely into market for assets type B. In this $\Delta \geq \Delta^{max}$ region, we have that in addition to $1-\alpha^D$, private investors hold a share $\alpha^S(\Delta \geq \Delta^{max})$ of their wealth in assets type B. Thus, in region we have that:

$$p_t^{A,QE} = \frac{\alpha^D}{\alpha^S(1-\Delta^{max})}\frac{Y_t}{\theta}; \qquad r_t^{A,QE} = r^{A,min}$$

and

$$p_t^{B,QE} = \frac{1-\alpha^D + \alpha^S(\Delta-\Delta^{max})}{1-\alpha^S}\frac{Y_t}{\theta}; \qquad r_t^{B,QE} = g + \delta\theta\frac{1-\alpha^S}{1-\alpha^D+\alpha^S(\Delta-\Delta^{max})}.$$

Some of this search for yield is concerning, as agents that should not be holding certain risks begin to do it (this is what caused the demise of Reserve Primary Fund at the worst point of the subprime crisis). Initially the search goes to marginally riskier assets, but as the progression continues the private sector loads increasing amounts of risks into its balance sheet. In fact, this pattern is already building up, as some pension funds that traditionally have invested in type A assets are now being forced to move into type B assets since r^A is too low for them to honor their future contingent liabilities.

One area of particular concern arises once we think of assets type B as those that are most exposed to systemic events. In the post-subprime-crisis years, the price for insurance against "Black Swan" type events has been so high, that it is pricing in the possibility of an event worse than the great depression in the next few years. This situation is worrisome not only because it reflects a major dislocation, but also because it provides potentially dangerous incentives for the distribution of aggregate risk holding. Because p_t^A is so high, it deters agents that should be insuring against systemic events from doing so, and it gives incentives to institutions that should not be in the business of selling this type of insurance to get into this business (a sort of AIG on steroids).

In summary, QE policy targeted at assets type A can be effective in reducing r^B when flight-to-quality is moderate (a situation that can be captured by low but positive), but it entails important risks as it essentially consists in pushing private investors into risky

investments by reducing the effective supply of safe assets. This reallocation may be fine for some investors but may also raise systemic fragility if the wrong economic agents end up holding the risk. From the point of view of the distribution of risks in the economy, current QE is very different from credit policy targeted to the purchase of assets type B, as in the latter it is the government that increases its risk exposure while the private sector reduces it. Which one is the right recipe depends largely on the fragility of the financial institutions that are required in equilibrium to shift their portfolio in one direction or the other.

5. CONCLUSION

In this article I have proposed an extremely stylized organizing framework to get a first impression on some of the consequences of the different forces that are influencing global financial and macroeconomic patterns. The organizing theme is the relative scarcity of different types of financial assets, which I argue offers a parsimonious account of many broad patterns as well as insight into the workings of quantitative easing policies.

What makes an asset type A or type B? This varies from time to time. Today, it seems that a central feature is the degree of exposure of the asset to systemic macroeconomic risk. The cost of insurance against "Black Swan" type events has risen since the pre-crisis period, and hence the degree to which an asset provides or consumes such insurance is a key determinant of its perceived value.

Relative to the pre-crisis period, at the world level, g, δ, θ, α^S have declined while α^D has risen. The most immediate consequence is an extremely low r^A for the few assets that are considered type A (a few sovereigns and corporations), and an enormous reluctance to hold macroeconomic risk (a sharp rise in λ when we think of type B assets as those that are exposed to systemic events).

Moreover, the world is decoupled with most emerging markets growing at a fast pace and reducing the institutional gap with developed economies, there is a shrinking group of developed economies whose sovereigns can issue type A assets and hence finance their deficits at record low rates level, and there is a range of economies whose sovereign's liabilities lay in the gray area between type A and type B assets. This environment is conducive to a chronic rise in capital flows to EMs and to great instability in the economies that live in the downgrade-region.

In the developed world, it is not that interest rates are low because central banks have decided to keep them there. The causality runs the other way round: they have to set low policy rates because the equilibrium rates are so low that if they did not, the economy would experience strong deflationary forces (this is by Walras' Law, since an excess demand for assets must mean an excess supply of goods—see Caballero (2006)).

Of course, the counterpart of the tough environment for B assets is the enormous reward from being a type A asset producer, which is precisely what has maintained very low deficit funding costs for prime sovereigns.

Quantitative easing is not the most effective instrument to address this environment. It operates by pushing the private sector into riskier investments rather than by the government absorbing a bigger share of the risk during the recovery. This may be the only politically feasible policy, but it does come with additional systemic risks.

Needless to say, many governments are simply not in condition of strength to absorb any additional risk, in which case there is no way around but to have the private sector hold a larger share of aggregate risk and build up a buffer to prevent panic-driven asset perception swings. But this is not an objective in itself, rather it is one of the many costs of chronic fiscal misbehavior. For economies suffering from weak public finances, a reduction in θ (the government component of it) could be extremely effective, since in addition to the direct effect on the budget there could be an increase in perceived α^S.

There have been many recent calls for a global rebalancing, which essentially means that θ should rise in surplus economies and, perhaps, decline in deficit economies. Note that if only the former takes place, the direct impact would be a rise in all interest rates and scarcity premium. This negative effect from the asset market side should be weighed against the conventional net-exports channel, which underlies the prescription.

To conclude, it is important to highlight that in this context, the long-run fiscal health of a country has a first order importance, since governments are the ultimate providers of extreme-events systemic insurance. The perception that such implicit or explicit facility is unavailable, is in itself a great source of instability and self-fulfilling downward spirals.

REFERENCES

Acharya, V. and P. Schnabl. 2010. "Do Global Banks Spread Global Imbalances? The Case of Asset-Backed Commercial Paper During the Financial Crisis of 2007-09." *IMF Economic Review* 58(1): 37–73.

Bernanke, B. 2005. "The Global Saving Glut and the U.S. Current Account Deficit." Board of Governors of the Federal Reserve System Speech, March 10th.

Caballero, R. 2006. "On the Macroeconomics of Asset Shortages." In *The Role of Money: Money and Monetary Policy in the Twenty-First Century*, edited by A. Beyer and L. Reichlin. Frankfurt: European Central Bank.

Caballero, R., E. Farhi, and P. Gourinchas. 2008a. "Financial Crash, Commodity Prices, and Global Imbalances." NBER Working Paper 14521.

————. 2008b. "An Equilibrium Model of 'Global Imbalances' and Low Interest Rates." *American Economic Review* 98(1): 358–93.

Caballero, R. and A. Krishnamurthy. 2001. "International and Domestic Collateral Constraints in a Model of Emerging Market Crises." *Journal of Monetary Economics* 48(3): 513–48.

————. 2006. "Bubbles and Capital Flow Volatility: Causes and Risk Management." *Journal of Monetary Economics* 53(1): 35–53.

————. 2008a. "Collective Risk Management in a Flight to Quality Episode." *Journal of Finance* 63(5): 2195–230.

————. 2008b. "Knightian Uncertainty and its Implications for the TARP." In *Financial Times Economists' Forum*, November 24th.

————. 2009. "Global Imbalances and Financial Fragility." *American Economic Review* 99(2): 584–88.

Coval, J., J. Jurek, and E. Stafford. 2009. "The Economics of Structured Finance." *Journal of Economic Perspectives* 23(1): 3–26.

Gennaioli, N., A. Shleifer, and R. Vishny. 2012. "Neglected Risks, Financial Innovation, and Financial Fragility." *Journal of Financial Economics* 104(3): 452–68.

Gorton, G. and N. Souleles. 2006. "Special Purpose Vehicles and Securitization." In *The Risks of Financial Institutions*, edited by R. Stulz and M. Carey. Chicago, IL: University of Chicago Press.

Gourinchas, P. and H. Rey. 2007. "From World Banker to World Venture Capitalist: U.S. External Adjustment and the Exorbitant Privilege." In *G7 Current Account Imbalances: Sustainability and Adjustment*, edited by R. Clarida. Chicago, IL: University of Chicago Press.

Krishnamurthy, A. and A. Vissing-Jorgensen. 2011. "The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy." *Brookings Papers on Economic Activity* (Fall): 215–87.

THE LIQUIDITY APPROACH TO BUBBLES, CRISES, JOBLESS RECOVERIES, AND INVOLUNTARY UNEMPLOYMENT

Guillermo Calvo
Columbia University

Future generations will likely remember the turn of the 21st century as the time when mainstream macroeconomics was about to completely remove money and finance from its models, and perished in the attempt. Before the subprime crisis, macroeconomic/monetary theory reached a level of pristine perfection according to which central banks could be masters of the (macro) universe by expertly tweaking a policy interest rate (usually a very short-run interest rate) and/or (some) exchange rate. The hard work was not placed on the shoulders of experienced sleuths that would scour every corner of the financial system in search of structural defects. Rather, the job fell on the shoulders of bright-eyed PhDs whose main task was to develop computer algorithms that would reveal the deep secrets of models in which money and finance were largely emasculated. Money disappeared from the picture as a policy instrument because it was assumed to be an *endogenous* variable. Finance remained but only as a faint shadow of itself; represented by a policy interest rate and a set of inter-temporal arbitrage conditions (which, incidentally, have dubious empirical support). The map was completed by slapping on some exogenous (unexplained and poorly motivated) random shocks and, above all, assuming some kind of expectations' rationality. The latter made the task especially challenging and fit for PhDs in economics (or physics). Don't get me wrong. This is valuable research from a scientific point of view. There is nothing wrong for scientists to explore what may at first look as implausible scenarios (just think

of Einstein's theory of relativity!). The problem in this case is that, in my opinion, those models kept central banks from paying enough attention to the workings of the financial system. To be true, central banks were not alone in this struggle. Either inside or outside central banks, there were financial regulators whose countenance better fit that of experienced sleuths. However, financial regulators tended to focus on *micro* issues and, as a general rule, kept their communications with their central banks at a bare minimum (and it seemed to work!).

To be true, for emerging market economies (EMs) the Great Moderation period was much less than tranquil, and it was rather tempting to relabel it Great Immoderation! Sudden Stop crises were the order of the day since the mid 1990s. But this was taken as a reflection of weak domestic institutions involving the financial sector, deficient rule of law and sheer corruption. Get your house in order, was the stern advice from multilateral institutions, and the rest will be fine. As a result, EM crises failed to put a dent on the shining models coming from the *North*. On the contrary, EMs felt the pressure to have their own models, with the same characteristics, if they wanted to have a seat at the table of sophisticated world central bankers. The models' disconnect with EM reality was striking. Central phenomena like Sudden Stops and balance-sheet imbalances (e.g., foreign exchange denominated credit, *Liability Dollarization*) were obliterated (see Calvo (2006)). Fortunately, the higher echelons of several EM central banks were less than completely dazzled by those models—and common sense prevailed. EMs that had learned the lessons of past financial crises fared relatively well during the subprime crisis. But this was not enough to generate a new macro/monetary paradigm to challenge conventional wisdom.

A prominent characteristic of financial crises is that they seem to come from nowhere and spread like wildfire. Moreover, far from staying within the boundaries of the financial sector, these crises deal a severe blow on the *real* economy: output, expenditure and employment suffer major blows. These characteristics are not easily supported by mainstream macro models in which features like the *permanent income hypothesis* are assumed to prevail, and the financial sector is not at the heart of macroeconomic disturbances. Microeconomics, in turn, was much more alert about liquidity issues. There is a long and distinguished literature focusing on bank runs, for example (see Allen and Gale (2007)). Existence of multiple equilibria is a salient characteristic of those models, a situation that arises because of liquidity considerations. In the seminal paper by

Diamond and Dybvig (1983), for instance, banks create liquidity by offering demand deposits, which proceeds are employed to finance long-maturity projects. Depositors are able to withdraw their deposits any time they wish, which is attractive because it helps depositors meet random contingencies. On the other hand, investment in productive projects induces a competitive bank to offer a positive return on those deposits. The resulting risk-sharing arrangement dominates those in a bank-less economy (with incomplete capital markets) and can even help reaching a Pareto Optimum. A major problem is that those banks are subject to bank runs, because if depositors believe that a bank run is in the offing, they will rush to withdraw all of their deposits. Banks would then be unable to fulfill their obligations because part of the funds would have been employed to finance long-term maturity projects. One way to prevent bank runs from happening would be to establish a Lender of Last Resort (LOLR) and other similar arrangements. But the point that I wish to stress here is that the micro-finance literature had a rich arsenal of models which, once again, macroeconomists ignored. A proof of this is that if the bank-run literature had been taken into account, central banks would have realized that "shadow banks"—central factors behind the subprime crisis—were, in principle, bereft of a LOLR, and could easily be toppled by a wave of negative self-fulfilling expectations.

In the present chapter I will argue that liquidity can help to rationalize the creation and destruction of "bubbles" in an intuitive manner, and without having to assume that they stem from highly unlikely *real* supply shocks ("tail risks"). To illustrate this, I will employ a model in which liquidity services have a role to play (e.g., facilitating market transactions). But, in contrast with the conventional models in which liquidity is represented by "money" only, I will assume that real goods can also provide liquidity services. This is not a novel assumption. However, it seems to me that the importance of this assumption for understanding the significance of a liquidity crunch in explaining central features of financial crises has been largely overlooked.

To study the implications of this assumption, I will initially focus on the case in which the only available real asset is inelastically supplied land. This setup is enough to demonstrate that the relative price of land in terms of output increases as land becomes more liquid. Thus, for instance, financial innovation that enhances land's liquidity may help to explain a real estate "bubble." This is not an irrational bubble because it would stem from a *fundamental*, i.e., financial

innovation. This effect is altogether missed by mainstream macro because liquidity of real assets is not part of the story; in fact, for someone sticking to the conventional approach, the increase in the price of land would have no explanation in terms of his/her model's smaller set of fundamentals.

Since conventional money is part of the model discussed here, I will be able to test the effects of standard monetary variables. To highlight the role of liquidity, I will conduct the analysis under the assumption that prices and wages are perfectly flexible. I will show that variables like the policy interest rate and the rate of inflation have an impact on the relative price of land that would be absent if land's liquidity was abstracted from. For example, a fall in the policy interest rate boosts land's price; this supports the view that Greenspan's low interest rates after 2001 may have fueled the boom in U.S. real estate prices (see Taylor (2009)). On the other hand, "helicopter money" which increases the supply of, say, high-powered money without touching the policy interest rate has no impact on the relative price of land. Therefore, simply expanding the balance sheet of the central bank may not cushion the economy from the fall in collateral values in terms of output.

The fall in collateral values implied by a liquidity crunch is then employed to argue that a liquidity shock could bring about significantly lower credit flows. This is bound to have negative effects on employment and output, as it drains working capital credit. The fall in collateral values does not affect all projects alike. I will argue that projects involving new labor hires are hard to finance relative to those involving physical capital, because the latter come with their own collateral, whereas the former require posting collateral not directly linked to hiring. This helps to explain so-called jobless recovery. In addition, I will explore a situation in which the credit crunch is so severe that full employment would call for a major collapse in real wages. This may be seriously detrimental to workers' morale to such an extent that firms will find it optimal not to lower wages below a certain critical point, even though unemployed laborers are willing to work for a smaller wage. This type of involuntary unemployment cannot be cured with monetary policy unless substantial credit flows can be unleashed to credit-constrained sectors or labor subsidies are enacted. Open market operations may be highly ineffective in this respect.

Identifying liquidity as an important factor in financial crisis episodes is very different from claiming that liquidity is the missing

piece of the puzzle that will henceforth give us a solid foundation for macroeconomic policy. Liquidity is a subtle phenomenon that cannot be measured in terms of, say, "mass" or "energy." An asset's liquidity depends very much on social convention, market makers and the availability of a LOLR. This makes liquidity hard to pinpoint and potentially unstable.[1] Liquidity's capacity to rationalize bubbles and sudden crashes derives from its relative inscrutability and surprising dynamics. This has to be faced point blank by macroeconomics. Liquidity will not easily submit to the concavity and continuity assumptions that conventional theory calls for, unless we find a way to tame it without destroying much of the energy of market economies. To stress this point the paper will start in section 1 by discussing Liquidity Illusion, and then analyze how its creation and destruction can affect the real economy. Section 2 will examine the phenomenon of jobless recovery and involuntary unemployment, where both are depicted as stemming from credit-market malfunction. Section 3 concludes.

Foundations of the liquidity approach

One of the most revolutionary and enduring contributions of the *General Theory* (Keynes (1961)) is the central role given to *liquidity* and *liquidity preference*, a topic later elaborated and expanded by Minsky in an important body of work, which has only recently been widely recognized by the profession (see, e.g., Minsky (2008)). The reader will find some echoes of those books in the present chapter and conclude, perhaps, that what I offer in section 2 is a bare-bones version of some of their ideas (which would be good enough for me!). In my view, however, the main contribution of that part of the paper is that it focuses on liquidity issues, almost exclusively, leaving aside many other financial issues discussed by Keynes and Minsky that, although highly relevant, may make it much more difficult to appreciate the power liquidity considerations have for explaining the mechanics of financial crises. Moreover, while I think the liquidity approach is fundamental for understanding financial crises, I am less sure that it is fundamental for explaining what might be called the

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1. For an up-to-date discussion of liquidity issues stressing relevant institutional aspects, see Mehrling (2011).

poverty of nations, as the *General Theory* seems to suggest.[2] Section 3, in turn, stands mostly on its own.

1. LIQUIDITY ILLUSION AND DISILLUSION

The topic of *Money* Illusion has been at the center stage of monetary theory for many long years now (see, e.g., Fisher (1928)). Money illusion is a situation in which a substantial number of economic agents miscalculate the *real* (or output) value of nominal flows (e.g., wages) or stocks (e.g., high-powered money). To illustrate, let W denote the nominal wage and P the price level. Therefore, the real wage $w = W/P$. The explicit or implicit assumption in the money-illusion literature is that agents have a much more accurate assessment about W than about P; hence, they are bound to miscalculate w because they base their computations on the wrong price level, which I will denote P^e (*e* for "expected"). Keynes in the *General Theory*, for example, claims that workers resist a fall in W because they have a relatively fixed notion about P^e. This induces workers to reject lower nominal wages, resulting in high real wages and unemployment during a price-deflation episode. This *expectations stickiness* is still high in policymakers' minds, and it is a major factor in their aversion to price deflation.[3] Another popular example of money illusion that is more akin to the ensuing discussion involves the stock of *money*. Denoting the stock of money in nominal terms by M, I define real monetary balances, m, by $m = M/P$. Again, money illusion in this instance is defined as a situation in which a significant number of economic agents miscalculate m. Thus, assuming expectations stickiness, an increase in M will make some agents feel richer even though the price level rises in the same proportion as M (keeping actual m constant). The seminal rational expectations model in Lucas (1972) portrays this feature. A feature shared by the above examples is that money illusion arises because individuals make mistakes in estimating the *denominator* in the definition of w or m—not the numerator.

2. To wit "That the world after several millennia of steady individual saving, is so poor as it is in accumulated capital-assets, is to be explained, in my opinion, neither by the improvident propensities of mankind, nor even by the destruction of war, but by the high liquidity-premiums formerly attaching to the ownership of land and now attaching to money," Keynes (1961, Chapter 17).

3. Another factor is Irving Fisher's (1933) *Debt Deflation*, which will be discussed later in this note.

Henceforth, I will focus on *M*. I will consider situations in which individuals know *M*, but dividing *M* by *P* does not necessarily give a correct assessment about *real* monetary balances. An example may help to motivate the discussion. Consider the case in which *M* is equated to M1, which includes bank deposits, and is typically defined by $M = H + D$, where *H* stands for high-powered money in the hands of the public (or "cash" for short) and *D* denotes bank deposits. Under normal conditions, the relative price of *D* in terms of *H* is unity. However, this may not hold if, for instance, there is a bank run. Thus, it is possible for individuals to make errors if there is a bank run. But as the bank-run literature illustrates (e.g., Diamond and Dybvig (1983)), a banking system may easily display multiple equilibriums, which means errors—indeed, even "large" errors— could be "rational" because rational individuals may not have the information that allows them to base their judgment on "objective" probabilities. Central banks usually ensure that the relative price of deposits in terms of cash is equal to 1 and, therefore, errors about the relative price of deposits are eliminated. However, the example is relevant because the financial sector has a variety of assets that are not protected by a LOLR, like many of the instruments developed by "shadow banks" prior to the recent crisis, including foreign-exchange denominated bank deposits.

In what follows, I will show the channels through which liquidity illusion can impact asset prices, the credit market and output.

1.1 Liquidity and Asset Prices, or How Liquidity Can Create (the Illusion of) Real Wealth

I will illustrate the impact of liquidity on asset prices in terms of a simple model. Again, let us denote real monetary balances by *m*; I will assume that there is another asset, land, which is in fixed supply. Output, *y*, is produced by land, and the production function satisfies $y = \rho k$, where ρ is a positive constant. Real (in terms of output) liquidity is produced by *m* and *k*. Let real liquidity be denoted by *z*. I will assume that *z* satisfies the following central equation:

$$z = m + \theta q k, \tag{1}$$

where *q* is the relative price of land in terms of output, and θ is the liquidity parameter, $0 \le \theta < 1$. Thus, capital is endowed with liquidity but will not dominate money, unless the return on capital is high

enough (because $\theta < 1$). One can think of land liquidity as produced by bank deposits that are channeled to the purchase of land or by Collateralized Debt Obligations, CDOs, with land as collateral.[4]

Let us take z as given and look for the combination of m and k that minimizes the cost of liquidity holding. The opportunity cost of holding liquidity, at steady state, where $q=0$ is given by the following expression:

$$(r + \pi - i_m)\, m + (rq - \rho)k, \tag{2}$$

where r, π, and i_m stand for real interest rate (i.e., output own-rate of interest), inflation and interest rate on money. Here I follow Calvo and Végh (1995) in identifying i_m with the policy interest rate set by the central bank. The optimal combination of non-negative m and k, given z, is obtained by minimizing cost (2) subject to equation (1), $m \geq 0$ and $k \geq 0$. To solve it in a straightforward manner, I will use constraint (1) in equation (2), yielding

$$(r + \pi - i_m)\, (z - \theta q k) + (rq - \rho)k. \tag{3}$$

Thus, the problem is now equivalent to minimizing expression (3) with respect to land k. Expression (3) is linear with respect to k. Hence, interior solutions require that the cost of liquidity holding be independent of k. A necessary and sufficient condition for this condition to hold is

$$- (r + \pi - i_m)\, \theta q + rq - \rho = 0. \tag{4}$$

Solving for the price of land q from equation (4), we get[5]

$$q = \frac{\rho}{r(1 - \theta) + (i_m - \pi)\theta}. \tag{5}$$

To help intuition, consider the special case in which $r = \rho$, and inflation and the interest rate on money are zero (i.e., $\pi = i_m = 0$).[6] Then,

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4. For a discussion on how an expression similar to (1) can be derived in a model with bank loans and deposits, see Calvo (2011b).

5. Notice that the interior equilibrium price of land q is independent of the inelastically supplied stock of land. This is an implication of the strong linearity assumptions of the model.

6. For a derivation of equation (5) in a general-equilibrium rational-expectations setup, see Calvo (2011b).

$$q = \frac{1}{1-\theta}.\tag{6}$$

It follows that an increase in land's liquidity raises the price of land in terms of output. Moreover, by equations (1) and (6), it follows that

$$m = z - \frac{\theta}{1-\theta}k.\tag{7}$$

Therefore, an increase in land's liquidity displaces money, given z.[7]

An important insight of the model is that standard fundamentals (ρ in the present case) are not enough to rationalize asset prices. The latter may widely differ from what can be inferred from standard fundamentals, given that $q = 1$ if $\theta = 0$ (recall equation (6) and the assumption $r = \rho$). However, standard fundamentals still play a key role. For example, if land was totally unproductive, i.e., $\rho = 0$, then, by equation (5), $q = 0$. Thus, the present approach does not help to rationalize the existence of *pure* bubbles, unless the underlying assets are perfect substitutes for regular money, m.

Parameter θ will be endogenized below but it is inadvisable to rush to do it. Parameter θ should be thought of as the result of a complex transactions network, which may be highly stable for some periods of time but is subject to sudden revision and, in particular, collapse. Premature endogenizing may give the wrong impression that liquidity is another stable structural parameter, when the whole point of the liquidity approach is that liquidity is not a fundamental based on individual preferences or production functions. This view is portrayed in the seminal paper by Samuelson (1958). This line of research, in which some concept of "liquidity" is exogenous to the model, is an active area of research; see, for example, Farhi and Tirole (2011) and Martin and Ventura (2012).

As it stands, the model can also be employed to get some insight on monetary policy and asset prices. By equation (5), a drop in the policy interest rate, i_m, increases the price of land q, *conditional on*

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7. By equation (7), $m = 0$ whenever $\theta \geq z/(k+z)$. Notice that if nominal money stock M is given, an increase in the liquidity of land, i.e., an increase θ, in provokes a rise in the price level P. This effect would not necessarily hold under other sensible modeling of liquidity services in which the marginal substitution between money and land was not constant and depended, for example, on the land/money ratio.

land exhibiting some liquidity (i.e., $\theta > 0$). This gives some support to the conjecture that the real estate bubble, in the U.S. at least, may be partly due to the Fed's low rates of interest following 9/11 (see Taylor (2009)). This result is new; it does not hold in standard monetary models, because in those models $\theta = 0$. Likewise, an asset price bubble could be controlled by raising the policy interest rate. One thus wonders, incidentally, if the present regime of exceedingly low interest rates is not provoking liquidity bubbles in a variety of assets, e.g., gold, and real estate in emerging market economies (EMs), for example.

1.2 Liquidity Destruction. Shattered Dreams: Asset Price Meltdown and Credit Sudden Stop

As pointed out above, liquidity does not hold in isolation. Robinson Crusoe would have had little use of financial liquidity (unless he was an inveterate miser!). Moreover, another central characteristic of liquidity, as pointed out above, is that it can quickly evaporate. Diamond and Dybvig (1983) provides a nice example in which, without a Lender of Last Resort (LOLR), liquidity could be destroyed in a flash, even though it provides a social service (in their model, liquidity provides some form of insurance). A similar situation occurs in a slightly fleshed-out version of the above model in which land liquidity is a function of expectations. For example, if land is suddenly expected to be devoid of liquidity, then there will be no incentives for holding land for liquidity purposes, and $\theta = 0$. If $\theta > 0$ prior to this liquidity-expectations shock, the price of land will collapse, and analysts are likely to characterize the episode as a bust of the real estate bubble.[8] The consequences of this may be minor if the collapse was widely anticipated. Otherwise, if specifying state contingencies in financial contracts is costly, the price collapse is unlikely to be incorporated in state-contingent contracts. Under those circumstances, leveraged speculators may be subject to margin calls and forced to liquidate other assets in a short span of time, triggering fire sales and a generalized fall in asset prices (except in the unlikely case in which assets being sold are perfectly liquid). The fall in asset prices lowers collateral values and causes a sudden stop in bank credit flows. The latter is more likely, the closer are

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8. For a model with a similar flavor that focuses on capital inflow episodes, see Calvo (2011a).

borrowers to their collateral constraints, which is arguably the case after a credit boom.[9] If prices and wages are flexible and debts are denominated in domestic currency, *real* debt rises (bringing about Irving Fisher's Debt Deflation, see Fisher (1933)) inducing deleverage in indebted sectors. Even setting aside Keynesian aggregate-demand effects due to different marginal propensities to spend between lender and borrowers, the sudden cut in credit flows may bring about a new round of *sharp changes* in relative prices, because the composition of debtors' and creditors' consumption and investment baskets are unlikely to be the same. These changes stem from an unanticipated liquidity crunch. Therefore, it is unlikely that individuals are well prepared to cope, or even understand the nature of the shock. The impact of a credit crunch differs across sectors and individuals. This environment is enormously more complex than a market economy under normal conditions in which the knowledge of a few price series and the reputations of a select number of business partners may suffice. Creditworthiness, in particular, is very hard to assess because the shock raises doubts about every agent in the system, with few exceptions. Opinions depend on individual experiences and, thus, may sharply differ across individuals. This militates against assets' liquidity because salability is hard to assess—exacerbating the collapse of asset prices. In this manner, a liquidity crunch could generate wholesale insolvency problems and Knightian uncertainty (see Frank Knight (1921)). Notice that none of these effects depend on wage/price inflexibility. They stem from the toxic link between liquidity and asset prices, a phenomenon largely ignored by mainstream macroeconomics, including the New Keynesian approach (which, by the way, should more appropriately be labeled *New Hicksian*, for Hicks (1937)).

But, the question arises, if the root of this nightmare is a liquidity shock, why not instruct the central bank to offset the shock by engaging in a massive infusion of central bank liquidity (i.e., a massive increase in money supply)? This is somewhat what the Fed and the ECB have been trying to do. However, as equation (5) shows, a once-and-for-all increase in nominal money supply has *no* effect on *relative* asset prices. Thus, averting CPI deflation has no effect on credit problems stemming from the fall of collateral

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9. For recent papers showing that credit booms could be harbingers of financial crisis, see Agosin and Huaita (2012), Schularick and Taylor (2009), and Reinhart and Rogoff (2011).

values. It helps to stave off Debt Deflation, but it may be far from restoring financial health—which, by the way, helps to explain why the world economy is still in the doldrums despite the absence of CPI deflation. The situation might be better if, assuming that debt is denominated in domestic currency, the price level P increased sharply enough so as to keep the nominal price of land $(= qP)$ virtually intact. The implementation of this, however, is fraught with serious problems. Take the case of the U.S. where average real estate prices fell by around 30 percent, and consider the case of many borrowers who borrowed close to 100 percent of their house's market value. To compensate these borrowers, the price level P would have to increase by 30 percent in a short span of time! Given the political circumstances, I much doubt that Bernanke or Trichet would have been able to hold on to their posts if they dared to travel even half-way that route. Besides, by equation (5), the once-and-for-all price-rise shock would not be strong enough to restore assets' relative prices and reinvigorate the rickety credit market. On the other hand, if political resistance can be overcome, high inflation π could be more effective because, by equation (5), it would be capable of lifting the price of land q.[10] But, even this policy would be rendered ineffective if land's liquidity completely collapsed (i.e., $\theta = 0$).

In summary, a liquidity meltdown may seriously complicate the workings of the credit market and provoke major changes in relative prices that exacerbate credit-market problems. Averting price deflation may not prevent the generation of a vicious cycle.

1.3 A Brief Detour: Modeling Debt

Debt problems are not borne out by conventional closed-economy representative-individual models, because in that setup individuals are identical to each other and are neither net borrowers nor lenders in equilibrium.[11] However, high debt can be rationalized in terms of an open-economy model (opened to trade and capital flows) without having to discard the representative-individual assumption. Debt can be positive or negative in equilibrium, and takes the form

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10. That is what theory implies. However, the present theory abstracts from realistic and important issues having to do with inflationary expectations, which may offset the benefits of higher inflation highlighted here.

11. To be more precise, in that context one can still account for debt obligations between the private and the public sectors. However, that is not an issue that appears to shed light on the link between liquidity and debt, and will be ignored in the present paper.

of external debt. Suppose, for example, a world with a common currency (e.g., gold), $\pi = i_m = 0$, and that external creditors do not care about the liquidity services provided by land. There is perfect capital mobility but loans to domestic residents will take place if and only if they ensure a real rate of return equal to r, internationally given, and do not exceed a maximum loan-to-equity ratio (in order to ensure incentive-compatibility). Suppose $r = \rho$ and that, initially, land yields no liquidity services for domestic residents. Then, by previous analysis, land's price would be unity and it would offer the same services to foreign and domestic residents. I will assume that, initially, land is fully owned by foreign residents.[12] I will now consider the effect of a financial innovation that succeeds in increasing the liquidity of land for domestic residents only. This obviously makes land more attractive to domestic residents, and at an interior equilibrium (in which $m > 0$) domestic residents will be willing to buy all the foreign residents' land. I will assume that demand for liquidity, z, stays the same.[13] Thus, the price of land q is given by equation (6), implying that $q > 1$. Let m_0 and m_1 stand for the demand for real monetary balances before and after financial innovation, respectively. Therefore,

$$z = m_0 = m_1 + \theta qk = m_1 + \frac{\theta}{1-\theta}k, \tag{8}$$

implying that

$$m_0 - m_1 = \frac{\theta}{1-\theta}k < \frac{1}{1-\theta}k = qk. \tag{9}$$

Therefore, the demand for money falls (i.e., $m_1 < m_0$), but freed up resources (i.e.,) are not enough to buy the entire stock of land, qk. This is so because, by (9), the difference, i.e.,

$$qk - (m_0 - m_1) = qk - \frac{\theta}{1-\theta}k = k > 0. \tag{10}$$

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12. This assumption helps to streamline the argument presented below and could be replaced by other more realistic assumptions.

13. At an interior solution the marginal cost of liquidity is invariant to this type of financial innovation, which helps to rationalize a constant demand for liquidity z.

The difference is borrowed from foreign residents at interest rate r. The loan-to-equity ratio is

$$\frac{k}{qk} = 1 - \theta < 1. \tag{11}$$

Thus, if $1 - \theta$ is smaller than the maximum loan-to-equity ratio, borrowing will take place, and it will be enough to buy all of foreign residents' land. This will be reflected in *gross* portfolio capital inflows equivalent to k in terms of output (the output equivalent of the external loan to purchase domestic land at price q) *plus* $m_0 - m_1$ (i.e., the decumulation of global currency holdings by domestic residents in order to complete the land purchase), coupled with FDI outflows equal to qk. By (10), gross inflows and outflows are equal implying, of course, that net capital flows are zero. The operation does no widen the current account deficit. Thus, an observer that ignores the possibility of a liquidity meltdown, would see no reason for concern.

Consider now a liquidity crunch pushing θ down to zero and hence, by expression (11), raising the loan-to-equity ratio. This may force borrowers to liquidate some of their land, in which case the only option would be to sell it to foreign residents. The price of land will fall to 1, implying a capital loss for domestic residents. However, this is likely to be the least of their problems. By assumption, land renders no liquidity services to foreign residents, thus the sudden liquidation of land may entail additional fire-sale type losses, which could be easily modeled in a richer framework. This example captures in very simple way the disruption in capital markets that might ensue from a liquidity meltdown.

1.4 Liquidity Creation and Destruction: Dreams and Nightmares

Until now, the discussion has taken liquidity creation and destruction as exogenous processes. This is a good first approximation to understand the basic role of liquidity, but it does not give much insight relevant for understanding the kind of financial innovation and destruction associated with the subprime crisis. Unfortunately, liquidity endogeneity is a hard subject. Mainstream macroeconomics has ignored it, and the available literature addresses fundamental topics but it does not shed light on the issues highlighted above (see, for example, Jones (1976), Kiyotaki and Wright (1989)). The papers are useful for developing intuition about the factors that may play

a role in determining an economy's choice of one or several means of payment, including some general welfare implications. But little more than that. Here I will pursue a much more modest approach in which I take the assets which are candidates for being endowed with liquidity as given, and examine how their liquidity reacts to variables like inflation and the central bank interest rate. Moreover, I will focus on the model developed above and study the determination of the liquidity parameter θ. Following Calvo (2011b) I will assume that individuals could endow their land holdings with liquidity at a cost. This they can do, for example, by offering insurance against low land productivity, or paying a fee to a well-respected firm (Sotheby?) to advertise the land, or making individual plots of land part of a pool administered by a well-known global bank. The latter arrangement would be akin to asset-backed securities which have played a prominent role in the subprime crisis. These are just examples in which individuals may have incentives to make their holdings better known to potential buyers by enhancing their liquidity.[14]

I will assume that the output cost of endowing a piece of land k with liquidity is an increasing function of the value of land qk, and the liquidity coefficient θ. More concretely, I will assume that the cost function is given by $\varphi(\theta)qk$ where function φ is defined on the nonnegative real line, it is twice-continuously differentiable and $\varphi(0)=0$, $\varphi'>0$ and $\varphi''>0$. The assumptions are intuitive and are partly made in order to ensure that second-order conditions can be taken for granted. Under these assumptions, the opportunity cost of holding liquidity would take the following expanded form (recall expression (3)):

$$(r + \pi - i_m)(z - \theta qk) + (rq - \rho)k + \varphi(\theta)qk. \tag{3'}$$

Hence, minimizing (2') with respect to we get the following first-order condition:

$$\varphi'(\theta) = r + \pi - i_m. \tag{12}$$

Correspondingly, assuming an interior solution, equation (5) becomes

$$q = \frac{\rho}{r(1-\theta) + \varphi(\theta) + (i_m - \pi)\theta}. \tag{5'}$$

14. The analysis will be confined to a competitive environment which is likely to be inconsistent with the example of land pooling by large corporations.

The price of land is lower than in the exogenous-liquidity model, reflecting the cost of liquidity, but it can readily be shown, employing equation (12), that the effects on q of a change in r, i_m and π have the same signs as in the basic model in section 2. Thus, new results are entirely encapsulated in equation (12), which implies that monetary policy can have an effect on land's liquidity. This is a conjecture that goes back at least to Minsky (1957). He conjectured that tight monetary policy may be partially offset by the creation of quasi-monies. By equation (12), this holds true in the present model if tighter monetary policy increases the real interest rate r, a common assumption in conventional monetary theory. But the opposite holds if, given r, central bank tightening operates through a higher i_m. The intuition is that a higher i_m makes money more attractive relative to land and, thus, the payoff of making land more liquid declines.[15] Similarly, an increase in the rate of inflation (from which land is insulated at steady state) makes land more attractive, increasing the payoff of land liquidity. Thus, the model gives further support to the argument that the Fed's lax monetary stance after 2001 is responsible for the real estate bubble (once again, if "lax" is equivalent to low i_m). But the model also provides some backing to the view that the bubble stems from "savings glut" in Asia, which arguably pushed down real interest rates, r.

Liquidity meltdown has received much greater attention in the literature (although, again, mainstream macroeconomics is oblivious about it). For example, to rationalize a liquidity crunch through a collapse in the liquidity coefficient θ, one can appeal to the bank-run literature (e.g., Diamond and Dybvig (1983), Allen and Gale (2005)). The meltdown of "shadow banks" had similar characteristics to an old-fashioned run on bank deposits. In the subprime crisis, the run was staged mostly by bond holders (even in the case of Northern Rock, see Shin (2010)), and the ensuing financial distress was linked to maturity mismatch between assets and liabilities. A full-fledged model would probably include the probability of liquidity crunch into the decision of liquidity creation—a feature that is ignored in the model discussed above—although I doubt that this feature will result in a significant modification of previous insights. However,

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15. An increase in i_m increases the demand for m and, in a closed economy model, pushes down the price level. However, if prices are sticky, this may give rise to higher real interest rate r. Therefore, the net effect on the liquidity coefficient is ambiguous unless one makes more explicit assumptions about the demand side.

the analytics are likely to get substantially more complicated. For instance, one would have to specify a mechanism for equilibrium selection (the bank-run model exhibits equilibrium multiplicity). An option is to adapt the model in Morris and Shin (1998). A simpler one is to assume that the probability of liquidity crunch is exogenous. If one has in mind the U.S. and advanced economies, the probability of severe liquidity crunch can realistically be modeled as very small. Thus, as a first approximation, one should not be far from target by assuming that the probability is zero, in which case the model of liquidity creation discussed above stands unchanged. The zero-probability case also serves to illustrate, if not dramatize, the financial disarray that follows a liquidity crunch, because under zero probability no financial contract will take that contingency into account, and bankruptcies will be the order of the day.

In sum, this segment shows that one can get some insights about liquidity creation by assuming that liquidity can be created at a cost. The insights suggest that policies followed after 9/11 may have contributed to enhancing the liquidity of some financial assets, even if one abstracts from regulatory changes. Finally, it appears that from a macro perspective the assumption that liquidity meltdown are exogenous low-probability events may not be misleading.

2. Jobless Recovery and Involuntary Unemployment

A salient feature of recovery from financial crisis is that certain key relative prices like the real wage and the real exchange rate do not bounce back to their pre-crisis levels (see Calvo, Izquierdo, and Talvi (2006)). In the U.S., output has still not reached pre-crisis level but it is already evident that the labor market lags far behind with unemployment still hovering around 10 percent.[16] In this section I will explore two lines of explanation geared to disturbances and imperfection in the labor and credit market.

2.1 Collateral Constraints

A liquidity crunch may bring about sharp changes in relative prices and wealth destruction, lowering the output value of assets

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16. For some evidence about U.S. recovery, see Calvo and Loo-Kung (2010).

that can be employed to collateralize—and, thus, support—credit transactions. However, there are various ways in which the economy can start mending itself, even if it gets no external help or the government remains inactive.

To illustrate this point, consider the case in which banks require borrowers to post collateral in order to ensure that they have incentives to repay (a typical principal-agent problem), and that there are three types of investment projects: (1) firing old workers to improve efficiency, (2) buying new computers, and (3) hiring new workers. Firing old workers is the easiest to fund. It requires little imagination. Basically, all you have to know is severance costs and foregone wages (the benefit), and make sure that output stays about the same—no new markets have to be opened or new ideas sold to potential customers. In contrast, projects (2) and (3), to the extent that they are aimed at increasing output or developing new product lines, require convincing the banker that there will be a healthy demand for the new stuff. This may be difficult when recovery is still iffy, as in present circumstances. Funding for hiring new workers is likely to be decisively more difficult than buying new computers—and the reason is that computers provide their *own* collateral, a situation that I will characterize by saying that they exhibit "intrinsic collateral." If the project fails, the bank can repossess the computers, a situation that, of course, does not apply to project (3). Project (3) could thus be said to be relatively more "extrinsic-collateral" intensive—where "extrinsic collateral" stands for collateral which is not imbedded in the investment project. Therefore, *ceteris paribus*, in a collateral-scarce environment, project (2) is likely to dominate project (3), which suggests that, as the economy comes out from liquidity/credit crunch, labor-intensive projects may be discriminated in favor of capital-intensive projects that are more likely to be less dependent on extrinsic collateral.[17] Therefore, until the credit market does not recover its pre-crisis conditions, a salient characteristic of Phoenix Miracles, real wages and employment will lag behind output and, if there is real-wage downward inflexibility (a feature that will be displayed by the next model), unemployment will tend to be high.

17. For recent evidence in this respect, see Madigan (2011), although collateral considerations are not mentioned in the journal's article.

2.2 Involuntary Unemployment (a Non-Keynesian Perspective)

Deep financial crisis is a brutal blow to the core of the economic system. In contrast to a regular supply shock (standard in mainstream macro theory), a liquidity/credit crunch destroys channels of information. Under these conditions, production efficiency takes the back seat, and output is dictated by financial constraints. A firm could be highly productive and yet unable to have access to working capital, for example. The firm could have an impeccable credit record but this is not enough to establish creditworthiness during financial crisis. The bank has to make sure that the firm's clients—to whom the firm extends trade credit, for example—will repay their debt obligations. Absent that, the firm in question may not be able to comply with its own debt obligations.

A cut in working capital credit lowers the (effective) demand for labor, independently of labor's marginal productivity. If labor supervision is not an issue, the new equilibrium will lie on the labor supply curve. Thus, the fall in the demand for labor dictated by the credit crunch would likely bring about lower real wages and employment; but not unemployment (i.e., excess supply of workers willing to work at the current wage), unless nominal wages are downward inflexible—a problem that could be easily be dealt with by preventing price deflation and will, thus, be ignored in the ensuing discussion. The following discussion will focus on *structural* problems that cannot be remedied by standard monetary or aggregate-demand fiscal policies.

If labor supervision is an issue, the fall in real wages may make supervision matters harder to handle. Consider the case in which individuals face the option of working in firms owned by others (which I will just refer to as true-firms) or become self-employed, the latter being technologically inferior to the former. Thus, without credit constraints and labor supervision problems, labor would be fully allocated to true-firms. For future reference, I will denote the associated equilibrium real wage by w^*. Existence of supervision problems may change things in a dramatic way. Suppose that workers aim at maximizing income and that, hence, if unsupervised they will sneak out of true-firms and engage in self-employment activities which, to simplify the exposition, I assume require no capital or credit. Clearly, without labor supervision true-firms could not survive.

I will now take a closer look at shirking. I will assume that if a shirker is not caught he gets his wage plus self-employment income.

Otherwise, he only gets self-employment income. Therefore, given the probability of being caught, shirking incentives are likely to rise as the gap between wages and self-employment income goes to zero. In the limit case in which the gap between true-firms' wages and self-employment income is nil, a true-firm will have to supervise everybody all the time because workers suffer no cost if caught shirking.[18] Therefore, it is plausible to assume that below a critical point, effective labor costs may *rise*, not decline, with lower wages. Let us denote the critical real wage by $\underline{w}$. Clearly, if the credit-crunch wage $w^* < \underline{w}$, true-firms' equilibrium wages will be higher than w^*, even though workers will be banging at their doors ready to work for less—and, thus, involuntary unemployment arises.[19]

In this scenario, the equilibrium rate of unemployment depends on true-firms' "wage fund," i.e., funds allotted for the payroll, including working capital credit and own funds—and the critical wage $\underline{w}$. The wage fund is not a constant over time because its effectiveness could be gradually augmented by undistributed earnings and/or by a decline in $\underline{w}$. Firms have incentives to increase the wage fund because at the after-shock equilibrium the marginal productivity of labor exceeds $\underline{w}$. Thus, absent credit expansion, employment may rise over time by the accumulation of true-firms' own funds (although this does not guarantee that unemployment will fall, since employment may be outstripped by labor force). The dynamics of $\underline{w}$ depends on what happens in the self-employment sector and on workers' expectations. After the initial credit shock it is likely that workers' discipline would be quickly lost if wages fall below pre-crisis levels, especially if workers have backward-looking expectations. However, $\underline{w}$ is likely to fall over time as unemployment arises and shows no signs to subside. The fall in $\underline{w}$ is another factor that contributes to attenuating unemployment, but in this case real wages will drop and workers' total income may actually contract, deteriorating income distribution. All in all, the process is likely to occur at a snail's pace, a pace much slower than if the economy was facing a sheer supply shock without credit market complications—validating the observation that recovery from financial crisis is more painful and time consuming than if the financial sector was not part of the problem.

18. This is bad enough but things are likely to be worse: who supervises the supervisors?

19. There are several models bearing this kind of unemployment, but they focused on less-developed countries in which formal-sector wages are "low." See, for instance, Harris and Todaro (1970), Calvo (1979), and Shapiro and Stiglitz (1984).

2.3 Some Key Implications

    • The discussion has identified some central factors that prevent quick recovery from financial crisis, a phenomenon that has been amply documented by Reinhart and Rogoff (2010) and others.

    • Unemployment arises even absent nominal rigidities, which are central to New Hicksian models. Therefore, beyond a certain point, lax monetary policy may become ineffective in triggering employment and growth—and result in stagflation.[20]

    • In contrast, credit policy may be effective, if it helps to increase the wage fund, for example. This could be accomplished by directed credit and/or *debt haircuts* that allay deleveraging from highly indebted sectors. These are heterodox policies that will face strong resistance from established orthodoxy. However, their plausibility follows from the fact that serious obstruction in the credit channel prevents the private sector from doing its job.

3. CONCLUSIONS

    A major implication of this discussion is that liquidity creation and destruction can have strong effects on some key relative prices and wreak havoc in the credit market, particularly after an episode of sudden and highly unexpected liquidity crunch. This may sound *déjà vu* for some readers because liquidity-crunch episodes are not unprecedented and are known to cause bankruptcies if there is no LOLR bailing out credit-stressed sectors. However, if momentary dearth of liquidity was all that there was to it, liquidity crunches could be easily dealt with by a timely LOLR who pumped in liquidity in the affected sectors. But, as section 2 shows, there may be long-lasting effects that cannot be easily undone by open-market operations of the regular sort. The financial sector does not generate liquidity on the back of U.S. wealth, say, but on the back of a much narrower set of assets like asset-backed securities. The example discussed in section 2 shows that this type of liquidity-creation process increases the relative price of the underlying assets. This is indeed highly intuitive but, despite its appeal and simplicity, the insight runs against the mainstream's cherished view that "money

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20. Phelps (1994) applies this view for non-crisis situations.

is neutral," and that monetary policy is ineffective for changing real variables like relative prices and unemployment in the long run (illustrated by the "vertical Phillips curve" conjecture). Granted, the vertical-Phillips curve view refers to money issued by the sovereign, and not private money of the sort discussed in section 2. But it seems to me quite clear that as long as private money becomes a close substitute to sovereign money, economists are prone to jump to the conclusion that private money can be bundled together with sovereign money and display the same neutrality properties (isn't it common practice to define "money" as an aggregate that includes bank deposits issued by private banks?). Another indication that the neutrality proposition ranks high in economists' minds is that the overwhelming majority of financial commentators refer to the recent meltdown of real estate prices as the bursting of a speculative bubble, stemming from irrational expectations, or prompted by SOEs like Fannie Mae, or stealthy financial moguls—but no reference is given to the liquidity effects highlighted in section 1.[21]

The paper focused on issues relevant for the U.S. in the context of the subprime crisis. However, the insights of this note are applicable to a variety of circumstances. For example, a capital-inflow episode in EMs. Again, the model of section 2 can be employed to conjecture that a surge of capital inflows to a given economy can increase the liquidity of some of that economy's assets. In fact, if the economy is small enough, enhanced liquidity could provoke a real appreciation of the domestic currency (i.e., a fall in the *real exchange rate*, defined as the relative price of tradables with respect to non-tradables). This is a typical phenomenon during these episodes, which gets reverted by a Sudden Stop, usually causing severe problems in the domestic credit market. Ignoring the liquidity effect has led policymakers to attribute currency appreciation to their own good policies (of course), catching them mostly underprepared when hit by Sudden Stop (see Calvo (2007 and 2011a)).

Liquidity is a very slippery concept which, unfortunately, economists have eschewed or over-simplified. Concepts like money and liquidity are much harder to model than a regular consumption good, for example. Their market value depends on a transactions

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21. Taylor (2009) stands, however, closer to the view offered here, albeit in an indirect way; for he claims that low Fed interest rates after 9/11 are behind the real estate price hike, a statement that is supported by the model in section 2 but not by mainstream theory.

technology that is hard to specify and may undergo large mutations during crisis episodes. But this is no basis for ignoring the issue, because it could lead to wrong and costly policy prescriptions. Liquidity is a *fundamental*, and has to be treated like that. Moreover, it changes relative prices and during its inception is likely to foster credit flows. Therefore, although difficult to pinpoint and define in practice, liquidity fingerprints have some regularity that may help to identify the presence of liquidity cycles. Unfortunately, there are other shocks that mimic the effects of liquidity shocks. For example, technical innovations or terms-of-trade shocks. Telling them apart is momentarily more an "art" than a "science." There are many instances, however, in which there is no clear evidence of competing explanations, in which case liquidity should be the primary suspect.

Would it be possible to prevent liquidity cycles? One strategy would be to shackle the financial sector by some Basel III agreement that shrinks the sector to a mere bureau of exchange. This may prevent serious blow-outs but credit may vanish unless, going back to the 1950s, the financial sector is mostly run by government. On the other hand, if draconian financial regulation fails, new and even more unstable financial institutions may arise. Therefore, the financial regulatory road has to be trod with a high degree of caution. This does not imply total inaction on the part of government.[22] Given the liquidity fingerprints mentioned above, the central bank would be well-advised to imposing counter-cyclical controls on credit flows or capital inflows, and accumulating international reserves during capital inflow episodes. This will not totally insulate the economy from a liquidity crunch, particularly when the latter stems from external sources, but it may help to attenuate its effects.

The liquidity aspects discussed in this chapter should make macroeconomists more aware that they navigate waters considerably more risky than they used to think, and that the necessary tools to prevent and manage crises may involve operations resembling those of a Lender of Last Resort. These operations should therefore be incorporated in central bank monitoring. An effective LOLR should have in its ranks individuals with first-hand knowledge of the credit market and credit-market instruments, and should be able to conduct regular stress tests and fire drills to prevent and deal with extreme situations. The latter, in particular, will likely require tight coordination with other government departments, like the finance

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22. See Borio (2011) for a similar view and a fuller discussion of these issues.

ministry and the executive branch—not something that can wait for crisis to happen.

In closing, it is worth pointing out that the analysis of section 2 regarding jobless recovery and unemployment stems from credit market disturbances, which may or may not be associated with a liquidity crunch. However, absent a liquidity shock it is hard to rationalize credit crunch, i.e., a sudden and large cut in credit flows. If the market senses that there is overinvestment in the real estate sector, for example, investment will start to fall and the economy will decelerate. Sharp recession, like the one triggered by the Lehman episode, is unlikely to happen. For that to occur, a clear signal will have to come from somewhere, which leads investors and financial intermediaries to stop demanding and offering loans in a coordinated way. Some sort of divine revelation. Keynes identified the phenomenon in a more materialistic fashion as 'animal spirits.' If this holds true, 'animal spirits' should be reflected in a wide variety of human endeavors. The appeal of the liquidity factor, in contrast, is that *its very nature* makes it highly labile, and its destruction can easily be verified—while arguments that appeal to 'animal spirits' without liquidity shocks often refer to sudden contraction of consumption or investment that are triggered by a swift and massive change in expectations about the real economy. However, 'animal spirits' in the form of *herding*, for example, could follow a large shock on relative prices caused by liquidity crunch. Since a liquidity crunch easily escapes the attention and analytical abilities of most economic agents, the latter are bound to attribute the corresponding initial drop in asset prices to the existence of a new "downward trend." This "rational" behavior can contribute to magnifying the effects of the initial liquidity shock, and play a major role in major price-bubble episodes.

Postscript, June 2015

This paper was written about four years ago. Since then, liquidity issues have acquired greater significance. A slew of highly valuable material addressing these issues has been circulated. Despite having to share the stage with many worthy competitors, though, I feel that the original paper is still relevant and has the advantage of presenting some key issues in very simple form. However, I also think that it is worth linking up the paper, albeit in a brief and incomplete manner, with some central issues and a couple of the ideas—one of

which mine—that have surfaced in recent times. This is the main objective of this postscript.

Liquidity concepts familiar to financial experts are now making their entrance in the macro field. A prominent example is "safe assets." Safe assets ensure command on output, subject to minimal uncertainty. Safe assets are critical for oiling the international payments system (see Gorton and Metrick (2012)). U.S. Treasury bills and German bunds are good examples. Empirical estimates show that safe assets suffered a major blow during the Lehman crisis from which they have not fully recovered (see Fernández and others, 2015). Safe assets' shortage can have severe effects on output and impede recovery unless unconventional policy is implemented. If left untreated, shortage of safe assets could give rise to Secular Stagnation (see Caballero and Farhi, 2015). The model in my paper can display some features in common with the safe assets literature, since the phenomenon is akin to a fall in coefficient θ.[23] It can easily be shown, for instance, that a fall in θ causes unemployment under price stickiness or, alternatively, under policies that prevent price level deflation (as the ones currently implemented in developed market economies). I suspect, however, that this model will be criticized for its weak microfoundations, which I do not deny. But this type of objection is pointless because *all macro models have weak microfoundations*. In fact, my main criticism against many of the new crop of papers is that they contain *unnecessarily complex microfoundations*, which oftentimes have weak empirical support to boot. Their microfoundations are often prompted by "elegance" or "tractability," i.e., making the model amenable to computing techniques, given current computational capabilities. Moreover, we seem to be far from agreeing on a common paradigm. Each paper chooses its own microfoundations, a striking difference with Physics that strives for a common framework or, more modestly, the Real Business Cycle literature of the 20th century that was built on the conventional general equilibrium apparatus. This situation makes the new crop of papers unreliable sources for policy advice. It actually may be preferable to derive intuition from simple models like the one discussed in this paper. However, I would like to make it very clear that these comments are not intended to invalidate the contribution of the new papers but... *caveat emptor*: this stuff has to be handled with care, especially by policymakers!

23. For some related ideas and more formal discussion of the present paper's model, see Calvo (2012).

I will now address an issue ignored by the literature, including the present paper. A common assumption is the existence of an object, usually called "money," which is also assumed to be the epitome of liquidity (in terms of the present paper, money's liquidity coefficient $\theta=1$, and there is virtually no risk of θ falling). Typically, money is identified with *fiat money* or some of its derivatives (M1, M2, etc.) having no intrinsic value. Models focusing on advanced markets further assume that money is the ultimate safe asset towards which investors converge in the midst of financial crisis, causing what Keynes labeled Liquidity Trap. This curious phenomenon does not apply to all currencies. Actually, empirical evidence shows that it applies to a few currencies like the U.S. dollar, the euro, and the yen. What makes a currency as "safe" as those just mentioned (hereon, "safe money")? This is a fundamental question for which I don't think we have a very satisfactory answer, particularly in macroeconomics.

This is not the place to discuss this issue in great detail. However, to start closing the circle I would like to refer to Calvo (2012) where some progress is made in that direction. I develop an idea that can be found in a paragraph of Keynes's *General Theory*, which sets the foundations for what I call "The Price Theory of Money" (PTM). Here is the paragraph:

"The fact that contracts are fixed, and wages are usually somewhat stable in terms of money, *unquestionably* plays a large part in attracting to money so high a liquidity-premium" (Keynes 1961, Chapter 17, italics are mine).

By liquidity premium, Keynes was referring to the difference between output that a unit of money can fetch in the market and its intrinsic output value (which Keynes implicitly assumes to be nil). Obviously, Keynes must have been intrigued by the Liquidity Trap phenomenon, and was trying to find a rationale for the fact that money can fetch valuable commodities, despite having no intrinsic value. As discussed in Calvo (2012), the idea was novel at the time and is still novel today. The fundamental insight is that the output backing of monies (even non-safe monies) derives from the fact that these objects are utilized as units of account and, more importantly, that the private sector is willing to set prices and wages in advance for a considerable length of time. Safe monies, in addition, have that sort of backing in a large economic area. The output value of money, thus, would depend on the rate of (expected) inflation (the standard insight from conventional monetary models) but, in addition, it would also depend on the existence of a large set of agents that are prepared

to post their prices and wages in advance or to manipulate output in order to stabilize prices in terms of that unit of account (like the OPEC does for oil's U.S. dollar price). Safe monies are further enhanced by being a unit of account for international financial transactions.

The PTM helps to understand why fiat money was able to substitute for the gold standard, for example, without causing the monetary chaos that some economists feared, especially after the demise of Bretton Woods. On the other hand, the PTM helps to explain why the U.S. dollar is king and many emerging market currencies are weak second-fiddlers, and thus understand why these weak currencies are often pegged to safe currencies (a phenomenon labeled Fear of Floating, see Calvo and Reinhart, 2002). Moreover, the PTM puts some damper on floating exchange rates for non-safe monies.

None of this invalidates the models in the current crop of papers, but opens up a door towards richer and more relevant scenarios where, among other things, multiple monies are taken into account. In this respect, I sense that we need a much better understanding of a world with at least two equally strong safe monies. The U.S. dollar was king since the breakdown of Bretton Woods. Now there is a chance that the euro and even the renminbi surge as worthy contenders. How will the world economy manage that situation if these currencies play the game of floating exchange rates? This is an open question of enormous importance.

REFERENCES

Agosin, M. and F. Huaita. 2012. "Overreaction in Capital Flows to Emerging Markets: Booms and Sudden Stops." *Journal of International Money and Finance* 31(5): 1140–55.

Allen, F. and D. Gale. 2007. *Understanding Financial Crises*. New York, NY: Oxford University Press.

Borio, C. 2011. "Implementing a Macropudential Framework: Blending Boldness and Realism." *Capitalism and Society* 6(1): 1–23.

Caballero, R.J. and E. Farhi. 2015. "The Safety Trap." Unpublished manuscript, M.I.T., February.

Calvo, G. and C.M. Reinhart. 2002. "Fear of Floating." *Quarterly Journal of Economics* 117(2): 379–408.

Calvo, G. 1979. "Quasi-Walrasian Theories of Unemployment." *American Economic Review* 69(2): 102–7.

————. 2006. "Monetary Policy Challenges in Emerging Markets: Sudden Stop, Liability Dollarization, and Lender of Last Resort." NBER Working Paper 12788.

————. 2007. "Crises in Emerging Market Economies: A Global Perspective." NBER Working Paper 11305.

————. 2011a. "On Capital Inflows, Liquidity and Bubbles." Unpublished manuscript, Columbia University.

————. 2011b. "Financial Crises and Liquidity Shocks: A Bank-Run Perspective." Unpublished manuscript, Columbia University.

————. 2012. "Financial Crises and Liquidity Shocks: A Bank-Run Perspective." *European Economic Review* 56(3): 317–26.

Calvo, G., A. Izquierdo, and E. Talvi. 2006. "Phoenix Miracles in Emerging Markets: Recovering without Credit from Systemic Financial Crisis." NBER Working Paper 1201.

Calvo, G. and R. Loo-Kung. 2010. "U.S. Recovery: A New 'Phoenix Miracle?" Unpublished manuscript, Vox, CEPR.

Calvo, G. and C. Vegh. 1995. "Fighting Inflation with High Interest Rates: The Small Open Economy under Flexible Prices." *Journal of Money, Credit, and Banking* 27(1): 49–66.

Diamond, D. and P. Dybvig. 1983. "Bank Runs, Deposit Insurance and Liquidity." *Journal of Political Economy* 91(3): 401–19.

Farhi, E. and J. Tirole. 2011. "Bubbly Liquidity." NBER Working Paper 16750.

Fernández, D., J. Chag, S. Wang, Y. Zhou, M. Gavin, M. Kotecha, and D. Tan. 2015. "Beyond SDR: RMB as a Safe Asset." Emerging Markets Research Report, Barclays PLC, May.

Fisher, I. 1928. "*The Money Illusion*." New York, NY: Adelphi Company.
————. 1933. "The Debt-Deflation Theory of Great Depressions." *Econometrica* 1(4): 337–57.

Gorton, G. and A. Metrick. 2012. "Securitized Banking and the Run on Repo." *Journal of Financial Economics* 104(3): 425–51.

Harris, J. and M. Todaro. 1970. "Migration, Unemployment and Development: A Two-Sector Analysis." *American Economic Review* 60(1): 126–42.

Hicks, J. 1937. "Mr. Keynes and the 'Classics': A Suggested Interpretation." *Econometrica* 5(2): 147–59.

Jones, R. 1976. "The Origin and Development of Media of Exchange." *Journal of Political Economy* 84(4): 757–75.

Keynes, J.M. 1961. *The General Theory of Employment, Interest, and Money*. London: Macmillan & Co.

Knight, F. 1921. *Risk, Uncertainty and Profit*. Chicago, IL: University of Chicago Press.

Kiyotaki, N. and R. Wright. 1989. "On Money as a Medium of Exchange." *Journal of Political Economy* 97(4): 927–54.

Lucas, R. 1972. "Expectations and the Neutrality of Money." *Journal of Economic Theory* 4(2): 103–24.

Madigan, K. 2011. "It's Man v/s Machine and Man is Losing." *Wall Street Journal,* September 28th.

Martin, A. and J. Ventura. 2012. "Economic Growth with Bubbles." *American Economic Review* 102(6): 3033–58.

Mehrling, P. 2011. "*The New Lombard Street*." Princeton, NJ: Princeton University Press.

Minsky, H. 1957. "Central Banking and Money Market Changes." *Quarterly Journal of Economics* 71(2): 171–87.
————. 2008. "*Stabilizing an Unstable Economy*." New York, NY: McGraw Hill.

Morris, S. and H.S. Shin. 1998. "Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks." *American Economic Review* 88(3): 587–97.

Phelps, E. 1994. "*Structural Slumps*." Cambridge, MA: Harvard University Press.

Reinhart, C. and K. Rogoff. 2011. "From Financial Crash to Debt Crisis." *American Economic Review* 101(5): 1676–706.

Samuelson, P. 1958. "An Exact Consumption-Loan Model of Interest with or without the Social Contrivance of Money." *Journal of Political Economy* 66(6): 467–82.

Schularick, M. and A. Taylor. 2009. "Credit Booms gone Bust: Monetary Policy, Leverage Cycles and Financial Crises, 1870-2008." *American Economic Review* 102(2): 1029–61.

Shapiro, C. and J. Stiglitz. 1984. "Equilibrium Unemployment as a Worker Discipline Device." *American Economic Review* 74(3): 433–44.

Shin, H.S. 2010. "*Risk and Liquidity*." Oxford, UK: Oxford University Press.

Taylor, J. 2009. "The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong." NBER Working Paper 14631.

Financial Reforms and Capital Flows: Insights from General Equilibrium

Alberto Martin
CREI, Universitat Pompeu Fabra and Barcelona GSE

Jaume Ventura
CREI, Universitat Pompeu Fabra

How are capital flows affected by financial reforms that relax credit constraints and raise the ability of domestic firms to borrow? At first glimpse, one might be tempted to dismiss the question as trivial. If some domestic firms are credit constrained (which we assume to be the case!), relaxing their constraints will allow them to borrow more and increase their investment. If domestic savings are not affected by this relaxation of credit constraints (which we also assume to be the case!), then this increased investment must be financed with foreign savings. This line of reasoning naturally leads to the conclusion that financial reforms raise capital inflows. Indeed, this reasoning has led many to argue that emerging economies should reform their financial systems if they want to absorb more foreign savings and speed up investment and economic growth.

Of course, things are never so simple. The first point of this paper is to show that this line of reasoning is, at best, incomplete and, possibly, misleading. The reason is that it does not take into account that any additional borrowing and investment by some domestic firms crowds-out investment by other domestic firms. This is far from an innocent oversight, as we prove here. The second point of this paper is that recognizing this crowding-out effect might shed light on some real-world questions regarding capital flows into and out of emerging

economies. For instance, it might be the case that financial reforms in emerging economies raise, rather than reduce, global imbalances.

Let us start by revisiting the line of reasoning and consider the effects of a financial reform that relaxes credit constraints and allows domestic firms to borrow more. In a closed economy, this newfound ability to borrow leads high-productivity firms to expand their investments. The resources needed for this expansion come from low-productivity firms, which are no longer able to compete and are forced to shut down. Although the savings and labor available within the economy might be both fixed in the short run, the relaxation of credit constraints leads to a better allocation of these scarce resources. In the short run, the reform raises the capital stock, wages and savings and it, therefore, also raises the quantity of investment.

It is useful to think more carefully about the role of the domestic interest rate in this process. A key observation is that, if the reform is successful in raising the quality of investment, future wages will be high and this reduces the return to all types of investment today. This reduction in profitability leads marginal or low-productivity firms to close and stop investing, releasing some domestic savings that can be used by high-productivity firms. Are these savings large enough to accommodate the increased investment demand by high-productivity firms? The answer depends on the distribution of firm productivities within the economy. If there is only a small pool of marginal or low-productivity firms, the reduction in their investments does not free enough savings and the interest rate must increase to equilibrate domestic savings and investment. If, instead, there is a large pool of marginal or low-productivity firms, the reduction in their investments frees savings in excess of those demanded by high-productivity firms, and the interest rate must fall. Somewhat surprisingly, then, the effects of a financial reform that relaxes credit constraints and directly raises investment demand does not necessarily lead to an increase in the interest rate. There is a countervailing general equilibrium effect that works through wages and indirectly reduces investment demand. The size of this effect depends on the distribution of productivities, and it is pivotal in determining whether aggregate investment demand increases or decreases after a financial reform.

How does this picture change in the open economy? Consider, for simplicity, the case of the small open economy in which the interest rate is not affected by changes in the domestic investment demand. If the domestic investment demand increases, the reform leads to

capital inflows. This is what one would expect if there were only a small pool of marginal or low-productivity firms in the economy. If, instead, this pool is large, the reform reduces the domestic investment demand and leads to capital outflows. Moving away from the small open economy and allowing the financial reform to have effects on the world interest rate does not affect this result.

This theoretical insight has important implications for two real-world developments that have attracted substantial interest from academics and policymakers alike: the appearance of large global imbalances in the world economy and the puzzling observation that capital tends to flow to those emerging economies that exhibit the lowest growth in productivity and output. We discuss each of these developments in turn.

A first striking development of the past two decades has been the emergence of large and persistent current account surpluses and deficits in the world economy, a phenomenon referred to as "global imbalances." The lion's share of these deficits has been concentrated in the United States, which began experiencing an increasing current account deficit in the mid-1990s. This deficit exceeded 1% of world GDP after 1999, and it peaked at more than 1.5% of world GDP in 2006. In the late 1990s, the main counterparts to this deficit were surpluses in emerging Asia (excluding China) and Japan. In the 2000s, however, the largest surpluses became those of China and of the oil-producing countries. These current account deficits and surpluses have had a tremendous influence on the evolution of international asset positions. The net foreign liabilities of the United States quadrupled in size between 1998 and 2008, for instance, rising to $3.5 trillion in 2008. In the same period, Chinese net foreign assets rose to $1.5 trillion, which represented a third of the country's GDP in 2008.[1]

There is one aspect of global imbalances that has drawn the attention of economists: the deficits have been largely concentrated in industrial economies while the surpluses have been concentrated in emerging economies. This is contrary to the prediction of conventional economic theory that capital should flow towards emerging economies, where it is relatively scarce. This discrepancy between facts and

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1. Since the onset of the financial crisis, the magnitude of global imbalances has been reduced. At the time of this writing, it is unclear whether the reduction is temporary or permanent. See Blanchard and Milesi-Ferretti (2009) and Servén and Nguyen (2010) for a discussion of this point.

theory has prompted a substantial amount of research that, broadly speaking, can be grouped into one of two categories. The first category views global imbalances as the result of unsustainable behavior by economic agents (particularly governments), which must therefore be eventually reversed. We do not comment on this view here, except for noting that no formal models of it have yet been developed. A second, and more interesting, category views global imbalances as the result of equilibrium behavior by rational agents, which might therefore persist far into the future. This literature has largely adopted the view that underdeveloped financial markets prevent capital from flowing towards fast-growing, capital-scarce emerging economies. This is the narrative that, details aside, emerges from theories recently laid forth in Caballero and others (2008) and Song and others (2011).[2] This view has also been in the mind of some important policymakers.[3]

The theoretical results in this paper indicate that this view needs to be qualified, since financial sector reform might increase rather than decrease global imbalances. This seems especially likely if, as Song and others (2011) argue, the Chinese economy is characterized by a large pool of low-productivity public enterprises that are not credit constrained. These firms coexist with a smaller pool of high-productivity private firms that are severely constrained. Under these circumstances, the model developed in this paper suggests that financial reform is likely to reduce the demand for credit in China, leading to larger global imbalances and even lower interest rates around the world.

A second striking development is that, among emerging economies, surpluses tend to be concentrated in those economies that exhibit the

2. Mendoza and others (2009) also portray global imbalances as the result of financial underdevelopment in emerging economies. In their view, it is the lack of insurance markets in emerging economies that fosters precautionary savings, lowering domestic interest rates and causing capital to flow out of these economies.

3. In a well-known speech from 2005, Federal Reserve Chairman Ben Bernanke concluded that "...(S)ome of the key reasons for the large U.S. current account deficit are external to the United States, implying that purely inward-looking policies are unlikely to resolve the issue. Thus a more direct approach is to help and encourage developing countries to re-enter international capital markets in their more natural role as borrowers, rather than as lenders...Providing assistance to developing countries in strengthening their financial institutions...could...increase both the willingness of those countries to accept capital inflows and the willingness of foreigners to invest there." Raghuram Rajan expressed himself in a similar vein in 2006 when, as Economic Counselor and Director of Research at the IMF, he noted that: "I will focus on a familiar issue, the problem of global current account imbalances, and will describe how financial sector reform can help narrow them..."

highest growth in productivity. Gourinchas and Jeanne (forthcoming), for instance, examined a large sample of emerging economies and found that the cross-country correlation between productivity growth and capital inflows is negative. That is, emerging economies with high productivity growth tend to export capital, while emerging economies with low productivity growth tend to import capital. This surprising empirical regularity cannot be explained easily within standard theory and led Gourinchas and Jeanne to coin the term, the "allocation puzzle," to refer to it. In a related paper, Prasad and others (2007) examined two samples containing industrial countries and emerging economies, respectively. In the sample of industrial countries, they found a positive correlation between economic growth and capital inflows. As textbook theory suggests, capital flows to industrial countries are capital scarce (relative to the steady state) and are close to their steady states.

The theoretical results in this paper suggest that these puzzling observations could be the result of asymmetric financial development. The model developed in this paper suggests that, if there is a large pool of low-productivity firms in emerging economies, asymmetric reforms among these economies could lead to the allocation puzzle. Emerging economies that implement successful financial reforms see that many of these low-productivity firms shut down and this has two simultaneous effects: (i) increases in productivity and capital stock; and (ii) capital outflows. Emerging economies that implement failed financial reforms see that many of these low-productivity firms expand. This has two simultaneous effects: (i) reductions in productivity and capital stock; and (ii) capital inflows. Thus, the allocation puzzle might be nothing but the manifestation of asymmetric financial development.[4]

From a modeling perspective, this paper builds on Martin and Ventura (2011), who developed a model of the macroeconomy with heterogeneous firms and credit constraints. Given its focus, the paper is closely related to a body of research that has studied the effects of contracting frictions on the direction and magnitude of capital flows. Gertler and Rogoff (1990) and, in dynamic contexts, Boyd and Smith (1997) and Matsuyama (2004) are some key models within this

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4. There are, of course, other plausible explanations for this puzzle. Alfaro and others (2011), for instance, argue that it is essentially driven by the behavior of public capital flows.

literature.[5] These models have been used to argue that more severe contracting frictions, by constraining credit, reduce capital inflows and sometimes even generate capital outflows in capital-scarce or high-productivity economies.

Martin and Taddei (2013) have recently challenged this view by arguing that the effects of contracting frictions on capital flows depend on the specific origin of these frictions. They build a model with two types of contracting frictions: limited pledgeability and adverse selection. While limited pledgeability tends to constrain credit and reduce capital inflows, adverse selection might do just the opposite, that is, expand credit and increase capital inflows. To some extent, the present paper also challenges the notion that more severe contracting frictions reduce capital inflows. We focus exclusively on limited pledgeability as the source of contracting frictions, but we find the following: (i) the presence of contracting frictions reduces capital inflows globally (relative to the frictionless economy), and; (ii) less severe contracting frictions do not necessarily raise capital inflows locally (relative to an economy with more severe contracting frictions).

The study most similar to ours is Matsuyama (2011), which also develops a model of limited pledgeability to show that a reduction in the severity of contracting frictions has ambiguous effects on capital flows. For a given mix of investment projects, it allows entrepreneurs to borrow more; this first effect raises capital inflows, but it also changes the equilibrium mix of investment projects. In particular, low-productivity projects with high pledgeability are replaced by high-productivity projects with low pledgeability; this second effect tends to reduce capital inflows. Like us, Matsuyama (2011) finds that less severe contracting frictions might reduce capital inflows. But the mechanisms emphasized by both papers are different. In our model, all projects have the same pledgeability, but financial reforms cause some of the low-productivity ones to be abandoned because the expansion of high-productivity ones raises their costs. Thus, our results rely only on general equilibrium interactions among investment projects. In Matsuyama's model these interactions

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5. Recent papers that emphasize the role of contracting frictions on different aspects of capital flows include Aoki and others (2009), who focus on the effects of capital account liberalization; Antràs and Caballero (2009), who focus on the relationship between commodity trade and capital flows; Ju and Wei (2010), who focus on the composition of capital flows; and Buera and Shin (2011), who focus on the effects of productivity-enhancing reforms on capital flows.

are absent since technologies are linear and the return to a given investment project is unaffected by the amount of investment in other projects.

The paper is organized as follows. Section 1 develops a world equilibrium model of economic growth and capital flows. Section 2 uses this model to derive the main theoretical results of the paper. Section 3 explores their implications for global imbalances and the allocation puzzle. Section 4 concludes.

1. A STYLIZED MODEL OF ECONOMIC GROWTH AND CAPITAL FLOWS

This section presents a world equilibrium model of economic growth and capital flows. There are two productive resources in this world, labor and savings. The labor market is perfectly competitive but geographically segmented. The credit market is imperfect because firms cannot pledge part of their future output to their creditors. We allow countries to vary in the severity of this friction (i.e., their level of financial development). We define the world equilibrium assuming first that the credit market is geographically segmented, and then that the credit market is integrated. We refer to these opposite cases as financial autarky and financial globalization, respectively.

1.1 Setup

The world economy contains an infinite sequence of generations that live for two periods, youth and old age. Each generation is evenly distributed across C countries or regions, each of them containing a continuum of individuals of measure one. Each generation contains individuals with $N + 1$ different levels of productivity. Therefore, individuals are characterized or indexed as follows: (i) their generation ($t = 0,1, \dots , \infty$); (ii) their country ($c = 1, \dots , C$); and (iii) their productivity type ($n = 0,1, \dots , N$).

All individuals maximize expected old-age consumption (i.e., $E_t \left\{ c_{c,\, t+1}^n \right\}$); where $c_{c,\, t+1}^n$ is the old-age consumption of type n generation t in country c. To finance this consumption, individuals supply one unit of labor when young and receive a wage. This wage is common for all types within a generation and country. Let $w_{c,t}$ be the wage that all types of generation t in country c receive during their youth.

Since individuals only care about old age consumption, they save this wage. Since there is no risk, they invest these savings so as to maximize their return.

All individuals have access to a standard Cobb-Douglas production technology. In particular, type n of generation t in country c has access to the production function, $F\left(l_{c,t+1}^n, \pi^n \cdot k_{c,t+1}^n\right) = \left(l_{c,t+1}^n\right)^{1-\alpha} \cdot \left(\pi^n \cdot k_{c,t+1}^n\right)^{\alpha}$ where $k_{c,t+1}^n$ is investment during youth and $l_{c,t+1}^n$ are the workers hired in old age. Capital fully depreciates in production. As mentioned, productivity varies across types (i.e., $\pi^n \in \left\{\pi^0, \ldots, \pi^N\right\}$). We order types such that $0 = \pi^0 < \ldots < \pi^N = 1$. All generations and countries have the same distribution of types. In particular, let $\varepsilon^n \in [0,1]$ be the fraction of individuals of type n. Thus, $\sum_{n=0}^{N} \varepsilon^n = 1$ All individuals can participate in the credit market, but there is an agency cost that limits their ability to obtain credit. In particular, all types in generation t in country c can commit or pledge to their creditors only a fraction $\phi_{c,t+1} \in [0,1]$ of their resources in period $t+1$:

$$R_{c,t+1} \cdot \left(k_{c,t+1}^n - w_{c,t}\right) \le \phi_{c,t+1} \cdot \left[F\left(l_{c,t+1}^n \cdot \pi^n \cdot k_{c,t+1}^n\right) - w_{c,t+1} \cdot l_{c,t+1}^n\right], \tag{1}$$

where $R_{c,t+1}$ is the gross interest rate on credit. To capture time-series and cross-country differences in the level of financial development, we allow the friction $\phi_{c,t+1}$ to be known in period t, i.e. $E_t \phi_{c,t+1} = \phi_{c,t+1}$.

With these assumptions and notation in hand, we can write the budget constraint of type n of generation t in country c as follows:

$$c_{c,t+1}^n = F\left(l_{c,t+1}^n \cdot \pi^n \cdot k_{c,t+1}^n\right) - w_{c,t+1} \cdot l_{c,t+1}^n - R_{c,t+1} \cdot \left(k_{c,t+1}^n - w_{c,t}\right). \tag{2}$$

Equation (2) indicates that consumption consists of production minus labor and financial costs. Of course, if type n is a creditor (i.e., $k_{c,t+1}^n < w_{c,t}$), financial costs become negative and, in this case, we say that type n receives financial income. The problem of type n of generation t in country c consists of maximizing expected old-age consumption subject to equations (1) and (2), taking the wage and the interest rate as given.

All transactions take place in the labor and credit markets. In the labor market, the young supply labor to the old. All young supply one unit of labor, while maximization implies the following of labor demands of the old:

$$l_{c,t+1}^n = \left(\frac{1-\alpha}{w_{c,t+1}}\right)^{\frac{1}{\alpha}} \cdot \pi^n \cdot k_{c,t+1}^n. \tag{3}$$

Equation (3) results from equating the wage to the marginal product of labor. Since the labor market is geographically segmented, we must match supply and demand within each of the C countries, i.e. $1 = \sum_{n=0}^{\infty} l_{c,t+1}^{n} \cdot \varepsilon^{n}$. This means that:

$$w_{c,t+1} = (1 - \alpha) \cdot k_{c,t+1}^{\alpha}, \qquad (4)$$

where $k_{c,t+1}$ is the capital-labor ratio in efficiency units, i.e. $k_{c,t+1} \equiv \sum_{n=0}^{\infty} \pi^{n} \cdot k_{c,t+1}^{n} \cdot \varepsilon^{n}$. Equation (4) simply says that the wage in country c equals the marginal product of labor evaluated at the aggregate (effective) capital-labor ratio.

In the credit market, the young borrow and lend. Let $\bar{x}_{c,t}^{n}$ be the maximum amount of investment that type n can finance as a share of his/her wage or wealth. This quantity is given as follows:

$$\bar{x}_{c,t}^{n} = \begin{cases} \dfrac{R_{c,t+1}}{R_{c,t+1} - \phi_{c,t+1} \cdot \alpha \cdot \left(\dfrac{1-\alpha}{w_{c,t+1}}\right)^{\frac{1-\alpha}{\alpha}} \cdot A \cdot \pi^{n}} & if\, R_{c,t+1} > \phi_{c,t+1} \cdot \alpha \cdot \left(\dfrac{1-\alpha}{w_{c,t+1}}\right)^{\frac{1-\alpha}{\alpha}} \cdot A \cdot \pi^{n} \\[2em] +\infty & if\, R_{c,t+1} < \phi_{c,t+1} \cdot \alpha \cdot \left(\dfrac{1-\alpha}{w_{c,t+1}}\right)^{\frac{1-\alpha}{\alpha}} \cdot A \cdot \pi^{n} \end{cases} \qquad . \quad (5)$$

Equation (5) spells out the implications of the credit constraint in equation (1). To understand this equation, note that the marginal product of capital for type n is given by $\alpha \left(\dfrac{1-\alpha}{w_{c,t+1}}\right)^{\frac{1-\alpha}{\alpha}} \cdot \pi^{n}$ and the fraction of this marginal product that can be pledged to creditors is $\phi_{c,t+1}$. If the interest rate is high, this fraction is an insufficient guarantee and type n is credit constrained. That is, the amount this type can borrow depends on its wealth or net worth, which in this model equals the wage. If the interest rate is low, the fraction of the marginal product that can be pledged is enough to pay the interest rate and type n is not constrained.

Let $x_{c,t}^{n}$ be the actual investment that type n undertakes as a share of his/her wage or wealth. Maximization implies that:

$$x_{c,t}^n \begin{cases} = 0 & \text{if} \quad R_{c,t+1} > \alpha \cdot \left(\dfrac{1-\alpha}{w_{c,t+1}}\right)^{\frac{1-\alpha}{\alpha}} \cdot \pi^n \\[2em] \in \left[0, \bar{x}_{c,t}^n\right] \text{if} \quad R_{c,t+1} = \alpha \cdot \left(\dfrac{1-\alpha}{w_{c,t+1}}\right)^{\frac{1-\alpha}{\alpha}} \cdot \pi^n \\[2em] = \bar{x}_{c,t}^n & \text{if} \quad R_{c,t+1} < \alpha \cdot \left(\dfrac{1-\alpha}{w_{c,t+1}}\right)^{\frac{1-\alpha}{\alpha}} \cdot \pi^n \end{cases} \tag{6}$$

Equation (6) describes the optimal investment policy. If the interest rate is above the marginal product of capital, type n prefers to lend. If the interest rate is equal to the marginal product of capital, type n is indifferent between investing and lending. If the interest rate is below to the marginal product of capital, type n invests as much as possible.

Finally, we can write the law of motion of the capital stock as follows:

$$k_{c,t+1} = \left(\sum_{n=0}^{N} \pi^n \cdot x_{c,t}^n \cdot \varepsilon^n\right) \cdot (1-\alpha) \cdot k_{c,t}^\alpha. \tag{7}$$

Equation (7) simply indicates that the capital stock in efficiency units in period $t+1$ equals domestic investment in period t, weighted by its productivity. This result follows from the assumption that capital fully depreciates and net and gross investments coincide.

Equations (4), (5), (6) and (7) describe the dynamics of the world economy as a function of the interest rates in each country (i.e., $R_{c,t+1}$). To complete the model, we must explain how these interest rates are determined. We consider two alternative arrangements: (i) financial autarky, in which case the credit market is geographically segmented into C local credit markets; and (ii) financial globalization, in which case there is a single global credit market.

Under financial autarky, the credit market is geographically segmented and equilibrium requires:

$$\sum_{n=0}^{N} (x_{c,t}^n - 1) \cdot \varepsilon^n = 0. \tag{8}$$

Equation (8) states that investment must equal savings within each country. Within a country, all types save the same, but they might invest differently. If some types invest in excess of their savings and obtain credit (i.e., $x_{c,t}^n > 1$); it must be because other types invest less than their savings and supply credit (i.e., $x_{c,t}^n < 1$). Equations (4), (5), (6), (7) and (8) provide a full description of the dynamics of the world economy under financial autarky.

Under financial globalization, there is a single integrated credit market; the interest rate is equalized across countries:

$$R_{c,t+1} = R_{t+1},\tag{9}$$

and equilibrium requires:

$$\sum_{c=1}^{C}\left(\sum_{n=0}^{N}(x_{c,t}^n - 1)\cdot\varepsilon^n\right)\cdot k_{c,t}^{\alpha} = 0.\tag{10}$$

Equation (10) says that world investment must equal world savings. If some countries invest in excess of their savings and obtain credit (i.e., $\sum_{n=0}^{N}(x_{c,t}^n - 1)\cdot\varepsilon^n > 0$); it must be because other countries invest less than their savings and supply credit (i.e., $\sum_{n=0}^{N}(x_{c,t}^n - 1)\cdot\varepsilon^n < 0$). Equations (4), (5), (6), (7), (9) and (10) provide a full description of the dynamics of the world economy under financial globalization.

2. FINANCIAL REFORMS, PRODUCTIVITY AND CAPITAL FLOWS

This section uses the model developed above to study the effects of financial reforms on productivity and capital flows. In particular, we explore the basic mechanism through which financial reforms affect investment, the interest rate and capital flows. We first build some intuitions and then develop some concrete examples.

2.1 Building Intuitions

The key question that this paper addresses is how investment changes after financial reform. Throughout, we think of financial reform in country c as a reduction in the country-specific agency cost that limits the ability of entrepreneurs to obtain credit (i.e., as an increase in $\phi_{c,t}$). The main insight of our model is that such a reform

has conflicting effects on investment. By relaxing credit constraints, the reform allows all entrepreneurs to expand investment. But this expansion has general equilibrium effects that reduce the return to investment, so that the reform also makes some entrepreneurs reduce their investment. The relative magnitude of these two effects, as we shall see, depends on the distribution of productivities.

To formalize the discussion, combine equations (5) and (6) to obtain the investment of each type as a function of the interest rate and future wages:

$$
i_{c,t}^n
\begin{cases}
= 0 & \text{if } R_{c,t+1} > \alpha \cdot \left(\dfrac{1-\alpha}{w_{c,t+1}} \right)^{\frac{1-\alpha}{\alpha}} \cdot \pi^n \\[3em]
\in \left[0, \dfrac{1}{1-\phi_{c,t+1}} \cdot (1-\alpha) \cdot k_{c,t}^\alpha \right] & \text{if } R_{c,t+1} = \alpha \cdot \left(\dfrac{1-\alpha}{w_{c,t+1}} \right)^{\frac{1-\alpha}{\alpha}} \cdot \pi^n \\[3em]
= \dfrac{R_{c,t+1}}{R_{c,t+1} - \phi_{c,t+1} \cdot \alpha \left(\dfrac{1-\alpha}{w_{c,t+1}} \right)^{\frac{1-\alpha}{\alpha}} \cdot \pi^n} \cdot (1-\alpha) \cdot k_{c,t}^\alpha & \text{if } R_{c,t+1} < \alpha \cdot \left(\dfrac{1-\alpha}{w_{c,t+1}} \right)^{\frac{1-\alpha}{\alpha}} \cdot \pi^n
\end{cases}
\tag{11}
$$

We can also combine equations (4) and (7) to express future wages as an increasing function of the current investment:

$$
w_{c,t+1} = (1-\alpha) \cdot \left(\sum_{n=0}^{N} \pi^n \cdot i_{c,t}^n \cdot \varepsilon^n \right)^\alpha .
\tag{12}
$$

Jointly considered, equations (11) and (12) allow us to derive, for each interest rate $R_{c,t+1}$, the equilibrium investment of each type. As usual, we refer to this relationship between investment and the interest rate as the investment demand of the corresponding type, and write it as follows:

$$
i_{c,t}^n = i_c^n \left(R_{c,t+1}; k_{c,t}, \phi_{c,t+1} \right).
\tag{13}
$$

The individual investment demand functions in equation (13) are always decreasing in $R_{c,t+1}$. To see this, consider an increase in the

interest rate. Since this raises financing costs and reduces the return to investment some entrepreneurs decide to stop investing. Moreover, those entrepreneurs that still continue investing face tighter borrowing constraints and are forced to reduce their investments as well. The demand functions in equation (13) might be increasing or decreasing in $\phi_{c,t+1}$. To see this, consider an increase in $\phi_{c,t+1}$. Holding the future wage constant does not affect the return to investment but it relaxes credit constraints and allows entrepreneurs to expand their investment. But this additional investment raises the future wage, and this lowers the return to investment. If a type did not invest before the increase in $\phi_{c,t+1}$ it will not do so afterwards. Among the types that did invest before the increase in $\phi_{c,t+1}$, we can distinguish between those that stop investing and those that continue to invest. The former have relatively low productivity and stop investing because the return is too low with the higher wage. The latter have relatively high productivity and the relaxation of credit constraints allows them to expand their investments.[6]

We construct the aggregate investment demand of country c as follows:

$$i_{c,t} \equiv \sum_{n=0}^{N} i_c^n(R_{c,t+1}; k_{c,t}, \phi_{c,t+1}) \cdot \varepsilon^n \ . \tag{14}$$

The properties of this aggregate demand follow directly from the individual ones. In particular, this aggregate demand is decreasing in $R_{c,t+1}$. Interestingly, and this is the main insight on which we build this paper, whether its aggregate demand is increasing or decreasing in $\phi_{c,t+1}$ depends on the distribution of the types. If there is a sufficient mass of "marginal" entrepreneurs (i.e., whose return to investment is close to the interest rate), then the aggregate investment demand is decreasing in $\phi_{c,t+1}$. Otherwise, the aggregate investment demand is increasing in $\phi_{c,t+1}$.

With this observation at hand, we can trace the effect of financial reforms under financial autarky and globalization. Under autarky, financial reforms that raise the aggregate investment demand lead to an

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6. Whether the individual demand functions in equation (13) are increasing or decreasing in $k_{c,t}$ also depend on the type. An increase in $k_{c,t}$ provides wealth and relaxes the credit constraint of all entrepreneurs. But since the additional investment raises the future wage and lowers the return to investment, some entrepreneurs decide to stop investing.

increase in the equilibrium interest rate.[7] Likewise, financial reforms that lower the aggregate investment demand lead to a fall in the equilibrium interest rate. Thus, the effects of financial reforms on the domestic interest rate depend on the distribution of the types. Under globalization, financial reforms that raise the aggregate investment demand lead to capital inflows and, to the extent that the country is "large", they also raise the world interest rate. Likewise, financial reforms that lower the aggregate investment demand lead to capital outflows and they might also lower the world interest rate. Thus, the effects of financial reforms on capital flows depend on the distribution of types.

2.2 Examples

We consider next a series of concrete examples in which the forces described above are at work. To simplify the discussion, we consider a world economy with many infinitely small countries (i.e., $C=+\infty$). Our objective is to determine the effects of a financial reform in one of these countries. We model this financial reform as a one-time permanent increase in ϕ_c. That is, we assume that $\phi_{c,t} = \phi_L$ if $t < T$ and $\phi_{c,t} = \phi_H$ if $t \geq T$, with $\phi_H > \phi_L$. We refer to T as the reform period. In order to assess the effects of this reform, we proceed from the special to the general.

Homogeneous Investments

Consider first a world in which the distribution of productivities is extreme (i.e., $N=1$ with $\pi^0=0$ and $\pi^1=1$). This world economy contains "savers" which cannot produce at all (i.e., $\pi^0=0$), and a single type of "entrepreneur" with high productivity (i.e., $\pi^1=1$). This is quite a popular model in international economics since it has the virtue of simplicity.

The top two panels of figure 1 show the effects of the reform under financial autarky. The reform period is $T=010$.[8] The top left panel

---

7. Remember that, for a given capital stock, domestic savings are not affected by financial reforms. The reason is that domestic savings equal current wages and financial reforms affect only future wages.

8. In the figures, $NFA_{c,t} = \sum_{n=0}^{N}(x_{c,t}^n - 1) \cdot \varepsilon^n$ is defined as net capital inflows as a share of wages and TFP_t is defined as the average productivity of investment in country c, given by

$$TFP_{c,t} = \frac{\sum_{n=0}^{N}\pi^n \cdot x_{c,t}^n \cdot \varepsilon^n}{\sum_{n=0}^{N}x_{c,t}^n \cdot \varepsilon^n}.$$

Table 1 in the appendix describes all parameter values used in the different simulations.

shows the law of motion of the economy before and after the reform (they are the same!), and the top right panel shows the dynamics of the capital stock and the interest rate. The reform has no effect on the law of motion of the economy since it affects neither the quality nor the quantity of investment. The reason is simple: both before and after the reform, entrepreneurs invest all the savings of the economy. The reform only affects the terms at which savers and entrepreneurs trade in the credit market. By relaxing credit constraints, the reform raises the demand for credit by entrepreneurs and thus the interest rate. This raises the consumption and welfare of savers, and reduces the consumption and welfare of entrepreneurs.

Figure 1. Effects of Financial Reform: One Investment Technology
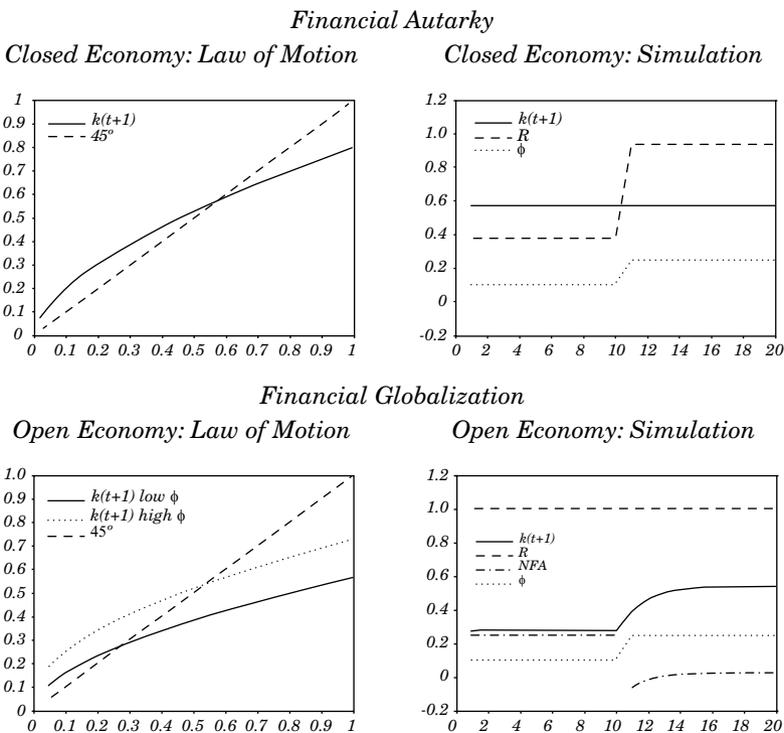
Source: Authors' elaboration.

The bottom two panels of figure 1 show the effects of the reform after financial globalization. Since the country is just one among infinitely many others of the same size, the reform has no effect on world interest rate. We see now that the reform shifts the law of motion of the economy upwards. Almost by assumption, the reform cannot affect the quality of investment, since there is only one type of entrepreneur in the country. Thus, the shift in the law of motion does not reflect an increase in the quality of investment but, instead, an increase in the quantity of investment. The relaxation of credit constraints allows domestic entrepreneurs to borrow more from abroad and invest more. These capital inflows raise the steady state capital stock and growth during the transition. Savers and entrepreneurs both enjoy higher consumption and welfare.

The first example shows a striking difference between the effects of financial reforms under financial autarky and financial globalization. Under financial autarky, reforms do not raise average income but only change the way income is shared. In particular, a higher share of income goes to savers relative to entrepreneurs. Under financial globalization, however, the reform raises average income and everybody wins. The key to this success is that the reform enables the economy to receive capital inflows. This story is simple and clear-cut. But it leaves out a very important aspect of financial reform: its effect on the allocation of investment and therefore the quality of investment. The next example shows this.

Heterogeneous Investments

Consider the possibility that a country also contains low-productivity entrepreneurs (i.e. $N=2$ with $\pi^0=0$, $\pi^1=\pi \in (0,1)$ and $\pi^2=1$). Thus, the country now contains "savers" and two types of "entrepreneurs," which we refer to as low- and high-productivity. This simple extension of the previous example opens up a new role for financial reforms: improving the allocation of investment and enhancing average productivity.

The top two panels of figure 2 show the effects of the reform under financial autarky in the extended model. Now the law of motion of the economy shifts upwards as a result of the reform. Since capital inflows are not possible, the quantity of investment is unaffected in the short run. But the reform allows the economy to improve the quality of this investment. The mechanism is quite natural: as credit constraints are relaxed, high-productivity firms borrow more and

increase their investment at the expense of low-productivity firms. This raises average productivity, the steady state capital stock and growth during the transition. In the short run, only low-productivity entrepreneurs lose. In the long run, everybody wins.

It is interesting to study the response of the interest rate to the financial reform. Since the reform raises the quality of investment, future wages are high and this reduces the return to both types of entrepreneur. This reduction in profitability leads some low-productivity entrepreneurs to stop investing, releasing domestic savings that can then be used by high-productivity entrepreneurs. Are these savings large enough to accommodate the increased credit and investment demand by high-productivity entrepreneurs? The answer depends on the proportions of low-productivity and high-productivity entrepreneurs in the economy (i.e., ε^1 and ε^2). If there is only a small pool of low-productivity entrepreneurs, the reduction in their investments does not free enough savings and the interest rate must increase. If, instead, there is a large pool of low-productivity entrepreneurs, the reduction in their investments frees savings in excess of those demanded by high-productivity entrepreneurs and the interest rate must fall. The top right panel of figure 2 shows a case in which this is indeed the case.

The middle and bottom panels of figure 2 show the effects of the financial reform under financial globalization in the extended model. The law of motion has two increasing regions and two flat regions. When domestic savings are low (that is, the initial capital stock is so low that we are to the left of the first flat region), investment is low, the marginal product of capital is high, and both types of investors are credit constrained. As domestic savings increase, all types of investment increase and the marginal product of capital declines. Eventually, this marginal product is such that low-productivity entrepreneurs are indifferent between producing or not. When this happens, we have reached the first flat region. At this point, further increases in domestic savings do not translate into higher domestic investment. High productivity entrepreneurs, who are constrained, effectively expand their investment in response to their higher savings but low-productivity entrepreneurs do not. The reason is that, if all additional savings were invested at home, the marginal product of capital would be so low that low-productivity entrepreneurs would not want to invest. But this would be inconsistent with equilibrium because high-productivity entrepreneurs are constrained and they

cannot absorb these additional savings. In this flat region, then, increases in domestic savings enable high-productivity entrepreneurs to expand their investment while crowding-out low-productivity investment. The region comes to an end once all low-productivity investment has stopped. Any increases in savings beyond this point simply lead to more investment by high-productivity entrepreneurs, as their credit constraint is further relaxed. The second flat region is reached when domestic savings are so high that high-productivity entrepreneurs are no longer credit constrained.

As figure 2 shows, the financial reform shifts the law of motion upwards, except for some parts of the flat regions. Thus, the effects of the reform crucially depend on the location of the steady state. The middle and bottom panels of the figure display two extreme possibilities. The middle panel shows a parameterization of the model in which both steady states of the economy, before and after the reform, lie above the first flat region of the law of motion. In this case, low-productivity entrepreneurs do not invest either before or after the reform. As a result, these entrepreneurs are *de facto* savers and the reform has the same effects as in a world with only one type of investment (i.e., it affects the quantity of investment but not its quality). It leads to capital inflows that raise the steady state stock of capital and the growth rate during the transition.

The bottom panel of figure 2 shows a parameterization of the model in which the steady states before and after the financial reform both lie in the first flat region of the law of motion. In this case, the financial reform sets in motion two effects that operate simultaneously on the capital stock in efficiency units. Increased investment by high-productivity entrepreneurs raises the capital stock and wages. Increased wages, however, lower the profitability of low-productivity entrepreneurs and force some of them out of the market. How many of these entrepreneurs will stop investing? Just enough of them to undo the effect of higher investment by high-productivity entrepreneurs on the capital stock. Only in this way will wages remain constant and allow the remaining low-productivity entrepreneurs to continue operating. This leads us to the conclusion that, in this case, the reform does not affect the capital stock. As high-productivity entrepreneurs expand and low-productivity ones contract, the average productivity of the country grows. But since the capital stock remains constant, this means that the quantity of investment falls and the reform leads to capital outflows!

Figure 2. Three Investment Technologies

Financial Autarky

Closed Economy: Law of Motion   *Closed Economy: Simulation*

Financial Globalization
Case 1: Capital Inflows

Open Economy: Law of Motion   *Open Economy: Simulation*

Case 2: Capital Outflows

Open Economy: Law of Motion   *Open Economy: Simulation*
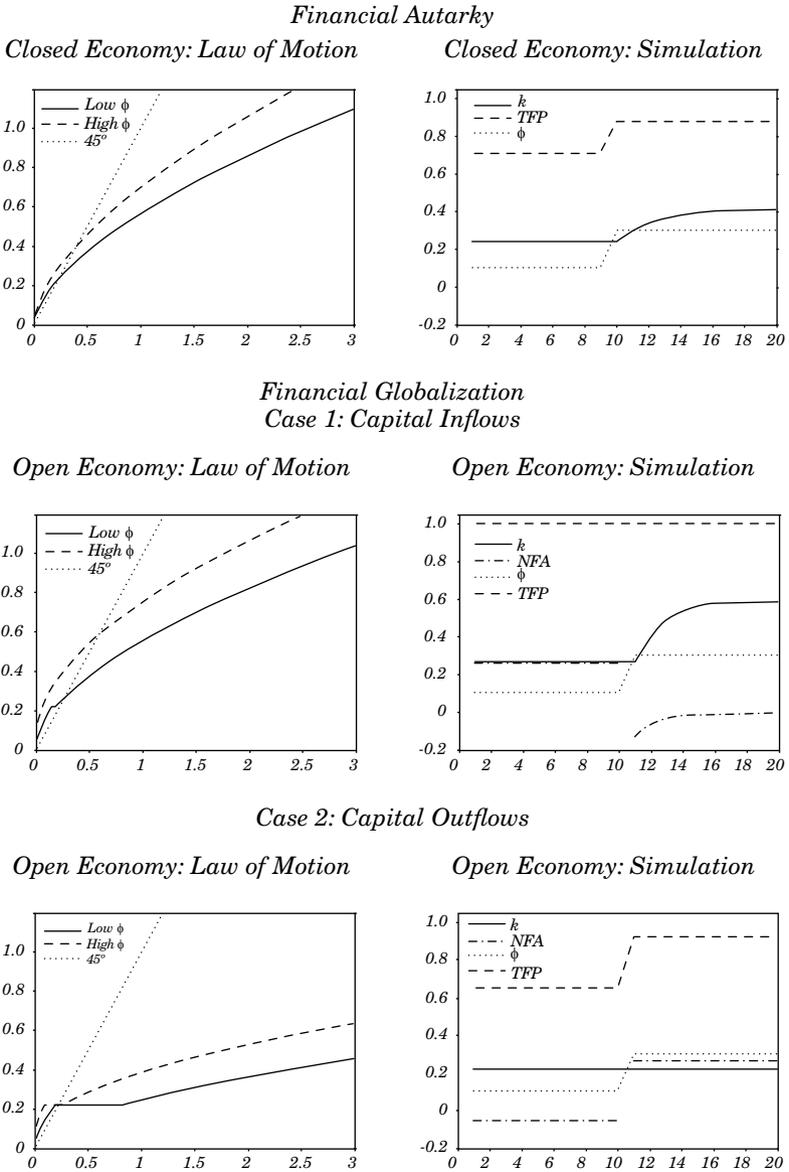
Source: Authors' elaboration.

The two examples in figure 2 are revealing but, with only two types of entrepreneurs, they might strike the reader as extreme. The main message of these examples can easily be extended to the case of many technologies (i.e., $n=N$). This extension is shown in figure 3. Under financial autarky, the effects of a financial reform are similar to those of the previous example. Under financial globalization, we have plotted two examples. In both of them, a reform raises average productivity and thus the quality of investment. In one of the examples, there is a small pool of marginal-productivity entrepreneurs or low-productivity entrepreneurs and the reform leads to capital inflows. In the other example, there is a large pool of marginal-productivity entrepreneurs or low-productivity entrepreneurs and the reform leads to capital outflows.

Figure 3. *N*-Investment Technologies

Financial Globalization
Case 1: Capital Inflows

Uniform Distribution: Law of Motion   *Uniform Distribution: Simulation*

Case 2: Capital Outflows
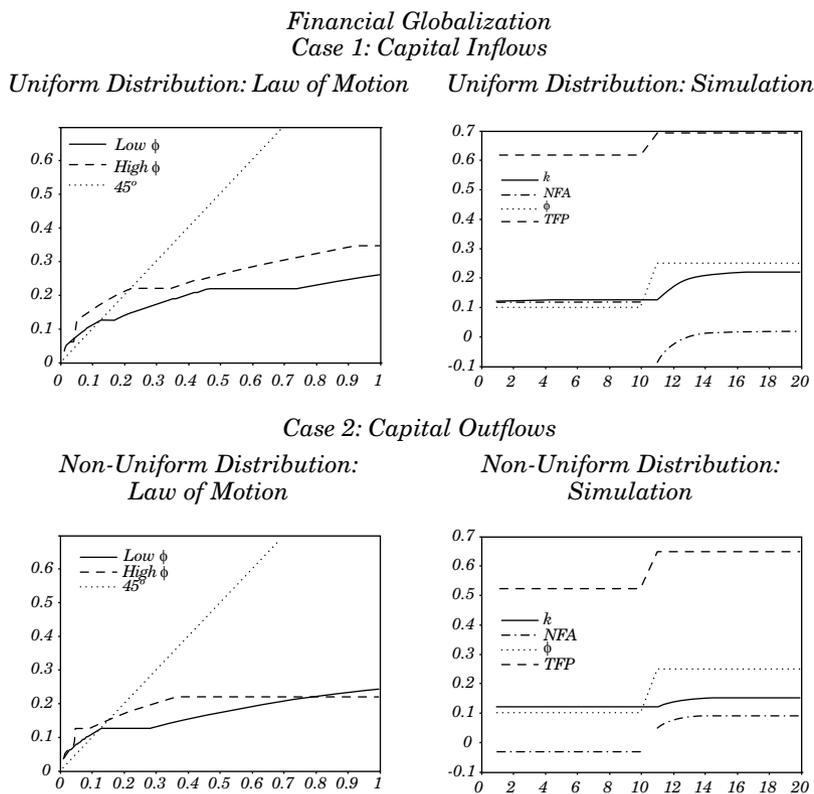
Non-Uniform Distribution: *Non-Uniform Distribution:*
Law of Motion   *Simulation*

3. POTENTIAL REAL-WORLD IMPLICATIONS

The mechanisms discussed above have potentially important implications for understanding some recent trends in the world economy. We show this here by focusing on the evolution of global imbalances and the so-called "allocation puzzle."

3.1 Global Imbalances

A major recent development in the world economy has been the emergence of large global imbalances (i.e., large capital flows from emerging economies—mainly China—to industrial countries—mainly the United States) that have led to record-low interest rates in the latter. Many see these global imbalances as worrisome since they reallocate capital from capital-scarce countries to capital-abundant ones. The efficiency at which the world economy operates can only decline as a result. Some also point out that these record-low interest rates create the conditions for bubbles to exist, leading to boom-bust cycles in industrial countries. Indeed, this argument has led some to blame global imbalances for the recent financial crisis of 2007-08.

What drives these global imbalances? A view shared by many academics and policymakers is that they stem from the existence of underdeveloped financial markets in China and other emerging economies. The narrative of this view is as follows: in the early 1990s, many emerging economies undertook a major process of financial liberalization. In many cases, the effects of this process were somewhat unexpected. The reason is that weak enforcement institutions did not allow entrepreneurs in emerging markets to borrow and raise investment as expected, while savers in emerging markets decided to send part of their savings abroad in search of a better risk-return combination. Contrary to the predictions of standard economic theory, financial underdevelopment thus turned some emerging market economies into capital exporters instead of capital importers. A natural corollary of this view, it seems, is that financial development in China and other emerging economies would reduce these imbalances and raise interest rates across the world.

We can use our model to evaluate these claims and, in particular, this last corollary. To do this, consider a world with two countries, i.e. $C = 2$. Fittingly, we refer to these countries as "East" and "West" (i.e., $c \in \{E, W\}$). West is richer than East and has better financial markets: $k_{W,t} > k_{E,t}$ and $\phi_{E,t} = \phi_H$ if $t \geq T$, with $\phi_H > \phi_L$.

The first observation is that the model is broadly consistent with the views described above if one has in mind a drastic financial reform (i.e., $0 \approx \phi_L < \phi_H = 1$). Before financial globalization, the interest rate in East is close to minus one. Nobody is able to borrow and average productivity is extremely low. In West, the interest rate is high and only the highest-productivity entrepreneurs invest. Financial liberalization raises the interest rate in East and lowers it in West. As a result, low-productivity entrepreneurs in East stop investing and start lending to high-productivity entrepreneurs in West. High-productivity entrepreneurs in East cannot borrow in order to raise their investment. As a result, financial globalization leads to global imbalances (i.e., capital flows that are potentially large and go from East to West).

In this scenario, a drastic reform would totally redress the picture. After the reform, high-productivity firms in East would invest the same as their counterparts in West. Since West is richer and has higher savings, this would lead to capital flows from West to East. One generation later, East would have converged to the income levels of West, just as the textbook model predicts.

Things might look quite different however if the reform is not drastic (i.e., $0 \ll \phi_L < \phi_H \ll 1$). What are the effects of the reform in this case? As figure 4 shows, all of the intuitions that were developed for the small economy in the previous section carry through to this case. In the figure, the right panels show the law of motion of the relative capital stock in East (i.e., $k_{E,t}/k_{W,t}$), while the left panels show the evolution of $NFA_{E,t}$ and $TFP_{E,t}$. If there is a small pool of marginal-productivity or low-productivity entrepreneurs in East, the reform reduces global imbalances. Since East is large, this also leads to an increase in the world interest rate. This case, which is consistent with the corollary above, is depicted in the top panel of figure 4. But it is also possible that there is a large pool of marginal or low-productivity entrepreneurs in East. In this case, the reform exacerbates global imbalances and leads to a reduction in the world interest rate. This case, which directly contradicts the corollary above, is depicted in the bottom panel of figure 4.

Which case is more likely to be relevant empirically? We cannot, of course, answer this question without a careful analysis of the distribution of firm productivities in China and other emerging economies. At least for the case of China, however, there is a strong presumption that there is a large pool of marginal-productivity or low-productivity companies, namely, state owned enterprises (SOEs). Song and others (2011)

provide evidence in this regard. They study the evolution of the Chinese manufacturing sector and document how, despite losing substantial ground relative to private enterprises (PEs) over the last two decades, SOEs still accounted for almost half of all manufacturing employment in 2007. They also document that SOEs are substantially less productive than PEs, displaying consistently lower profitability ratios since the early 1990s.[9] Finally, PEs seem to be more financially constrained than SOEs, as they exhibit lower capital-labor shares and finance a lower share of their investment from bank loans and government subsidies.

Figure 4. Two-Country Case: Global Imbalances

Financial Globalization
Case 1: Capital Inflows

Evolution of k_{east} / k_{west}   *Capital Inflows: Simulation*

Case 2: Capital Outflows

Evolution of k_{east} / k_{west}   *Capital Outflows: Simulation*
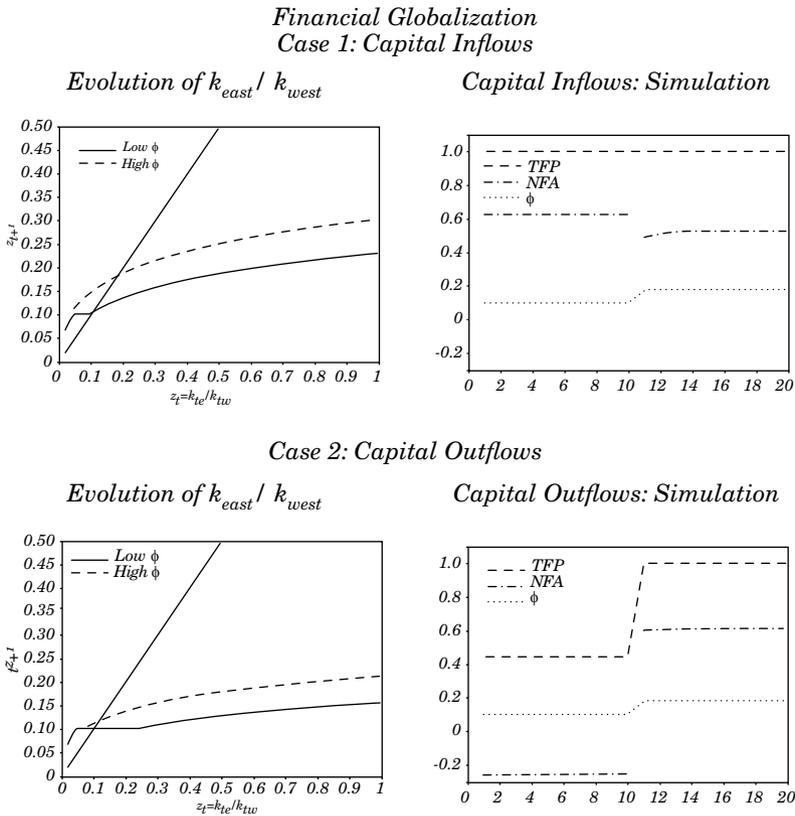
Source: Authors' elaboration.

9. Song and others (2011) define the profitability ratio as the share of total profits to fixed assets net of depreciation and find that the differential in favor of PEs is stable around 9 percentage points. Hsieh and Klenow (2009) also find that PEs are more productive than SOEs, with a revenue TFP gap of 1.42.

Viewed through the lens of our model, the evidence on Chinese manufacturing suggests that incremental reforms in China might actually increase capital outflows. The reason, as should be clear by now, is that financial reform enables PEs to expand at the expense of SOEs and this raises the productivity of the economy. As long as the SOEs are still operative, however, the reform does not affect the capital stock. The combination of an unchanged capital stock with a higher productivity of investment means that the quantity of investment must fall, and that capital outflows must increase. The question is then, how large must the reform be to ensure that wages grow enough to fully wipe out the low-productivity SOE sector? Any realistic package of financial reforms would probably fall short of this threshold and, as a consequence, it would exacerbate global imbalances and lead to even lower interest rates worldwide.

3.2 The Allocation Puzzle

The direction of capital flows within the developing world has also attracted a substantial amount of attention in recent years. Gourinchas and Jeanne (2009) examined a large sample of emerging economies and found a negative cross-country correlation between productivity growth and capital inflows. In other words, emerging economies with high-productivity growth, in recent decades, tended to export capital, while emerging economies with low-productivity growth tended to import capital. Since this empirical regularity seems to contradict standard economic theory, Gourinchas and Jeanne coined the term the "allocation puzzle" to refer to it. In a related paper, Prasad and others (2007) found a similar result when examining two samples containing industrial countries and emerging economies, respectively. In the industrial-country sample, they found a positive correlation between economic growth and capital inflows over the recent past. As textbook theory suggests, capital among industrial countries seems to have migrated towards those countries that are capital scarce (relative to the steady state) and quickly converge towards their steady state. In the emerging-economy sample, however, Prasad and others (2007) found a negative correlation between economic growth and capital inflows. Contrary to the textbook theory, capital among emerging economies seems to have migrated towards those countries that are less capital scarce (relative to the steady state) and are close to their steady states.

To be sure, the robustness and exact implications of these findings are still being debated.[10] It is nonetheless interesting to note that our model could provide a natural explanation for the allocation puzzle based on asymmetric financial development among emerging economies. To illustrate this point, we expand the example of the previous section to include a third country named "South" (i.e., $c \in \{E, W, S\}$). In the example, East and South are meant to respectively represent a different subset of emerging economies. We assume that, initially, East and South have the same (low) level of financial development (i.e., $\phi_E = \phi_S < \phi_W = 1$). We also assume that, initially, East and South have the same capital stock (i.e., $k_{W,t} > k_{E,t} = k_{S,t}$). Starting from this benchmark, we consider a financial reform in East. That is, we assume again that $\phi_{E,t} = \phi_L$ if $t < T$ and $\phi_{E,t} = \phi_H$ if $t \geq T$, with $\phi_H > \phi_L$.

All previous intuition applies to this case. In particular, the reform could generate capital inflows or outflows in East. Assume that it leads to capital outflows. This is the case depicted in figure 5. East grows faster than the world average, both in terms of average productivity and capital stock. At the same time, East exports capital. This lowers the world interest rate and leads West and South to import capital and expand their investment. Growth in East, however, is higher than in West and there is convergence between these two regions. Average productivity grows in East as low-productivity entrepreneurs stop investing and high-productivity ones expand their investments. The opposite occurs in South, which grows at the same rate as West. Its average productivity, however, declines as the low interest rate induces low-productivity entrepreneurs to raise their investment. Thus, this world exhibits not only global imbalances, but also the allocation puzzle.

10. Alfaro and others (2011) break down capital flows into their public and private components and study their correlation with productivity growth. They claim that the puzzling pattern of capital flows among emerging economies is due to the behavior of the public component of capital flows. The private component of capital flows, according to their findings, behaves according to the predictions of standard economic theory.

Figure 5. Three-Country Case

Financial reform in East Leads to Capital Outflows

| *Financial Innovation* | *Total Factor Productivity* |

| *Evolution of Capital Ratios* | *Foreign Asset Position* |
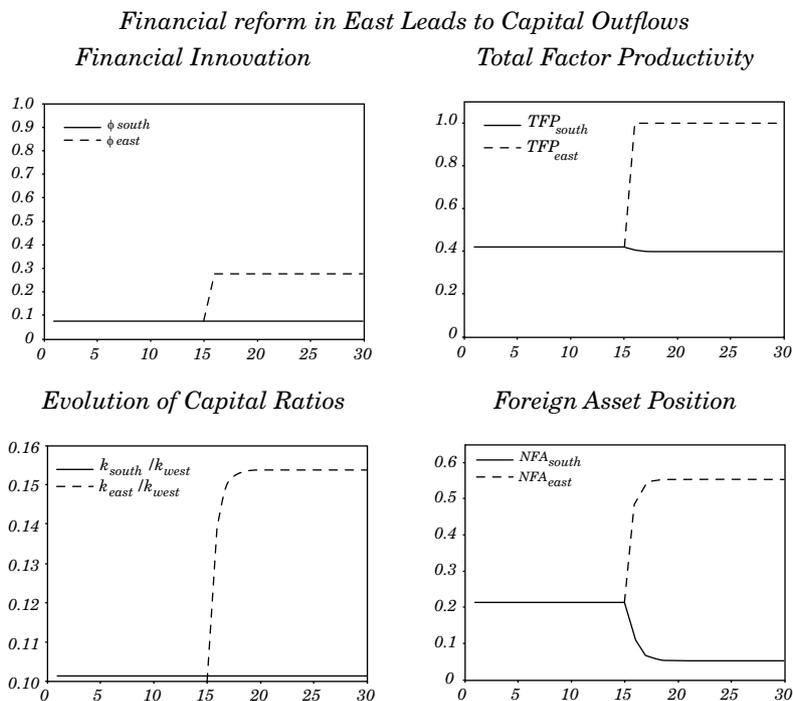
Source: Authors' elaboration.

4. CONCLUDING REMARKS

This paper has developed a simple model to make a simple point: financial reforms that relax credit constraints and raise the ability of domestic firms to borrow have ambiguous effects on capital flows. The reason is that financial reforms lead to opposing effects. On one hand, they relax credit constraints, enabling productive firms to expand their investments, thereby fueling capital inflows. On the other hand, this expansion of productive firms reduces the profitability of unproductive ones and crowds-out their investment, reducing capital inflows. Which of these two effects dominates in practice depends on the distribution of firm productivities within the economy. If there is only a small pool of marginal-productivity firms or low-productivity firms, the reduction in their investments is small

and financial reforms increase capital inflows. If, instead, there is a large pool of marginal-productivity firms or low-productivity firms, the reduction in their investments is large and financial reforms are more likely to increase capital outflows.

In our formal model, the only channel through which an expansion in the investments of high-productivity firms reduces the profitability of low-productivity firms is an increase in the wage. Financial reforms raise the demand for labor and, since labor markets are local, the wage increases. We have focused only on the labor market for simplicity. But our results are more general than that. In reality, firms also use many intermediate inputs that are not tradable. Financial reforms would also raise the prices of these inputs, leading to a real appreciation and further reductions in profitability. In this regard, the results of this paper are related to the well-known Dutch-disease phenomenon.

The theoretical results of this paper are potentially important for understanding two real-world phenomena that have received a substantial amount of attention in recent years. The first such phenomenon is the emergence of global imbalances (i.e., large and persistent capital flows from emerging economies to the developed world). These imbalances have been widely interpreted as the result of low financial development in emerging economies. This interpretation has, in turn, led many to argue that in order to address global imbalances, these economies should embark on a process of financial reform. Our results cast some doubts on this implication: although large-scale financial reforms would most likely lead to lower capital outflows from emerging economies and reduce global imbalances, more gradual reforms might actually increase them. The second phenomenon is the so-called allocation puzzle (i.e., the apparently negative correlation between productivity growth and capital inflows in emerging economies). This correlation is puzzling because it is contrary to the prediction of standard economic theory—in the sense that capital should flow to those economies where productivity growth is high. Our results provide a potential explanation for these observations, which may arise as the result of asymmetric financial reforms across the developing world.

Whether or not the mechanism that we have highlighted here is important in practice, it is ultimately an empirical question, the answer to which depends on the distributions of productivities within emerging economies. It thus seems crucial to further study the properties of these distributions if we are to gain a deeper understanding of the relationship between financial reforms, productivity growth and capital flows.

References

Alfaro, L., S. Kalemli-Ozcan, and V. Volosovich. 2011. "Sovereigns, Upstream Capital Flows and Global Imbalances." Unpublished manuscript, Harvard University.

Antràs, P. and R. Caballero. 2009. "Trade and Capital Flows: A Financial Frictions Perspective." *Journal of Political Economy* 117(4): 701–44.

Aoki, K., G. Benigno, and N. Kiyotaki. 2008. "Adjusting to Capital Account Liberalization." Unpublished manuscript, London School of Economics.

Blanchard, O. and G. Milesi-Ferretti. 2009. "Global Imbalances: In Midstream?" International Monetary Fund Staff Position Note SPN/09/29.

Boyd, J. and B. Smith. 1997. "Capital Market Imperfections, International Credit Markets, and Nonconvergence." *Journal of Economic Theory* 73(2): 335–64.

Buera, F. and Y. Shin. 2011. "Productivity Growth and Capital Flows: The Dynamics of Reforms." Unpublished manuscript, UCLA.

Caballero, R., E. Farhi, and P. Gourinchas. 2008. "An Equilibrium Model of 'Global Imbalances' and Low Interest Rates." *American Economic Review* 98(1): 358–93.

Gertler, M. and K. Rogoff. 1990. "North-South Lending and Endogenous Domestic Capital Market Inefficiencies." *Journal of Monetary Economics* 26(2): 245–66.

Gourinchas, P. and O. Jeanne. 2009. "Capital Flows to Developing Countries: The Allocation Puzzle." Unpublished manuscript, UC Berkeley.

Hsieh, C. and P. Klenow. 2009. "Misallocation and Manufacturing TFP in China and India." *Quarterly Journal of Economics* 124(4): 1403–48.

Ju, J. and S. Wei. 2010. "Domestic Institutions and the Bypass Effect of Financial Globalization." *American Economic Journal: Economic Policy* 2(4): 173–204.

Martin, A. and F. Taddei. 2013. "International Capital Flows and Credit Market Imperfections: A Tale of Two Frictions." *Journal of International Economics* 89(2):441–52.

Martin, A. and J. Ventura. 2011. "Theoretical Notes on Bubbles and the Current Crisis." *IMF Economic Review*, 59(1): 6–40.

Matsuyama, K. 2004. "Financial Market Globalization, Symmetry-Breaking and Endogenous Inequality of Nations." *Econometrica* 72(3): 853–84.

————. 2011. "Institution-Induced Productivity Differences and Patterns of International Capital Flows." Unpublished manuscript, Northwestern University.

Mendoza, E., V. Quadrini, and J. Ríos-Rull. 2009. "Financial Integration, Financial Development, and Global Imbalances." *Journal of Political Economy* 117(3): 371–416.

Prasad, E., R. Rajan, and A. Subramanian. 2007. "Foreign Capital and Economic Growth." *Brookings Papers on Economic Activity* 38(1): 153–230.

Servén, L. and H. Nguyen. 2010. "Global Imbalances Before and After the Crisis." World Bank Policy Research Working Paper 5354.

Song, Z., K. Storesletten, and F. Zilibotti. 2011. "Growing like China." *American Economic Review* 101(1): 196–233.

Table 1. Summary of Parameters Used for Simulation

	figure	# of countries	# of industries	α	R*	π1	π2	π3	ε1	ε2	ε3	As	An	Ae	φ0	φ1
A/I	1	1	2	0.6	1.1	0	-	1	0.4	-	0.6	2	-	-	0.1	0.3
A	2	1	3	0.6	1.1	0	0.5	1	0.2	0.2	0.6	2	-	-	0.1	0.3
I	2			0.6	1.1	0	0.5	1	0	0.75	0.25	2	-	-	0.1	0.3
O	2			0.6	-	0	0.5	1	0.2	0.5	0.3	2	-	-	0.1	0.3
I	3	1	6	0.6	1.1	0	3.0 4.0 5.0	1	0.2	-	0.2	2	-	-	0.1	0.3
O	3			0.6	1.1	0	3.0 4.0 5.0	1	[0.1;0.1;0.40;0.2;0.1;0.1]			2	-	-	0.1	0.3
I	4	2	3	0.6	-	0.001	0.3	1	0.35	0.4	0.25	1.8	1.35	-	0.1	0.18
O	4			0.6	-	0.001	0.3	1	0.1	0.73	0.17	1.8	1.35	-	0.1	0.18
O	5	3	3	0.6	-	0	0.3	1	0.1	0.8	0.1	1.8	1.35	1.8	0.075	0.275

Cases:
A Autarky;
I Financial reform leads to capital inflows;
O Financial reform leads to capital outflows.

Fiscal Policy, Debt Crises, and Economic Growth

William Easterly
New York University
National Bureau of Economic Research

It is very well known that growth rates play a role in debt dynamics. Despite this widespread knowledge, real world narratives of public debt crises often focus almost exclusively on budget deficits and neglect the role of growth. This paper presents the simplest arithmetic possible to illustrate how growth slowdowns could contribute to rapid increases in public debt to GDP ratios. It shows that growth slowdowns have indeed played a role in a wide variety of well known debt crises. It then considers what would be good practice for precautionary fiscal policy, focusing in particular on conservative forecasts of future growth. Unfortunately, political economy incentives cause policymakers to violate such good forecast practices, with a systematic tendency to excessive optimism about future growth. There even appears to be some anecdotal examples of even worse optimism biases when the debt crises are worse.

There are many things this paper does not do. It does not present or test a well developed theory of fiscal policy making and policymakers' expectations formation, relying instead on simple arithmetic and descriptive analysis of outcomes. The focus is on medium-run to long-run growth, not on cyclical fluctuations or cyclicality of deficits or debt. The paper considers only the effects running from growth changes to public debt ratios. It does not consider any effects running the other way, from fiscal policy to growth. Obviously, these effects deserve consideration, but this paper omits them to keep the paper focused and of manageable length.

There is already an important literature that tests for biases in growth and budget forecasts, often confirming an optimistic bias. Frankel (2011a) examines official growth forecasts across 30 countries for upward bias, and Frankel (2011b) considers the Chilean case. The literature on the U.S. includes McNab and others (2005), Auerbach (1994), Auerbach (1999), and Frendreis and Tatalovich (2000). The literature considering over-optimistic growth and budget forecasts in the Eurozone includes Strauch and others (2004), Jonung and Larch (2004), and Marinheiro (2010). Other papers on biased official growth forecasts cover Japan (Ashiya 2007), and Canada (Mühleisen and others 2005). Easterly (2013) provides further extensions of some of the same results presented in this paper.

1. Some Unpleasant Fiscal and Growth Arithmetic

1.1 Debt Dynamics

The simple arithmetic equation for the dynamics of public debt to GDP is extremely well known. I repeat it here for ease of exposition, giving the version in continuous time.

D = Public debt in constant prices

Y = GDP in constant prices

F = Primary Fiscal Deficit in constant prices

r = Interest rate on government debt

g = growth of real GDP

$$d = \frac{D}{Y}, \tag{1}$$

$$f = \frac{F}{Y}, \tag{2}$$

$$\Delta d = f + (r - g)d. \tag{3}$$

Let f^* be the primary fiscal deficit that stabilizes the debt ratio at its current level d (which actually has to be negative, i.e. a primary

surplus, because *r-g* in the long run is positive). Substituting f^* for *f* in equation (3) will by definition make $\Delta d = 0$, so

$$f^* = (r - g)d. \tag{4}$$

1.2 Effect of Growth Change if Fiscal Policy Unchanged

Now suppose that the growth rate g changes.[1] Since we are assessing the possible role of growth rates on debt dynamics, let us go to the extreme case that fiscal policy f stays at its old value set in (4), which keeps the debt ratio stable for the OLD growth rate. I don't consider what combination of reasons or possible theories could predict such a lack of response of fiscal policy: unanticipated growth changes, lack of knowledge that growth has changed, or political economy factors that keep fiscal policy rigid and unable to adjust to a new long-run situation.

The interest rate also does not change, and the debt ratio of course does not immediately change either. So the only change in equation (3) is the growth change. Debt dynamics will now depart from the stable debt ratio achieved by (4) in the following amount:

$$\Delta d = (-\Delta g)d. \tag{5}$$

Given the assumptions above, this (admittedly simplistic) unpleasant arithmetic of growth predicts that debt ratios will start rising for decreases in growth, and will fall for increases in growth. These effects are larger, the larger is the initial debt ratio when the change in growth occurs.

As already mentioned in the introduction, I am considering the effects of growth on debt crises, and not the reverse. Reverse causality in which debt crises decrease growth (such as the "lost decade" of growth often attributed to the Latin American debt crisis) would simply amplify the negative correlation already predicted in (5). However, we are assuming away any changes in fiscal policy in the thought experiment analyzed in this paper.

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1. I leave some ambiguity about whether I am talking about the short-run or long-run growth rate. It is usually the latter because I am thinking of long-run fiscal policy *f*, but (3) also holds arithmetically for short-run growth rates ex-post.

2. Public Debt Problems and Growth Slowdowns

2.1 Previous Results, HIPCS, and Middle Income Debt Crises of 1980s

I showed in an old paper (Easterly 2001) that indeed growth slowdowns were strongly associated with rising debt ratios among all developing countries for 1975-94. I reproduce here figure 3 from that paper illustrating those results (figure 1).

Figure 1 includes two different sets of debt crises—those of low income countries and those of middle income countries (both in 1980s and early 1990s). The low income countries eventually got debt relief under the Highly Indebted Poor Countries (HIPC) program of bilateral and multilateral aid agencies. The old paper ran counterfactual exercises in which the debt ratios would have remained stable or even declined if growth had continued at the 1960-75 rate for cases as diverse as Costa Rica, Cote d'Ivoire, Gabon, and Togo, and hence these countries would not have become HIPCs or middle income debt crises. The point is not that it was reasonable to expect the old growth to continue, but that debt crises occurred partly because fiscal policy failed to adjust to the new growth rate.

Figure 1. Change in Growth and Rise in Public Debt Ratio to GDP for Developing Countries, 1975-94
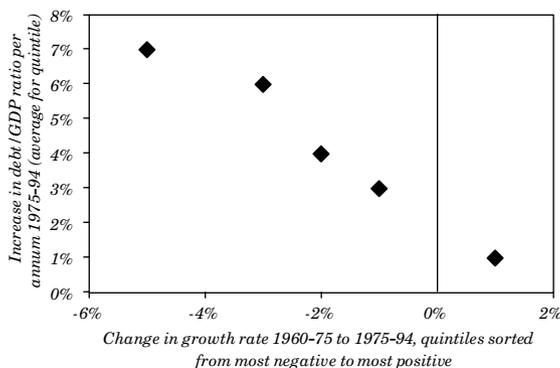
Note: Replicated from Easterly (2001), figure 3.

Replication of old results with new data is an exercise that should be performed more often to make sure that results are robust (especially with the constant fear among audiences that results are reported selectively to make a strong case, i.e. data mining. Data mining would be exposed if new data fail to fit the already specified previous result). In the rest of this section, I consider new debt crises that have occurred more recently. The most recent public debt problems are not among the poor countries, but among the rich countries: the Eurozone countries (especially Portugal, Ireland, Greece, and Spain, the unfortunately named group PIGS) and the United States.

2.2 Eurozone Debt Crises

Figure 2 below corresponds to figure 1 for the Eurozone countries over the successive decades 1980s to 1990s to 2000s.

The graph indicates a negative relationship between debt increases primarily because of 4 extreme observations. The way to think of this graph is not so much as a test of significance of the correlation in this one sample alone (which only has 22 observations). Rather the test is whether the prediction of such a negative relationship in the earlier paper will fit out of sample with the new data.

Ireland and Portugal are examples of recent debt crises in which there was a major growth slowdown from 1990-2000 to 2000-2010. Ireland had earlier benefited from the "Celtic tiger" growth acceleration from 1980-1990 to 1990-2000 to achieve falling public debt ratios in 1990-2000 (the idea of sticky fiscal policy could apply to positive growth changes as well as negative ones). Another example of a growth slowdown associated with exploding public debt ratios was Finland in the 1990s.

Figure 3 shows the growth slowdown for the PIGS countries, where we can see the large growth changes in particular in Ireland and Portugal. All of the PIGS countries have a slowdown by 2010 of course, because of the deep crisis in 2007-2010.

This also contributed to increasing debt ratios over that short period. The debt ratios over 2007-2010 would have increased anyway because of large deficits in those years, but the growth collapse added further to the debt ratio increase. This is most important for Greece, because it already had the highest debt to GDP ratio in 2007 (105 percent), and as shown earlier, high debt countries show the largest effects of growth slowdowns. The Greek debt ratio would have been 10 percentage points lower in 2010 if the growth collapse had not occurred.

Figure 2. Debt Ratio Change per Annum and Change in Growth per Decade for Eurozone Countries, 1980-2010
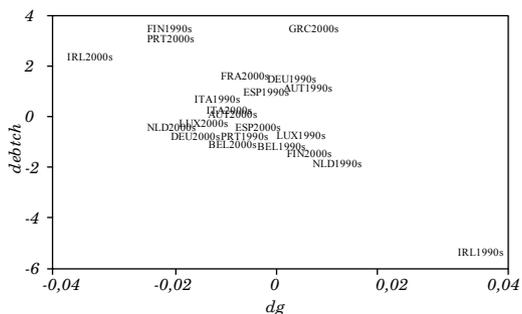
Source: See appendix. Note: Debt ratio change per annum, 1990-2000 and 2000-2010 (vertical axis), and change in growth from one decade to next, 1980-1990 to 1990-2000, and 1990-2000 to 2000-2010 (horizontal axis).[2]

Figure 3. 10-Year Moving Average GDP Growth Rate Ending in Year Shown
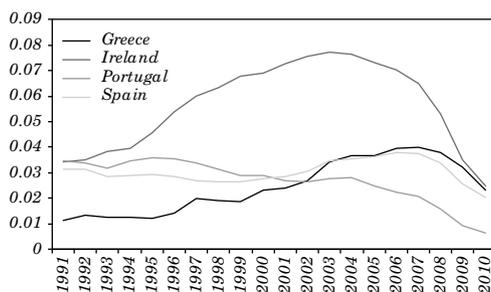
Source: See appendix.

2. The figure omits transition countries in the Eurozone because the transition featured extreme and unreliably measured changes in growth, and transition countries did not have comparable growth data for the 1980s.

3. U.S. DEBT CRISIS

Analysts of the recent crisis with U.S. government debt usually focus on large deficits in the new millennium. Did growth slowdowns have any role in the U.S., like they did for some Eurozone countries, the HIPCs, and the 1980s middle income debt crisis?

Figures 4 and 5 shed some light on that question. The acceleration of growth in the 1960s played some role in the steady decline in the U.S. federal government debt to GDP ratio from its World War II high to a low around 1970. Another similar episode (although shorter and smaller) was the decline in the debt ratio during the Clinton years as growth accelerated in the second half of the 1990s. Finally, the recent climb in U.S. debt ratio corresponds to a collapse of the U.S. growth rate in the new millennium. The 2008-2010 crisis was of course very important here, but the growth rate was already sharply decelerating during the George W. Bush years before the crisis.

Figure 4. U.S. Federal Debt to GDP
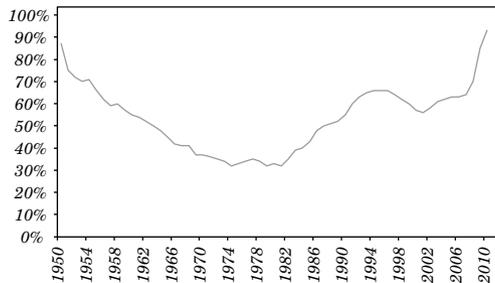
Source: See appendix.

Figure 5. U.S. Real GDP Growth, 5 Year Moving Average
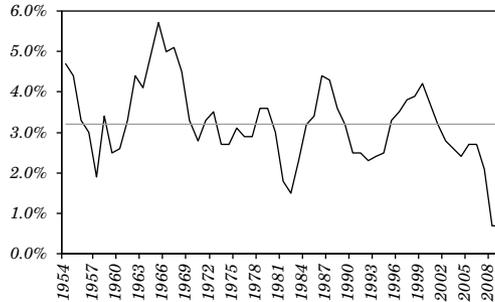
Source: See appendix. Five-year moving average ending in the year shown on horizontal axis.

4. PROBLEMS OF GROWTH PROJECTIONS AND EXPECTATIONS

If debt crises can occur partly because of a growth slowdown to which fiscal policy fails to adjust, it is particularly important to have sound growth forecasting practices. This will give as much lead time as possible to precautionary fiscal policy to avoid debt crisis. Unfortunately, we will see some suggestive evidence and anecdotes that the reverse seems to occur. As debt crises start to develop, policy makers seem to use optimistic and unrealistic growth forecasts as a way to evade fiscal adjustment.

4.1 Sound Forecasting Practices

Regression to the Mean

A well known property of growth rates both within countries and across countries is regression to the mean. Regression to the mean is not necessarily 100 percent, as there could be permanent changes in growth rates within countries and permanent growth differences between countries. However, a vast body of evidence suggests these permanent changes or differences are small relative to the total variation of growth rates, so mean reversion is quantitatively large.

To see the importance of mean reversion in the examples just discussed, the following two graphs show it within the Eurozone countries and within the U.S. alone. Both graphs show the change in growth has a negative relation to the initial growth rates. Above

average growth regress partly back towards the mean, while the below average growth regresses upward towards the mean.

Another way to state regression to the mean is there is low persistence in growth rates, and growth accelerations are temporary. This has received abundant confirmation in a wide variety of panel data sets on GDP growth rates (Easterly, Kremer, Pritchett, and Summers 1993, Hausmann, Rodrik, and Pritchett 2005).

Figure 6. Change in Decade Average GDP Growth Against Initial Decade Average Growth in Eurozone Countries, 1980-2010
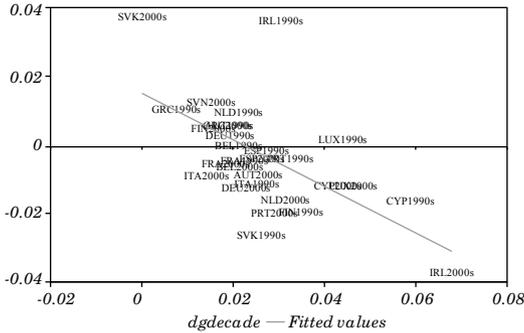
Source: See appendix. Note: Decades included are 1980s and 1990s and 2000s. Vertical axis dgdecade is the change in average growth from one decade to the next. The horizontal axis is growth in the initial decade. So for example, IRL2000s is the change in growth in Ireland from 1990-2000 to 2000-2010 on the vertical axis and the growth in Ireland for 1990-2000 on the horizontal axis.

Figure 7. Regression to the Mean in U.S. Growth Rates
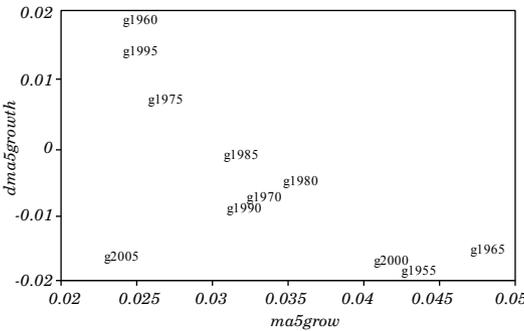
Source: See appendix. Vertical axis dma5growth is change in average U.S. growth from one five-year period to the next. Horizontal axis ma5growth is average growth in the initial five-year period.

The application of mean reversion to fiscal policy is obvious. For example, Ireland during the boom Celtic Tiger years of 7-8 percent GDP growth would have been foolish to expect these growth rates to continue indefinitely. Fiscal policy should have anticipated mean reversion at least a good part of the way back towards the Eurozone mean (as did in fact happen). Likewise, the U.S. at the end of the 1990s should not have expected the high growth of the late 1990s to continue indefinitely, and fiscal policy should have been gauged more to the U.S. long-run growth rate than to the temporarily high growth rate in the Clinton years.

Conservative Forecasts

Aside from mean reversion, countries should take into account how sensitive their debt paths are to growth slowdowns. As already suggested, countries that already have high debt are more sensitive to growth slowdowns. It makes sense that the higher is the initial debt, the more conservative should be the growth forecasts. In our examples for both the Eurozone and the U.S., the high debt countries should be more conservative about forecasts, and the U.S. should have been more conservative as the debt ratio got worse.

4.2 Actual Forecasting Practices

Mean Reversion in Growth Forecasts?

We have already seen that debt ratios rise strongly when there are growth slowdowns. Most slowdowns are the result of mean reversion (such as Portugal and Ireland in the new millennium, and the U.S. after the Clinton era boom). Hence it seems to follow that fiscal policy did not rationally anticipate the predictable mean reversion (or adjust quickly once it was already happening).

The failure to predict the predicable mean reversion could reflect at least two things: (1) the inability of politicians to engage in preemptive fiscal adjustment during the boom years, for political economy reasons, (2) the well known psychological cognitive bias that fails to anticipate mean reversion even when it is completely predictable (as confirmed in many psychology and behavioral economics experiments, beginning with the path-breaking work of Kahneman and Tversky (1973)).

More Conservative the Worse is the Debt Situation?

HIPCs

HIPCs became HIPCs because in many cases they failed to adjust to the growth slowdown. In other cases, growth played a smaller role or no role, and the HIPCs simply ran excessive deficits to accumulate high debt relative to GDP. In either case it would seem to suggest that the HIPCs would need to do fiscal adjustment along with receiving debt relief to prevent the emergence of new debt crises all over again.

However, the HIPC program was determined in part by an international political campaign to grant debt forgiveness to poor countries. This campaign applied pressure not only to forgive the debts but also to maintain the same flow of official financing to poor countries (which partly consisted of loans and not just grants), which implied NOT doing any major fiscal adjustment in HIPC countries. This would result in the emergence of new debt problems eventually. The World Bank and IMF analysts who designed HIPC debt relief packages were required to do long-run debt and growth forecasts to demonstrate that the HIPCs debt after relief was "sustainable", i.e. debt ratios would not increase again in the future.

How to reconcile these irreconcilable mandates? The answer appears in the next table: official HIPC programs prepared by IMF and World Bank staff exaggerated future growth prospects of the HIPCs. I gained access to a large database of growth forecasts in HIPC documents produced in the 1990s and early 2000s. I was also given growth forecasts made for non-HIPC countries for the same time periods by Bank and Fund staff. Now that I have access to actual growth data up through 2010, I can calculate the ex-post forecast errors (forecasterr in the regressions shown below) in both groups. There is a significant positive forecast error of HIPC countries of about 1 percentage point of growth relative to non-HIPC countries. Although many HIPC countries are in Africa, the results are not a spurious consequence of excessive optimism about Africa (there is indeed no evidence for the latter). To avoid the unpalatable expectation that debt ratios will start climbing again in the absence of fiscal adjustment in HIPCs (although from very low levels after debt forgiveness took effect in recent years), the analysts apparently resorted to high growth forecasts. A situation that called for conservative growth forecasts—countries with a long track record of fiscal mismanagement—instead generated the reverse.

Table 1. Regression of Annual Growth Forecast Errors

Variables	(1) forecasterr	(2) forecasterr	(3) forecasterr
Africa	0.145		0.605
	(0.394)		(0.367)
Hipc	0.954**	1.022***	
	(0.380)	(0.343)	
Constant	-0.0416	0.0111	0.152
	(0.307)	(0.271)	(0.298)
Observations	156	156	156
R-squared	0.055	0.054	0.018

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Source: See appendix. Note: Regression of annual growth forecast errors ("forecasterr") and dummies for HIPC countries ("hipc") and sub-Saharan Africa ("Africa"), 1995-2010.

The U.S. during the new millennium

The final story is from U.S. growth forecasts made in budget documents prepared by the executive branch. The forecast paths for U.S. per capita income (set to an index of 1 in the year 2000) became more optimistic starting in 2002 and continuing with the same optimism for the next few years. The less optimistic forecast made in early 2001 (before 2001 data itself became available) turned out to be closer to the actual, which would have been true even if the 2007-2010 crisis had not happened and growth continued on the same trend as of 2006.

What happened? Ironically, the U.S. fiscal situation became worse from 2001 to 2002. 2001 was the last in a string of federal budget surpluses, and 2002 was the first in an ever worsening string of budget deficits (again, even before the financial crisis and recession). What's more the deficits could have been anticipated as a consequence of new spending for homeland security and the war in Afghanistan (and soon after Iraq) after 9/11/01 occurred. U.S. administration budget analysts are required to project future debt

Figure 8. Growth Projections in U.S. Budgets Against Actual
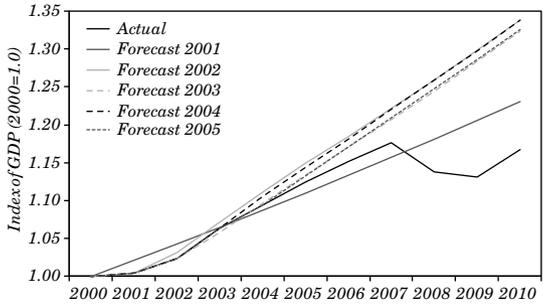
Source: See appendix.

ratios, and obviously do not want to show exploding debt to GDP. They seem to have resorted to more optimistic growth forecasts as a way of avoiding and disguising the unpalatable choice between rising federal debt to GDP and making other fiscal adjustments elsewhere in the budget to compensate for the new post-9/11 spending. Whether anybody was really fooled is another question. Perhaps politicians do not face any strong discipline to present rational expectations, since knowledge about what are reasonable growth forecasts is a public good in which voters may rationally under-invest.

The bottom line is that a worsening fiscal and debt situation should have called for more conservative growth forecasts, and that instead the opposite happened.

5. CONCLUSION

The unpleasant arithmetic of growth and public debt is that growth slowdowns call for sharp fiscal adjustments that (as in many examples shown here) politicians are unwilling or unable to make. As a result, debt crises often result in part from major growth slowdowns, a factor which has been underemphasized in the literature and in public discussion compared to the emphasis on budget deficits. This unpleasant arithmetic calls for sound forecasting of growth that acknowledges mean reversion and is more conservative the more precarious the debt situation. Unfortunately, political economy factors seems to result in analysts sometimes doing the reverse —making growth forecasts more optimistic to disguise the need for fiscal adjustment.

REFERENCES

Ashiya, M. 2007. "Forecast Accuracy of the Japanese Government: Its Year-Ahead GDP Forecast is Too Optimistic." *Japan and the World Economy* 19(1): 68–85.

Auerbach, A.J. 1994. "The U.S. Fiscal Problem: Where We are, How We Got Here, and Where We're Going." In *NBER Macroeconomics Annual*, edited by S. Fischer and J. J. Rotemberg. Cambridge, MA: National Bureau of Economic Research.

————. 1999. "On the Performance and Use of Government Revenue Forecasts." *National Tax Journal* 52(4): 765–82.

Easterly, W.R. 2001. "Growth Implosions and Debt Explosions: Do Growth Slowdowns Cause Public Debt Crises?" *The B.E. Journal of Macroeconomics* 1(1): 1–26.

————. 2013. "The Role of Growth Slowdowns and Forecast Errors in Public Debt Crises." In *Fiscal Policy after the Financial Crisis*, edited by A. Alesina and F. Giavazzi. Cambridge, MA: National Bureau of Economic Research.

Easterly, W.R., M. Kremer, L. Pritchett, and L. Summers. 1993. "Good Policy or Good Luck? Country Growth Performance and Temporary Shocks." *Journal of Monetary Economics* 32(3): 459–83.

Frankel, J. 2011a. "Over-Optimism in Forecasts by Official Budget Agencies and its Implications." *Oxford Review of Economic Policy* 27(4): 536–62.

————. 2011b. "A Solution to Fiscal Procyclicality: the Structural Budget Institutions Pioneered by Chile." *Economía Chilena* 14(2): 39–78.

Frendreis, J. and R. Tatalovich. 2000. "Accuracy and Bias in Macroeconomic Forecasting by the Administration, the CBO, and the Federal Reserve Board." *Polity* 32(4): 623–32.

Hausmann, R., L. Pritchett, and D. Rodrik. 2005. "Growth Accelerations." *Journal of Economic Growth* 10(4): 303–29.

Jonung, L. and M. Larch. 2004. "Improving Fiscal Policy in the EU: The Case for Independent Forecasts." EC Economic Paper 210.

Kahneman, D. and A. Tversky. 1973. "On the Psychology of Prediction." *Psychological Review* 80(4): 237–51.

Marinheiro, C. 2010. "Fiscal Sustainability and the Accuracy of Macroeconomic Forecasts: Do Supranational Forecasts Rather than Government Forecasts Make a Difference?" *Journal of Sustainable Economy* 3(2): 185–209.

McNab, R.M., M. Rider, and K. Wall. 2005. "Are Errors in Official U.S. Budget Receipts Forecasts Just Noise?" Andrew Young School Research Paper Series Working Paper 07–22.

Mühleisen, M., S. Danninger, D. Hauner, K. Krajnyák, and B. Sutton. 2005. "How Do Canadian Budget Forecasts Compare with Those of Other Industrial Countries?" IMF Working Paper 05/66.

Strauch R., M. Hallerberg, and J. von Hagen. 2004. "Budgetary Forecasts in Europe – The Track Record of Stability and Convergance Programs." European Central Bank Working Paper 307.

APPENDIX: DATA SOURCES

GDP Growth: for 1951-1960 from Summers-Heston or Penn World
Table, for 1961-2010 from World Bank on-line database.

Public debt: for Europe from OECD on-line database, for the rest
from World Bank on-line database. I net out foreign exchange
reserves from public external debt. The domestic debt is net of
government deposits in the banking system. Where the country
is eligible for concessional loans, I use the present value of debt
service series from the World Bank, which is an internationally
comparable measure of public external debt burden (removing
the grant element of concessional loans). The data on the
present value of publicly guaranteed external debt obligations is
constructed from the World Bank's Global Development Finance
database.

GDP Growth Forecasts: For the U.S. from the Office of Budget
and Management, while for the rest of the countries the source
is a large internal database produced by International Monetary
Fund and World Bank staff, made available to the author.

Why do Countries have Fiscal Rules?

Ibrahim Elbadawi
Dubai Economic Council

Klaus Schmidt-Hebbel
Pontificia Universidad Católica de Chile

Raimundo Soto
Pontificia Universidad Católica de Chile

Professor Vittorio Corbo, in whose honor this conference is organized, has an outstanding academic and professional career that spans teaching, research, policy making, and advice provided to the private sector, international institutions, and governments. In the latter capacity of government advisor, he served recently as Chairman of the Advisory Committee on Fiscal Policy to Finance Minister Felipe Larraín, coordinating preparation of the Committee's proposals for strengthening Chile's fiscal institutions and decade-old fiscal policy rule. The final document delivered by the Committee to Minister Larraín offers relevant and well-grounded recommendations on fiscal policy reform in Chile, which undoubtedly will be useful to other reforming countries, too (Advisory Committee on Fiscal Policy in Chile, 2011). The latter document—like many others written or led by Vittorio Corbo—is a tribute to his skills in guiding deep and productive debate among economists that hold different views, toward the goal of attaining consensus on research and policy advice.

Chile, like many other countries, is certainly not alone among countries that have adopted fiscal rules. While four countries had fiscal rules in place in 1982, many more countries have adopted rules since the 1990s, from a universe of 10 countries in 1990 to

30 in 2001 and 51 in 2009 (figure 1). Another group of 46 countries had supra-national rules in place in 2009—most of them are EU members. Countries with fiscal rules had on average 2.5 active fiscal rules in 2009.

Reforms of fiscal institutions and fiscal rules are motivated by objectives similar to those that inspired the changes in central banking. In the case of fiscal rules, the explicit objectives that motivate their adoption comprise strengthening fiscal solvency and sustainability (i.e., attaining sustainable levels of government deficits and debt), contributing to macroeconomic (or cyclical) stabilization (i.e., reducing fiscal policy pro-cyclicality or raising policy counter-cyclicality), and making fiscal policy design and execution more resilient to government corruption and private-sector lobbies (i.e., strengthening the political economy of fiscal policy decisions and budget management).

The latter objectives are shared by most fiscal policy makers worldwide. Hence why do countries adopt fiscal rules? This question boils down to identifying the conditions under which some countries do adopt fiscal rules and maintain them over time, while others do not. In particular, which political and institutional conditions are behind the decision of policy makers to tie their own hands? Are fiscal rules more likely to be associated to particular monetary and exchange-rate regimes, or to deeper financial market development and openness? Is it more likely that countries have fiscal rules in place when they exhibit stronger fiscal policy performance—or is it the opposite? Are fiscal rules more likely to be adopted by richer countries? These are the empirical questions addressed by this paper.

Yet fiscal rules are only one element of fiscal reform. Currently many countries—industrial and emerging economies alike—are designing and implementing major reforms of their institutional framework for fiscal policy. These reforms are motivated by different reasons. First, they reflect a growing global consensus among academics and policy makers about the economic benefits of procedures and rules that shape and limit planning and execution of fiscal policy. Second, they respond to the political benefits of more transparency and accountability in the exercise of fiscal policy in a democracy. Third, they respond to the failure of previous fiscal institutions and rules in many industrial countries, as is the case of the systematic violation of the fiscal rules of the Stability and Growth Pact by many member countries of the euro zone.

Figure 1. Number of Countries with Fiscal Rules
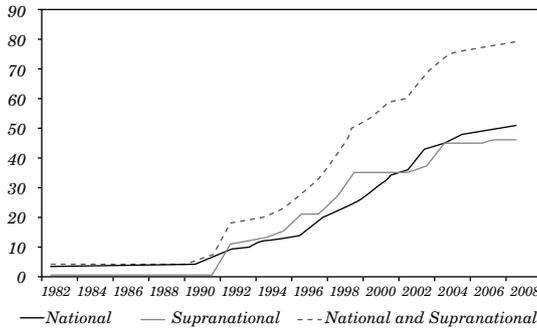
Source: International Monetary Fund (2009).

A modern institutional framework for the conduct of fiscal policy and financial management should aim at addressing the principal-agent problems that arise between voters and political authorities due to government impatience, lack of representation of future generations, electoral competition, sensitivity to special-interest lobbies, corruption, and use of asymmetric and biased information (von Hagen 2005, Wren-Lewis, 2010). To overcome these distortions and negative externalities, the academic literature and international experience suggests adopting an institutional framework for fiscal policy based on the following components (Ter-Minassian 2010, IMF 2009, Schmidt-Hebbel 2012): a fiscal responsibility law, modern financial management, a planning horizon that exceeds one year, rules for government asset and liability management, requirements on accountability and public information on the government's financial management, effective external control and auditing, and establishment of a fiscal council and/or fiscal committees—and a fiscal rule for the budget.

Reforms of fiscal institutions and adoption of fiscal rules came with a time lag following the revolution in monetary policy institutions that took place in the 1980s and 1990s, with the adoption of independent and accountable central banks conducting rule-based monetary policy under conditions of increased transparency and accountability. The reform of central banks and their monetary policy frameworks was politically motivated by the 1970s Great Inflation

and intellectually grounded in the rational expectations revolution in macroeconomics, reflected in the theoretical work in support of independent central banking and the dominance of rules over discretion (Cukierman 1992, Kydland and Prescott 1977, Barro and Gordon 1983). This radical change in central banking was pursued for objectives to raise policy effectiveness, increase economic efficiency, and strengthen democratic accountability.

Fiscal rules differ widely across countries in how they are defined. Fiscal rules include rules that set targets, ceilings or floors for the government budget balance (on overall or primary balance; on actual cyclically-adjusted balance, or multi-year balance "over the business cycle"), targets or ceilings for government debt levels, targets or ceilings for government expenditure levels (on aggregate, primary or current spending), and targets, ceilings or floors for government revenue. Target levels are set in absolute terms, as growth rates or as ratios to GDP.

Different types of rules are related to different fiscal policy objectives. One category are deficit and debt ceilings set predominantly to strengthen fiscal sustainability. A paramount example of the latter rules is the Stability and Growth Pact ceilings on government deficits (3% of GDP) and debt levels (60% of GDP) set in the 1990s for prospective euro zone member countries. Another category is comprised by fiscal rules that aim at strengthening both fiscal sustainability and counter-cyclical fiscal stabilization (or at least avoiding pro-cyclical policy bias). Ten countries had such rules in place in 2009 (IMF 2009), including Chile, which sets a yearly cyclically-adjusted balance target. Among the 10 countries, Germany, the UK, and Sweden have a fiscal rule in place that defines a numerical target for the average budget balance throughout the economic cycle.

There is a growing literature on fiscal rules, comprising descriptive and empirical papers on country and cross-country experiences, their design and institutional issues, and the fiscal, macroeconomic, growth, and welfare effects of different fiscal rules (a few examples include Debrun and Kumar 2007; IMF 2009; Ter-Minassian 2010; Anderson and Minarik 2006; Deroose, Moulin and Wierts 2006; and Maliszewski 2009).

To our best knowledge there are only two previous empirical studies that identify institutional and economic variables that explain why countries have fiscal rules in place. Calderón and Schmidt-Hebbel (2008a) estimate a model for the likelihood of having

a fiscal rule in place on an unbalanced panel dataset constructed by the authors (extending the database compiled by Kopits and Symanski 1998 and others) on fiscal rules for 75 countries (of which 24 have fiscal rules) and spanning 1975-2005. Their results (based on pooled, fixed-effect, and random effect logit estimation; and pooled and fixed-effect probit estimations) show that a larger budget balance, lower population dependency ratio, lower expenditure pro-cyclicality, and more government stability raise the likelihood of having a fiscal rule in place.

In an appendix, IMF (2009) presents some panel data results for the likelihood of adopting a fiscal rule and for having a *de jure* fiscal regime in place, using a panel dataset constructed by the IMF for 68 countries (of which two thirds have fiscal rules) and spanning 1985-2008. Results show that the likelihood of adopting a fiscal rule (based on an exponential hazard model that identifies the probability of switching to a rule in any given country and year) is raised by a higher primary budget balance and a lower public debt ratio, and is also affected by various macroeconomic performance variables. Additional results show that the likelihood of having a fiscal rule in place (based on a conditional fixed-effects logit model that identifies the probability of having a fiscal rule in any given country and year) respond to the same variables that help explaining adoption of a rule.

While its focus is also on explaining the likelihood of having a fiscal rule in place, this paper extends very significantly the two previous studies. Its specification form is much broader, focusing on five categories of potential determinants of the choice of *de jure* national fiscal rules that address the particular questions raised by us above. The sample size is larger, comprising an annual-data panel sample of 94 countries (of which 35 have adopted fiscal rules) and spanning the 1975-2008 period. Empirical estimation is performed using a battery of estimation models, chosen after a detailed discussion of econometric issues relevant to this choice. Finally, the base-line results are subject to several robustness checks, presenting alternative results for different time samples, country samples, and categories of fiscal rules (national and supra-national rules).

This paper is structured in the following way. Section 2 presents the comprehensive set of potential determinants of the decision to adopt fiscal rules, providing the broad theoretical arguments for the relevance of five categories of such correlates. Section 3 describes data and descriptive statistics, including providing detailed descriptions of the variables and empirical proxies used to account for the theoretical

determinants of the previous sections. Section 4 briefly reviews the state of non-linear panel data econometrics for discrete dependent variable in order to motivate the model selection. Section 5 analyzes the estimation results. Section 6 concludes.

1. VARIABLE SELECTION AND MODEL SPECIFICATION

The availability of data on fiscal rules is limited. The pioneering work of Kopits and Symansky (1998) has been updated and extended recently by the IMF (2009) to include the 89 countries (21 advanced, 33 emerging, and 26 low-income economies) with national and/or supra-national *de jure* fiscal rules in place in 2008, as depicted in figure 1 Using this information, countries have been classified for this paper using a binary variable that takes a value of one if the country has in place any form of national fiscal rule and zero otherwise.

The measure is arguably simplistic and it certainly does not reflect the variety of fiscal rules[1] or the degree of enforcement of rules.[2] However, coding fiscal rules is adequate to specify a behavioral model for a limited dependent variable defined as a binary random variable explained by a vector of potential determinants, making use of discrete-choice panel-data estimation methods.

There is no narrow theoretical framework that explains the choice of macroeconomic policy regimes. Hence most empirical studies of the determinants of macroeconomic regime choice is based on a narrative about objectives pursued by policy makers, (pre-) conditions that facilitate adoption of a particular regime, complementarity with regimes in other policy areas (e.g., inflation targeting and exchange rate floats) or structural features that require or facilitate adoption of a particular regime. This is the case of empirical studies

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1. As discussed in the introduction, there is a large variety or fiscal rules. We limit our empirical analysis to national (and supra-national) rules of any type.

2. Most fiscal rules do not specify escape clauses. Even those governments with *ex ante* defined escape clauses attached to their rules face sometimes situations where escape clauses do not apply but rules should be suspended—say, facing the deep 2008-2009 recession. However, with or without escape clauses, many governments have violated their fiscal rules and some of them—including several euro zone members—have incurred in recurrent, systematic violation of their national and supra-national fiscal rules. Hence enforcement of *de jure* rules varies significantly across countries and over time. However, in the absence of data on enforcement of *de jure* rules (i.e., data on *de facto* rules), we limit our statistical analysis to *de jure* fiscal rules.

of determinants of exchange-rate regimes (Levy-Yeyati and others 2010; Calderón and Schmidt-Hebbel 2008c), monetary policy regimes (Calderón and Schmidt-Hebbel 2008c, and fiscal regimes based on fiscal rules (Calderón and Schmidt-Hebbel 2008a, IMF 2009).

This paper follows the latter literature, extending significantly the two previous studies on fiscal rules. We identify five categories of potential determinants of choosing fiscal rules: political and institutional variables, fiscal policy conditions, monetary and exchange-rate regimes, financial market development measures, and the overall development level. For these categories we select the most representative variables available for each category. We match the sample of countries with fiscal rules with a larger control group of economies without fiscal rules.

1.1 Political and Institutional Variables

We identify four potential determinants of fiscal rules among political and institutional variables, and discuss their expected signs next.

Fiscal rules are very likely to be an outcome of particular political regimes and institutions. Fiscal rules—by constraining fiscal policy makers in the design and execution of the budget, in a way that is relatively transparent and subject to open monitoring—contribute to transparency, democratic accountability, less discretion, and less corruption. Therefore our first political determinant is a standard measure of democracy.

At the constitutional level, the distinction between federal and unitary government is likely to make a difference for the adoption of fiscal rules. In federal countries fiscal sovereignty of federal governments is weaker than that enjoyed by central governments in unitary countries. The large literature on fiscal federalism attests to the important differences in the conduct and outcome of fiscal policy between federal and unitary countries (Feld and Schnellenbach, 2010). We expect federal governments to be more likely to adopt fiscal rules than unitary governments because they strengthen their bargaining position with respect to the federated states or provinces.[3] Hence we include a binary dummy variable for federal governments.

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3. Federal states complement adoption of fiscal rules at the federal (or national) level with adoption of sub-national rules at state or provincial levels (IMF 2009).

There is evidence suggesting that rules reflect an implicit contract between governments and voters, that is, they signal a government commitment to maintain mutually agreed standards of fiscal discipline (Debrun and Kumar, 2007). Therefore, we include a measure of political risk and checks and balances, the Political Constraint Index.

Political instability of governments make it difficult or pre-commit to rules. Hence fiscal rules are more likely to be adopted and continued over time under conditions of government stability.[4] Hence we include a government stability measure as potential regressor.

1.2 Fiscal Policy Conditions

We identify three variables related to fiscal policy strength and conduct that may exert an influence on choosing a fiscal rule. First, we include the population dependency ratio, i.e., the ratio of under-15 and above-64 population to those in the 15-64 year range. As the ratio rises, the demands for higher government spending on social programs in support of the young and the elderly (for child-care, education, pensions, and health) rise. This makes it more difficult for government to commit to a fiscal rule, reducing the likelihood of putting them in place.

Next we include the (lagged) government budget balance as a measure of overall fiscal policy strength. We expect that a higher budget balance raises the likelihood of adopting a rule-based fiscal regime, as it is easier to adopt a disciplining device and stick to it when fiscal accounts are on a more sustainable footing (Debrun and Kumar 2007). Intrinsically well-behaved governments adopt strict rules and institutions to reveal the nature of their unobservable preferences. However, in many papers on fiscal institutions and policy outcomes the focus is on the reverse causality (from institutions to outcomes): because institutions are effective commitment devices, the fiscal outcomes are observed. It thus remains an empirical issue to determine which causality prevails—an issue outside the scope of this paper. In any case, we include the budget balance as a possible determinant of fiscal rule choice, noting its potential endogeneity.

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4. This argument is analogous to the inclusion of government stability measures as determinants of counter-cyclical fiscal and monetary policies in international panel data studies (e.g., Calderón and Schmidt-Hebbel 2008d, Calderón and others 2010).

Several explanations for the existence of pro-cyclicality in government expenditures are provided in the analytical and empirical literature. First, restricted government access to credit markets, particularly during recessions, preclude borrowing to weather temporary shocks or recessions (Gavin and Perotti 1997, Agénor and Aizenman 2000, Kaminsky and others 2004). Second, citizens in countries with corrupt governments demand less taxes and more government benefits in good times for fear that these rents will be appropriated by government officials (Alesina and Tabellini, 2005). Third, voracity effects arise from interest groups influencing government expenditure to raise their consumption more than output in response to favorable income shocks (Talvi and Végh, 2004). The recent empirical literature shows that weaknesses in political institutions and financial underdevelopment are the main determinants of fiscal pro-cyclicality in the world (Calderón and Schmidt-Hebel 2008c, Ilzetzki and Végh 2008).

We expect that governments prone to pro-cyclical government expenditure behavior are less willing to subject themselves to the discipline of a fiscal rule. Therefore we include a measure of fiscal pro-cyclicality.

1.3 Monetary and Exchange-Rate Regimes

Inflation targeting requires central banks to commit to a pre-announced, explicit target for inflation as well as developing a highly transparent set of rules for operating monetary instruments and providing information to the public. Moreover, there is significant theoretical and policy consensus that a pre-condition for the success of inflation targeting is the absence of fiscal dominance. In turn, fiscal dominance—the need to rely on central bank resources (ultimately seigniorage)—is more unlikely when a government commits to a fiscal rule.

Minea and Villieu (2009) develop a theoretical model whereby inflation targeting provides an incentive for governments to improve institutional quality in order to enhance tax revenue performance.[5] Testing of this model by Lucotte (2010), using propensity score matching, indicates that in thirteen emerging countries inflation targeting has a significant positive effect on public revenue collection.

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5. The result requires monetary policy to be set in advance of fiscal effort to collect taxes. In our case, this requirement is empirically valid: no country in the sample initiated national fiscal rules prior to setting up inflation targeting.

Hence we include a discrete variable for the countries where monetary policy is based on an inflation targeting regime. We expect that inflation targeting regime raises the likelihood of having a fiscal rule in place.

While there is literature that links the choice of exchange rates to fiscal performance, it focuses on the impact of government deficits and public debt levels on the success of fixed, intermediate, and floating exchange rates. The conventional view (e.g., Giavazzi and Pagano (1988) and Frenkel and others (1991), among others) is that pegs provide more fiscal discipline than floats. If governments adopt a lax fiscal policy under a fixed exchange rate, this would lead to a speculative attack on reserves and consequently to currency devaluation. Because the eventual collapse of the peg would imply a large political cost for the policy maker, fixed regimes impose discipline on fiscal authorities.

However, political economy arguments provide the opposite rationale. Tornell and Velasco (2000) stress that under reasonable conditions (linked to uncertainty of government about their re-election and lack of access to capital markets), more fiscal discipline is attained under floats, where fiscal mismanagement leads to devaluation and inflation in the short-term. Under pegs, unsustainable fiscal policy leads to higher debt and lower reserves in the short term, postponing the costs of devaluation and inflation to the future.

Hence we include as a second policy regime measure a binary variable for a fixed exchange-rate regime. Considering the arguments of the preceding literature, its effect on the likelihood of having a fiscal rule in place is ambiguous.

1.4 Financial-Market Development Variables

Financial-market development could have a positive influence on the likelihood of having fiscal rules in place through two channels. First, both domestic financial development and stronger integration into world capital markets raise government access to domestic and external debt financing and subjects governments to closer scrutiny of fiscal sustainability by financial market analysts and rating agencies. This strengthens the case for adopting fiscal rules that commit governments to a course of fiscal prudence and solvency. Second, if domestic financial markets are deeper and integration into world capital markets is full and comprehensive, governments will be more likely to access domestic or external funding during cyclical

downturns. This reinforces government adoption of fiscal rules that minimize fiscal pro-cyclicality or strengthen fiscal counter-cyclicality.

Therefore we include one variable that reflects domestic financial development and another variable that measures international financial integration or openness as potential determinants of having fiscal rules in place.

1.5 Overall Development Level

Finally, we control for the overall level of development, for which we use per-capita GDP in real terms (US$ of 2000). Much of the literature has focused on the reverse causality, i.e., on the impact of fiscal rules on economic growth (Castro 2011). Here we focus on the reverse causality from the level of development to the likelihood of having a fiscal rule in place. This hypothesis embodies the stylized fact that governments in richer economies have more human and financial resources available to undertake the complex task of implementing, monitoring, and evaluating operation of a fiscal rule.

2. Data and Descriptive Statistics

Next we describe the empirical measures chosen for our dependent variable and the ten variables selected as potential determinants. We also present summary information about the variables, their distributions and correlations in graphical and tabular form. Appendix table A.1 provides more detail on data definitions and sources, while appendix table A.2 contains a country list showing adoption of fiscal rules, inflation targeting and federal system.

Our dependent variable is the binary measure for a *de jure* fiscal rule that includes 89 countries and covers the period from 1975 to 2008, compiled by IMF (2009). We code national rules and supra-national rules separately. Most of our empirical analysis is conducted for national rules only, but we use national and supra-national rules for conducting sensitivity analysis.

Our first political and institutional variable is a measure of democracy: the democracy and Polity 2 indices of the Polity IV project. Then we include a binary dummy variable for federal governments (1 for federal governments, 0 otherwise). In this paper we use a *de jure* definition of a country as federal or unitary. In most cases the *de jure* classification matches the *de facto* fiscal structure; in a few

cases, like Spain, the country is *de jure* unitary, but one could argue that its fiscal structure is so decentralized that it resembles *de facto* a federal structure.

As measure of political checks and balances, we use the Political Constraint Index (POLCON-V), developed originally by Henisz (2000) and later refined and extended by Henisz and Zelner (2010). It is is a quantitative measure of the institutional constraints faced by authorities, reflecting the extent to which a political actor or the replacement for any one actor (e.g., the executive or a chamber of the legislature) is constrained in his or her choice of future policies.

An alternative to the latter is the index developed by the World Bank in its database of Political Indicators (CHECKS2a), which counts the number of veto players in a political system, adjusting for whether these veto players are independent of each other, as determined by the level of electoral competitiveness in a system, their respective party affiliations, and electoral rules (Beck and others, 2001). Checks rank countries from 1 (low) to 6 (high). While the CHECKS2a index takes into account the complex relations between veto points, party preferences, and preference heterogeneity, it also assumes a linear relationship between the number of adjusted veto points and the degree of constraints on policy change. Similarly, the number of adjusted veto points increases linearly in parliamentary systems with each addition of a party to the ruling coalition without regard to the relative size of the parties in the coalition. The Political Constraint Index (POLCON-V) overcomes these limitations. The pair wise correlation between both measures of political checks and balances is 68%.

As a measure of government stability we use the corresponding International Country Risk Guide (ICRG) Index.

Now let us turn to fiscal condition variables. We use the standard population dependency ratio determined by a country's population structure (share of the population between 15 and 64 years old). For the budget balance we use the general government balance on a cash basis. Our third fiscal variable is a measure of government pro-cyclicality. Here most of the literature on cyclical behavior of fiscal policy has focused on cross-section models, for which time correlations in preceding periods can be used for measuring the degree of government spending pro-cyclicality. For our panel-data model, we need a time-varying instrument. We compute a rolling-window correlation between detrended data on government consumption and GDP. Data were detrended using the Hodrick-Prescott filter with the optimal smoothing parameter suggested by Ravn and Uhlig (2002).

The pro-cyclicality measure is computed subsequently as a rolling correlation of three, five, and ten periods.

For monetary and exchange-rate regimes, we use a binary variable for countries under an inflationtargeting and another binary variables under a fixed exchange-rate regime. On classification of countries according to their adherence to inflation targeting, there is no difference between *de facto* and *de jure* regimes, and little disagreement among different sources on the dating of the start of inflation targeting. This is in contrast with classification of exchange-rate regimes, which are either *de facto* or *de jure*. Following the recent literature, we use the *de facto classification*. Our binary variable is for fixed exchange-rate regimes (encompassing monetary union, dollarization, and currency boards) with a value of one, and other regimes (intermediate and floating exchange rates) with a value of zero. Because our interest is mainly on institutions, we consider as fixed exchange-rate systems only dollarization, currency boards, and monetary unions. To account for (unlikely) mutual causation between these extreme and largely institutional fixed exchange-rate regimes and fiscal rules, we use lagged values in the regressions.

Our first financial-market development variable is domestic financial development, for which we use a standard measure: the outstanding stock of domestic bank credit to the private sector as a ratio to GDP.

The second dimension is international financial integration or openness, for which we use the measure developed by Chinn and Ito (2008). Choosing between ex-post measures of financial integration (such as foreign asset ratios to GDP) and ex-ante policy measures, we prefer the latter for reasons of consistency with other policy measures included among regressors.

Finally, we follow the standard measure of overall development, which is real per-capita GDP at market prices (expressed in US$ of 2000).

Potential endogeneity of our independent variables to having a fiscal rule in place should not be a significant concern because countries either adopt once and then for the full remaining sample period or do not adopt at all a fiscal rule. However, in order to address in some way possible residual endogeneity, we use lagged values for several variables that may be affected by the contemporaneous choice of a fiscal rule, namely capital account openness, government balance ratio to GDP, fixed exchange-rate regime, dependency ratios and GDP per capita.

We summarize country information for our sample of three key variables: starting sates of national and supra-national fiscal rules, classification of countries by constitutional federal governments, and starting dates of inflation targeting. While fiscal rules were started in the 1970s (as reflected by figure 1), inflation-targeting regimes started around 1990.

Table 1 reports descriptive statistics for the dependent and all independent variables for the sample period 1975-2008. While the number of available observations for all variables is around 3,000, there are missing data for some countries and years (in particular in the 1970s) so that the effective sample used in the econometric analysis is around 2,200 observations. It can be seen that around 16% of the sample corresponds to observations of countries employing fiscal rules. Likewise, in around 9% of the years, countries had conducted monetary policy using inflation-targeting schemes while in another 24% of the cases, countries had relinquished monetary policy by having fixed exchange-rate regimes. The coefficient of variation of each variable indicates that heterogeneity is notorious among several control variables, including those representing political aspects (democracy, federalism) and fiscal policies (government budget balances and pro-cyclicality of government expenditures).

Table 1. Descriptive Statistics

	Obser-vations	Mean	Standard Deviation	Coefficient of Variation	Range
Fiscal Rule	3,026	0.158	0.365	2.306	[0,1]
Checks and Balances	2,855	0.451	0.328	0.727	[0,0.9]
Democracy	2,871	2.690	7.382	2.744	[-10,10]
Federalism	3,026	0.169	0.374	2.221	[0,1]
Government Stability	2,798	7.344	2.125	0.289	[1,11]
Dependency Ratio	2,937	-0.413	0.277	-0.671	[-1.08, 0.12]
Government Budget	2,434	-0.058	0.412	-7.089	[-13.4,0.23]
Pro-cyclicality Gov. Expend.	2,840	0.168	0.554	3.293	[-0.99,0.99]
Fixed-Exchange Rate	2,781	0.242	0.428	1.772	[0,1]
Inflation Target	3,026	0.090	0.286	3.189	[0,1]
Capital Account Openness	2,823	0.272	1.586	5.836	[-1.84, 2.48]
Financial Development	2,810	3.562	0.877	0.246	[-0.38, 5.55]
GDP per capita	2,807	7.897	1.543	0.195	[4.81, 10.65]

Source: Authors' calculation.

Table 2. Correlations, 1975-2008

	Checks and Balances	Democracy	Federalism	Government Stability	Dependency Ratio	Government Budget	Pro-cyclicality Gov. Expend	Fixed-Exchange	Inflation Target	Capital Acc. Openness	Financial Develop.	GDP per capita
Checks and Balances	1.000											
Democracy	0.605	1.000										
Federalism	0.231	0.175	1.000									
Government Stability	0.386	0.204	0.076	1.000								
Dependency Ratio	0.630	-0.470	-0.154	-0.400	1.000							
Government Balance	-0.014	-0.030	0.022	0.048	0.047	1.000						
Pro-cyclicality Gov. Expend.	-0.136	-0.059	-0.021	-0.136	0.172	0.021	1.000					
Fixed-Exchange	0.258	0.183	0.066	0.142	-0.328	-0.129	-0.078	1.000				
Inflation Target	-0.186	-0.173	-0.070	0.005	0.179	0.027	-0.015	-0.175	1.000			
Capital Acc. Openness	0.435	0.304	0.104	0.319	-0.530	-0.024	-0.171	0.216	0.035	1.000		
Financial Development	0.472	0.193	0.199	0.287	-0.654	0.019	-0.144	0.261	-0.026	0.480	1.000	
GDP per capita	0.620	0.439	0.220	0.341	-0.790	0.003	-0.143	0.274	-0.133	0.555	0.712	1.000

Source: Authors' calculation.

Table 2 presents a matrix with simple correlations between all variables. In general, variables tend to display very low correlation, in particular when comparing political and economic fundamentals. Among political variables, there is only a relatively high correlation between democracy and political checks and balances—which to some extent is expected—but neither variable is highly associated with having federal or stable governments. Among economic variables, there is very little correlation between fiscal variables (dependency ratio, fiscal balances and the pro-cyclicality of government expenditures) and a positive—yet unsurprising— correlation between the degree of development (measure by GDP per capita) and the two variables representing financial development and integration to international capital markets. Across these groups of variables, there is minor evidence that higher development levels are positively correlated with higher degrees of checks and balances.

3. ESTIMATORS AND ECONOMETRIC ISSUES

The econometric literature on panel data models has progressed substantially in the last half-century. The properties of the parametric estimators in linear models are well understood, at least for the popular cases of the fixed-effects, random-effects and mixed (or two-way) estimators. Their performance under different conditions (sample size, endogeneity, misspecification, error-correlation, sampling, etc.) has been widely explored from both analytical and empirical viewpoints (Wooldridge, 1995).

The conventional practice indicates that in static linear models, fixed-effects estimators are preferred to random-effects estimators when the effects are correlated with other regressors. However, the random-effects estimator is more parsimonious, requiring only one additional parameter to be estimated (namely, the variance of the distribution of random effects), and hence it is preferred in the absence of correlation between effects and control variables.[6]

The properties of estimators in non-linear panel data models, in particular for discrete variables, are less developed and therefore

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6. Time dependency in disturbances can only be modeled using the random-effects estimator; fixed effects estimators are biased (Nickell, 1981). Fully dynamic models taking into account complex dynamic patterns require estimation using instrumental variables procedures to account for the endogeneity of pre-determined variables.

substantial issues remain unsolved (Greene, 2009). The current consensus view about the choice of fixed versus random effects in linear models does not carry through to non-linear models. In the general case of the fixed-effects estimator for discrete data models, the incidental parameter problem (Neyman and Scott, 1948) leads to estimator bias when the time dimension T is fixed, even when the cross-section dimension tends to infinity ($N \to \infty$). In simple terms, the estimator for the included control variables depends on the estimator of the fixed effects and the latter is only consistent when $T \to \infty$.[7] Consider the general fixed-effects model:

$$f\left(y_{it} \mid x_{it}, x_{it}, \ldots, x_{it}\right) = g\left(y_{it}, \beta x_{it} + \alpha_i, \theta\right), \tag{1}$$

where y is the variable of interest, x are exogenous control variables, α is the individual effect, β is the vector of slope coefficients, and θ is an ancillary parameter (e.g., scale parameter or dispersion of disturbances). The log likelihood function for a sample of size (N,T) is:

$$\log L = \Sigma_{i=1}^{N} \Sigma_{i=1}^{T} \log g\left(y_{it}, \beta x_{it} + \alpha_i, \theta\right). \tag{2}$$

Maximization of equation (2) to obtain the maximum likelihood (*ML*) estimators is complicated by the fact that the first-order conditions conform to a set of non-linear equations and therefore estimates are obtained by numerical approximation.

The incidental parameter problem arises from the fact that, in general, the estimator of the parameters of interest (say, $\hat{\beta}_{it}$) will depend on the estimator of the individual effects ($\hat{\alpha}_i$). Assume that β and θ were known. Then the estimator of α_i would use the T_i observations for each individual. Only when T converges to ∞, the estimator of $\hat{\alpha}_i$ converges to the population parameter and it allows the estimators $\hat{\beta}_{it}$ to also converge. However, for fixed T, the latter will be generally biased. The size of the bias diminishes relatively rapidly in T, so that Heckman (1981) suggests that biases are negligible for $N=100$ and $T=8$.

However, for the particular case when y is a binary variable and the cumulative distribution function of $g(.)$ in equation (1) is

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7. Linear models avoid this problem by virtue of the Frisch-Waugh theorem (which separates estimation of the parameters of interest from estimation of the fixed effects) and recover the individual effects using the individual mean, which is a sufficient statistic for the effect.

the logistic distribution, the incidental parameter can be avoided altogether if one focuses on the conditional logit estimator. As noted in Greene (2001), in any group where the sample of the dependent variable is comprised by either all 1s or all 0s, there is no ML estimator for α_i—the likelihood equation for *log Li* has no solution if there is no within-group variation in y_{it}. However, conditional upon observing such variation, the *ML* estimator can be obtained: by focusing on the distance between control variables before and after such variation, the fixed effects cancel out as they do in the linear model. Note, however, that this procedure eliminates a potentially large number of observations. The conditional estimator is consistent, so it bypasses the incidental parameter problem. However, it does have a major shortcoming (Greene 2009). By avoiding the estimation of the fixed effects it precludes computation of the partial effects or estimates of the probabilities for the outcomes. After all, there is no way to tell if an individual has any value of α_i if he does not change his behavior. Therefore this approach limits the analyst to infer only about β.[8]

The fixed-effects probit model, on the other hand, has not been widely used because *ML* estimators are biased and difficult to implement computationally. As noted by Maddala (1987), the conditional *ML* method does not produce computational simplifications as in the logit model because the fixed effects do not cancel out. This implies that all *N* fixed effects must be estimated as part of the estimation procedure. This also implies that, since the estimates of the fixed effects are inconsistent for small *T*, the fixed-effects probit model yields inconsistent estimates for β as well. Greene (2001) disputes the computation intractability of the probit fixed-effect model but he acknowledges the inconsistency of the estimator.[9]

Thus, in applying the fixed-effects estimator to panel-data models with discrete dependent variables, the conditional logit model seems to be the preferred choice. Nevertheless, one should bear in mind that the conditional logit estimator requires strict exogeneity of the

8. There is an extensive literature on semi-parametric and GMM approaches for some panel data models with latent heterogeneity (Honoré, 2002). Among the practical limitations of these estimators is that although they provide estimators of the primary slope parameters, they usually do not provide estimators for the full set of model parameters and thus preclude computation of marginal effects, probabilities or predictions for the dependent variable.

9. The estimator is biased upward, but the bias declines relatively fast. For a sample of 20 observations and in the case of a single scalar regressor, the fixed-effects probit estimator is biased upward by around 4% ($\pi/80$).

regressors and stationarity over time (it cannot, at least in principle, accommodate heteroskedasticity over time in the latent model).[10] As these conditions are frequently violated in economic data, the random-effects estimator is an attractive alternative. For panel data, the probit model is computationally tractable while the logit model is not.[11]

For the random-effects estimator, equation (1) is modified to acknowledge the fact that individual effects (μ_i) come from realizations of a density function $f(\mu_i)$. The complete model is then:

$$f\left(y_{it},\mu_i \mid x_{it},x_{it},\ldots,x_{it}\right) = g\left(y_{it},\beta x_{it},\mu_i,\theta\right).$$
$$f\left(\mu_i\right) = h(\mu_i \mid \theta). \tag{3}$$

One can safely assume that in static models, conditional on μ_i, the T_i observations in each group are independent. This allows us to write the joint distribution of the y_{it} observations and the μ_i individual effects as:

$$f\left(y_{it},\mu_i \mid x_{it},x_{it},\ldots,x_{it},\beta,\theta\right) = f\left(y_{it} \mid x_{it},x_{it},\ldots,x_{it},\mu_i,\beta,\theta\right)f\left(\mu_i\right)$$
$$= {}_1^{Ti}\, g\left(y_{it},\beta x_{it},\mu_i,\theta\right)h(\mu_i \mid \theta). \tag{4}$$

In order to form the likelihood function for the observed data, μ_i must be integrated out. The assumption that the individual effects follow a normal distribution—the essence of the probit model—allows for the tractability that is missing in the logit case. The log likelihood function becomes:

$$\log L = \sum_{i=1}^{N}\log\left[\int_{\mu}\Pi_1^{Ti}\, g\left(y_{it},\beta x_{it},\mu_i,\theta\right)h\left(\mu_i \mid \theta\right)d\mu_i\right]. \tag{5}$$

Several methods are available to maximize the probit likelihood function (Hermite quadrature, exact integration, and simulated maximum likelihood). These methods are useful but they are also computationally cumbersome. Quadrature operates effectively when

10. The conditional *ML* estimator for the logit model is inconsistent if the conditional independence assumption fails (Kwak and Wooldridge, 2009).

11. According to Wooldridge (2009) some headway has been made in obtaining bias-corrected versions of fixed-effects estimators for non-linear models but these new methods have several practical shortcomings.

the dimension of the integral is small—as in our case—but not with higher dimensions.

In general, the probit model imposes the restriction that the correlation between successive error terms for the same individual is a constant (defined in the literature as the "equicorrelation" model). The only limitation of probit models is that they require normal distributions for all unobserved components, a feature that may characterize most unobserved, random components but that is notoriously absent in cases where variables are truncated (e.g., incomes or prices must be positive).

In summary, the econometric literature on limited dependent variable in non-linear panel data models has not yet reached the point where researchers can confidently identify the strengths and weaknesses of the different estimators. In general, random-effects probit models and conditional fixed-effects logit models tend to be preferred to other estimators when, as in our case, both N and T are relatively large.

The analysis undertaken below is econometrically rigorous. However, it is subject to limitations. In particular, because economic theory cannot guide the econometric specification, there is a possibility that omitted variables may exert a joint influence on the decision to implement fiscal rules and build institutions, suggesting a causal linkage while institutions would just be proxies for those omitted determinants of fiscal rules.

The general specification of our regression model for the likelihood of having a fiscal rule in place is as follows:

$$y_{it} = \alpha_i + \beta x_{it} + \varepsilon_{it}, \tag{6}$$

where y_{it} is a vector of discrete-choice country-year observations for a fiscal rule (a dummy that takes a value of 1 for having a fiscal regime in place, 0 otherwise), x_{it} is the matrix of country-year observations for the 12 explanatory variables that were introduced in the previous section, α is a vector of individual country effects that reflect unobservable country heterogeneity, β is a vector of slope coefficients that are common to all countries, and ε is a vector of error terms.

We estimate equation (6) making use of pooled-data probit and logit, random-effects probit, and conditional fixed-effects probit estimators.

4. ECONOMETRIC RESULTS

Following the conceptual framework regarding the choice of a fiscal regime (the likelihood of having a fiscal regime in place) and the detailed discussion of the corresponding econometric issues, now we turn to our estimation results of pooled logit and probit as well as random-effects probit and fixed-effect logit models. As discussed above we confine ourselves to the random-effects probit model because its fixed-effects counterpart produces a biased estimator, even asymptotically. On the other hand, the estimates of the random-effects logit model are difficult to interpret because the estimated coefficients are characterized by a mixed of distributions, normal (for the error) and logistic (for the fundamentals).

The results of the pooled-data regressions are reported in table 3. The results lend strong support to the conceptual framework discussed above. However, we do not pursue further discussion of the pooled regression results because they do not account for country heterogeneity, which we find to be present in our sample. According to likelihood-ratio tests reported in tables 5 to 10, the data strongly reject the null hypothesis of country homogeneity in all cases.

Hence we focus on random-effects probit and conditional fixed-effects logit models, starting with full sample regressions of table 4. Our unbalanced panel comprises the full 1975-2008 sample period and up to 89 countries, as long as data is available. Of course, sample size differs considerably across the two models (at most 941 country-year observations for fixed-effect estimations, compared to more than 2,250 for random-effect estimations). The treatment group (comprised by up to 37 countries) is the same under fixed and random effects—it includes all country-year observations of countries with a fiscal regime since their starting dates. In fixed-effects conditional logit models, the full sample is reduced to 34 countries because three countries have had fiscal rules through the entire period and the conditional estimator only uses information from countries that switched regimes. In contrast, in random-effects models the treatment group includes the 37 countries with fiscal rules and the 52 non-fiscal regime countries. We should, therefore, be mindful of the large differences in overall sample size when contrasting the results of the two models.

The results in table 4 provide strong evidence in support of our priors. Moreover, the evidence is generally robust across fixed-effects and random-effects estimations, notwithstanding their large sample

differences. However, the results of the conditional fixed-effects logit model are less robust for the capital account openness and the fixed exchange-rate regime, since this model accounts only for the country years close to the regime change (such as the switch from fixed to flexible exchange-rate regimes or from closed to open capital accounts). Moreover, due to the smaller sample size under fixed effects, multicollinearity appears to be affecting some variables, such as financial development, pro-cyclicality of government expenditure, and GDP per capita.

Now we turn to discuss the results by category of variables. Institutional and political variables (democracy, federalism, checks and balances, and government stability) are robustly significant for most regressions under the two models.[12] As expected, having fiscal rules is likely to be associated with democratic regimes, federal governments, strong political checks and balances, and stable governments. While democracy is an important determinant of fiscal rules, checks and balances tend to have an independent and even stronger effect. This is important because democracy, which mainly measures the competitiveness of the political process, may not necessarily promote strong checks and balances (figure 2). In particular, the high democracy-low checks and balances quadrant of the figure contains a few Latin American countries that have experienced democracy for some time now, yet failed to develop strong system of political checks and balances.

Second, among all categories of determinants, fiscal conditions are the most obvious correlates of fiscal rules. In fact, they are found to be empirically significant in the decision of having fiscal rules in place. Countries with high shares of young and old people are less likely to opt for a fiscal rule, reflecting the large (and typically rising) government liabilities due to government spending programs on the young and the old. Countries running fiscal surpluses are more likely to adopt fiscal rules. Both effects tend to be highly significant and robust to the choice of the estimating model. However, our first fiscal policy condition, government spending pro-cyclicality, was found to be uniformly non-significant under the random-effects model and in regression 3 of the fixed-effects model (which excludes GDP per capita to alleviate multicollinearity). Although the theoretical case

12. However, the time-invariant federal dummy is dropped from the fixed-effects model. Also in the random-effects model government stability turns to be significant only when removing the financial development variable.

for inclusion of spending pro-cyclicality appears to be compelling, it does not seem to have a significant influence on fiscal rules.

In the category of monetary and exchange-rate regimes, we find that inflation-targeting countries are more likely to adopt fiscal rules—a result that is found to be robust under both models. Fixed exchange-rate regimes are also found to be positively associated with fiscal rules under the random-effects model, and in regression 6 of the conditional fixed-effect model. These findings lend support to the view that inflation-targeting countries, and to a lesser extent those with a fixed exchange-rate regime, have stronger incentive to adopt fiscal rules.

Our results are mixed for the two variables reflecting financial-market development. Domestic financial development was generally not found to be significant. However, open capital accounts are positively associated with fiscal rules under the random-effects probit model and in regression 6 of the conditional fixed-effects logit regression.

Finally, per-capita GDP, the proxy of economic development, is also positively and robustly associated with fiscal rules under both models. This result suggests that, controlling for all other determinants that were discussed above, the richer countries are more likely to adopt and stick to fiscal rules, possibly because they have in place the institutional and human-resource capabilities that are required for abiding successfully to fiscal rules.

We conclude that our priors about potential determinants are largely confirmed by the main results reported in table 4. Our preferred results are those reported by regression 3. There we find four political and institutional variables, two fiscal-policy conditions, two monetary and exchange-rate regime variables, one financial-market development variable, and overall development are significantly robust determinants of the choice of fiscal rules. Only two variables are not robustly significant determinants of fiscal rules: government spending pro-cyclicality and domestic-financial development.

Table 3. Base-Case Results for National Fiscal Rules: Pooled-Data Probit and Logit Models, 1975-2008

	(1)	(2)	(3)	(4)	(5)	(6)
	Logit Models			*Probit Models*		
Checks and Balances	1.87***	1.96***	2.07***	1.06***	1.14***	1.20***
	(0.40)	(0.39)	(0.37)	(0.22)	(0.22)	(0.21)
Democracy	0.03**	0.03**	0.03**	0.02**	0.02**	0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Federalism	0.66***	0.62***	0.60***	0.43***	0.41***	0.40***
	(0.16)	(0.16)	(0.16)	(0.09)	(0.09)	(0.09)
Government Stability	0.11***	0.10***	0.10***	0.06***	0.06***	0.07***
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)
Dependency Ratio	-3.00***	-2.80***	-2.67***	-1.63***	-1.52***	-1.42***
	(0.46)	(0.44)	(0.38)	(0.25)	(0.24)	(0.21)
Government Budget	0.57**	0.56**	0.55**	0.34***	0.34***	0.33***
	(0.24)	(0.24)	(0.24)	(0.14)	(0.14)	(0.14)
Pro-cyclicality Gov. Expenditures	0.43***	0.37***	0.38***	0.23***	0.21***	0.21***
	(0.12)	(0.12)	(0.12)	(0.07)	(0.07)	(0.07)
Fixed-Exchange Rate	0.23	0.16	0.14	0.13	0.09	0.06
	(0.17)	(0.17)	(0.17)	(0.10)	(0.09)	(0.10)
Inflation Target	1.60***	1.60***	1.60***	0.96***	0.96***	0.96***
	(0.18)	(0.17)	(0.18)	(0.10)	(0.10)	(0.10)
Capital Account Openness	0.75***	0.74***	0.73***	0.41***	0.41***	0.40***
	(0.06)	(0.06)	(0.06)	(0.03)	(0.03)	(0.03)
Financial Development	-0.16			-0.11		
	(0.12)			(0.07)		
GDP per capita	-0.01	-0.06		-0.01	-0.04	
	(0.09)	(0.09)		(0.05)	(0.03)	
Constant	-3.50***	-3.50***	-3.85***	-1.95***	-1.97***	-2.18***
	(0.62)	(0.59)	(0.33)	(0.32)	(0.32)	(0.18)
Observations	2,190	2,213	2,215	2,190	2,213	2,215
Countries	89	89	89	89	89	89
Without fiscal regime	52	52	52	52	52	52
With fiscal regime	37	37	37	37	37	37
LR statistic	610.95	618.35	617.77	618.75	625.97	625.28
Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Log Likelihood	-718.95	-735.02	-735.71	-715.05	-731.21	-731.95

Source: Authors' estimations.

Table 4. Main Results for National Fiscal Rules: Random-Effects Probit and Conditional Fixed-Effects Logit Models, 1975-2008

	(1)	(2)	(3)	(4)	(5)	(6)
	Random-Effects Probit			Conditional-Fixed Effects Logit		
Checks and Balances	4.04***	4.07***	3.29***	10.24**	8.88**	7.84**
	(0.81)	(1.10)	(0.91)	(5.89)	(4.10)	(4.02)
Democracy	0.24***	0.14**	0.24***	0.94***	0.78***	0.75***
	(0.05)	(0.06)	(0.06)	(0.34)	(0.30)	(0.30)
Federalism	5.09***	1.98**	3.41***	-	-	-
	(0.61)	(1.11)	(0.67)			
Government Stability	0.15***	0.16***	0.19***	-0.04	0.08	0.05
	(0.06)	(0.06)	(0.05)	(0.20)	(0.18)	(0.18)
Dependency Ratio	-19.55***	-26.49***	-19.15***	-151.76***	-138.31***	-133.9***
	(1.55)	(2.71)	(2.15)	(32.32)	(28.06)	(26.22)
Government Budget	3.84***	3.02	3.60**	-0.14	-0.09	-0.10
	(0.84)	(2.62)	(1.11)	(1.57)	(1.38)	(1.33)
Pro-cyclicality Gov. Expenditures	0.10	0.14	-	-1.43***	-0.94*	-
	(0.16)	(0.16)		(0.68)	(0.57)	
Fixed-Exchange Rate	2.15***	1.85***	2.09***	-0.46	0.44	0.71
	(0.35)	(0.41)	(0.35)	(1.30)	(1.23)	(1.30)
Inflation Target	1.87***	1.90***	1.82***	5.33***	3.95***	3.94***
	(0.31)	(0.35)	(0.29)	(1.35)	(1.06)	(1.04)
Capital Account Openness	0.59***	0.46***	0.56***	0.44	0.88	0.94*
	(0.14)	(0.17)	(0.14)	(0.66)	(0.58)	(0.53)
Financial Development	0.03	-	-	-5.50***	-	-
	(0.26)			(1.67)		
GDP per capita	2.96***	7.02***	2.54***	66.92***	48.28***	45.25***
	(0.40)	(0.36)	(0.37)	(11.43)	(8.35)	(7.66)
Constant	-39.66***	-85.19***	-38.62***	-	-	-
	(2.47)	(2.46)	(1.97)			
Observations	2,190	2,213	2,252	932	941	941
Countries	89	89	89	89	89	89
Without fiscal regime	52	52	52	55	55	55
With fiscal regime	37	37	37	34	34	34
LR statistic	863.91	944.40	907.28	839.52	844.45	843.69
Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Log Likelihood	-283.09	-259.00	-293.47	-38.41	-45.75	-47.29

Source: Authors' estimations.

Figure 2. Scatter of Political Variables, Average 1975-2009
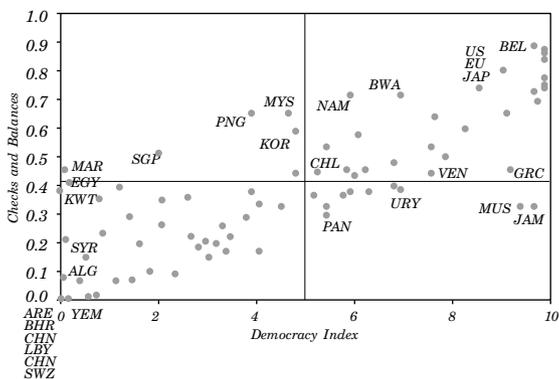
Sources: Henisz and Zelner (2010); Integrated Network for Societal Conflict Research.

4.1 Robustness Checks

Next we undertake three robustness checks, including against shorter time period; smaller sample comprised of advanced countries only; and an alternative concept of fiscal rule that combines both national and supranational rules. We find that our results are not affected under the shorter period, where the estimated individual effects remain remarkably simila—in terms of sign, order of magnitudes and degree of significance (table 5). However, for the other two robustness checks some variables turned insignificant, which in our view, reveal some interesting insights (tables 6 and 7).

For the advanced country regressions, the estimation of the pooled[13] logit and probit regressions reveal two interesting results (table 6). First, democracy, checks and balances and government stability were no longer significant. Second, government budget balance and dependency ratio were also uniformly insignificant. These results suggest that, within this group, there are little variations in these variables; hence they cannot be a factor in explaining the adoption decision. However, variables, such as inflation target, federalism and GDP per capita, that tend to exhibit sufficient variations across the advanced group of countries, retain their significance as determinants of the fiscal rules decision.

13. We used pooled regressions because country heterogeneity is not likely to be important for this sample and sample size would reduce too much (only 22 countries).

Table 5. Alternative Results for National Fiscal Rules and Smaller Time Sample: Random-Effects Probit and Conditional Fixed-Effects Logit Models, 1990-2008

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Random-Effects Probit			*Conditional-Fixed Effects Logit*		
Checks and Balances	5.13***	5.28***	4.22***	8.84**	8.25**	10.04***
	(1.18)	(1.40)	(1.05)	(4.76)	(4.11)	(3.54)
Democracy	0.29***	0.35***	0.30***	0.92***	0.77***	0.98***
	(0.06)	(0.12)	(0.05)	(0.32)	(0.30)	(0.32)
Federalism	2.78***	3.22***	3.43***	-	-	-
	(1.03)	(0.95)	(0.90)			
Government Stability	0.27***	0.28***	0.24***	0.05	0.13	0.61***
	(0.06)	(0.07)	(0.06)	(0.20)	(0.19)	(0.15)
Dependency Ratio	-18.87***	-21.96***	-19.95***	-133.1***	-140.9***	-78.9***
	(2.37)	(2.56)	(2.47)	(28.73)	(28.92)	(11.54)
Government Budget	2.47*	2.80*	3.07*	-0.16	-0.07	8.17***
	(1.45)	(1.71)	(1.63)	(1.37)	(1.35)	(7.86)
Pro-cyclicality Gov. Expenditures	-0.05	-0.09	-	-1.40**	-1.00*	0.04
	(0.18)	(0.19)		(0.65)	(0.59)	(0.37)
Fixed-Exchange Rate	2.33***	2.44***	2.33***	0.06	0.15	5.19***
	(0.40)	(0.42)	(0.39)	(1.36)	(1.19)	(0.93)
Inflation Target	1.47***	1.59***	1.56***	3.54***	3.14***	2.93***
	(0.38)	(0.39)	(0.38)	(1.37)	(1.19)	(0.83)
Capital Account Openness	0.39***	0.38**	0.37**	0.25	0.79	1.00***
	(0.16)	(0.17)	(0.16)	(0.64)	(0.58)	(0.42)
Financial Development	0.52	-	-	-4.97***	-	-
	(0.37)			(2.10)		
GDP per capita	0.25	0.98**	0.88***	57.91***	46.90***	-
	(0.55)	(0.41)	(0.45)	(11.58)	(8.75)	
Constant	-19.98***	-27.81***	-24.97***	-	-	-
	(2.62)	(2.21)	(2.49)			
Observations	1,380	1,392	1,409	564	570	570
Countries	89	89	89	89	89	89
Without fiscal regime	55	55	55	55	55	55
With fiscal regime	34	34	34	34	34	34
LR statistic	599.20	613.19	609.62	466.85	468.59	386.41
Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Log Likelihood	-261.32	-260.24	-272.69	-39.19	-42.99	-84.09

Source: Authors' estimations.

Table 6. Alternative Results for National Fiscal Rules in Advanced Economies: Pooled-Data Probit and Logit Models, 1975-2008

	(1)	(2)	(3)	(4)	(5)	(6)
	Conditional-Logit Models			Random-Effects Probit Models		
Checks and Balances	-76.42 (144.79)	54.06 (72.32)	-32.99 (23.68)	6.20 (12.89)	3.99 (7.00)	6.20 (12.89)
Democracy	12.73 (34,388)	11.41 (16025)	14.25 (3,512)	0.13 (0.20)	0.19 (0.33)	0.129 (0.20)
Federalism	-	-	-	-4.72** (2.05)	-4.50*** (1.66)	-4.72** (2.05)
Government Stability	-0.65 (0.50)	-0.31 (0.37)	0.44 (0.18)	0.10 (0.14)	0.14 (0.13)	0.10 (0.14)
Dependency Ratio	-133.94 (98.57)	-67.85 (69.33)	-25.86 (13.02)	-12.00 (11.64)	-12.89 (11.60)	-12.00 (11.64)
Government Budget	-47.52 (37.50)	-50.05 (32.54)	17.49 (11.36)	1.42 (6.87)	0.77 (7.00)	1.42 (6.87)
Pro-cyclicality Gov. Expenditures	-3.69* (1.90)	-3.87** (1.78)	0.55 (0.46)	-0.02 (0.33)	-0.05 (0.33)	-0.02 (0.33)
Fixed-Exchange Rate	12.92 (6,871)	10.80 (1,809)	21,83 (1,132)	2.30** (1.17)	2.84** (1.17)	2.30** (1.17)
Inflation Target	5.18* (2.66)	4.18* (1.93)	4.93*** (1.09)	1.98** (0.79)	2.30** (0.65)	1.98** (0.79)
Capital Account Openness	0.60 (3.32)	0.05 (2.47)	2.43*** (0.70)	1.57*** (0.60)	1.27** (0.61)	1.57*** (0.60)
Financial Development	-3.58 (8.13)	-	-	1.34 (1.15)	-	-
GDP per capita	140.37*** (46.80)	135.75*** (41.20)	-	14.59*** (1.48)	14.96*** (1.19)	-
Constant	-	-	-	-170.72*** (14.58)	-167.84*** (12.83)	-170.72*** (14.58)
Observations	415	422	422	632	640	2,215
Countries	22	22	22	22	22	22
Without fiscal regime	8	8	8	8	8	8
With fiscal regime	14	14	14	14	14	14
LR statistic	422.76	438.60	345.51	240.79	248.79	753.43
Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Log Likelihood	-12.32	-13.48	-60.04	-86.94	-89.74	-889.56

Source: Authors' estimations.

Table 7. Alternative Results for National and Supra-National Fiscal Rules: Random-Effects Probit and Conditional Fixed-Effects Logit Models, 1975-2008

	(1)	(2)	(3)	(4)	(5)	(6)
	Random-Effects Probit			*Conditional Fixed-Effects Logit*		
Checks and Balances	0.70	0.51	0.49	1.85	-2.66	0.04
	(0.74)	(0.75)	(0.72)	(2.08)	(1.95)	(1.69)
Democracy	0.20***	0.20***	0.20***	0.47***	0.44***	0.53***
	(0.04)	(0.04)	(0.04)	(0.13)	(0.12)	(0.13)
Federalism	-4.37***	-4.30***	0.92	-	-	-
	(1.06)	(1.41)	(0.91)			
Government Stability	0.22***	0.23***	0.22***	0.24**	0.30***	0.51***
	(0.05)	(0.05)	(0.05)	(0.11)	(0.11)	(0.10)
Dependency Ratio	-21.03***	-21.17***	-21.69***	-66.25***	-71.3***	-59.7***
	(2.08)	(1.64)	(3.25)	(9.66)	(9.61)	(6.22)
Government Budget	0.57	0.55	0.54	0.02	-0.03	0.80
	(0.43)	(0.42)	(0.42)	(1.43)	(1.24)	(0.85)
Pro-cyclicality Gov. Expenditures	-0.11	-0.10	-	-0.33	-0.31	0.08
	(0.14)	(0.14)		(0.31)	(0.31)	(0.25)
Fixed-Exchange Rate	2.00***	1.92***	1.94***	1.55	1.58*	5.22***
	(0.39)	(0.38)	(0.43)	(0.98)	(0.96)	(0.85)
Inflation Target	2.45***	2.38***	2.35***	4.79***	4.35***	4.52***
	(0.34)	(0.32)	(0.35)	(0.90)	(0.83)	(0.64)
Capital Account Openness	0.74***	0.74***	0.75***	0.91***	0.98***	1.82***
	(0.12)	(0.12)	(0.13)	(0.30)	(0.30)	(0.26)
Financial Development	-0.25	-	-	-1.96**	-	-
	(0.26)			(0.78)		
GDP per capita	2.61***	2.46***	2.38***	25.13***	21.83***	-
	(0.38)	(0.38)	(0.54)	(3.26)	(2.74)	
Constant	-36.00***	-35.72***	-35.34***	-	-	-
	(1.83)	(2.08)	(2.80)			
Observations	2,189	2,213	2,252	1,210	1,219	1,219
Countries	89	89	89	89	89	89
Without fiscal regime	40	40	40	43	43	43
With fiscal regime	49	49	49	46	46	46
LR statistic	938.18	973.86	907.28	1082.29	1091.87	973.85
Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Log Likelihood	-396.16	-398.79	-293.47	-108.21	-111.90	-170.91

Source: Authors' estimations.

Finally, for the alternative concept of fiscal rules that combines both national and supranational ones (table 7), all previously significant variables (under the national fiscal rules concept of table 4) remain so, except for two variables: checks and balances and the government budget balance. Again, we would argue, this in our view is an interesting finding. It seems that the broadening of the fiscal rules concept to include a supranational component has diluted the link between these two variables and the decision process. While under monetary unions fiscal rules act like a mechanical eligibility criteria for member countries; neither checks and balances nor were budget balances rigorously enforced. Evidence abounds from recent experiences of the EU, CFA, and Mercosur.

5. CONCLUSIONS

The 1990s ushered the world not only into a democracy wave, following the collapse of the former Soviet Union, but also a wave of fiscal rules, where the number of countries adopting this fiscal regime steadily rose from only 10 in 1990 to reach 97 in 2009, including 46 with supra-national rules in place, mostly from EU members. This paper, therefore, asks the all important research and policy question as to why do countries adopt fiscal rules?

In this context the paper contributes to a small nascent literature, comprised of only two previous studies, by significantly extending the analytical framework for analyzing the potential determinants of the choice of *de jure* national fiscal rules. We provide detailed theoretical arguments for five sets of potential determinants spanning political institutions; fiscal policy conditions; monetary and exchange-rate regimes; financial market development and overall development. On view of the overlap between the two democratic and fiscal waves this paper's most notable contribution to the literature, we would argue, should be the introduction of democracy and political checks and balance as two pivotal institutional determinants, which were not accounted for by the received literature.

Moreover, aside from significantly expanding the sample, this paper briefly reviews the state of non-linear panel data econometrics for discrete dependent variable in order to motivate the model selection process—from a menu of random-fixed and logit-probit sets of regression models, in a literature that is largely in a state of flux and, therefore, mired with many unresolved econometric issues.

Though naturally such literature would not offer definitive guidance on the strengths and weaknesses of the different estimators, our review broadly suggests that random-effects probit models and conditional fixed-effects logit models should be preferred to other estimators in our case, given the relatively large sample size we have on both the time series and cross-sectional dimensions. The regression results of both models strongly corroborate the prediction of the paper's conceptual framework.

We find that in the full sample that includes developed and developing countries all variables are robustly significant determinants of fiscal rules, except for government spending pro-cyclicality and domestic financial development. Thus we broadly corroborate earlier findings in the received literature, but more importantly we also find that the new variables are robustly associated with the adoption of fiscal rules. For example, for the monetary and exchange-rate regime variables, our results suggest that inflation-targeting countries, and to a lesser extent those with a fixed exchange-rate regime, have stronger incentive to adopt fiscal rules. And with regard to the financial market variables, we find that open capital account economies, rather than those with financially developed ones per se, are likely to also have fiscal rules in place.

Perhaps the most important finding of this paper relates to the role of political institutions, which were all (democracy, federalism, checks and balances, and government stability) found to be robustly significant.

However, it is interesting to note that while democracy is an important determinant of fiscal rules, checks and balances tend to have an independent and even stronger effect. Moreover, except for fiscal federalism all other three political variables are not significant when only developed countries are included in the regressions, which reflect the lack of large variations on these variables for this particular group of countries. Instead, the key determinants of the adoption of fiscal rules for these countries are inflation target, federalism and GDP per capita. Furthermore, when we broaden the concept of fiscal rules to include both national and supra-national ones, checks and balances and the government budget balance cease to be significant. Again, as we argue above the broadening of the fiscal rules concept might have diluted the role of these two factors due to the fact that under monetary unions fiscal rules act like a mechanical eligibility criteria for member countries; while neither checks and balances nor budgetary discipline were rigorously enforced as the recent country experiences make clear.

References

Advisory Committee on Fiscal Policy in Chile. 2011. "Propuesta para Perfeccionar la Regla Fiscal." Unpublished manuscript, Ministry of Finance of Chile.

Agénor, P. and J. Aizenman. 2000. "Savings and the Terms of Trade Under Borrowing Constraints." NBER Working Paper 7743.

Alesina, F. and G. Tabellini. 2005. "Why is Fiscal Policy Often Procyclical?" Discussion Paper 2090, Harvard Institute of Economic Research.

Anderson, B. and J. Minarik. 2006. "Design Choices for Fiscal Policy Rules." Paper for OECD Working Party for Senior Budget Officials GOV/PGC/SBO 4.

Arellano, M. and S. Bond. 1991. "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *Review of Economic Studies* 58(2): 277–97.

Barro, R. and D. Gordon. 1983. "Rules, Discretion and Reputation in a Natural Rate Model of Monetary Policy." *Journal of Monetary Economics* 12(1): 101–21.

Beck, T., G. Clarke, A. Groff, P. Keefer, and P. Walsh. 2001. "New Tools in Comparative Political Economy: The Database of Political Institutions." *World Bank Economic Review* 15(1): 165–76.

Calderón, C. and K. Schmidt-Hebbel. 2008a. "The Choice of Fiscal Regime in the World." Working Paper 487, Central Bank of Chile.

————. 2008b. "What Drives the Choice of Inflation Targets in the World." Unpublished manuscript, Central Bank of Chile.

————. 2008c. "Business Cycles and Fiscal Policies: The Role of Institutions and Financial Markets." Working Paper 481, Central Bank of Chile.

Chang, Y. 2003. "Non-linear IV Panel Unit Root Tests." Unpublished manuscript, Department of Economics, Rice University.

Chinn, M. and H. Ito. 2008. "A New Measure of Financial Openness." *Journal of Comparative Policy Analysis* 10(3): 307–20.

Cukierman, A. 1992. *Central Bank Strategy, Credibility, and Independence: Theory and Evidence*. Cambridge, MA: MIT Press.

Debrun X. and M. Kumar. 2007. "The Discipline-Enhancing Role of Fiscal Institutions: Theory and Empirical Evidence." Working Paper 07/171, International Monetary Fund.

Deroose, S., L. Moulin, and P. Wierts. 2006. "National Expenditure Rules and Expenditure Outcomes: Empirical Evidence for EU Member States." *Wirtschaftspolitische Blaetter* 1: 27–42.

Feld, L. and J. Schnellenbach. 2010. "Fiscal Federalism and Long-Run Macroeconomic Performance: A Survey of Recent Research." *Environment and Planning C: Government and Policy* 29(2): 224–43.

Frenkel, J., M. Goldstein, and P. Masson. 1991. "Characteristics of a Successful Exchange Rate System." Washington, DC: International Monetary Fund.

Gavin M. and R. Perotti. 1997. "Fiscal Policy in Latin America." In NBER *Macroeconomics Annual 12*, edited by B. Bernanke and J. Rotemberg. Cambridge, MA: MIT Press.

Gengenbach, C., F. Palm, and J. Urbain. 2008. "Panel Unit Root Tests in the Presence of Cross-Sectional Dependencies: Comparison and Implications for Modelling." *Econometric Reviews* 29(2): 111–45.

Giavazzi, F. and M. Pagano. 1988. "The Advantage of Tying One's Hands: EMS Discipline and Central Bank Credibility." *European Economic Review* 32(5): 1055–75.

Greene, W. 2001. "Fixed and Random Effects in Non-linear Models." Working Paper EC-01-01, Department of Economics, Stern School of Business, New York University.

————. 2009. "Discrete Choice Modeling." In *Handbook of Econometrics vol. 2, Applied Econometrics*, edited by T. Mills and K. Patterson. London: Palgrave.

Heckman, J. 1981. "Statistical Models for Discrete Panel Data" In *Structural Analysis of Discrete Data with Econometric Applications*, edited by C. Manski and D. McFadden. Cambridge, MA: MIT Press.

Henisz, W. and B. Zelner. 2010. "Measures of Political Risk Database." Unpublished manuscript, The McDonough School of Business, Georgetown University.

Hlouskova, J. and M. Wagner. 2006. "The Performance of Panel Unit Root and Stationarity Tests: Results from a Large Scale Simulation Study." *Econometric Reviews* 25 (1): 85–116.

Honoré, B. 2002. "Non-linear Models with Panel Data." *Portuguese Economic Journal* 1(2): 163–79.

Ilzetzki, E. and C. Végh. 2008. "Pro-cyclical Fiscal Policy in Developing Countries: Truth or Fiction?" NBER Working Paper 14191.

Im, K., M. Pesaran, and Y. Shin. 2003. "Testing for Unit Roots in Heterogeneous Panels." *Journal of Econometrics* 115(1): 53–74.

International Monetary Fund. 2006. "Inflation Targeting and the IMF." Unpublished manuscript, Monetary and Financial Systems Department, Policy and Development Review Department, and Research Department.

————. 2009. "Fiscal Rules – Anchoring Expectations for Sustainable Public Finances." Unpublished manuscript, Fiscal Affairs Department.

Kaminsky, G., C. Reinhart, and C. Végh. 2004. "When it Rains, it Pours: Procyclical Capital Flows and Macroeconomic Policies." NBER Working Paper 10780.

Kopits, G. and S. Symansky. 1998. *Fiscal Rules*. Washington, DC: International Monetary Fund.

Kwak, D. and J. Wooldridge. 2009. "The Robustness of the Fixed Effects Logit Estimator to Violations of Conditional Independence." Unpublished manuscript, Michigan State University Department of Economics.

Kydland, F. and E. Prescott. 1977. "Rules rather than Discretion: The Inconsistency of Optimal Plans." *Journal of Political Economy* 85(3): 473–92.

Levy-Yeyati, E., F. Sturzenegger, and I. Reggio. 2010. "On the Endogeneity of Exchange Rate Regimes." *European Economic Review* 54(5): 659–77.

Lucotte, Y. 2010. "Adoption of Inflation Targeting and Tax Revenue Performance in Emerging Market Economies: An Empirical Investigation." *Economic Systems* 36(4): 609–28.

Maddala, G. 1987. "Limited Dependent Variable Models Using Panel Data." *Journal of Human Resources* 22(3): 307–38.

Maliszewski, W. 2009. "Fiscal Policy Rules for Oil-Producing Countries: A Welfare-Based Assessment." Working Paper WP/09/126, International Monetary Fund.

Minea, A. and P. Villieu. 2009. "Can Inflation Targeting Promote Institutional Quality in Developing Countries?" Unpublished manuscript, University of Auvergne.

Neyman, J. and E. Scott. 1948. "Consistent Estimates Based on Partially Consistent Observations." *Econometrica* 16(1): 1–32.

Nickell, S. 1981. "Biases in Dynamic Models with Fixed Effects." *Econometrica* 49(6): 1417–26.

Ravn, M. and H. Uhlig. 2002. "On Adjusting the Hodrick-Prescott Filter for the Frequency of Observations." *Review of Economics and Statistics* 84(2): 371–75.

Reinhart, C. and K. Rogoff. 2004. "The Modern History of Exchange Rate Arrangements: A Reinterpretation." *Quarterly Journal of Economics* 119(1): 1–48.

Schmidt-Hebbel, K. 2012. "Fiscal Policy for Commodity Exporting Countries: Chile's Experience." In *Commodity Price Volatility and Inclusive Growth in Low-Income Countries*, edited by R. Arezki, C.A. Patillo, M. Quintyn, and M. Zhu. Washington, DC: International Monetary Fund.

Ter-Minassian, T. 2010. "Preconditions for a Successful Introduction of Structural Fiscal Balance-Based Rules in Latin America and the Caribbean: a Framework Paper." Discussion Paper IDB-DP-157, Inter-American Development Bank.

Tornell, A. and A. Velasco. 2000. "Fixed versus Flexible Exchange Rates: Which provides More Fiscal Discipline?" *Journal of Monetary Economics* 45(2): 399–436.

Von Hagen, J. 2005. "Political Economy of Fiscal Institutions." Discussion Paper 149, Governance and the Efficiency of Economic Systems, Free University of Berlin, Humboldt University of Berlin, University of Bonn, University of Mannheim, and University of Munich.

Wooldridge, J. 1995. "Selection Corrections for Panel Data Models under Conditional Mean Independence Assumptions." *Journal of Econometrics* 68(1): 115–32.

————. 2009. "Correlated Random Effects Models with Unbalanced Panels." Unpublished manuscript, Department of Economics, Michigan State University.

World Bank. 2011. *World Development Indicators 2010*. Washington, DC: World Bank.

Wren-Lewis, S. 2010. "Comparing the Delegation of Monetary and Fiscal Policy." Economics Series Working Paper 540, Economics Series, Department of Economics, University of Oxford.

APPENDIX

Table A.1 Data Definition and Sources

Variable	*Definition*	*Source*
Fiscal Rules	Defined as a fiscal rule is defined as a permanent constraint on fiscal policy through simple numerical limits on budgetary aggregates.	Kopits and Symanski (2008) and International Monetary Fund (2009).
Dependency Ratio	Population between 15 and 64 years of age as share of total population.	Variable SP_POP_1564_TO_ZS World Development Indicators (WDI) by the World Bank (2011).
Real Income per capita	GDP per capita in constant 2000 US$.	Variable NY_GDP_PCAP_KD World Development Indicators (WDI) by the World Bank (2011).
Government Budget Balance	Cash surplus/deficit (% of GDP).	Variable GC_BAL_CASH_GD_ZS World Development Indicators (WDI) by the World Bank (2011), complemented by data from country authorities (ministries and central banks) to fill missing information.
Pro-cyclical government expenditures	Five-year rolling correlation of HP- filtered final consumption expenditures of General government (constant 2000 US$) to HP-filtered GDP (constant 2000 US$).	Variables NE_CON_GOVT_KD and NY_GDP_MKTP_KD World Development Indicators (WDI) by the World Bank (2011).
Financial Development	Domestic credit to private sector (% of GDP).	Variable FS_AST_PRVT_GD_ZS World Development Indicators (WDI) by the World Bank (2011).

Table A.1 (continued)

Variable	Definition	Source
Political Risk and Checks and Balances	Political Constraint Index (POLCON-V), quantitative measure of the institutional constraints faced by authorities. It ranks countries from 0 (high) to 1 (low).	Originally by Henisz (2000) and later refined and extended by Henisz and Zelner (2010).
Democracy	Democracy and Polity 2 indices of the Polity IV.	Developed by Integrated Network for Societal Conflict Research (INSCR).
Government Stability	ICRG Index.	Obtained from the WDI 2010.
Inflation Targeting	Dummy variable: 1 if the central bank operates formally an inflation targeting scheme and 0 otherwise.	Calderon and Schmidt-Hebbel (2008) and own updates using data from the reports at http://www.centralbanknews.info/p/inflation-targets.html
Capital Account Openness	KAOPEN measure, based on binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).	Chinn and Ito (2008), updated by the authors to 2009.
Exchange Rate Regime	Fixed exchange systems include dollarization, currency boards, and monetary unions. Any other system is not considered as fixed regime.	Reinhart and Rogoff (2004) *de facto* classification, extended to 2009 using IMF country reports.
Federalism	Dummy variable = 1 if the country defines itself formally as a federal entity.	Information from Forum of Federations web page.

Table A.2 Fiscal Rules, Federalism, and Inflation Targeting

	Fiscal Rules		Federal country	Inflation Targeting
	National	Supra-nat.		
Angola	2005			
Ant & Barb.		1998		
Argentina	2000		1	
Australia	1998		1	1993
Austria	1999	1995	1	
Belgium		1992	1	
Benin		1999		
Botswana	2003			2008
Brazil	2000		1	1999
Bulgaria	2003			2007
B. Faso		1999		
Cameroon		1996		
Canada	1991		1	1991
Cape Verde	1998			
CAF		1996		
Chad		1996		
Chile	2000			1991
Colombia	1997			2000
Comoros	2001		1	
Congo, Rep.		1996		
Costa Rica	2001			
Coted'Ivoire		1999		
Cyprus		2003		
Czech Rep.	2005	2004		1998
Denmark	1992	1992		
Dominica		1998		
Ecuador	2003			
Estonia	1993	2004		
Finland*	1999	1995		1993
France	1998	1992		
Gabon		1996		

Table A.2 (continued)

	Fiscal Rules		Federal country	Inflation Targeting
	National	Supra-nat.		
Germany	1975	1993	1	
Ghana				2007
Greece		1992		
Grenada		1998		
G.-Bissau		1999		
Hong Kong	1997			
Hungary	2007	2004		2002
Iceland	2004			2001
India	2003		1	
Indonesia	1975			2005
Ireland		1992		
Israel	1992			1992
Italy		1992		
Japan	1975			
Kenya	1997			
Korea, Rep.				1998
Latvia		2003		
Lithuania	1997	2004		
Luxembourg	1990	1992		
Madagascar	2006			
Mali		1999		
Malta		2004		
Mauritius	2008			
Mexico	1975		1	1999
Namibia	2001			
Netherlands	1994	1992		
New Zealand	1994	1994		1990
Niger		1999		
Nigeria	2004		1	
Norway	2001			2001
Pakistan	2005		1	

Table A.2 (continued)

	Fiscal Rules		Federal country	Inflation Targeting
	National	Supra-nat.		
Panama	2002			
Peru	2000			2002
Philippines				2002
Poland	1997	2004		2004
Portugal	2002	1992		
Romania		2007		2005
Senegal		1999		
Singapore	1991			
Slovak Rep.		2004		2005
Slovenia	2001	2004		
South Africa			1	2000
Spain*	2003	1992		1995
Sri Lanka	2003			
St. Kitts Nevis		1998	1	
St. Lucia		1998		
St. Vincent		1998		
Sweden	1996	1995		1993
Switzerland	2003		1	2000
Thailand				2000
Togo		1999		
Turkey				2006
UAE			1	
United Kingdom	1997	1992		1992
Venezuela	1999		1	

Notes: Dates reported for fiscal rules and for inflation targeting are the years when the corresponding regimes were started. (*) Finland and Spain had inflation targeting schemes but abandoned them when joining the euro. Sources: See Appendix Table A.1.

Exchange Rate, Structural Fiscal Balance, and Copper Price: A Puzzle

Patricio Rojas
Rojas y Asociados

Félix Berríos
Rojas y Asociados

Chile's exchange rate shows a strong volatility to copper price fluctuations. This correlation is essentially because copper is our main export product, therefore increases in the price of copper imply higher returns from copper export volumes, both for private and the state-owned mining company Codelco. However, from the early 2000s, the Chilean state has used a concept of structural balance for its public accounts, defining ex ante a copper price in order to formulate its budget spending. Thus, increases above this price should not have a significant impact on the peso-U.S. dollar parity, since most of the surplus revenue from higher copper prices would be saved overseas. Furthermore, in general, private mining companies do not bring into the country additional surplus revenues obtained from copper prices higher than what had been in their budget forecasting.

In short, the structural balance rule for fiscal accounts should significantly have reduced the volatility of the real and nominal exchange rate, especially since 2003, period where copper prices have been on an upward trend (only temporarily interrupted by the 2008 crisis).

However, evidence shows that nominal parity continues to be affected by changes in copper price, even when agents know that these additional foreign currencies will not enter the country. This could probably be because credibility in the rule is not total and agents consider that the government may not acknowledge their commitment and would enter these revenues to finance a more significant expenditure. Even though this is a feasible explanation, we believe that enforcement of this rule for more than ten years should significantly reduce the importance of this channel to explain the evidence.

Another alternative explanation could be that an increase in copper prices is an indicator that forecasts a better domestic and global economic outlook; on one hand, this would imply that other goods exported by the country, in terms of prices and demands, would improve and, on the other, that domestic agents would feel wealthier, increasing their future demand and, consequently, domestic spending which would most likely cause a monetary policy reaction by raising interest rates. In this context, a fiscal rule would have eliminated (or significantly reduced) the direct effect caused by higher copper prices on the nominal exchange rate, breaking the direct relationship with a higher currency settlement, but an indirect channel would have been produced (or intensified) that related copper prices to the general expectations for the Chilean economy.

The objective of this paper is to analyze this puzzle that causes the strong relationship between nominal exchange rate movements and copper price movements, when in theoretical terms it should not occur if there is a fiscal rule such as the one implemented by Chile since 2000. In this context, this paper is organized as follows. Section 2 includes a review of the real exchange rate equilibrium level (RER) concept and a review of empirical literature on RER determinants in Chile. In particular, the effect the application of this fiscal rule has on RER empirical estimates. Section 3 includes the empirical analysis of the real exchange rate faced with the implementation of the fiscal rule. Section 4 analyzes the relationship between the nominal exchange rate, the price of copper and the fiscal rule. Finally, Section 5 presents the conclusions.

1. RER Theoretical Aspects and its Equilibrium Level

In a small and open economy such as the Chilean economy, the real exchange rate (RER) is one of the most important relative prices of the economy; therefore its movements cause reallocation of resources and spending between the different sectors. Particularly, RER changes encourage activity to be directed towards the domestic or foreign market and/or towards tradable or non-tradable sectors.

However, it is worth noting that the relative price movement appropriate for the efficient allocation of resources is one that is consistent with its equilibrium level and, therefore, is a clear medium-run sign for production agents. In fact, it is this equilibrium level—that does not

necessarily coincide with the short-run level observed —which indicates where the resources of an economy should be moved to; this situation should organize and prioritize the different sector investments. On the contrary, sustain RER deviations from its equilibrium level may result in severe inefficiencies and macroeconomic disequilibria, and its correction tends to be extremely high.[1] Furthermore, history has shown that prolonged or recurrent real exchange rate misalignments have also involved low economic growth rates.

More specifically, the most important reasons to avoid real exchange rate deviations from its equilibrium value are based on microeconomics and macroeconomics costs that cause significant misalignments. From a microeconomic perspective, when the exchange rate is misaligned, it does not provide an appropriate guide to allocate productive resources and spending on foreign and domestic goods. From a macro perspective, when economic agents perceive a severe deviation, the expectations generated are that its value will be adjusted in the future to reach equilibrium through important variations in the nominal exchange rate. For example, an overvaluation of the local currency discourages local agents from holding domestic currency assets, which is a potential source of reversal of capital flows and exchange crisis.

In brief, it is crucial for both an efficient use of resources and making private decisions to analyze real exchange rate performance, basically because it is, in terms of an equilibrium level, a key price of the economy and it affects the profitability of the tradable sector. Furthermore, by establishing the fundamental variables that explain real exchange rate movements, future economic policy actions directed at modifying such fundamentals can be established as well as the real exchange rate level.

1.1 Determination of the Equilibrium Real Exchange Rate

It is not easy to determine the real exchange rate considered to be in equilibrium (ERER) because ERER represents an endogenous

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1. In general, currency would be overvalued (or undervalued) in real terms if the current real exchange rate is below (above) the equilibrium real exchange rate. A significant undervaluation of the real exchange rate (overvaluation of the domestic currency) it is usually considered an indicator of a potential future balance-of-payments crisis, while an overvaluation is usually a sign of higher future inflation.

variable that is not observable. However, its calculation is fundamental because it represents the rule against which RER fluctuations are calculated.

Economic literature has for several decades addressed this subject. Cassel (1922) put forward that the exchange rate should fluctuate so that it counteracts inflation rate movements related to the different currencies. This would convert purchasing power parity (PPP) into the first ERER measure, but, as will be described below, it would not be exempt from criticism.

Subsequently, Nurkse (1945) defined the exchange rate around an ideal condition of the economy. According to him, the equilibrium real exchange rate must be defined as: "the value of the real exchange rate compatible with the external and internal equilibrium objectives, given determined values of "other variables" that may influence these objectives." External equilibrium refers to a sustainable external capital inflow in order to finance the current account deficit of the balance of payments; while internal equilibrium refers to a non-tradable goods market in a sustainable equilibrium. This definition would originate what would later be known as the macroeconomic approach of the real exchange rate (made popular by Williamson, 1983 and 1994), that specifically defines ERER as the real exchange rate consistent with the simultaneous attainment of internal and external equilibrium of the economy.

Edwards (1989) defined equilibrium of the real exchange rate as: the relative price of tradable goods to non-tradable goods, for given sustainable values (of equilibrium) of other relevant variables— such as taxes, international prices and technology—simultaneously produces internal and external equilibrium. Internal equilibrium means that the non-tradable goods market is cleared during the current period, and it is expected to continue balanced in the future. It is implicit in this definition of equilibrium real exchange rate that equilibrium occurs when unemployment is at its natural rate. External equilibrium is attained when the intertemporal budget constraint is met, whereby the sum discounted from a country's current account balances must equal zero. In other words, external equilibrium means that current account balances (current and future) are consistent with the capital flows sustainable in the long run.

In turn, Edwards states that certain implications that arise from these concepts: (i) the equilibrium real exchange rate is not immutable. When there are changes in any of the variables that

affect the internal and external equilibrium, the real exchange rate must also vary. Hence, the real exchange rate required to attain equilibrium will vary, for instance, with global price movements of a country's main export product; with import tariffs; export taxes; real interest rate and capital controls. He calls these immediate determinants "real exchange rate fundamentals." (ii) There is not just "one" equilibrium real exchange rate, but a path of real equilibrium exchange rates through time. (iii) The temporal path will be affected not only by current values of the fundamentals, but also by "its expected future evolution," i.e., the economic agent's expectations.

In brief, equilibrium real exchange rate (ERER) definitions include, explicitly or implicitly, their conception of relative price of internationally tradable and non-tradable goods and make reference to *sustainability* as a necessary condition for real exchange rate equilibrium, therefore, the concept has, in general, a long-run nature. This in turn implies the existence of what is known in economic literature as *gap* or *misalignments of the* real exchange rate, i.e., the difference between current or observed real exchange rate and long-run sustainable or equilibrium real exchange rate.

1.2 ERER Modeling Strategies

According to Clark and MacDonald (1999), the real exchange rate (q_t) is determined by a series of economic variables and random shocks. Certain economic variables may have permanent effects on the RER level and other only a temporary effect. Hence, RER may be defined as follows:

$$q_t = \beta Z_t + \theta T + \xi_t, \tag{1}$$

where Z_t is a vector of economic variables or fundamentals that explain medium- and long-run RER behavior and T_t represents a temporary variable vector that have a short-run effect on RER. On the other hand, ε_t is random shocks, while β and θ represent coefficient vectors.

In the medium run, the equilibrium real exchange rate will be defined as consistent with the economy's internal and external balance. Hence, ERER does not include random shocks or temporary variables; then, using the hat symbol denotes medium-run variables, ERER would be:

$$\hat{q}_t = \beta \hat{Z}_t. \tag{2}$$

To calculate the different equilibrium RER, a formal structure is required, for which different theoretical models have been developed. The three most used paradigms to analyze long-run RER are: purchasing power parity (PPP), RER level consistent with a sustainable current account deficit and a full employment rate (internal and external equilibrium, known as FEER) and the empirical relationship between the exchange rate and its theoretical fundamentals (BEER).

It is important to note that despite all the approaches being susceptible to criticism, each one delivers a diagnosis on RER evolution and its eventual misalignment from its medium- and long-run equilibrium level. In line with the latest research undertaken in this area, concerning the Chilean economy, in our empirical analysis we will use an approach based on a reduced form of a model that explains the effective real exchange rate model over a specific sampling period. In this reduced form, the RER depends on the medium- and long-run macroeconomic fundamentals, as well as on short-run temporary factors.

This approach includes natural ERER (NATREX) and trend RER (BEER), providing a stock and flow dynamic analysis where key real exchange rate determinants are identified. Both models contrast the co-integration relationship between RER and its fundamentals to provide an ERER that moves in time.

Models based on time series (BEER) aim to capture how different variables determine RER dynamics. According to Faruqee (1995) a convenient form of analyzing RER is to divide its determinants into two categories: determinants that act through the current account (trade flow) and determinants that act through the capital account (country's net asset position), thus isolating RER determinants that affect the flow position of the *stock* position. Therefore, the relationship between RER (q_t) and its fundamentals is expressed in the following equation:

$$q_t = \beta_0 + \beta_1 TNT_t + \beta_2 TOT_t + \beta_3 \left(\frac{G}{Y} \right)_t + \beta_4 \left(\frac{NFA}{Y} \right)_t + \beta_5 TARIFF_t, \qquad (3)$$

where TNT is the tradable-to-non-tradable productivity ratio; G/Y is the governmental spending as a percentage of GDP, TOT are the terms of trade, NFA/Y refers to a country's net foreign assets as a percentage of GDP and TARIFF represents an average import tariff of the country. This specification corresponds to the reduced form of a general theoretical model.

It is evident that in the above models the variables considered —referred to as fundamentals—are the most important to determine the equilibrium of the economy and, therefore, of the real exchange rate. Even more so, it is feasible to describe the expected relationship of these fundamentals with the real exchange rate, which in the models is reflected in the sign and the significance of the β coefficients.

Key forecasts for the RER equation in (3) are:

Productivity (TNT): the most known theoretical relationship concerning the effect of productivity on determining the long-run equilibrium real exchange rate is the Balassa[2]-Samuelson[3] effect; it establishes that, given certain assumptions, countries that have a faster growing in total factor productivity related to its trading partners will tend to appreciate in real terms. In particular, while greater the difference in productivity of tradable goods production between two countries, greater will be the difference in salaries and non-tradable good prices and, therefore, greater will be the gap between purchasing powers of both currencies and the equilibrium exchange rate. Similarly, the faster the country in question grows compared to another country, greater will be the real currency appreciation that such a country must accept. The natural consequence of this greater growth of productivity is that international competitiveness of the domestic economy increases, which, all in all, results in an expansion of exports and a fall in RER, which is an equilibrium. In brief, greater productivity allows the economy to accommodate a lower equilibrium real exchange rate.

Fiscal Policy (G/Y): The effect of an increase in government spending on the real exchange rate depends on two factors: (i) composition of government spending on tradable and non-tradable goods; and (ii) financing government spending (through taxes or higher foreign debt), which change the availability of resources and spending of the private sector.

An increase in public spending would increase spending on tradable and non-tradable goods by the government. This would have two effects on the equilibrium real exchange rate; a direct effect of a higher demand for domestic goods that originates a real appreciation; and an indirect effect—if financed through higher taxes—of reducing

2. Balassa, Bela, 1964, "The Purchasing Power Parity Doctrine: A Reappraisal", *Journal of Political Economy,* vol. 72; 584 - 596.

3. Samuelson, Paul A. "Theoretical Notes on Trade Problems," *The Review of Economics and Statistics*, vol. XLVI, May 1964: 145 - 154.

private wealth and consumption of non-tradable goods, resulting in a real depreciation. Hence, the final effect on the non-tradable goods market and, therefore, on RER, is ambiguous and will depend on the marginal propensities to consume non-tradable goods by the private sector and the government. If the government's marginal propensity to consume non-tradable goods is higher (lower) than the private sector's marginal propensity, an increase in public spending would produce an increase (reduction) in the demand for non-tradable goods, and a fall (rise) in the real exchange rate. The empirical evidence has tended to support the hypothesis that the marginal propensity to consume non-tradable goods is higher in the public sector than in the private sector.

However, if an increase in public spending is financed with a net transfer of resources from overseas, then there will not be a shift in private spending (it is assumed that the private sector will not react faced with eventual tax increases in the future to service a higher public debt). In this case, the effect on ERER is not ambiguous; the demand for non-tradable goods increases and RER falls.

In short, the general argument is that lower public spending enables the economy to accommodate a lower ERER, and hence the competitiveness of the external sector increases.

Terms of Trade (TOT): a negative shock in the terms of trade generates a series of effects on the real exchange rate. These are: (a) income effect: a fall in the *TOT* originates a fall in the country's disposable income, resulting in lower consumption of all goods, including non-tradable goods. It is important to note that this effect is greater when a TOT fall is perceived as permanent, therefore faced with temporary shocks, the agents will not significantly adjust their consumption patterns, since their permanent income has changed very little. (b) Intertemporal substitution effect: a temporary TOT fall transfer future consumption to the present, generating a real appreciation in the present in exchange for real depreciation in the future. (c) Intratemporal substitution effect: a TOT fall causes imported goods to be relatively more expensive. The effect that this has on the demand for non-tradable goods will depend on the substitution level between these goods and imported goods; a real equilibrium appreciation is generated if the imported and the non-tradable goods are substitutes in consumption, and it is depreciated if they are only complementary.

Therefore, the final effect of a fall or an increase in the terms of trade on the real exchange rate is ambiguous. However, empirically,

it has been observed that, in general, TOT falls cause increases in RER, since the income effect tends to dominate the substitution effect, causing a decrease in demand for goods and a subsequent fall in prices of non-tradable goods. Likewise, it can be said that an improvement in the terms of trade allows the economy to adopt a lower equilibrium real exchange rate, incrementing the competitiveness of the external sector.

Net Foreign Assets (NFA/Y): A higher volume of net foreign assets, as a GDP percentage, reflects more net payments to factors from overseas, and therefore, it implies a higher sustainable deficit of the balance of trade. This higher deficit is consistent with a more appreciated real exchange rate.

In short, an increase in the net foreign asset stock can sustain a higher trade deficit and, therefore, accommodate a lower real exchange rate.

Trade Policy: Changes in the level of open trade, by modifying tariff levels (TARIFF), have an important effect on a country's wealth and, therefore, on the real exchange rate. In fact, a permanent increase in import tariff rates will have two effects: income and substitution. The final effect on RER will depend on the direction and magnitude of each effect. As for the income effect, the measure reduces wealth due to the loss of efficiencies attributable to this distortion, bringing about a fall in demand for all goods. This causes a depreciation of the real exchange rate.

The RER movement that will follow as a consequence of the substitution effect, will depend on whether the imported goods and the non-tradable goods are substitute or complementary. If tariffs rise and these goods are complementary, it will require RER to increase, since the demand for non-tradable goods will decrease. If they are substitute goods, the higher prices of imported goods will increase the demand and thus the prices of non-tradable goods, resulting in a lower RER.

In short, the widespread perception that a permanent increase in tariffs requires, in order to return to a position of equilibrium, a lower RER; this will only occur when there is substitution between domestic and imported goods and also when the substitution effect dominates over the income effect. In other words, when these conditions exist, the general argument could be reached that a tariff reduction allows the economy to adopt a lower equilibrium real exchange rate, and due to this effect exporters will see their competitiveness increase.

The relationship between RER and fundamental variables is typically estimated applying co-integration methods. In particular,

an error correction model is estimated where RER is moved to correct any long-run deviation:

$$\Delta q_t = -\lambda \left(\begin{array}{c} q_{t-1} - \beta_1 TNT_{t-1} - \beta_2 TOT_{t-1} - \beta_3 \left(\dfrac{G}{Y} \right)_{t-1} \\ -\beta_4 \left(\dfrac{NFA}{Y} \right)_{t-1} - \beta_5 TARIFF_{t-1} \end{array} \right) + \theta \Delta T_t \, ,$$

where $\theta \Delta T$ are variables that have temporary effect on RER.

In Chile various studies have been conducted that estimate a similar relationship to the aforementioned. In general it is concluded that there is a relationship between fundamental variables and the real exchange rate; specifically, most estimates indicate that β are negative and statistically significant. In fact, table 1, extracted from Caputo and Núñez (2008), provides a summary of elasticities obtained by different studies, generally indicating the magnitude of elasticity.

Once the beta coefficients for the error correction model have been estimated, the short-run equilibrium RER may be calculated. This is determined by the contemporary values of the fundamentals, leaving aside temporary elements and random shocks. This is calculated as:

$$q_t = \beta_{BASE} + \beta_1 TNT_t + \beta_2 TOT_t + \beta_3 \left(\frac{G}{Y} \right)_t + \beta_4 \left(\frac{NFA}{Y} \right)_t + \beta_5 TARIFF_t \, ,$$

Table 1. Summary of RER Elasticity to its Fundamentals

Fundamental Variables	Céspedes - De Gregorio	Soto - Valdés	Calderón	Caputo - Dominichetti
TNT	-0.34	-0.49	-0.20	-0.47
TOT	-0.59	-0.16	-0.89	-0.35
G/Y	-1.10	-1.60	-0.89	-0.13
NFA/Y	-0.18	-0.17	-0.07	-0.14
TARIFF	-	-	-	-0.02

Note: Calderón (2004), and Caputo and Dominichetti (2005) introduce variable G/Y in logarithm, while Céspedes and De Gregorio (1999) and Soto and Valdés (1998) do it in levels. Therefore, the comparison between different studies is not direct.
Source: Caputo and Núñez (2008).

where β_{BASE} incorporate the difference between the calculation of RER for a base period (where explanatory variables and RER are believed to be in equilibrium)[4] and the actual value (hence, in the base period the predicted value and the effective value are the same).

On the other hand, medium-run equilibrium requires the determination of sustainable or trend values for the fundamental variables. This is calculated by the following expression:

$$\hat{q}_t = \beta_{BASE} + \beta_1 T\hat{N}T_t + \beta_2 T\hat{O}T_t + \beta_3 \left(\frac{\hat{G}}{Y}\right)_t + \beta_4 \left(\frac{N\hat{F}A}{Y}\right)_t + \beta_5 TA\hat{R}IFF_t,$$

where the hat symbol indicates the corresponding variable's medium-run (or sustainable) value. One way of calculating these values is to apply statistical filters to the fundamentals, such as the Hodrick-Prescott filter, that separate the cyclical component from the trend component (considering the latter as a medium-run component). Alternatively, sustainable values may be determined based on the historical component of the series and applying judgment elements.

1.3 Effect of Structural Surplus Rule on RER

Since the early 2000s, the Chilean economy has been applying a structural balance rule[5] to manage its public finances. This fact is a fundamental change in the economic policy, allowing to align public spending with the more permanent revenues received by the Treasury, reducing nearly all the habitual pro-cyclical response demonstrated by government public spending in prior years. In particular, evidence shows that every time copper prices rose sharply and, therefore the economy confronted a positive terms of trade shock as a result of this rise, government spending tended to grow a lot more than the actual economic growth as well as the trend economic growth. In this context, it was normal that in response to positive terms of trade shocks, caused by copper price increases, a significant RER appreciation would be observed. This is the case for the period 1995-96, when copper prices rose from levels close to US$0.80 per

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4. According to Caputo and Núñez (2008), the analyses conducted by the Chilean Central Bank consider two alternative base periods: 1994 and the period 1990 - 2002.

5. Initially, it was a structural surplus rule of 1% of GDP, subsequently it was moved to a structural balance rule and recently it has tended to a rule to reduce structural deficit to a certain value, which today is set at 1% of GDP.

pound at the beginning of 1994 to approximately US$1.35 towards mid-1995; during this period RER appreciated by about 17%.

Undoubtedly, the existence of a structural fiscal rule has tended to modify this behavior, since the surplus revenues received by the Treasury, due to higher copper prices, is saved. This situation should significantly reduce the effect that improved terms of trade would have on RER caused by a rise in copper prices. Then, the fiscal rule, by constraining public spending based on the evolution of revenues considered sustainable, makes the appreciation effect on RER of most terms of trade to be significantly lower than what was observed when the fiscal rule was not applied.

Indeed, a fact that has stood out in recent years is the steep increase in copper prices on world markets since 2003, raising copper prices from an average US$ 0.74 per pound during the period 1998-2002 to about US$ 3.90 in mid 2008, falling to US$ 1.39 towards the end of that year, then starting an upward trend to about US$ 4.50 in February 2011. The country's subsequent abundance of resources is certainly a source of concern among those who consider that this could result in what is known as the Dutch Disease.[6] However, evidence shows that RER has had a limited appreciation during the last seven years, at a an average annual rate of 1.9%, even though the price of copper has multiplied by four during the same period and the terms of trade grew at an average annual rate of 8.7% between 2004 and 2010. However, the implementation of the fiscal rule has entailed an important change in the role played by certain fundamentals in explaining RER behavior and, therefore, prior RER models have started to include this new scenario for the Chilean economy.

In this context, Caputo and Núñez (2008) put forward that implementing the new structural balance fiscal rule based had mitigated the TOT shock effect, resulting from the increase in copper prices,[7] on RER. This, insofar as the structural rule avoids

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6. It is worth noting that Chile is an important copper producer in the global market, according to 2006 figures, accounting for approximately 35% of the world copper production and 40% of net exports. In Chile, the copper sector accounts for nearly a quarter of GDP and more than half of the country's total exports. Additionally, the copper industry delivers to the Treasury nearly 30% of its total revenues.

7. An important point to consider is that Codelco's production is only 30% of the total copper produced in Chile, the rest is owned by private mining companies. Therefore, insofar as the Treasury saves Codelco's revenues, and private investors either reinvest part of their revenues and the rest is sent overseas as profits, that the appreciation effect on the real exchange rate due to high copper prices tends to significantly decrease.

positive terms of trade shocks, resulting from increases in copper prices, are fully transferred into the economy, since when the price of copper exceeds the long-run equilibrium price, the resources are saved. This situation would make the terms of trade elasticity in the RER equation, using 2007 data, become insignificant and eventually positive, which is not consistent with the theoretical aspects under which the RER reduced-form equation was obtained.

In fact, the information provided by Caputo and Núñez (2008) indicates that the correlation between RER and the terms of trade, from 1977 to 1999, is negative and statistically significant, but this relationship begins to weaken in 2000. Additionally, the dynamic OLS estimate carried out by the authors for the period between the first quarter 1977 and the second quarter 2007 confirms that RER response to TOT is not statistically different to zero and in one case it is even positive (and statistically significant). This contrasts with the estimates applying different models with a horizon covering dates prior to 2004, where RER elasticities to TOT were negative and statistically significant (table 1).

In other words, everything indicates that the implementation of the structural fiscal rule meant a structural change that affected the estimate of RER reduced-form equations. This hypothesis is approved by Caputo and Núñez (2008) by obtaining recursive estimates of RER elasticity to TOT, confirming that elasticity changes when more recent data is included and it becomes positive and not statistically significant as of 2003.

Therefore, everything would indicate that the terms of trade variable that would be included in the RER reduced-form equation must be redefined, given that its impact will be limited to prices variations of imported and exported goods which may change spending patterns; this condition would permit to exclude all copper price variations that exceed the long-run price of copper defined in compliance with the rule.

The above is implemented by Caputo and Núñez (2008) by excluding the price of copper from the terms of trade index. Figure 1 displays the different behavior, from the end of 2003, of the terms of trade with and without copper prices. According to these authors, the reduced model re-estimate, incorporating a terms of trade index that excludes mining (TOTEM), from the first quarter 1977 to the second quarter 2007, results in a RER elasticity to TOTEM of -0.544, resulting in the correct sign, statistically significant and relatively more stable throughout the estimate period.

However, the existence of the fiscal rule should lead to, faced with a positive copper price shock, the appreciation effect on RER should be significantly lower than when there was no rule. In order to validate this hypothesis and use the Central Bank of Chile Simulation and Analysis Model (SAM), Caputo and Núñez (2008) assess the effect on the different macroeconomic variables of a copper price shock, when a structural surplus rule (SSR) is applied and when the rule is not applied (i.e., the Treasury adjusts its spending in line with the changes in its revenues, keeping the cash balance constant).[8]

The general SAM equilibrium model reveals that, in the absence of a structural rule, the positive copper price shock increases public spending and private consumption, appreciating RER. Whereas under a SSR, part of the positive copper price shock is saved, thus GDP, demand for domestic goods and inflation have a minor reaction. Consequently, the real appreciation required is also less than when there is no structural rule applied (1% versus 0.4%). Additionally, if the *TOT* shock results from other components different to the price of copper, the fiscal rule is irrelevant. Therefore, *the RER response to TOT depend on the fiscal rule and the nature of the TOT shock*.

Figure 1. Terms of Trade Index, Including and Excluding Mining
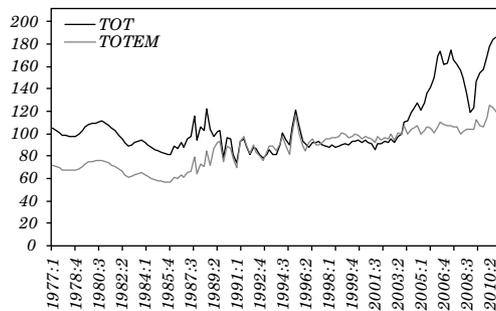
Source: Central Bank of Chile.

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8. It is important to note that the structural rule does not lessen the impact of the oil and imported product price evolution. Consequently, an oil price shock affects RER independently from the fiscal policy rule.

In brief, the implementation of a structural balance rule changes the RER response to TOT shocks, provided that these shocks originate from copper price movements. This explains why elasticity estimates only started to change towards the end of 2003, given that it is from this date that copper prices began to rise sharply.

Nevertheless, the fiscal rule mitigates the impact of copper price shocks on RER, which is consistent with stating that if this rule had not been applied, the real appreciation of the exchange rate would have been higher than the effective rate shown by this indicator over the period 2004-2010.

2. EMPIRICAL ANALYSIS OF THE REAL EXCHANGE RATE UNDER THE FISCAL RULE

2.1 Estimate for RER Reduced-Form Equation

Considering the evidence that the implementation of the fiscal rule, faced with a significant increase in copper prices as of 2004, implied a structural change in both public spending behavior and the country's net foreign asset stock, a reduced-form equation was estimated for the real exchange rate in line with the work undertaken by Caputo and Núñez (2008), but the estimate period was also extended by 15 quarters. Basically, the estimate aims to verify if previous results are still the same, especially during the last few years where the domestic economy has had to face a severe global crisis, together with a significant increase in copper prices. In this context, the structural balance fiscal rule is expected to have significantly absorbed RER volatility faced with the sharp increases in copper prices in recent years, since the variable that has become fundamental to RER has been the terms of trade, excluding copper mining. This estimate was conducted by dynamic least squares[9] from the first quarter 1977 to the first quarter 2011.

Before estimating the equation by dynamic least squares the co-integrated RER reduced-form equation was verified, including the

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9. The dynamic least square technique allows for corrections of the inverse causality problem caused by the correlation between RER shocks and the fluctuations of its fundamentals, if this problem were to affect an estimate carried out by ordinary least squares. This inverse causality problem may be parametrically solved by including lags and advances of the first differences of the explanatory variables in the co-integration equation.

explanatory variables: TNT, TOTEM (or TOT), G/Y, NFA/Y, TARIFF. This exercise is carried out applying the Johansen-Juselius method, indicating the existence of a co-integration vector.[10]

Applying the exercise conducted by Caputo and Núñez (2008), table 2 displays the estimates for the RER reduced-form equation, including as an explanatory variable the terms of trade, both total and excluding mining.

Like the authors, when considering the estimates for total terms of trade, the coefficient is positive and non-significant. Whereas for the term of trade that excludes mining, the coefficient is negative, but not significant. A residual analysis for the latter estimate indicates that as of the last quarter 2008, a structural change had occurred caused by the severe global economic crisis. This event is endogenized by including the U.S. GDP deviation with respect to its potential in the RER reduced-form equation, as a proxy variable of global deceleration. The results, displayed in table 2, indicate that all coefficients show the expected signs and are significant, the same as the results obtained by Caputo and Núñez (2008).[11]

Table 2. Estimate for RER Reduced-Form Equation

	TOT incl. Mining				*TOT excl. Mining*			
	Coefficient	*t-Student*	*Coefficient*	*t-Student*	*Coefficient*	*t-Student*	*Coefficient*	*t-Student*
TOT (TOTEM)	0.186	2.460	0.107	1.542	-0.092	-0.743	-0.429	-4.283
TNT	-0.317	-3.404	-0.360	-4.280	-0.154	-1.776	-0.137	-2.048
G/Y	-0.163	-2.991	-0.141	-2.829	-0.216	-2.493	-0.369	-5.470
NFA/Y	-0.149	-5.886	-0.183	-7.728	-0.109	-4.829	-0.137	-7.020
TARIFF	-0.004	-1.017	-0.010	-2.720	-0.009	-1.614	-0.023	-4.519
$(Y_{USA} - Y^*_{USA})$	-	-	0.000	-5.109	-	-	0.000	-6.614
Observations	132		132		132		132	
R^2 adjusted	0.723		0.777		0.714		0.783	

Source: Authors' estimations.
Note: All variables are expressed in natural logarithms, except for Net Foreign Assets and Tariff. The estimate period was the 1st Q 1977 – 1st Q 2011. The model was estimated by dynamic least squares, with two advances and two lags in the first difference of explanatory variables.

10. The data used was provided by R. Caputo and M. Núñez from the Central Bank of Chile.
11. In order to verify that this result is not due to applying the variable used to control the structural change, table 2 shows the estimate including the total terms of trade; the coefficient for this variable is positive and not significant.

The effect of introducing the terms of trade excluding mining in the estimate for the RER reduced-form equation is displayed in figures 2 and 3, which show the evolution of the recursive coefficients for the terms of trade parameter, including and excluding mining. In particular, if we look at the recursive estimate figure for the total terms of trade parameter, it was negative for most of the estimate period, and it becomes positive towards the end of the period, matching the period when the fiscal rule became relevant. While figure 3 shows the recursive coefficient evolution of the terms of trade excluding mining, indicating that throughout the period it is negative, as expected.

Figure 2. Recursive Estimates of RER Elasticity to TOT Including Copper Mining
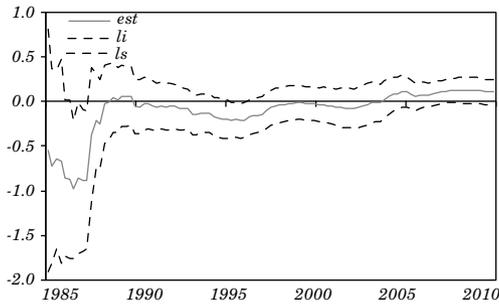
Source: Authors' estimations.

Figure 3. Recursive Estimates of RER Elasticity to TOT Excluding Copper Mining

Source: Authors' estimations.

2.2 Real Exchange Rate Volatility and Fiscal Rule

Additionally, it may be stated that the implementation of the fiscal rule should have resulted in copper price fluctuations losing relevance in explaining the behavior of the real exchange rate; therefore, the increased stability of the terms of trade excluding mining would imply that real exchange rate volatility should be less with a fiscal rule in operation than without one.

To prove the hypothesis that RER volatility has fallen, an extension of the ARCH and GARCH models is used. The advantage of using these models is that they require a minimum amount of data, basically a time series that includes data for the before, during and after variables of implementing a certain event, that in our case is the operating capacity of the fiscal rule.

The model used searches for potential regime changes, incorporating into the estimated equation a dummy or binary variable that controls during the period the fiscal rule has been in operation in the conditional variance. In this context, the model for two equation estimates is as follows:

Mean Equation:

$$y_t = \beta_0 + \beta_1 y_{t-1} + u_t + \beta_2 u_{t-1}, \tag{4}$$

Conditional Variance Equation:

$$h_t = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 h_{t-1} + \alpha_3 Dummy_t + w_t, \tag{5}$$

where u is a process of white noise with zero mean and finite variance; u^2 is the non-conditional variance and h is the conditional variance; w is the white noise process.[12]

In order to estimate if RER volatility diminishes by implementing the fiscal rule, a model was used for RER deviations from a trend.[13] This model involved ARMA(1.1) processes for the conditional mean and GARCH(1.1) for the conditional variance. The dummy variable

12. Before estimating equations (1) and (2) the null hypothesis of homoscedasticity and no autocorrelation was proven in the equation errors (4). As these hypotheses are rejected it is possible to state that the ARCH and GARCH models can describe the error process of such an equation. The evidence found showed a strong rejection of the null hypothesis of the $\Delta(TCR)$ quadratic residuals.

13. This trend was estimated using the Hodrick-Prescott filter.

incorporated into the GARCH models took the value 1 from the first quarter 2004 onwards. Basically, the fiscal rule only began to be operational in 2004, when the difference between the terms of trade excluding mining and total become significant, as shown in figure 1. Prior to this date, the fiscal rule, although it existed, had not been challenged nor tested, since copper prices only started an upward trend towards the end of 2003, when the actual copper price exceeded the long-run copper price estimates considered in the budgets.[14] The results obtained are presented in table 3.

The results indicate that the dummy is significant and with a negative sign, reflect that RER volatility declined when the fiscal rule has been in operation.

Considering that the terms of trade index that excludes copper prices has continued relatively stable during the last ten years—at just over 100, as shown in figure 1—it is highly probable that once foreign prices become normalized the index will not significantly vary from current values. Therefore it may be stated that the long-run terms of trade excluding mining, required to estimate the equilibrium real exchange rate, should not be very different from the level shown by this index in recent years. Therefore, and with the same long-run behavior of the other variables included in the RER reduced-form equation, the fiscal rule allows the economy to adjust to a lower equilibrium real exchange rate than would be required if there was rule no applied. Thus, if there is no fiscal rule, the relevant terms of trade are those that include the price of copper, then in the long run, a significant copper price fall would have to be considered compared to the current value, which makes the real exchange rate, that balances the domestic and foreign market, be above not only of the current rate, but also of the rate obtained when there is a rule. Also in this context, it can be anticipated that given the significant increase in copper prices, the misalignment of the actual RER compared to the equilibrium RER should be higher in the case with no rule applied in relation to the misalignment obtained when the fiscal rule is in operation.

14. From the early 2000s, when the structural balance fiscal rule concept started to be used, the long-term copper price assumption employed was constantly above the actual one, which not only meant that copper funds at the Central Bank decreased nearly in full, but also that this rule lacked credibility until that date. Credibility in the rule came when the actual copper price exceeded the long-run price estimated and the Treasury saved the surplus revenues overseas.

Table 3. RER Volatility - GARCH Model Estimate

Dependent Variable: RER Deviations with respect to its Trend			
For Conditional Mean	*Coefficient*	*z-Statistic*	*Probability*
C	-1.17	-0.93	0.350
AR(1)	0.68	8.49	0.000
MA(1)	0.43	4.36	0.000
For Conditional Variance	*Coefficient*	*z-Statistic*	
C	21.06	10.30	0.000
ARCH(1)	0.07	2.43	0.015
GARCH(1)	-1.04	-40.30	0.000
Dummy 2014	-8.39	-2.24	0.025
Observations	136		
Sample Period	1977:1 - 2011:1		

Source: Authors' estimations.

However, evidence allows to state that the significant increase shown by copper prices since 2004 has had a limited effect on the real exchange rate, which is explained by the existence of a fiscal rule that enables the Treasury to save most of the revenues generated by higher copper prices. Furthermore, this fiscal rule has reduced RER volatility.

Then, at a real exchange rate level, it can be concluded that this variable has behaved in keeping with what was expected after implementing a fiscal rule. This, given that the rule significantly reduces the impact that copper price fluctuations have on the terms of trade, limits the importance of this channel as one of the fundamentals of the equilibrium real exchange rate.

## 3. NOMINAL EXCHANGE RATE AND STRUCTURAL FISCAL RULE

As shown in figure 4, the exchange rate in Chile demonstrates a high negative correlation to copper prices. Historically, this relationship has been explained by higher U.S. dollar returns than by higher copper prices generated in our exports, which when entered

into the country and settled in the local exchange market produces a fall in the peso-U.S. dollar parity. However, the importance of this channel, at least, had to be significantly reduced after implementing the fiscal rule. Then this correlation would have been expected to significantly decrease, especially as of 2004 when the rule became operational, however, this behavior is not observed in figure 4, since this relationship has remained the same or stronger than when the fiscal rule was not applied.

Basically, the rule during the last eight years has gained credibility; therefore the government has consistently saved overseas the surplus revenues resulting from higher copper prices. While, it is also known by agents that private mining companies do not bring into the country additional revenues obtained from higher copper prices than what had been considered in their budgets. Then, it can be assumed that domestic agents should have internalized in their decision that this transfer channel—copper price to exchange rate—is no longer relevant in order to determine domestic parity.

In short, the structural balance rule of public accounts should have significantly reduced the correlation between copper prices and nominal exchange rate, and hence parity volatility, especially after 2003, when copper prices began to rise. However, evidence shows that nominal parity continues to be affected by copper price changes, even when agents know that this capital flows will not enter the country. Our thesis is that a copper price rise is an indicator that in view of a better domestic and global economy outlook, which would imply, on one hand, that the remaining goods exported by the country, both in terms of price and demand, will improve and, on the other, that domestic agents feel wealthier increasing their future demand, behavior which would also imply parity appreciation. In this context, the existence of the fiscal rule would have eliminated (or significantly reduced) the direct effect caused by higher copper prices on the nominal exchange rate, breaking the direct relation with a higher currency settlement, but it would have generated (or intensified) an indirect channel that related the copper price to the general outlooks for the Chilean economy.

This section analyzes this puzzle that causes agents to react to copper price changes, when theoretically (under a fiscal rule that uses the copper price as one of its structural parameters to set its sustainable revenues) it should not occur, since the price change should not affect the agents' outlooks for the currency amounts that will be settled by copper exporters (public and private) in the local exchange market.

Figure 4. Copper Price – Nominal Exchange Rate
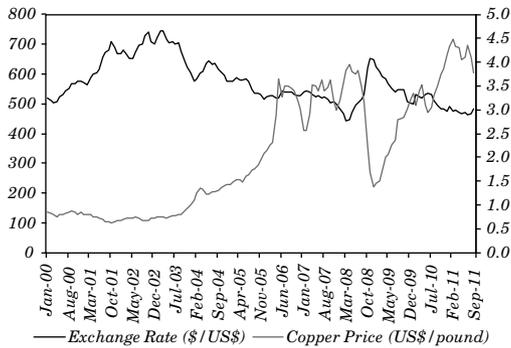
Source: Central Bank of Chile.

3.1 Nominal Exchange Rate and Monetary Policy

One of the expected effects from implementing the fiscal rule was the reduced volatility of the peso-U.S. dollar parity, given that one of the main variables by which it was affected, the price of copper, tended to be excluded as an indicator of currency flow into and out of the local exchange market.

However, when the fiscal rule was implemented, the Central Bank also made changes to its monetary and exchange rate policy. In fact, towards the end of the 1990s (fourth quarter 1999), the Central Bank abandoned its crawling peg system to adopt a flexible exchange, while in August 2001 it carried out the nominalization of its monetary policy, using a nominal interest rate as the monetary policy interest rate. Its aim was for the shocks that affected the economy not to be reflected in the interest rate fluctuations but in the nominal exchange rate (NER). Then, these exchange rate and monetary policy changes should be that the exchange rate volatility should increase while the nominal interest rate stabilized. Whereas, implementing the fiscal rule aimed to reduce the volatility of the peso-U.S. dollar parity. However, it is not clear which effect dominated the exchange rate volatility. However, if volatility falls after 2003 (when the fiscal rule is in operation) it would be feasible to say that the implementation of the fiscal rule could be responsible for this

result. If the exchange rate volatility increased after 2003, it is not clear if it increased because the fiscal rule has no effect on exchange rate volatility or if this effect has a lower magnitude to the higher volatility caused by moving to a flexible exchange rate.

Using the GARCH model similar to the model shown in equations (4) and (5), it was estimated that if the volatility of the exchange rate parity increased with the change to a flexible exchange rate policy at the end of the 1990s. In particular, an MA(1) model was used; its dependent variable was the change in the nominal exchange rate logarithm, together with a GARCH(1.1) model for the conditional variance. Both in the conditional variance and mean of this model a dummy variable was included that took the value 1 from the fourth quarter 1999, when the flexible exchange rate started to be used. This model was estimated using quarterly data from the first quarter 1984 until the first quarter 2011 and the results are shown in table 4. In particular, the estimate indicates that the dummy coefficient was positive and significant for the conditional variance, reflecting that from that date onwards, nominal exchange rate volatility increased.

Table 4. Volatility NER - GARCH Model Estimate

Dependent Variable: first difference of NER logarithm			
For Conditional Mean	*Coefficient*	*z-Statistic*	*Probability*
C	0.02	5.69	0.000
Dummy 1999,4	-0.02	-2.61	0.009
MA(1)	0.13	1.75	0.081
For Conditional Variance	*Coefficient*	*z-Statistic*	
C	0.00	5.88	0.000
ARCH(1)	-0.13	-6.14	0.000
GARCH(1)	1.04	23.63	0.000
Dummy 1999,4	2.43E-04	6.06	0.000
Observations	108		
Sample Period	1984:1 - 2011:1		

Source: Authors' estimations.

Additionally, table 5 displays the estimate for interest rate volatility. For this purpose an ARMA(1.1) model was used; its dependent variable was the change in the nominal interest rate, 30 to 89 days, together with a GARCH(1.1) model for the conditional variance. The conditional variance of this model included a dummy variable that took a value 1 from the fourth quarter 1999, period when a flexible exchange rate was adopted. This model was estimated using quarterly data from the first quarter 1990 until the first quarter 2011. Basically, the estimates indicate that the dummy coefficient was negative and significant for the conditional variance, reflecting that from that date onwards the volatility of the nominal interest rate fell, as was expected in a flexible exchange rate regime.

Figure 5 shows the first logarithm differences of the nominal exchange rate and the nominal interest rate; it can be observed that as of 2000 the exchange rate variability increased and the nominal interest rate variability dropped.

Table 5. Interest Rate Volatility - GARCH Model Estimate

Dependent Variable: first difference of NER logarithm			
For Conditional Mean	*Coefficient*	*z-Statistic*	*Probability*
C	-0.11	-0.15	0.881
AR(1)	0.94	21.04	0.000
MA(1)	-1.11	-9.17	0.000
For Conditional Variance	*Coefficient*	*z-Statistic*	
C	3.29	1.92	0.055
ARCH(1)	0.13	1.06	0.291
GARCH(1)	0.66	5.44	0.000
Dummy 2004	-2.94	-1.77	0.076
Observations	85		
Sample Period	1990:1-2011:1		

Source: Authors' estimations.

Figure 5. Exchange Rate – Interest Rate Volatility
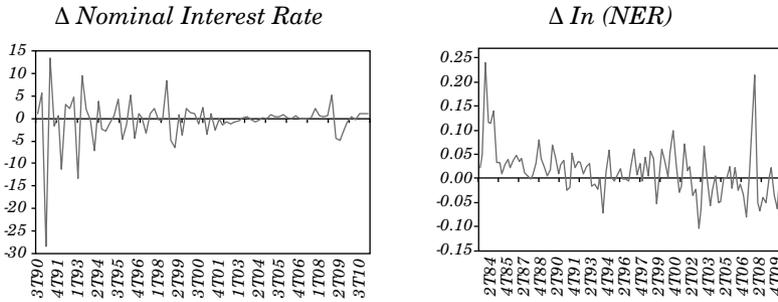
Source: Central Bank of Chile.

Table 6. NER Volatility – GARCH Model Estimate

Dependent Variable: First difference of NER Logarithm			
For Conditional Mean	*Coefficient*	*z-Statistic*	*Probability*
C	0.02	4.39	0.000
Dummy 1999,4	2.59E-03	0.22	0.829
Dummy 2004,1	-0.04	-2.14	0.032
MA(1)	0.15	4.09	0.000
For Conditional Variance	*Coefficient*	*z-Statistic*	
C	0.00	4.68	0.000
ARCH(1)	-0.13	-5.25	0.000
GARCH(1)	1.03	20.20	0.000
Dummy 1999,4	2.06E-04	4.33	0.000
Dummy 2004,1	9.47E-05	0.73	0.467
Observations	108		
Sample Period	1984:1 - 2011:1		

Source: Authors' estimations.

Subsequently, a similar GARCH model was used to prove if this parity volatility was affected once the fiscal rule was applied in 2004. This estimate is shown in table 6 which also includes a new dummy variable that takes value 1 from the first quarter 2004, reflecting the start of when the fiscal rule was applied. The results indicate that the dummy coefficient corresponds to the introduction of exchange

rate flexibility continues to be positive and significant for conditional variance, while the dummy coefficient for the fiscal rule in operation was insignificant and with the opposite expected sign.

Even though the result does not permit to verify if the fiscal rule affected or not parity volatility, we can state that the increased parity volatility was caused by changing to a flexible exchange rate policy. These because the volatility of the nominal interest rate fell as of 2000, as would be expected in a flexible exchange rate scheme.

In order to isolate the regime change caused by the implementation of a flexible exchange rate system at the end of 1999 on the volatility of the nominal exchange rate, a GARCH mode was estimated from the first quarter 2000 to the first quarter 2011. This estimate is shown in table 7 and no statistical evidence was found that volatility of the nominal exchange rate had been affected by the fiscal rule in operation.

In brief, the nominal exchange rate increased its volatility from the early 2000s, due to applying a flexible exchange rate policy, which is the normal result and goal of such a policy. Nevertheless, it cannot be concluded with this evidence that the volatility of nominal parity had decreased after implementing the fiscal rule, which could have been expected given that a key variable that has historically affected parity, the price of copper, was no longer relevant to explain the entry or exit of currency on the local foreign exchange market.

Table 7. NER Volatility – GARCH Model Estimate

Dependent Variable: First difference of NER Logarithm			
For Conditional Mean	*Coefficient*	*z-Statistic*	*Probability*
C	0.01	0.60	0.549
Dummy 2004,1	-0.03	-1.43	0.152
AR(1)	-0.40	-1.38	0.166
MA(1)	0.70	3.53	0.000
For Conditional Variance	*Coefficient*	*z-Statistic*	
C	0.00	1.09	0.277
ARCH(1)	-0.12	-4.55	0.000
GARCH(1)	1.10	31.83	0.000
Dummy 2004,1	3.25E-05	0.32	0.747
Observations	45		
Sample Period	2000:1 - 2011:1		

Source: Authors' estimations.

3.2 Copper Prices as an Expectation Indicator

The fact that the nominal exchange rate reacts to copper price changes, when the fiscal rule is in operation, should not be a regular movement, since the price change should not affect the expectations of agents for the currency amount that will be settled by copper exporters (public and private) in the local foreign exchange market. However, figure 4 demonstrates that this cause-effect relationship is more general than specific. Then, copper price movements could be interpreted as an indicator anticipating a better outlook for the domestic and global economy, which would lead agents to also expect prices to rise (as well as demands) of the remaining goods exported by the country and therefore more capital flows would enter and be settled on the local market.

Furthermore, higher copper prices could also anticipate increased domestic spending, but not through the direct channel of revenues derived from terms of trade, since it has been interrupted by the fiscal rule, but through a channel that improves the agents' expectations of wealth, boosting domestic spending and hence appreciating the peso.

In this context, the empirical evidence should be in line with the following events:

First, the price of copper shows a close positive relation to the price behavior of Chile's non-copper exports. Basically, financial agents expect that if there is an increase in copper prices, this behavior will also be replicated in other international prices for goods exported by Chile. This relationship is not necessarily unidirectional, it could be bidirectional.

Second, copper prices are positively related to global expectations for Chile's economy; copper prices are expected to be the unidirectional cause of expectations.

Third, copper prices are positively related to domestic spending, expecting unidirectional causality from copper prices to domestic spending, as a result of consumers having higher expectations.

Finally, expectations should play an important role in explaining the nominal exchange rate variability. In this context, the peso-U.S. dollar parity would be expected to be explained by copper prices, the domestic-foreign interest rate differential and the international context, as well as the country's economic expectations. The latter channel should be one of the most important to explain exchange rate variability.

Evidence on the first above mentioned event is shown in figure 6 which demonstrates the evolution of the price index for copper exports and the price index for non-copper exports. Table 8 displays causality test results between these variables (in first differences) from the first quarter 2001 to the second quarter 2011.

Figure 6. Export Price Indices
March 2001=100

Source: Central Bank of Chile and own estimates based on Central Bank of Chile data.
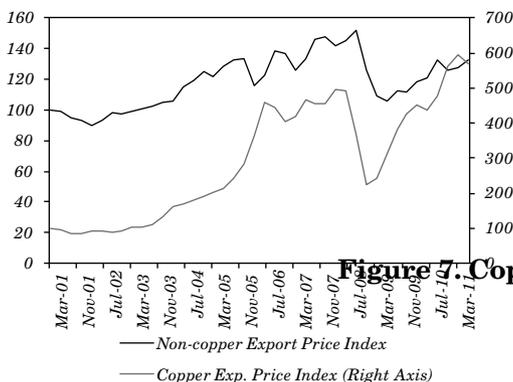
Figure 7. Copper Export Price Index

Source: Central Bank of Chile and University of Chile.
Expectations Index corresponds to the Country's Situation, calcul...
Economics, University of Chile.

Table 8. Granger Causality Test
Copper and Non-Copper Export Price Index

Granger Causality Test		
Null Hypothesis	*F-Statistic*	*Probability*
Non-copper price index does not cause copper price index	13.58	0.001
Copper price index does not cause non-copper price index	16.76	0.000
Observations	40	
Sample Period	2001:1 - 2011:2	

Source: Authors' estimations.
Note: Variables were used in first differences.

Results indicate that the correlation between both variables is high and that causality is bidirectional. This result is consistent with what was expected, since there should not be a unique causality from the international price of copper to other international prices of Chile's other export goods.

As for the second event, figure 7 shows the evolution of copper export price index and the expectation index of the country's economic situation (seasonally adjusted) that is calculated by the Microdata Center, Department of Economics, University of Chile. While table 9 displays the Granger causality test result and the variance decomposition results for a VAR system between both variables (in first differences).

The results show that both variables tend to move together, and there is evidence that causality would move from copper prices to expectations. In fact, the causality test demonstrates that the null hypothesis, that copper prices would not cause expectations, is significantly rejected. Furthermore, the variance decomposition backs this result by indicating that nearly 25% of expectation variability is explained by the price of copper, behavior that does not occur in the copper price variability, which is basically explained in itself.[15]
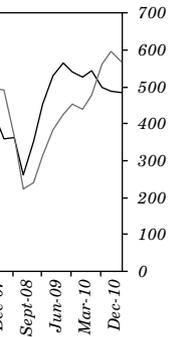
(Right Axis)

ated by the Microdata Center, Department of

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15. This result was not affected by changing the order of the VAR variables.

This positive relation that copper prices produce on expectations of the country's situation is reflected in that consumers tend to spend more, possibly indicating that consumers feel wealthier or more confident about their source of income. Figure 8 shows the evolution of the copper price index and annual variation in domestic spending, indicating a positive correlation, that according to causality results shown in table 10, it would go from copper prices to domestic spending. In fact, the Granger causality test indicates that the null hypothesis, that one variable would not cause the other, is only significantly rejected in the case of copper prices to domestic spending.

Table 9. Granger Causality Test: Copper Price Index - Expectations

Granger Causality Test

Null Hypothesis	F-Statistic	Probability
Expectations does not cause copper price index	1.11	0.358
Copper price index does not cause expectations	4.45	0.010

Observations	38
Sample Period	2001:1 - 2011:2

Analysis of Variance Decomposition

Variance Decomposition of Copper Price Index				Variance Decomposition of Expectations			
Period	*S.E.*	*Copper P.*	*Expec.*	*Period*	*S.E.*	*Copper P.*	*Expec.*
1	0.41	100.00	0.00	1	9.40	0.79	99.21
2	0.42	99.10	0.90	2	10.39	15.11	84.89
3	0.45	94.84	5.16	3	10.56	16.45	83.55
4	0.47	93.82	6.18	4	11.16	24.98	75.02
5	0.47	93.51	6.49	5	11.31	24.47	75.53
6	0.47	93.30	6.70	6	11.42	25.85	74.15
7	0.47	93.26	6.74	7	11.43	25.87	74.13
8	0.47	93.23	6.77	8	11.44	26.02	73.98
9	0.47	93.24	6.76	9	11.45	26.01	73.99
10	0.47	93.23	6.77	10	11.45	26.02	73.98

Source: Authors' estimations.
Note: Variables were used in first differences. For Variance Decomposition the price of copper was used as an exogenous variable.

Figure 8. Domestic Spending - Copper Export Price Index
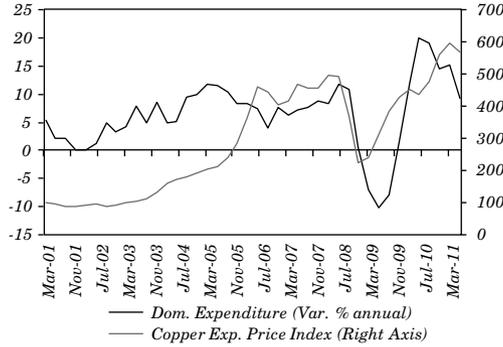
Source: Central Bank of Chile.

Table 10. Causality Test: Domestic Spending - Copper Price Index

Granger Causality Test		
Null Hypothesis	F-Statistic	Probability
Domestic spending does not cause copper price index	0.38	0.543
Copper price index does not cause domestic spending	17.78	0.000
Observations	40	
Sample Period	2001:1 - 2011:2	

Source: Authors' estimations.
Note: Variables were used in first differences.

Finally, tables 11 and 12 show the variance decompositions of the nominal exchange rate for a VAR system that includes the following variables: copper price, domestic-foreign interest rate differential, the international context measured by the U.S. GDP gap compared to its potential value and nominal exchange rate. Subsequently, this system also incorporated the expectation variable to observe the role this variable has in explaining the variability of local exchange rate parity (table 12).

The results show that the expectation variable tends to significantly explain the exchange rate variability; it is much higher that the effect of the interest rate differential and of the international context. Its relevance is comparable to the magnitude directly shown by copper prices.

Table 11. VAR System Estimate

Variance Decomposition of Nominal Exchange Rate					
Period	S.E.	Copper P.	U.S. GDP	Spread	NER
1	0.40	27.14	10.18	4.41	58.26
2	0.43	24.27	13.10	5.37	57.26
3	0.44	24.40	13.28	5.41	56.91
4	0.44	24.42	13.29	5.40	56.89
5	0.44	24.42	13.29	5.40	56.89
6	0.44	24.42	13.29	5.40	56.89
7	0.44	24.42	13.29	5.40	56.89
8	0.44	24.42	13.29	5.40	56.89
9	0.44	24.42	13.29	5.40	56.89
10	0.44	24.42	13.29	5.40	56.89

Source: Authors' estimations.
Note: Variables were used in first differences. For variance decomposition the price of copper was used as an exogenous variable.

Table 12. VAR System Estimate

Variance Decomposition of Nominal Exchange Rate						
Period	S.E.	Copper P.	U.S. GDP	Spread	Expectations	NER
1	0.44	21.97	10.77	2.65	19.35	45.26
2	0.47	21.37	11.31	7.47	21.62	38.23
3	0.52	29.45	9.61	8.34	16.60	36.00
4	0.56	27.93	9.16	8.19	23.38	31.34
5	0.60	26.98	10.65	8.78	23.30	30.28
6	0.61	26.93	10.09	8.63	23.35	30.99
7	0.62	26.39	9.66	9.25	24.35	30.34
8	0.63	26.60	8.99	12.35	24.07	27.99
9	0.64	26.29	8.98	12.45	24.47	27.81
10	0.64	27.17	8.79	12.29	24.51	27.24

Source: Authors' estimations.
Note: Variables are presented according to the exogenous order assumed by the Cholesky decomposition.

4. Conclusions

Chile's exchange rate shows strong volatility to copper price variations. However, the structural balance rule for public accounts should have significantly reduced real and nominal exchange rate volatility, especially after 2003, when copper prices began showing an upward trend.

As for the real exchange rate, based on the evidence it can be stated that the strong increase in copper prices since 2004 has had a limited effect on the real exchange rate, which is explained by the fiscal rule that allows the Treasury to save most of the surplus revenues resulting from high copper prices. The rule significantly reduces the impact of copper price fluctuations on the terms of trade, limiting the importance of this channel as one of the fundamentals of the equilibrium real exchange rate. Furthermore, the application of the fiscal rule has reduced RER volatility and has adjusted a lower equilibrium real exchange rate.

As for the nominal exchange rate, evidence shows that the peso-U.S. dollar parity continues to be strongly affected by copper price changes, even though agents know that these additional revenues do not enter the country when copper prices are above the prices employed in the government and private mining company budgets (i.e., when the fiscal rule is applied, this has occurred since 2004). Based on the empirical analysis undertaken, this is due to the fact that agents view a rise in copper prices as an indicator that would anticipate a better outlook for the domestic economy, which in turn would imply, on one hand, that the prices of the country's other exported goods will improve and hence a higher settlement for related currencies and, on the other, that domestic agents, faced with a rise in copper prices, would feel wealthier or more confident in their current situation, raising the future demand for goods and services, behavior that in the future would result in parity appreciation.

In this context, and based on evidence, it can be stated that the channel whereby copper prices affect local parity is not just through the possibility that the currencies associated with copper exports may be settled in the local market, but also by the effect that this price has on the country's economic expectations, effect that has most probably been intensified by the economic stability that shows the Chilean economy, where the fiscal rule has been a key policy in this result.

REFERENCES

Calderón, C. 2004. "Un Análisis del Comportamiento del Tipo de Cambio Real en Chile." *Economía Chilena* 7(1): 5–30.

Caputo, R. and B. Dominichetti. 2005. "Revisión Metodológica en el Cálculo del IPE e Implicancias sobre los Modelos de Series de Tiempo para el TCR." *Economía Chilena* 8(1): 77–88.

Caputo, R. and M. Núñez. 2008. "Tipo de Cambio Real de Equilibrio en Chile: Enfoques Alternativos." *Economía Chilena* 11(2): 59–77.

Cassel, G. 1922. *Money and Foreign Exchange after 1914*. New York, NY: Macmillan Co.

Céspedes, L.F. and J. De Gregorio. 1999. "Tipo de Cambio Real, Desalineamiento y Devaluaciones: Teoría y Evidencia para Chile." Unpublished manuscript, Departamento de Ingeniería Industrial, Escuela de Ingeniería, Universidad de Chile.

Clark, P.B. and R. McDonald. 1999. "Exchange Rates and Economic Fundamentals: A Methodological Comparison of BEERs and FEERs." In *Equilibrium Exchange Rates*, edited by R. MacDonald and J.L. Stein. London: Kluwer Academic Publishers.

Edwards, S. 1989. *Real Exchange Rates, Devaluation, and Adjustment*. Cambridge, MA: MIT Press.

Faruqee, H. 1995. "Long-Run Determinants of the Real Exchange Rate: A Stock-Flow Equilibrium Approach." IMF Staff Papers 42.

Nurkse, R. 1945. *Conditions of International Monetary Equilibrium*. Princeton, NJ: Princeton University Press.

Soto, C. and R.O. Valdés. 1998. "Tipo de Cambio Real de Equilibrio y Desalineamiento Cambiario en Chile." Unpublished manuscript, Central Bank of Chile.

Williamson, J. 1983. *The Exchange Rate System*. Washington, DC: Institute for International Economics.

Williamson, J. 1994. *Estimating Equilibrium Exchange Rates*. Washington, DC: Institute for International Economics.

Endogenous Exchange-Rate Pass-Through and Self-Validating Exchange Rate Regimes

Giancarlo Corsetti
University of Cambridge, Università Roma III,
and Centre of Economic Policy Research

Paolo Pesenti
Federal Reserve Bank of New York, National Bureau
of Economic Research, and Centre of Economic Policy Research

A long-standing question in open macroeconomics concerns the choice of currency denomination of nominal prices and contracts. A firm serving the export market may choose to set prices in its domestic currency, in the currency of the market of destination, or in a vehicle currency, possibly indexing these prices—fully or partially—to exchange rate movements.[1] To the extent that nominal prices remain sticky, the choice among these alternatives has crucial consequences for the design of stabilization policy—by determining the degree of exchange rate pass-through on export/import prices.[2] However, the causal relation may also go in the opposite direction, as the currency denomination choice may itself depend, among other factors, on the stabilization strategy pursued by policymakers.

In this paper, we analyze the interaction between firms' export pricing and monetary policy, and discuss its potential macroeconomic implications for business cycle synchronization and the choice of an exchange rate regime. In the framework of a highly stylized monetary model, we first provide an analytical characterization of the optimal export pricing by imperfectly monopolistic firms subject to nominal

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1. For a review of the empirical evidence see Goldberg and Knetter (1997), Goldberg and Tille (2008), Gopinath and Rigobón (2008) among others.
2. See Betts and Devereux (2000), Obstfeld and Rogoff (2000), Engel (2002), Corsetti and Pesenti (2005). Corsetti. Dedola and Leduc (2010) provides a synthesis of the debate.

rigidities. We show that, when choosing the currency denomination of exports (and/or the degree of indexation to the exchange rate) firms optimize over the covariance between the (log of the) exchange rate and the (inverse of the) markup. Intuitively, the currency denomination of exports affects the exposure of firms' marginal revenue to the shocks moving the exchange rate and demand in the destination markets. Depending on the covariance of these shocks with the shocks affecting marginal costs, firms can optimize their profit stream from the export markets, in the face of production and demand risk, including monetary policy risk.

By way of example, consider a firm producing in a country where monetary policy is relatively noisy, that is, frequent nominal shocks tend to simultaneously raise nominal wages and depreciate the exchange rate. In this environment, by choosing to preset prices in foreign currency a firm can secure that, whenever an unexpected monetary expansion causes nominal wages and thus its marginal cost to rise, its export revenues in domestic currency will correspondingly increase per effect of the nominal depreciation—with clear stabilizing effects on the firm's markup. The opposite will be true for a foreign firm exporting to the same country. By choosing to preset prices in local currency, this firm can insulate its revenue, and therefore its markup, from monetary noise.

In the second part of the paper, we turn to the analysis of optimal monetary policy, building on the well-known result that the design of optimal monetary rules in open economies crucially depends on the degree of exchange rate pass-through, i.e., on whether firms invoice their exports in their own currency (the hypothesis of producer currency pricing, or PCP, in which case the pass-through of exchange rate into import prices is full) or in local currency (the hypothesis of local currency pricing, or LCP, corresponding to zero pass through). Since in our model firms choose optimal pass-through taking into account monetary policy, in equilibrium monetary policy and firms' pricing strategies depend on each other. We show that this two-way interaction raises the possibility of equilibria in which the choice of the exchange rate regime and export pricing becomes self-validating, in the sense that central banks and firms adopt optimal policies conditional on beliefs about each other behavior.

Our findings warn against reliance on the conventional view, that business cycle synchronization and macroeconomic convergence are preconditions to the implementation of a currency area, as they crucially reduce the costs of giving up national monetary policy—i.e., of giving up the ability to deliver differentiated policy responses to country-specific

disturbances hitting the economy. In our model, the private sector responds to a credible adoption of an exchange rate peg by choosing pricing strategies that are optimal in the absence of exchange rate flexibility. Conditional on central banks' beliefs that firms set export prices in foreign currency, then, a fixed exchange rate turns out to be the (conditionally) optimal monetary regime from the vantage point of the national policymakers as well. Specifically, national outputs become more correlated for any given stochastic pattern of the shocks to fundamentals, thus reducing the (perceived) need for differentiated national monetary policies. Despite the absence of structural changes, economies that adopt a fixed exchange rate regime may end up satisfying the criteria for an Optimum Currency Area (henceforth OCA), according to the theory spelled out by the classic contributions by Mundell (1961), McKinnon (1963), Kenen (1969) and Ingram (1973).[3]

In the vast literature on the subject, early arguments for an endogenous OCA emphasize that the change in monetary regime could act as a catalyst of business cycle synchronization via trade integration. For instance, Frankel and Rose (1998) stress that the reduction of foreign exchange transaction costs associated to the adoption of a common currency promotes cross-border trade: to the extent that the process of integration enhances intra-industry trade rather than product specialization, national business cycles can be expected to become more synchronized, driven by sectoral demand shocks and productivity innovations affecting all countries at the same time. Higher national output correlation then reduces the need for exchange rate adjustments to stabilize national employment and prices, and minimizes the welfare costs of giving up national currencies.[4]

Our characterization of endogenous currency areas is different. Namely, we show that it is still possible for a monetary union to satisfy ex-post the OCA criterion even if monetary integration fails to boost economic convergence and intra-industry trade. To distinguish our

3. Modern applications and revisions include, among others, Eichengreen (1990, 1992), Dowd and Greenaway (1993), Tavlas (1993), Bayoumi and Eichengreen (1994), Melitz (1996), Bayoumi (1997), and Alesina and Barro (2002). See Buiter, Corsetti and Pesenti (1998), ch.10, for a critical survey of the literature.

4. Not everyone agrees with this argument: for instance Eichengreen (1992) and Krugman (1993) stress that monetary integration could lead to greater specialization in production, thus lowering output correlation and making regions more vulnerable to local shocks. On an empirical basis, however, the evidence presented by Frankel and Rose (1998) supports the view that trade links raise income correlations. Moreover, Rose and Engel (2000) show that membership in a common currency area increases international business cycle correlations by a significant amount.

theory from arguments appealing to increasing economic symmetry resulting from economic integration, throughout our analysis we assume that countries are perfectly specialized in the production of one type of good independently of the exchange rate regime.

In our stochastic setting, national welfare is measured by the expected utility of the representative household. The adoption of such non-arbitrary metrics allows us to rank equilibria in welfare terms. The result is that a fixed exchange rate and a currency union are Pareto-inferior to the Friedman-style optimal float. Although in our model the private and the public sector do the right thing—in terms of policy and pricing strategies—once the equilibrium without exchange rate flexibility is selected, there is still room for welfare improvement by creating conditions for relative price adjustment via changes of the exchange rate. A move toward more volatile rates and less synchronized business cycles would bring about the appropriate change in firms' pricing and pass-through strategies, which in turn would validate the floating regime as optimal.

While the model considered in this paper is highly stylized, in part reflecting the advantages of working with closed-form solutions in levels rather than relying on linear approximations, the principle it illustrates is more general. The literature provides examples of the potential range of application of our analysis, as in Chang and Velasco (2006) model of optimal currency denomination of debt contracts, once again regulated by an assessment of the covariance between contractual payment and revenues, expressed in the same currency. A related analysis by Goldberg and Tille (2008) extends the choice of currency denomination of exports to multiple currencies, thus including vehicle currencies.

Our contribution is related to a small but influential literature, modeling the specific determinants of the currency denomination of exports as an endogenous choice. Namely, Bacchetta and van Wincoop (2005), Devereux, Engel and Stoorgard (2004), and Friberg (1998) develop models where firms can choose whether to price exports in domestic or in foreign currency, knowing that price updates will be subject to frictions. As emphasized by this literature, a rich set of factors—from the market share of exporters to the incidence of distribution and the availability of hedging instruments—potentially play a crucial role in this choice (see Engel (2006) for a synthesis). Relative to this literature, our contribution emphasizes the covariance between exchange rates and markups as the key element of optimal strategies of currency denomination and pricing, rather than the

variance of the exchange rate. Also, in our model firms are allowed to index, if only imperfectly, their prices in the export markets to the exchange rate (say, by posting an exchange rate clause in their catalogs for overseas sales). This modeling choice enhances the flexibility and generality of the pricing framework, allowing for a clear and transparent analytical characterization of the equilibrium.

This paper is organized as follows. Section 2 develops the model. Section 3 studies price-setters' optimal behavior and endogenous pass-through strategies for given monetary policies. Section 4 instead focuses on optimal monetary policies given firm pricing strategies. The previous two pieces of analysis are brought together in section 5, in which we characterize the equilibrium of the economy. A final section discusses our main results.

1. THE MODEL

Our model shares the standard elements in modern monetary analysis: imperfect competition in production, nominal rigidities in the goods markets, and forward-looking price-setting behavior by firms (although we do not assume staggered price setting).[5] Drawing on Corsetti and Pesenti (2005), our setup allows for imperfect pass-through of exchange rate onto export prices. Different from our earlier contribution, here we further study how the degree of pass-through is endogenously chosen ex-ante by exporters on the basis of information on shocks and policy rules, in the form of a rule of limited price flexibility contingent on exchange rate movements. Taking firms' pass-through strategies as given, we characterize state-contingent monetary policy rules. In a world equilibrium, both the degree of pass-through and monetary policy are jointly determined by optimizing agents.

1.1 Consumer Optimization

We model a world economy with two countries, H (Home) and F (Foreign), each specialized in one type of traded good. Each good is produced in a number of varieties defined over a continuum of unit mass. Varieties are indexed by h in the Home country and f in the

5. Related contributions in the recent literature include Obstfeld and Rogoff (2000, 2002), Devereux and Engel (2003), Corsetti and Pesenti (2001, 2005), Benigno (2004), Canzoneri, Cumby and Diba (2004).

Foreign country. Each country is populated by households defined over a continuum of unit mass. Households are indexed by j in the Home country and j^* in the Foreign country.

Home agent j's lifetime expected utility $\mathcal{W}$ is defined as:

$$\mathcal{W}_{t-1}(j) \equiv E_{t-1} \sum_{\tau=t}^{\infty} \beta^{\tau-t}[lnC_\tau(j) - \kappa \ell_\tau(j)] \quad 0 < \beta < 1, \kappa > 0, \tag{1}$$

where β is the discount rate. The instantaneous utility is a positive function of the consumption index $C(j)$ and a negative function of labor effort $\ell(j)$ Foreign agents' preferences are similarly defined: the discount rate is the same as in the Home country, while κ^* in the Foreign country need not coincide with κ in the Home country.

$C(j)$ and its Foreign analogue are Cobb-Douglas baskets of the Home and Foreign goods:

$$C_t(j) \equiv C_{H,t}(j)^\gamma C_{F,t}(j)^{1-\gamma}, \; C_t^*(j^*) \equiv C_{H,t}^*(j^*)^\gamma C_{F,t}^*(j^*)^{1-\gamma} \quad 0 < \gamma < 1, \tag{2}$$

where the weights γ and $1-\gamma$ are identical across countries. $C_{H,t}(j)$ and $C_{(F,t)}(j)$ are CES baskets of, respectively, Home and Foreign varieties:

$$C_{H,t}(j) = \left(\int_0^1 C_t(h,j)^{1-\frac{1}{\theta}} dh \right)^{\frac{\theta}{\theta-1}}, \; C_{F,t}(j) = \left(\int_0^1 C_t(f,j)^{1-\frac{1}{\theta^*}} df \right)^{\frac{\theta^*}{\theta^*-1}}, \tag{3}$$

where $C_t(h, j)$ and $C_t(f, j)$ are, respectively, consumption of Home variety h and Foreign variety j by Home agent j at time t. Each Home variety is an imperfect substitute for all other Home varieties, with constant elasticity of substitution across varieties θ. We assume that θ is larger than the elasticity of substitution between Home and Foreign types. Similarly the elasticity of substitution among Foreign varieties is $\theta^*>1$. The consumption indices in the Foreign country, $C_{H,t}^*(j^*)$ and $C_{F,t}^*(j^*)$, are analogously defined.

We denote the prices of varieties h and f in the Home market (thus expressed in the Home currency) as $p(h)$ and $p(f)$, and the prices in the Foreign market (in Foreign currency) as $p^*(h)$ and $p^*(f)$. For given prices of the individual varieties, we can derive the utility-based

price indices P_H, P_F, P and their Foreign analogs.[6] In particular, the utility-based CPIs are:

$$P_t = \frac{P_{H,t}^\gamma P_{F,t}^{1-\gamma}}{\gamma_W}, \quad P_t^* = \frac{\left(P_{H,t}^*\right)\left(P_{F,t}^*\right)^{1-\gamma}}{\gamma_W} \quad \gamma_W \equiv \gamma^\gamma (1-\gamma)^{1-\gamma}. \tag{4}$$

Home households hold the portfolio of Home firms, and two international bonds, B and B^*, denominated in Home and Foreign currency, respectively. Both international bonds are in zero net supply. Households receive wages and profits from the firms. The individual flow budget constraint for agent in the Home country is:

$$B_t(j) + \varepsilon_t B_t^*(j) \le \left(1 + i_{t-1}\right) B_{t-1}(j) + \left(1 + i_{t-1}^*\right)\varepsilon_t B_{t-1}^*(j) + W_t \ell_t(j)$$
$$+ \int_0^1 \pi_t(h)dh - \int_0^1 p_t(h)C_t(h,j)dh - \int_0^1 p_t(f)C_t(f,j)df. \tag{5}$$

In the expression above, the nominal yields i_t and i_t^* are paid at the beginning of period $t+1$ and are known at time t. Taking prices as given, Home household j maximizes (1) subject to (5) with respect to consumption, labor effort, and bond holdings. A similar optimization problem is solved by Foreign household j^*.

Agent j's optimal demand for varieties h and f is a function of the relative price and total consumption of Home and Foreign goods, respectively:

$$C_t(h,j) = \left(\frac{p_t(h)}{P_{H,t}}\right)^{-\theta} C_{H,t}(j), \quad C_t(f,j) = \left(\frac{p_t(f)}{P_{F,t}}\right)^{-\theta^*} C_{F,t}(j), \tag{6}$$

and, similarly, the demand for Home and Foreign consumption goods is a constant fraction of agent j's total consumption expenditure:

$$P_t C_t(j) = \frac{1}{\gamma} P_{H,t} C_{H,t}(J) = \frac{1}{1-\gamma} P_{F,t} C_{F,t}(j). \tag{7}$$

6. For instance, the utility-based price index $P_{H,t}$ is defined as the minimum expenditure required to buy one unit of the composite good $C_{H,t}$ and is derived as $P_{H,t} = \left[\int_0^1 p_t(h)^{1-\theta} dh\right]^{\frac{1}{1-\theta}}$.

The intertemporal allocation is determined according to the Euler equation:

$$1 = (1 + i_t) E_t Q_{t,t+1}(j),$$ (8)

where $Q_{t,t+1}(j)$ is agent j's stochastic discount rate:

$$Q_{t,t+1}(j) \equiv \beta \frac{P_t C_t(j)}{P_{t+1} C_{t+1}(j)}.$$ (9)

The condition for optimal labor effort equates the real wage to the marginal rate of substitution between consumption and leisure:

$$W_t = \kappa P_t C_t(j).$$ (10)

The above equation implies that consumption and discount rates are equalized across agents, so that $Q_{t,t+1}(j) = Q_{t,t+1}$.

1.2 Nominal Rigidities, Exchange Rate Pass-through, and Price Setting

Each variety h is produced by a single Home firm and sold in both countries under conditions of monopolistic competition. Output is denoted Y. Technology is linear in household's h labor, $\ell(h)$:

$$Y_t(h) = Z_t \ell_t(h),$$ (11)

where Z is a country-specific productivity shock. Similarly, output of Foreign variety f is a function of Foreign labor $\ell^*(f)$ and the productivity shock in the Foreign country, Z^*.

Home firms take the nominal price of labor, W_t, as given. The nominal marginal cost, MC_t, is identical across firms:

$$MC_t(h) = MC_t = W_t / Z_t,$$ (12)

and Home firms' nominal profits Π_t are defined as:

$$\Pi_t(h) = (p_t(h) - MC_t) \int_0^1 C_t(h,j) dj + (\varepsilon_t p_t^*(h) - MC_t) \int_0^1 C_t^*(h,j^*) dj^*,$$ (13)

where E is the nominal exchange rate, expressed as Home currency per unit of Foreign currency. Foreign variables are similarly defined.

It is assumed that individual firms set the nominal price of their product one period in advance, and stand ready to meet demand at given prices for one period. In terms of our notation, Home firms selling in the Home market choose $p_t(h)$ at time $t-1$ by maximizing the present discounted value of profits:

$$p_t(h) = \arg \max E_{t-1} Q_{t-1,t} \Pi_t(h), \tag{14}$$

accounting for (6). Domestic firms optimally set prices equal to expected nominal marginal cost, appropriately discounted and augmented by the equilibrium markup $\theta / (\theta - 1)$:

$$p_t(h) = \frac{\theta}{\theta-1} \frac{E_{t-1}(MC_t Q_{t-1,t}\, p_t(h)^{-\theta} P_{H,t}^{\theta} C_{H,t})}{E_{t-1}(Q_{t-1,t}\, p_t(h)^{-\theta} P_{H,t}^{\theta} C_{H,t})}. \tag{15}$$

Accounting for (7) and (9), the previous expression can be rewritten as:

$$p_t(h) = P_{H,t} = \frac{\theta}{\theta-1} E_{t-1} MC_t = \frac{E_{t-1}(P_t C_t / Z_t)}{\Phi}, \tag{16}$$

where we define $\Phi \equiv (\theta-1)/\theta\kappa$. As we will see below, the Φ constant measures the expected level of labor effort in the Home country.

Home firms selling abroad also set nominal prices one period in advance. Different from most models in the literature, we do not impose a priori the restriction that export prices are set in Home currency, implying that all unexpected fluctuations in the exchange rate are 'passed through' one-to-one onto export prices in Foreign currency (in the literature this scenario is referred to as 'Producer Currency Pricing' or PCP). At the same time, we do not impose the opposite restriction that export prices are set in Foreign currency, implying that Foreign-currency prices of Home goods do not respond at all to unexpected exchange rate fluctuations (i.e. the case of 'Local Currency Pricing' or LCP). We consider instead the more general case in which Home firms preset export prices in Foreign currency, but are able to modify them after observing exchange rate changes, following Corsetti and Pesenti (2005) and Obstfeld (2002). In our

setup, the extent to which the Foreign-currency prices of Home exports adjust—contingent on the realization of the exchange rate—is a choice variable, determined by Home firms at time $t - 1$. In other words, the elasticity of exchange rate pass-through can endogenously be zero (as in the LCP case), one (as in the PCP case), or any intermediate number.

Formally, by definition of pass-through elasticity $\eta_t^* \equiv \delta \ln p_t^*(h)/\delta \ln(1/\varepsilon_t)$, Foreign-currency prices of Home varieties are:

$$p_t^*\left(h\right) \equiv \frac{\tilde{p}_t\left(h\right)}{\varepsilon_t^{\eta_t^*}} \quad 0 \le \eta_t^* \le 1, \tag{17}$$

where $\tilde{p}_t(h)$ is the predetermined component of the Foreign-currency price of good h that is not adjusted to variations of the exchange rate during period t.[7] At time t, Home firms choose $\tilde{p}_t(h)$ and η_t^* one period in advance in order to maximize expected discounted profits accounting for Foreign demand (i.e., the Foreign analog of (6)). The actual $p_t^*(h)$, however, depends on the realization of the exchange rate at time t.[8]

In equilibrium we obtain:

$$p_t^*\left(h\right) = \frac{\theta}{\theta-1}\frac{1}{\varepsilon_t^{\eta^*}}\frac{E_{t-1}(MC_t Q_{t-1,t}\, p_t^*\left(h\right)^{-\theta} P_{H,t}^{*\theta} C_{H,t}^*)}{E_{t-1}(Q_{t-1,t}\, p_t^*\left(h\right)^{-\theta} P_{H,t}^{*\theta} C_{H,t}^* \varepsilon_t^{1-\eta^*})}. \tag{18}$$

Using (7) and (9) letting $\Theta \equiv \gamma / (1-\gamma)(P_t^* C_t^* \varepsilon_t / P_t C_t)$, we can also write:

$$p_t^*\left(h\right) \equiv P_{H,t}^* = \frac{\tilde{p}_t\left(h\right)}{\varepsilon_t^{\eta_t^*}} = \frac{\theta}{\theta-1}\frac{E_{t-1}\!\left(\dfrac{MC_t \Theta_t}{\varepsilon_t^{1-\eta^*}}\right)}{\varepsilon_t^{\eta^*} E_{t-1}\Theta_t} = \frac{E_{t-1}\!\left(\dfrac{P_t C_t \Theta_t}{Z_t \varepsilon_t^{1-\eta^*}}\right)}{\Phi \varepsilon_t^{\eta^*} E_{t-1}\Theta_t}. \tag{19}$$

7. For instance, if $\eta^* = 1$, pass-through in the Foreign country is complete—as in the PCP case. If $\eta^* = 0$ we have $p_t^*\left(h\right) = \tilde{p}_t\left(h\right)$ which coincides with the price chosen by the Home producer in the LCP case.

8. The optimal degree of pass-through may well vary over time. The model could be easily extended to encompass the case in which the pass-through elasticity is a non-linear function of the exchange rate (e.g., η^* is close to zero for small changes of the exchange rate E but close to one for large exchange rate fluctuations). The key results of our analysis would remain unchanged.

Analogous expressions can be derived for the prices set by Foreign firms in the Foreign and the Home market. In the case of Foreign exports the notation is:

$$p_t\left(f\right) = \tilde{p}_t^*\left(f\right)\varepsilon_t^{\eta_t}, \quad 0 \le \eta_t \le 1, \tag{20}$$

where the degree of pass-through in the Home country, η_t, need not be equal to that in the Foreign country, η_t^*. The optimal pricing strategy is such that:

$$P_{F,t}^* = \frac{\theta^*}{\theta^*-1} E_{t-1}\left(MC_t^*\right), \quad P_{F,t} = \frac{\theta^*}{\theta^*-1}\varepsilon_t^{\eta_t}\frac{E_{t-1}(MC_t^*\varepsilon_t^{1-\eta_t}/\Theta_t)}{E_{t-1}(1/\Theta_t)}. \tag{21}$$

Clearly, Home firms are willing to supply goods at given prices as long as their ex-post markup does not fall below one:

$$P_{H,t} \ge MC_t, \quad P_{H,t}^* \ge \frac{MC_t}{\varepsilon_t}. \tag{22}$$

Otherwise, agents would be better off by not accommodating shocks to demand. In what follows, we restrict the set of shocks so that the 'participation constraint' (22) and its Foreign analog are never violated.

1.3 Monetary Policy

The government controls the path of short-term rates i, and provides a nominal anchor for market expectations. To characterize monetary policy, it is analytically convenient to introduce a forward-looking measure of monetary stance, μ_t, defined such that:

$$\frac{1}{\mu_t} = \beta\left(1+i_t\right)E_t\left(\frac{1}{\mu_{t+1}}\right), \tag{23}$$

or, integrating forward:

$$\frac{1}{\mu_t} = E_t \lim_{N\to\infty} \beta^N \frac{1}{\mu_{t+N}} \prod_{\tau=0}^{N-1}\left(1+i_{t+\tau}\right). \tag{24}$$

Monetary policy is assumed to make the variable μ_t/μ_{t-1} stationary around a constant long-run inflation target $1+\pi$. In a non-stochastic steady state μ grows at the rate $1+\pi$, and the steady-state nominal interest rate is $1+i = (1+\pi)/\beta$. Home monetary easing at time t (μ_t temporarily above trend) reflects a temporary interest rate cut (i.e., $1+i_t < (1+\pi)/\beta$).

Note that in equilibrium μ_t is equal to $P_t C_t$ (and μ_t^* is equal to $P_t^* C_t^*$): a monetary expansion delivers increased nominal spending.[9] A monetary union in our framework is defined as a regime in wich $i_t = i_t^*$ for all t. If both countries adopt the same numeraire, this implies $\mu_t = \mu_t^*$.

1.4 Market Clearing and the Closed-Form Solution

The resource constraint for variety h is:

$$Y_t(h) \geq \int_0^1 C_t(h,j)dj + \int_0^1 C_t^*(h,j^*)dj^*, \tag{25}$$

while the resource constraint in the Home labor market is:

$$\int_0^1 \ell_t(j)dj \geq \int_0^1 \ell_t(h)dh. \tag{26}$$

The resource constraint for Foreign variety f and Foreign labor are similarly defined. Finally, international bonds are in zero net supply:

$$\int_0^1 B_t(j)dj + \int_0^1 B_t(j^*)dj^* = \int_0^1 B_t^*(j)dj + \int_0^1 B_t^*(j^*)dj^* = 0. \tag{27}$$

In our analysis below we focus on symmetric equilibria in which, at some initial point in time $t = 0$, agents worldwide have zero net financial wealth. As shown in Corsetti and Pesenti (2001, 2005), in equilibrium both net wealth and the current account are endogenously zero at any subsequent point in time: Home imports from Foreign are always equal in value to Foreign imports from Home. Since agents are equal within countries (though not necessarily symmetric across countries) we can drop the indices j and j^* and interpret all variables in per-capita (or aggregate) terms. As trade

9. This result can be obtained by comparing (23) with the Home Euler equation under logarithmic utility (8) i.e. $1/P_t C_t = {}^2(1+i_t)E_t(1/P_{t+1}C_{t+1})$.

and the current account are always balanced, countries consume precisely their aggregate sales revenue:

$$\Theta_t = 1, \quad (1-\gamma)P_t C_t - \gamma\varepsilon_t P_t^* C_t^* = 0. \tag{28}$$

Table 1. The Closed-Form Solution of the Model

$$\varepsilon_t = \frac{1-\gamma}{\gamma}\frac{\mu_t}{\mu_t^*} \tag{29}$$

$$MC_t = \kappa\mu_t / Z_t \tag{30}$$

$$MC_t^* = \kappa^*\mu_t^* / Z_t^* \tag{31}$$

$$P_{H,t} = \frac{\theta}{\theta-1}E_{t-1}\left(MC_t\right) \tag{32}$$

$$P_{F,t} = \frac{\theta^*}{\theta^*-1}\varepsilon_t^{\eta_t}E_{t-1}\left[MC_t^*\varepsilon_t^{1-\eta_t^*}\right] \tag{33}$$

$$P_{H,t}^* = \frac{\theta}{\theta-1}\frac{E_{t-1}\left[MC_t/\varepsilon_t^{1-\eta_t^*}\right]}{\varepsilon_t^{\eta_t^*}} \tag{34}$$

$$P_{F,t}^* = \frac{\theta^*}{\theta^*-1}E_{t-1}(MC_t^*) \tag{35}$$

$$C_t = \frac{\gamma_W\left(\frac{\theta-1}{\theta}\right)^{\gamma}\left(\frac{\theta^*-1}{\theta^*}\right)^{1-\gamma}\mu_t\varepsilon_t^{-\eta_t(1-\gamma)}}{\left[E_{t-1}\left(MC_t\right)\right]^{\gamma}\left[E_{t-1}\left(MC_t^*\varepsilon_t^{1-\eta_t}\right)\right]^{1-\gamma}} \tag{36}$$

$$C_t^* = \frac{\gamma_W\left(\frac{\theta-1}{\theta}\right)^{\gamma}\left(\frac{\theta^*-1}{\theta^*}\right)^{1-\gamma}\mu_t^*\varepsilon_t^{\eta_t^*\gamma}}{\left[E_{t-1}\left(MC_t/\varepsilon_t^{1-\eta_t^*}\right)\right]^{\gamma}\left[E_{t-1}\left(MC_t^*\right)\right]^{1-\gamma}} \tag{37}$$

$$\ell_t = \left(\frac{\theta-1}{\theta\kappa}\right)\left[\gamma\frac{MC_t}{E_{t-1}\left(MC_t\right)}+(1-\gamma)\frac{MC_t/\varepsilon_t^{1-\eta_t^*}}{E_{t-1}\left[MC_t/\varepsilon_t^{1-\eta_t^*}\right]}\right] \tag{38}$$

$$\ell_t^* = \left(\frac{\theta^*-1}{\theta^*\kappa^*}\right)\left[(1-\gamma)\frac{MC_t^*}{E_{t-1}\left(MC_t^*\right)}+\gamma\frac{MC_t^*/\varepsilon_t^{1-\eta_t}}{E_{t-1}\left[MC_t^*\varepsilon_t^{1-\eta_t}\right]}\right] \tag{39}$$

Table 1 presents the general solution of the model, in which all endogenous variables (29) through (39) are expressed in closed form as functions of real shocks (Z_t and Z_t^*) and monetary stances μ_t and μ_t^*.[10]

Interpreting table 1: since the equilibrium current account is always balanced (see (28) above) and the demand for imports is proportional to nominal expenditures $P_t C_t$ and $P_t^* C_t^*$, the nominal exchange rate E_t in (29) is proportional to $P_t C_t / P_t^* C_t^*$, that is, a function of the relative monetary stance. The relations (30) and (31) link marginal costs to macroeconomic shocks and monetary policy. Domestic prices of domestic goods are predetermined according to (32) and (35), while import prices vary with the exchange rate, depending on the degree of exchange rate pass-through according to (33) and (34). Equilibrium consumption is determined in (36) and (37). Finally, employment and output levels are determined according to (38) and (39).

2. THE CHOICE OF CURRENCY DENOMINATION OF EXPORTS AND OPTIMAL EXCHANGE RATE PASS-THROUGH

What is the optimal degree of exchange rate pass-through onto export prices of Home goods in the Foreign market? Taking monetary stances and policy rules as given, Home firms choose η_t^* as to maximize expected discounted profits. In a symmetric environment with $p_t^*(h) = P_{h,t}^*$ the first order condition is:[11]

$$1 = \frac{\theta \kappa}{\theta - 1} \frac{E_{t-1}[\ln \varepsilon_t (P_t^* C_t^* / Z_t) / P_{H,t}^*]}{E_{t-1}(\ln \varepsilon_t)} \frac{\gamma}{1 - \gamma} . \tag{40}$$

---

10. Algebraic details can be found in the appendix of Corsetti and Pesenti (2004). Note that the solution does not hinge upon any specific assumptions or restriction on the nature of the shocks.

11. The optimal pass-through maximizes $E_{t-1}\left[Q_{t-1,t}, \Pi_t(h)\right]$, thus maximizes the expression:

$$E_{t-1}\left[Q_{t-1,t}\left(\tilde{p}_t(h) / P_{H,t}^*\right)^{-\theta} C_{H,t}^* \left\{\tilde{p}_t(h)\varepsilon_t^{1-\eta_t^*+\theta\eta_t^*} - MC_t \varepsilon_t^{\theta\eta_t^*}\right\}\right].$$

The first order condition yields:

$$0 = E_{t-1}\left[Q_{t-1,t}\left(\tilde{p}_t(h) / (\varepsilon_t^{\eta_t^*} P_{H,t}^*)\right)^{-\theta} C_{H,t}^* \ln \varepsilon_t \left\{(\theta-1)\tilde{p}_t(h)\varepsilon_t^{1-\eta_t^*} - \theta MC_t\right\}\right].$$

And accounting for the equilibrium expressions Q, P_H^*, C_H^* and MC, as well as (28), it is possible to rewrite the first order condition above as in (40).

Comparing (40) with (18) and (29), it follows that the optimal pass-through η_t^* is such that:

$$E_{t-1}\left[\frac{\mu_t}{Z_t\varepsilon_t^{1-\eta_t^*}}\right]E_{t-1}(\ln\varepsilon_t) = E_{t-1}\left[\ln\varepsilon_t\left(\frac{\mu_t}{Z_t\varepsilon_t^{1-\eta_t^*}}\right)\right], \tag{41}$$

that is:

$$Cov_{t-1}\left(MC_t / \varepsilon_t^{1-\eta_t^*}, \ln\varepsilon_t\right) = 0. \tag{42}$$

This is a critical condition. At an optimum, the (reciprocal of the) markup in the export market must be uncorrelated with the (log of the) exchange rate. Trivially, if E_t is constant or fully anticipated, any degree of pass-through is consistent with the previous expression. But if E_t is not perfectly predictable, the optimal degree of pass-through will depend on the expected monetary policies and the structure of the shocks. By the same token, the optimal pass-through chosen by Foreign firms selling in the Home market requires:

$$Cov_{t-1}\left(MC_t^* \varepsilon_t^{1-n_t^*}, \ln\left(1 / \varepsilon_t\right)\right) = 0. \tag{43}$$

To build intuition, observe that in equilibrium, Home ex-post real profits in the Foreign market[12] are proportional to $\tilde{p}_t(h) - MC_t / E_t^{1-\eta_t^*}$, that is, they are a concave function of E_t for $\eta_t^* < 1$.[13] This implies that, keeping everything else constant, exchange rate shocks reduce expected profits from exports. In general, however, to assess the overall exposure of profits to exchange rate uncertainty it is crucial to know whether the underlying shocks make marginal costs and exchange rate co-vary positively.

Suppose, for instance, that there are no productivity shocks. If exogenous monetary shocks in the Home country, μ_t, are the only source of uncertainty, condition (42) becomes:

---

12. Ex-post real profits from selling in the Foreign market are $Q_{t-1,t}\left(\varepsilon_t\tilde{p}_t(h)\varepsilon_t^{-\eta_t^*} - MC_t\right)C_{H,t}^*$. Using the equilibrium expression for C_H^*, E, and Q, the previous expression can be rewritten as:

$\beta(1-\gamma)\frac{\mu_{t-1}}{\tilde{p}_t(h)}(\tilde{p}_t(h) - MC_t / \varepsilon_t^{1-\eta_t^*})$. Recall that E is proportional to μ_t / μ_t^*, $Q_{t-1,t}$ is proportional to $1/\mu_t$, MC_t is proportional to μ_t/Z_t and $C_{H,t}^*$ is proportional to $\mu_t^* E_t^{\eta_t^*}$.

13. This result does not rely on the linearity of labor effort disutility. Suppose that the latter is nonlinear, say in the form $-\ell^\upsilon / \upsilon$. It can be shown that profits are concave in the nominal exchange rate for any $\upsilon \geq 1$.

$$Cov_{t-1}(\mu_t^{\eta_t^*}, \ln \mu_t) = 0, \tag{44}$$

which is solved by $\eta_t^* = 0$. Home monetary shocks affect symmetrically Home marginal costs MC_t and the Home discount rate Q_t, leaving their product unchanged. They also affect the exchange rate: E_t depreciates in those states of nature in which μ_t increases. Currency depreciation increases Home firms' nominal sales revenue per unit of exports (by a factor $1-\eta_t^*$) and increases Foreign demand for Home goods (by a factor η_t^*). By setting a zero degree of pass-through, or $\eta_t^* = 0$, Home exporters insure that both their export markup and the relevant demand curve for their products abroad are unaffected by monetary shocks.

Instead, if the only source of uncertainty is μ^*, condition (42) becomes:

$$Cov_{t-1}\left(\left(\mu_t^*\right)^{\eta_t^*-1}, -\ln \mu_t^*\right) = 0, \tag{45}$$

which is solved by $\eta_t^* = 1$. Home marginal costs are uncorrelated with the exchange rate. By choosing full pass-through and letting export prices absorb exchange rate changes, Home firms can insulate their export sales revenue from currency fluctuations and avoid any uncertainty of markup and profitability in the Foreign market. Note that these examples shed light on the reason why countries with high and unpredictable monetary volatility should also exhibit a high degree of pass-through, and vice versa—a view emphasized for instance by Taylor (2000).[14]

The same intuition carries over to the case in which there is both monetary and real uncertainty. In this case, patterns of endogenous intermediate pass-through can emerge, as the following example illustrates. If the Home monetary authority adopted the policy $\mu_t = Z_t^2 / \mu_t^*$, then it would be optimal for Home firms to choose $\eta_t^* = 0.5$. Abroad, we would need $MC_t^* E_t^{1-\eta_t}$ to be uncorrelated with the exchange rate. This would be the case, for instance, if $\mu_t^* = \left(Z_t^*\right)^5 / Z_t^4$ and $\eta_t = 0.6$.

---

14. When monetary policy is exogenous (suboptimal) and firms are only allowed to choose between zero and 100 percent pass-through (that is, between local-currency and producer-currency pricing), the results above are consistent with the analysis of Devereux, Engel, and Stoorgard (2004), and Bacchetta and Van Wincoop (2004).

In the literature that analyzes the currency denomination of exports as an endogenous choice by profit maximizing firms—see Bacchetta and Van Wincoop (2005), Devereux, Engel and Stoorgard (2004), and Friberg (1998) among others—this choice is influenced by a number of factors, ranging from the market share of exporters to the incidence of distribution and the availability of hedging instruments (see Engel (2006) for a synthesis). Relative to this literature, however, condition (42) emphasizes how the focus of the analysis should be shifted from the variance of the exchange rate towards the co-movements between the exchange rates on one hand and marginal revenues and marginal costs on the other.

Our framework naturally lends itself to the task of exploring the interactions between the choice of currency denomination of exports and monetary policy. Regarding this interaction, an early hypothesis is put forward by Taylor (2000), who specifically links low pass-through to a low trend-inflation environment (see Campa and Goldberg (2005) for evidence). Our analysis suggests that systematic effects of monetary policy stabilization do mainly work through the covariance between exporters' marginal costs and their revenues from the foreign market.

Intuitively, consider a firm producing in a country where monetary policy is relatively noisy, that is frequent nominal shocks tend to simultaneously raise nominal wages and depreciate the exchange rates. In this environment, by choosing LCP, a firm can secure that, whenever an unexpected monetary expansion causes nominal wages and thus its marginal cost to rise, its export revenues in domestic currency will correspondingly increase per effect of the nominal depreciation—with clear stabilizing effects on the firm's markup. The opposite will be true for a foreign firm exporting to the same country. By choosing PCP this firm can insulate its revenue, and therefore its markup, from monetary noise.

3. OPTIMAL MONETARY POLICY FOR GIVEN EXCHANGE RATE PASS-THROUGH

Consider now the policymakers' problem in a world Nash equilibrium where national monetary authorities are able to commit to preannounced rules. In specifying this equilibrium, we assume that policy makers take as given each other's monetary stance, as well as the degree of exchange rate pass-through onto export pricing. We

motivate the latter assumption by observing that central bankers may rely on a vast body of empirical findings point to a low elasticity of import prices to the exchange rate (see Corsetti, Dedola and Leduc (2008) for a theoretical assessment of these studies). Nonetheless, it is worth stressing from the start that, as a consequence of this assumption, the Nash equilibrium we solve for is conditional on policymakers' beliefs concerning equilibrium pass-through. A different allocation would follow, for instance, if we posited that policymakers take equilibrium prices, rather than pass-through, as given. We will return on this point below.[15]

In our Nash equilibrium, the Home monetary authority seeks to maximize the indirect utility of the Home representative consumer (1) with respect to $\left\{\mu_{t+\tau}\right\}_{\tau=0}^{\infty}$, given $\left\{\mu_{\tau}^{*}, Z_{\tau}, Z_{\tau}^{*}, \eta_{\tau}, \eta_{\tau}^{*}\right\}_{\tau=t}^{\infty}$. The Foreign authority faces a similar problem. Table 2 presents the closed-form reaction functions, the solution of which is the global Nash equilibrium up. Each reaction function is written in two ways: as a function of marginal costs and markups, or as a function of employment gaps and deviations from the law of one price.

The optimal policy requires that the Home monetary stance be eased (μ increases) in response to a positive domestic productivity shock (Z rises). Absent a policy reaction, a positive productivity shock would create both an output and an employment gap. In fact, ℓ would fall below $\Phi = (\theta - 1)/(\theta\kappa)$. Actual output Y would not change, but potential output, defined as the equilibrium output with fully flexible prices, would increase. In light of this, optimal monetary policy leans against the wind and moves to close the employment and output gaps.

In general, however, the optimal response to a Home productivity shock will not close the output gap completely. Home stabilization policy, in fact, induces fluctuations in the exchange rate uncorrelated with Foreign marginal costs. For the reasons seen above, these exchange rate shocks reduce Foreign firms' expected profits in the Home market. When pass-through in the Home market is incomplete, the elasticity of Foreign profits relative to the exchange rate is decreasing in $\tilde{p}^{*}(f)$. Then, charging a higher price $\tilde{p}^{*}(f)$ is a way for Foreign exporters to reduce the sensitivity of their export profits to exchange rate variability. But the higher average export prices charged by Foreign firms translate into higher average import prices

15. For an analysis of optimal monetary behavior under discretion see Corsetti and Pesenti (2005).

in the Home country, reducing Home residents' purchasing power and welfare.

This is why the Home monetary stance required to close the domestic output gap is not optimal when pass-through is incomplete. Relative to such a stance, domestic policymakers can improve utility by adopting a policy that equates, at the margin, the benefit from exchange rate flexibility (that is, from keeping domestic output close to its potential level) with the loss from exchange rate volatility (that is, the fall in purchasing power and real wealth due to higher average import prices)

Table 2. Monetary Authorities' Optimal Reaction Functions

$$
\gamma + (1-\gamma)(1-\eta_t) = \frac{\gamma MC_t}{E_{t-1}(MC_t)} + \frac{(1-\gamma)(1-\eta_t) MC_t^* \varepsilon_t^{1-\eta_t}}{E_{t-1}(MC_t^* \varepsilon_t^{1-\eta_t})}
$$

$$
= \frac{\gamma \dfrac{\theta\kappa}{\theta-1}\ell_t}{\gamma + (1-\gamma)\dfrac{P_{H,t}}{\varepsilon_t P_H^*}} + \frac{(1-\gamma)(1-\eta_t)\dfrac{\theta^*\kappa^*}{\theta^*-1}\ell_t^*}{\gamma + (1-\gamma)\dfrac{P_{F,t}}{\varepsilon_t P_F^*}} \tag{46}
$$

$$
1 - \gamma + \gamma(1-\eta_t^*) = \frac{(1-\gamma) MC_t^*}{E_{t-1}(MC_t^*)} + \frac{\gamma(1-\eta_t^*) MC_t / \varepsilon_t^{1-\eta_t^*}}{E_{t-1}(MC_t / \varepsilon_t^{1-\eta_t^*})}
$$

$$
= \frac{(1-\gamma)\dfrac{\theta^*\kappa^*}{\theta^*-1}\ell_t^*}{1-\gamma+\gamma\dfrac{\varepsilon_t P_F^*}{P_{F,t}}} + \frac{\gamma(1-\eta_t^*)\dfrac{\theta\kappa}{\theta-1}\ell_t}{1-\gamma+\gamma\dfrac{\varepsilon_t P_H^*}{P_{H,t}}} \tag{47}
$$

As long as η is below one, the Home monetary stance tightens when productivity worsens abroad and loosens otherwise. Rising costs abroad (a fall in Z^*) lower the markup of Foreign goods sold at Home. If Home policymakers were not expected to stabilize the markup by raising rates and appreciating the exchange rate, Foreign firms would charge higher prices onto Home consumers. Only when $\eta=1$ do Foreign firms realize that any attempt by the Home authorities to stabilize the markup is bound to fail, as both P_F and the exchange rate fall in the same proportion.

With complete pass-through in both countries, the policies in a Nash equilibrium satisfy:

$$\frac{\mu_t}{Z_t} = E_{t-1}\left(\frac{\mu_t}{Z_t}\right) \qquad \mu_t^* / Z_t^* = E_{t-1}(\mu_t^* / Z_t^*). \qquad (48)$$

The optimal policy consists in a commitment to provide a nominal anchor for the economy,[16] and deviate from such stance only when productivity shocks in the economy threaten to destabilize marginal costs and move employment and output far from their potential levels. Output gaps are fully closed and employment remains unchanged at the potential level Φ or Φ^*. Both domestic and global consumption endogenously co-move with productivity shocks. Thus, the Nash optimal monetary policy leads to the same allocation that would prevail were prices fully flexible. This result restates the case for flexible exchange rates made by Friedman (1953): even without price flexibility, monetary authorities can engineer the right adjustment in relative prices through exchange rate movements. In our model with PCP, expenditure-switching effects makes exchange rate and price movements perfect substitutes.

The Nash equilibrium will however not coincide with a flexible-price equilibrium when the pass-through is less than perfect in either market. Consider the case of LCP. Here, the optimal monetary policy in each country cannot be inward-looking, but must respond symmetrically to shocks anywhere in the world economy—the optimal monetary policies in Table 2 can be written as:

$$\mu_t = \left[\gamma \frac{1/Z_t}{E_{t-1}\left(\mu_t / Z_t\right)} + (1-\gamma) \frac{1/Z_t^*}{E_{t-1}\left(\mu_t / Z_t^*\right)}\right]^{-1}. \qquad (49)$$

---

16. As well known (see e.g. Woodford (2003)), rules such as (48) define the monetary stances up to the scale of nominal variables. In fact, the equations of (48) are solved by $\mu_t = \alpha_t Z_t$, and $\mu_t = \alpha_t^* Z_t^*$ where α_t and α_t^* are variables forecastable at time $t-1$, pinning down nominal expectations in each country. In models with one-period nominal price rigidities, the variables α_t and α_t^* are arbitrary. Under the assumption that the policymakers target the CPI inflation rate, we would have $\alpha_t = P_{t-1}(1+\pi)$.

For an analysis of the conditions for a unique equilibrium, see Adao, Correia, and Teles (2011).

$$\mu_t^* = \left[\gamma \frac{1/Z_t}{E_{t-1}\left(\mu_t^* / Z_t\right)} + (1 - \gamma) \frac{1/Z_t^*}{E_{t-1}\left(\mu_t^* / Z_t^*\right)} \right]^{-1}$$ (50)

expressions which imply $\mu = \mu^*$.[17]

In our model, the exchange rate is a function of the relative monetary stance μ_t / μ_t^*. Our analysis then suggests that exchange rate volatility will be higher in a world economy close to purchasing power parity, and lower in a world economy where changes in the exchange rate generate large deviations from the law of one price.[18] In fact, if the exposure of firms' profits to exchange rate fluctuations is limited, inward-looking policymakers assign high priority to stabilizing domestic output and prices, with 'benign neglect' of exchange rate movements. Otherwise, policymakers 'think globally', taking into account the repercussions of exchange rate volatility on consumer prices; hence, the monetary stances in the world economy come to mimic each other, reducing currency volatility.

The characterization of a (conditionally) optimal monetary union (or conditionally optimal fixed exchange rate regime) is a simple corollary of the analysis above. We define a monetary union $\mu_t = \mu_t^*$ as optimal if the single monetary stance is optimal for both countries. It is straightforward to show that when shocks are perfectly correlated, the optimal allocation is such that $MC_t = E_{t-1}(MC_t)$ and $MC_t^* = E_{t-1}(MC_t^*)$ regardless of the degree of pass-through. Optimal monetary policies support a fixed exchange rate regime and an optimal monetary union while fully closing the national output gaps. If shocks are asymmetric, a monetary union is optimal only when both countries find it optimal to choose a symmetric monetary stance, that is, when pass-through is zero worldwide according to (49) and (50).

17. Once again, these rules define the monetary stances up to the scale of nominal variables. Note that in a monetary union, goods prices cannot diverge and the nominal anchors mentioned in the footnote above must satisfy $\alpha_t = \alpha_t^*$.

18. This result has been stressed by Devereux and Engel.

4. ENDOGENOUS EXCHANGE RATE REGIMES

The conventional wisdom about the choice of exchange rate regime is that asymmetries in business cycles weaken the case for fixed exchange rates or the adoption of a single currency. With domestic monetary authorities unable to use differentiated policy responses to the disturbances hitting the economy, business cycle synchronization and macroeconomic convergence are emphasized as pre-conditions to the implementation of single currency areas, as they obviously reduce the costs of giving up national monetary policy.

In what follows, we build on our model to provide an instance of an economy in which a move toward symmetric monetary policy increases endogenously business cycle synchronization and convergence even if there is no change in the magnitude and sign of fundamental shocks. In other words, independently of any structural change in the economy, the adoption of a credible fixed exchange rate regime can be supported in equilibrium as a self-validating optimal monetary arrangement, in the sense that endogenous changes in private agents' expectations and behavior eliminate all the (perceived) incentives for monetary authorities to pursue independent strategies of national output stabilization in response to asymmetric shocks.

We show that, conditional on beliefs about exchange rate pass-through, the model admits two equilibria. While exporters could in principle choose any intermediate level of pass-through, in equilibrium pass-through is either 100 percent or zero, as profit maximization turns out to require 'corner' pricing strategies.[19] There is one equilibrium in which firms choose to preset prices in domestic currency, and let the foreign price adjust according to the law of one price. With complete pass-through, monetary policies are fully inward-looking: they implement stabilization rules that close national output gaps completely in every period. This equilibrium is inconsistent with fixed exchange rates, and implies low correlation among output levels—depending on the cross-country correlation of fundamental shocks. The exchange rate plays the role stressed by Friedman (1953): it brings about the required relative price

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19. Related literature focuses on the choice of pricing strategies where monetary authorities are assumed to implement non-optimizing, noisy policies (as in the work by Bacchetta and van Wincoop (2004) and Devereux, Engel and Stoorgard (2004)) rather than optimal rules.

adjustments that are hindered by the presence of nominal price rigidities.

But there is another equilibrium in which firms are believed to preset prices in the consumers' currency, so that there is no response of prices to the exchange rate. With zero pass-through in the world economy, optimal monetary policies are perfectly symmetric across countries, that is, they both respond to the same average of national shocks. This equilibrium is thus consistent with OCA: there is no cost in giving up monetary sovereignty because, even if national monetary authorities remained independent, they would still choose to implement the same policy rules, moving interest rates in tandem and responding symmetrically to world-wide shocks. National outputs are perfectly correlated even when shocks are asymmetric. Most interestingly, in our model the same result would follow assuming that the two national policymakers cooperate with each other.

The two equilibria are however not equivalent in terms of welfare: OCA is Pareto-inferior to the Friedman-style optimal float in the first equilibrium. In the OCA equilibrium, the private and the public sectors act rationally—in terms of policy and pricing strategies— once the equilibrium without exchange rate flexibility is selected, conditional on beliefs about export pricing. Yet, there is still room for welfare improvement by creating conditions for relative price adjustment via changes of the exchange rate. A move toward more volatile rates and less synchronized business cycles would bring about the appropriate change in firms' pricing and pass-through strategies, which in turn would validate the floating regime as optimal.

4.1 Optimal Exchange Rate Pass-through and Monetary Policy in Equilibrium

To recapitulate our main analytical findings: Home and Foreign firms choose the levels of pass-through η_t^* and η_t on the basis of their information at time $t-1$ regarding marginal costs and exchange rates at time t, by solving (42) and (43). Home and Foreign monetary authorities take the levels of pass-through η_t^* and η_t as given and determine their optimal monetary stances by solving the conditions (46) and (47). We now consider the joint determination of μ_t, μ_t^*, η_t and η_t^* satisfying the four equations above in the non-trivial case in which the shocks Z_t and Z_t^* are asymmetric.

The following allocation is an equilibrium:

$$MC_t = E_{t-1}(MC_t), \ MC_t^* = E_{t-1}(MC_t^*), \quad \eta_t = \eta_t^* = 1. \tag{51}$$

Purchasing power parity holds and there is full pass-through of exchange rate changes into prices. Monetary policies fully stabilize the national economies by closing output and employment gaps. Exchange rates are highly volatile, their conditional variance being proportional to the volatility of Z_t/Z_t^*. We will refer to this equilibrium as an optimal float (OF).

The logic underlying the OF case can be understood as follows. Suppose Foreign firms selling in the Home market choose $\eta_t = 1$ and let Home-currency prices of Foreign goods move one-to-one with the exchange rate, stabilizing their markups. Then the Home monetary authority chooses as a rule to stabilize Home output fully, no matter the consequences for the exchange rate (the volatility of which does not affect Foreign exporters' profits and therefore does not affect, on average, the price of Foreign goods paid by Home consumers). Note that when $\eta_t = 1$, Home output stabilization implies that MC_t is constant, and therefore uncorrelated with the exchange rate. Home firms, then, will optimally set their pass-through abroad and choose $\eta_t^* = 1$ in order to stabilize their export markup. Since Home firms are now fully insulated from exchange rate fluctuations, the Foreign monetary authority optimally chooses to stabilize Foreign output with benign neglect of the exchange rate, so that MC_t^* is a constant. But in this case Foreign firms optimally choose $\eta_t = 1$, as we had assumed initially: the OF case is an equilibrium.

Consider now the following allocation:

$$1 = \gamma \frac{MC_t}{E_{t-1}(MC_t)} + (1 - \gamma) \frac{MC_t^*}{E_{t-1}(MC_t^*)}, \quad \varepsilon_t = const, \ \eta_t = \eta_t^* = 0. \tag{52}$$

This is the LCP scenario brought to its extreme consequences: there is no pass-through of exchange rate changes into prices, but this hardly matters since the exchange rate is fixed! Optimal national monetary policies are fully symmetric, thus cannot insulate the national economies from asymmetric shocks: it is only on average that they stabilize the national economies by closing output and employment gaps—the most apparent case of an optimal currency area.

To see why the above is an equilibrium, note that if Home and Foreign firms choose $\eta_t = \eta_t^* = 0$, Home and Foreign authorities are concerned with the price-distortions of exchange rate volatility. They will optimize over the trade-off between employment stability and consumers' purchasing power. While they choose their rules independently of each other, the rules they adopt are fully symmetric, thus leading to exchange rate stability. But if the exchange rate is constant during the period, the choice of the pass-through is no longer a concern for Home and Foreign firms: zero pass-through is as good as a choice as any other level of η_t and η_t^*. Such weak preference implies that the monetary union is an equilibrium.

4.2 Nash Versus Coordination

Would the two allocations above still be equilibria, if national authorities could commit to coordinated policies, maximizing some weighted average of expected utility of the two national representative consumers? This is an important question, as one may argue that policymakers in a monetary union would set their rules together (taking private agents' pricing and pass-through strategies as given), rather than independently. By the same token, if there were large gains from cooperation in a floating exchange rate regime, there would also be an incentive for policymakers to design the optimal float in a coordinated way. One may conjecture that, once cooperative policies are allowed for, the equilibrium allocation becomes unique.

Interestingly, it turns out that the possibility of cooperation does not modify at all the conclusions of our analysis. It can be easily shown that optimal policy rules conditional on $\eta_t = \eta_t^* = 1$ are exactly the same in a Nash equilibrium and under coordination: there are no gains from cooperation in the PCP scenario which replicates the flex-price allocation.[20] Also, as shown in Corsetti and Pesenti (2004), optimal policy rules conditional on $\eta_t = \eta_t^* = 0$ are exactly the same in a Nash equilibrium and under coordination: there are no gains from cooperation: since exchange rate fluctuations are the only source of international spillover, there cannot be gains from cooperation when non-cooperative monetary rules already imply

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20. This result is stressed by Obstfeld and Rogoff (2000, 2002).

stable exchange rates.[21] While there are policy spillovers for any intermediate degree of pass-through ($0 > \eta$, $\eta^* > 1$), they disappear in equilibrium under the two extreme pass-through scenarios. In the only two cases relevant for our equilibrium analysis, optimal monetary policy rules are exactly the same whether or not the two national policymakers cooperate.

Macroeconomics and Welfare Analysis

Can a monetary union or a regime of irrevocably fixed exchange rate be a self-validating OCA? Our model suggests yes. Policy commitment to monetary union—i.e., the adoption of the rules (49-50)—leads profit-maximizing producers to modify their pricing strategies, lowering their pass-through elasticities. Such behavioral change makes a currency area optimal, even if macroeconomic fundamentals and the pattern of shocks (Z_t and Z_t^* in our framework) remain unchanged across regimes.

A crucial result is that, under an OCA, output correlation is higher than under the alternative OF equilibrium. In fact, under OF, monetary policies are such that employment in both countries is always stabilized (both ex-ante and ex-post) at the constant levels $\ell = \Phi$ and $\ell^* = \Phi^*$. This implies that output correlation under OF depends on the degree of asymmetry of the fundamental shocks:

$$Corr_t\left(Y_t^{OF}, Y_t^{*OF}\right) = Corr_t\left(Z_t \ell_t^{OF}, Z_t^* \ell_t^{*OF}\right) = Corr_t(Z_t, Z_t^*). \tag{53}$$

Instead, in a monetary union, employment levels are functions of relative shocks:

$$\frac{\theta\kappa}{\theta-1}\ell_t^{OCA} = \frac{\mu_t^{OCA}/Z_t}{E_{t-1}(\mu_t^{OCA}/Z_t)}, \ \frac{\theta^*\kappa^*}{\theta^*-1}\ell_t^{*OCA} = \frac{\mu_t^{OCA}/Z_t^*}{E_{t-1}(\mu_t^{OCA}/Z_t^*)}, \tag{54}$$

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21. With LCP, expected utility at Home is identical to expected utility in the Foreign country up to a constant that does not depend on monetary policy. For any given shock, consumption increases by the same percentage everywhere in the world economy. Even if ex-post labor moves asymmetrically (so that ex-post welfare is not identical in the two countries, as is the case under PCP), ex ante the expected disutility from labor is the same as under flexible prices.

where μ^{OCA} is the solution of the system(49)-(50). This implies that output levels and $Y_t^{OCA} = Z_t \ell_t^{OCA}$ are $Y_t^{*OCA} = Z_t^{*OCA} \ell_t^{*OCA}$ perfectly correlated:

$$Corr\left(Y_t^{OCA}, Y_t^{*OCA}\right) = Corr_t\left(\mu_t^{OCA}, \mu_t^{OCA}\right) = 1, \tag{55}$$

so that $Corr_t\left(Y_t^{OCA}, Y_t^{*OCA}\right) \geq Corr(Y^{OF}, Y^{*OF})$, consistent with the traditional characterization of OCAs.

It is nonetheless possible to rank the OF and the OCA regimes in welfare terms. Focusing on the Home country, expected utility $\mathcal{W}$ in (1) can be written as:

$$\mathcal{W}_{t-1} = \mathcal{W}_{t-1}^{FLEX} - \{\gamma E_{t-1} \ln\left[E_{t-1}\left(\frac{\mu_t}{Z_t}\right) / \frac{\mu_t}{Z_t} \right]$$

$$+ \left(1 - \gamma\right) E_{t-1} \ln\left[E_{t-1}\left(\frac{\left(\mu_t^*\right)^{\eta_t} \mu_t^{1-\eta_t}}{Z_t^*} \right) / \left(\frac{\left(\mu_t^*\right)^{\eta_t} \mu_t^{1-\eta_t}}{Z_t^*} \right) \right] \}, \tag{56}$$

where $\mathcal{W}^{FLEX}$ is defined as the utility that consumers could expect to achieve if prices were fully flexible, thus independent of monetary regime. By Jensen's inequality, the term in curly brackets is always non-negative: expected utility with price rigidities is never above expected utility with flexible prices. At best, what monetary policy rules can do is to bridge the gap between the two.

Observe that under the OF equilibrium (51) the term in square bracket becomes zero and $\mathcal{W}^{OF} = \mathcal{W}^{FLEX}$. But this implies that $\mathcal{W}^{OF} \geq \mathcal{W}^{OCA}$, an inequality that holds with strong sign when shocks are asymmetric. It follows that an optimal currency area is always Pareto-inferior vis-à-vis a Friedman style optimal flexible exchange rate arrangement.

Indeed, it is easy to show that the optimal float allocation is the solution to a Nash equilibrium in which monetary authorities take firms' prices, rather than pass-through coefficients, as given. In this case, the monetary reaction function is no longer constraints by specific beliefs about firms' pricing strategies. Rather, central banks in either country focus on actual export pricing, which, as we have explained above, are quite sensitive to stabilization rules.

5. Conclusion

One of the main contributions of the recent open-economy monetary literature consists in assessing the international dimensions of optimal monetary policy and the potential welfare gains from following rules that are not strictly inward-looking, that is, deviate from canonical closed-economy prescriptions. One aspect that has received a great deal of attention concerns firms' export pricing decisions as a key determinant of optimal stabilization policy. In this paper, we take a step further, and recognize that export pricing strategies themselves, and in particular the choice of currency denomination of exports, are a function of stabilization policy. We first characterize analytically the optimal choice by firms within a stylized framework. While to a large extent specific to the model, this analytical characterization allows us to shed light on a general principle: the degree of exchange rate pass-through affects the exposure of firms' profits to supply and demand shocks in both the domestic and the destination markets. To the extent that the firm can choose its pass-through, it will do so optimally accounting for the covariance between exchange rates and markups.

In general equilibrium, the interaction between export pricing and monetary policy gives rise to the possibility of self-validating currency and monetary regimes. In particular, we have provided an example of a global economy with standard features where there can be two equilibria, as the choice between pricing-to-market and law of one price depends on optimal choices by firms in response to policy decisions. This result suggests that credible policy commitment to monetary union may lead to a change in pricing strategies, making a monetary union the optimal monetary arrangement in a self-validating way.

It is worth emphasizing that, conditional on the central bank's beliefs about firms' pricing, a common monetary policy is optimal because, for given producers' pricing strategies, the use of the exchange rate for stabilization purposes would entail excessive welfare costs, in the form of higher import prices and lower purchasing power across countries. Once a monetary union takes off and firms adapt their pricing strategies to the new environment, the best course of action for the monetary authorities is to avoid any asymmetric policy response to asymmetric shocks. As a result, even in the absence of structural effects brought about by monetary integration, the correlation of national outputs increases.

But our model also suggests that the argument for self-validating optimal currency areas could be used in the opposite direction, as an argument for self-validating optimal floating regimes. For a given pattern of macroeconomic disturbances, in fact, policy commitment to a floating regime may be the right choice despite the observed high synchronization of the business cycle across the countries participating in a monetary union: in equilibrium there will be an endogenous change in pricing strategies (with higher pass-through levels in all countries) which support floating rates as the optimal monetary option. In fact, the two institutional corner solutions for exchange rate regimes can be Pareto ranked in welfare terms, leaving the optimal float the unambiguous winner.

Two observations are in order, regarding the fact that the model we adopt in this paper assumes a high degree of risk sharing. As a future direction for research, and in light of the evidence against efficient integration of financial markets, it would be appropriate to revisit the same topic in a model with financial frictions and imperfections (a point stressed by Corsetti, Dedola and Leduc (2010)). While this perspective may make it harder to derive a clean case of self-validating regimes, the main message of our contributions would remain valid. An ex-post increase in business cycle synchronization is at best a very imperfect criterion to assess the success of monetary integration.

Second, once we move away from the strong conditions ensuring risk sharing, it would be appropriate to reconsider in a model where firms can hedge (if only imperfectly) exchange rate risk. In a more general model (say, allowing for non-traded goods), monetary policy and exchange rate movements will generally not be unable to stabilize sectoral outputs and domestic and international relative prices. Efficient markets for hedging instruments may then be a precondition for reaping the benefits of floating exchange rates. Incidentally, this an argument which has been repeatedly emphasized by Vittorio Corbo, to whom this book is dedicated. We indeed find appropriate to end this article with a quotation of Vittorio's work on exchange rate regimes, taken from one of his papers addressing the issue "Is it time for a common currency for the Americas?" (Corbo 2001, 2002).

> While few countries are willing to follow the path of dollarization, a larger number is moving toward more flexible systems. However, more flexible systems must be accompanied by the development of forward

and future exchange rate markets, to enable market participants to hedge against exchange rate volatility. Otherwise, the costs of real exchange rate variability could be high. As countries move toward the use of more flexible exchange rate arrangements, they will need to make the selection of the monetary anchor more explicit. Here, much progress has been made in the region in implementing quite successful full-fledged inflation-targeting frameworks. Thus, for a country that has built strong macro fundamentals and has a safe and sound financial system, the alternative of keeping its own currency, combining a floating exchange rate system with inflation targeting, may be a better choice (Corbo 2002: p. 109).

REFERENCES

Adao, B., I. Correia, and P. Teles. 2011. "Unique Monetary Equilibria with Interest Rate Rules." *Review of Economic Dynamics* 14(3): 432–42.

Alesina, A. and R.J. Barro. 2002. "Currency Unions." *Quarterly Journal of Economics* 117(2): 409–36.

Bacchetta, P. and E. van Wincoop. 2004. "A Scapegoat Model of Exchange Rate Fluctuations." *American Economic Review* 94(2): 114–8.

———. 2005. "A Theory of the Currency Denomination of International Trade." *Journal of International Economics* 67(2): 295–319.

Bayoumi, T. 1997. *Financial Integration and Real Activity - Studies in International Trade Policy*. Ann Arbor, MI: University of Michigan Press.

Bayoumi, T. and B. Eichengreen. 1994. "One Money or Many? Analyzing the Prospects for Monetary Unification in Various Parts of the World." *Princeton Studies in International Finance* 76.

Benigno, P. 2004. "Optimal Monetary Policy in a Currency Area." *Journal of International Economics* 63(2): 293–320.

Betts, C. and M.B. Devereux. 2000. "Exchange Rate Dynamics in a Model of Pricing-to-Market." *Journal of International Economics* 50(1): 215–44.

Buiter, W.H., G. Corsetti, and P. Pesenti. 1998. *Financial Markets and European Monetary Cooperation. The Lessons of the 1992-93 Exchange Rate Mechanism Crisis*. Cambridge: Cambridge University Press.

Campa, J.M. and L.S. Goldberg. 2005. "Exchange Rate Pass-Through into Import Prices." *Review of Economics and Statistics* 87(4): 679–90.

Canzoneri, M.B., R. Cumby, and B. Diba. 2004. "The Cost of Nominal Inertia in NNS Models." NBER Working Paper 10889.

———. 2005. "The Need for International Policy Coordination: What's Old, What's New, What's Yet to Come?" *Journal of International Economics* 66(2): 363–84.

Chang, R. and A. Velasco. 2006. "Currency Mismatches and Monetary Policy: A Tale of Two Equilibria." *Journal of International Economics* 69(1): 150–75.

Corsetti, G., L. Dedola, and S. Leduc. 2008. "High Exchange-Rate Volatility and Low Pass-Through." *Journal of Monetary Economics* 55(6): 1113–28.

————. 2010. "Optimal Policy in Open Economies." In *Handbook of Monetary Economics*, edited by M. Woodford and B. Friedman. Amsterdam: North Holland.

Corbo V. 2001. "Is It Time for a Common Currency for the Americas?" *Journal of Policy Modeling* 23(3): 241–48.

————. 2002. "Exchange Rate Regimes in the Americas: Is Dollarization the Solution?" Working Paper 229, Instituto de Economía, Pontificia Universidad Católica de Chile.

Corsetti, G. and P. Pesenti. 2001. "Welfare and Macroeconomic Interdependence." *Quarterly Journal of Economics* 116(2): 421–46.

————.2004. "Endogenous Pass-Through and Optimal Monetary Policy: A Model of Self-Validating Exchange Rate Regimes." Unpublished manuscript, European University Institute.

————. 2005. "International Dimensions of Optimal Monetary Policy." *Journal of Monetary Economics* 52(2): 281–305.

Devereux, M. B. and C. Engel. 2003. "Monetary Policy in the Open Economy Revisited: Price Setting and Exchange Rate Flexibility." *Review of Economic Studies* 70(4): 765–83.

Devereux, M. B., C. Engel, and P. E. Stoorgard. 2004. "Endogenous Exchange Rate Pass-through when Nominal Prices are Set in Advance." *Journal of International Economics* 63(2): 263–91.

Dowd, K. and D. Greenaway. 1993. "Currency Competition, Network Externalities and Switching Costs: Towards an Alternative View of Optimum Currency Areas." *Economic Journal* 103(420): 1180–89.

Eichengreen, B. 1990. "One Money for Europe? Lessons from the US Currency Union." *Economic Policy* 10: 117–87.

————. 1992. *Should the Maastricht Treaty Be Saved?* Princeton Studies in International Finance 74. Princeton, NJ: Princeton University Press.

Engel, C. 2002. "Expenditure Switching and Exchange Rate Policy." *NBER Macroeconomics Annual* 17: 231–72.

————. 2006. "Equivalence Results for Optimal Pass-through, Optimal Indexing to Exchange Rates, and Optimal Choice of Currency for Export-Pricing." *Journal of the European Economic Association* 4(6): 1249–60.

Frankel, J. A. and A.K. Rose. 1998. "The Endogeneity of the Optimum Currency Area Criteria." *Economic Journal* 108(449): 1009–25.

Friberg, R. 1998. "In Which Currency Should Exporters Set their Prices?" *Journal of International Economics* 45(1): 59–76.

Friedman, M. 1953. "The Case for Flexible Exchange Rates." Reprinted in *Essays in Positive Economics*, Chicago, IL: University of Chicago Press.

Goldberg, L.S. and C. Tille. 2008. "Vehicle Currency Use in International Trade." *Journal of International Economics* 76(2): 177–92.

Goldberg, P. and M.M. Knetter. 1997. "Goods Prices and Exchange Rates: What have We Learned?" *Journal of Economic Literature* 35(3): 1243–72.

Gopinath, G. and R. Rigobón. 2008. "Sticky Borders." *Quarterly Journal of Economics* 123(2): 531–75.

Ingram, J.C. 1973. *The Case for European Monetary Integration.* Essays in International Finance 98. Princeton, NJ: Princeton University Press.

Kenen, P. 1969. "The Theory of Optimum Currency Areas: An Eclectic View." Reprinted in *Exchange Rates and the Monetary System: Selected Essays of Peter B. Kenen*. Aldershot: Elgar. 1994.

Krugman, P. 1993. "Lessons of Massachusetts for EMU." In *Adjustment and Growth in the European Monetary Union*, edited by F. Torres and F. Giavazzi. Cambridge: Cambridge University Press.

Melitz, J. 1996. "The Theory of Optimum Currency Areas, Trade Adjustment, and Trade." *Open Economies Review* 7(2): 99–116.

McKinnon, R. 1963. "Optimum Currency Areas." *American Economic Review* 53(4): 717–24.

Mundell, R. 1961. "A Theory of Optimum Currency Areas." *American Economic Review* 51(4): 657–64.

Obstfeld, M. 2002. "Exchange Rate and Adjustment: Perspectives from the New Open Economy Macroeconomics." NBER Working Paper 9118.

Obstfeld, M. and K. Rogoff. 2000. "New Directions for Stochastic Open Economy Models." *Journal of International Economics* 50 (1): 117–53.

———. 2002. "Global Implications of Self-Oriented National Monetary Rules." Quarterly *Journal of Economics*, 117 (2): 503–35.

Rose, A. and C. Engel. 2000. "Currency Unions and International Integration." NBER Working Paper 7872.

Tavlas, G. 1993. "The 'New' Theory of Optimal Currency Areas." *World Economy* 16: 663–85.

Taylor, J. 2000. "Low Inflation, Pass-Through, and the Pricing Power of Firms." *European Economic Review* 44(7): 1389–408.

Woodford, M. 2003. *Interest and Prices: Foundations of a Theory of Monetary Policy.* Princeton, NJ: Princeton University Press.

Monetary Policy in Chile: Institutions, Objectives, and Instruments

Francisco Rosende
Pontificia Universidad Católica de Chile

Matías Tapia
Pontificia Universidad Católica de Chile

Inflation seemed to be an endemic disease of the Chilean economy for most of the 20th century, with its presence being felt even before the creation of the Central Bank in 1925. However, things seemed to change drastically in the mid 1990s, when the country began to experience a sustained process of convergence toward inflation rates similar to those prevailing in industrialized economies. While convergence has not been completely smooth, and inflation concerns managed to get back to the spotlight as recently as 2008, Chile's long inflationary tradition seems to be a thing of the past, and the country now enjoys the benefits of price stability.

Table 1. Inflation in Chile, 1931-2010

Decade	Average Annual Inflation Rate (%)
1931-1940	7.2
1941-1950	18.6
1951-1960	37.3
1961-1970	27.8
1971-1980	174.8
1981-1990	20.3
1991-2000	8.5
2001-2010	3.2

Sources: Central Bank of Chile and EH-Cliolab.

Chile's history of inflation highlights the role played by the institutional framework in which economic policy is developed, and particularly the priorities and restrictions faced by economic authorities over time. This study discusses the main changes in the institutional framework of monetary management over the last 50 years, as well as the evolution in the consensus among economists regarding the causes and consequences of inflation. We also provide an empirical description of the behavior of inflation in Chile, and link it to recent evidence for industrialized economies using the state-space methodology presented in Stock and Watson (2007).

A recent and interesting contribution to the inflation literature, related in spirit to the research agenda we plan to start with this paper, was made by Cecchetti, Hooper, Kasman, Schoenholtz and Watson, in the context of the 2007 "U.S. Monetary Policy Forum". The authors present an empirical analysis of inflation cycles in G7 economies over the recent decades, and attempt to disentangle the institutional, structural, and methodological factors that underlie those fluctuations.[1] Hence, Cecchetti, and others review the explanations proposed by the literature to account for the dramatic rise in inflation in the United States beginning in the late 1960's, which was followed by a period of macroeconomic stability that began at the end of the 1980's and lasted until the middle of the past decade, with the burst of the "subprime crisis". The first phenomenon is known in the literature as "The Great Inflation" and the second is referred to as "The Great Moderation."

Similarly, the sharp reduction in Chilean inflation has been explained by several (complementary) hypotheses which emphasize some particular change in the macroeconomic environment during the last 15 years:

i) The 1990 constitutional bill stating the independence of the Central Bank with a clear mandate to preserve price level stability, which can be interpreted as maintaining a low rate of inflation.

ii) The gradual adoption of an explicit inflation targeting scheme by the Central Bank of Chile. This framework became full-fledged with the adoption of a (mainly) floating exchange rate at the end of the 1990s.

iii) An exogenous external shock, reflected in a worldwide process of disinflation, associated to the entry of China, India, and former

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1. The same question is analyzed, but from a different perspective, in Romer and Romer (2002).

Soviet republics in the international market, and its impact on the global supply of goods.

The first part of the paper reviews the discussion about the sources of inflation fluctuations in developed economies during the last four decades, with a particular focus on the U.S. More specifically, we examine the explanations behind the so called "conquest of American inflation" since the mid 80s.

The second part of the paper discusses analytically the Chilean inflation experience, reviewing the Central Bank's institutional framework as well as the domestic literature on the causes and consequences of inflation. We also provide a preliminary discussion of the stylized facts surrounding the different hypotheses explaining the reduction of inflation in the 1990s.

The third part of the paper provides a formal analysis of the empirical properties of inflation over the last 30 years, using the methodology to identify structural breaks developed by Bai and Perron (1998, 2003), as well as the state-space representation proposed by Stock and Watson (2007) and recently applied by Ceccheti and others to the G7 economies, to identify changes in the inflation process of the Chilean economy between 1977 and 2011. This allows us to put the Chilean experience on an international context, and to disentangle the contribution of temporary and permanent shocks to the behavior of inflation. We interpret this evidence as preliminary, and as the starting point for a more exhaustive analysis about the structural foundations for the evolution of inflation in recent decades.

1. Inflationary Cycles: A Look at Recent Literature

Modern interpretations of inflation cycles experienced by industrialized economies over the last 40 years—particularly in the United States—highlight: i) changes in the level of knowledge prevailing in the profession—and consequently among government authorities—about the nature of restrictions and trade-offs faced in exercising monetary policy; ii) information problems caused by unexpected and significant shocks, which led to errors in estimation by the authorities regarding the "speed limits" of monetary policy;[2] iii) "tactical" or "strategic" monetary policy movements based on changes

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2. In the case of the United States this point relates with the estimation of the "potential output" and then with the estimation of the "output gap".

in the authorities' perception of the nature of the trade-off between inflation and unemployment, which is recognized as important for a certain period of time; iv) changes in the institutional framework for monetary policy and particularly, its relationship with fiscal policy;[3] and v) exogenous shocks, unrelated to monetary management—good or bad luck—which led to fluctuations in inflation.

Regarding the first explanation, some theories have emphasized the profession's relative ignorance in the late 1960s about the nature of the trade-offs faced by monetary policy, summarized in the shape of the "Phillips curve," as a driving force behind the policy decisions that lead to the inflation outburst. For Romer and Romer (2002), who review the memoranda and statements of the U.S. Federal Reserve over a long period of time, the institutional perspective on the options and tradeoffs associated to monetary policy changed significantly over time. In the 1950s, the consensus view on the relationship between inflation and economic activity was fairly similar to what was later identified as the "natural rate hypothesis",[4] with the additional insight that distortions would make the relationship between inflation and unemployment positive if inflation exceeded an upper threshold.[5] By the mid-1960s, however, the idea of a stable "Phillips curve" began to take root. This initially stimulated the application of expansive policies and later delayed the adoption of stabilization policies. Thus, the general perception of a negative and stable relationship between inflation and unemployment first nurtured the application of expansive policies—to stimulate economic activity and employment—and later impeded the application of stabilization policies, which generated fear of a politically unsustainable rate of

3. In the United States, which has a strong influence on the development of the academic agenda, this does not appear to be an attractive line of analysis for explaining inflation cycles in that economy since the mid-1960s, insofar as the institutional framework of the Federal Reserve did not undergo major changes in that period. However, this was not the case in Chile and other economies in the region, as is thus an hypothesis to explore in the future.

4. Friedman (1968) and Phelps (1968).

5. A perspective similar to the dynamic behind the monetary policy decisions causing inflation cycles is found in Milton Friedman's Nobel Lecture of 1977. Here, Friedman poses the existence of a third stage within the discussion of the Phillips curve, where the first stage is that which suggests a stable trade-off between inflation and unemployment and the second one is the vertical curve that emanates from the "natural rate hypothesis." The third would be a Phillips curve with a positive slope, originated in the difficulties encountered by an economy in efficiently assigning resources, in a context in which inflation is accelerating. During this period of adjustment—which according to Friedman could be prolonged—inflation stabilizes at a certain level and society learns to coexist with it as best it can.

sacrifice. This was particularly true after the traumatic experience of the Great Depression of the 1930s, which provoked a high level of implicit penalization for episodes of high unemployment and contraction of economic activity.

While the high level of inflation in the United States towards the end of the 1970s was sufficient reason to implement a stabilization program—especially considering the special feature of the dollar as international medium of exchange and store of value—the process was reinforced by the environment generated in the academic economic discussion by the proposal of the "natural rate hypothesis" first and the "rational expectations hypothesis" later. While the first hypothesis established that there wasn't a long-run trade-off between inflation and unemployment, the "rational expectations hypothesis" severely questioned the effectiveness of stabilization policies for variables such as aggregate output and employment, recommending that monetary policy be focused on achieving low inflation.[6]

In mid-1979, with U.S. inflation peaking at an annual 13%, the Federal Reserve under Paul Volcker's leadership began an aggressive anti-inflation program, through a strong increase in interest rates. By 1982, inflation reached 3.8% in 1982, its lowest in a decade. The U.S. stabilization program was subsequently followed by other similar experiences, such as that implemented in Great Britain by Margaret Thatcher's government.

While the policy implications of the "rational expectations hypothesis" gave rise to a heated academic debate,[7] which ultimately enriched the initial conclusions, a broad agreement was achieved among economists that the essential objective of monetary policy should be to control inflation, because any real gains from an expansive monetary policy would be essentially temporary. In this perspective, the gains achieved by numerous economies in controlling inflation would be fundamentally lasting, reflecting a kind of "technological progress" caused by a better understanding of economic phenomena.

Since the mid-1990s the so-called "Taylor principle"—a monetary rule proposed by economist John B. Taylor[8]—became popular among central bankers of industrialized economies. According to this rule,

6. In this regard, see Lucas and Sargent (1981) and Sargent and Wallace (1975).

7. A cause of the debate was the high and prolonged unemployment that generated this stabilization program, despite having been announced with a great deal of publicity by the Federal Reserve.

8. Taylor (1993).

inflation control could be achieved through an elastic response—more than one to one—of the monetary policy rate (MPR) to changes of the inflation trend (π^T) over the relevant horizon. For Taylor (1999), the progress achieved in numerous economies in controlling inflation —since the mid-1980—was the result of applying what he calls the "new monetary policy", which is simply the timely and elastic adjustment of the MPR given changes in π^T, as previously described.

On a similar vein, the "inflation targeting" scheme became a popular framework to organize the monetary management.[9] According to this concept, the long-term neutrality of monetary policy implies that monetary policy should aim for an inflation trend that is coherent with an explicit target. On the other hand, the existence of sluggish adjustments in the goods and factors markets would support defining the target as a medium term objective, leaving room for such adjustments to be completed.

The adoption of institutional regimes aimed at protecting the central bank from a potential subordination to fiscal policy,[10] the application of monetary strategies inspired by "Taylor's principle," and the adoption of some form of "inflation targeting" are the outcomes of an intellectual environment stimulated by the "rational expectations revolution" that began in the mid-1970s and in that sense, reflects true progress in economic theory and policy. According to this optimistic perspective, gains in inflation control should be permanent, a scenario that Sargent (1999) calls "the triumph of the natural rate hypothesis." This concept summarizes the influence of the mentioned theory of short-run aggregate supply, incorporating into it the rational expectations hypothesis.

However, as discussed earlier, this triumphant interpretation is not accepted universally. As indicated in point ii), other theories of inflation cycles in industrialized economies—particularly the U.S. economy—have stressed the existence of information problems and the associated mistakes by the Federal Reserve in identifying inflation pressures, which lead to reaction that was both slow and timid. In particular, Orphanides (2002) and (2003) points out that if the Fed's monetary policy is evaluated with the information that was effectively available at the time decisions were made, there are no major changes between the policy applied in the 1960s and a good part of the following decade—a period associated with the gestation and

9. Mishkin and Schmidt-Hebbel (2007).
10. Regarding this experience, see Cukierman, Neyapti and Webb (1993).

subsequent development of the "Great Inflation" in that economy—and the policy later followed by Volcker and Greenspan during the period of greater stability known as the "Great Moderation." In other words, monetary policy management, conditional on the information held by the authorities, didn't differ greatly in the "Great Inflation" and the "Great Moderation" periods. Under this view, authorities did not become wiser or more enlightened in time.

The empirical research of Ceccheti and others refutes this analysis by extending the experiment proposed by Orphanides across time and countries. According to their results, since the 1980s the Fed showed a more hawkish attitude in combating inflation, manifested by stricter adhesion to "Taylor's principle," reflected in a elastic response (greater than 1) of the monetary policy rate to inflation.

The review of different episodes of inflation cycles suggests that in each economy there is a certain critical level of inflation (π^*) above which the benefits of a stabilization program compensate for the possible real costs of applying it. However, below π^* the monetary authorities place a greater weight on the costs—both economic and political—of the stabilization program, and as a result discard its implementation. This "equilibrium inflation rate"[11] is specific to each economy and depends on numerous factors which have been treated extensively in the literature, beginning with research on the characteristics of aggregate supply, which emphasizes its changing character as a function of the inflation level and the global macroeconomic environment. Another interesting line of analysis, suggested by Posen (1993) and more recently by Acemoglu and collaborators,[12] is related to the distribution of winners and losers caused by a certain macro environment. According to this view a certain critical level of inflation would produce significant political support for the implementation of a stabilization program.

This line of analysis coincides with that posed by Sargent (1999), which highlights the essentially strategic character of monetary policy adjustments undertaken by the central banks of the G7 starting in the early 1960s, which caused the above mentioned inflation cycles. Thus, the expansionary management of aggregate demand during the 1960s reflected the period's expectation on the slope of the Phillips

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11. See, for example, Barro and Gordon (1983).
12. For example, Acemoglu, Johnson and Robinson (2004).

curve.[13] Later, as policymakers revised their priors regarding the nature of the trade-off, this turned less convenient to policymakers and then a more vigorous stabilization policy was advisable.

Following this line of reasoning, the succession of favorable supply shocks[14]—including the deflationary effect of the definitive incorporation of China, India, and the former Soviet republics into international trade—would have shaped a scenario that lead to low inflation, even in the context of monetary management by the Fed that, during much of what has been called the Great Moderation, could be considered expansionary.

As can be seen in table 2, inflation in 1990 reached 5.8%[15] in the United States and then began a gradual decline until the end of that decade, in the context of vigorous output growth. While the traditional monetary indicators show modest growth at the beginning of the inflation deceleration process, their growth accelerates in the context of strong GDP growth and declining inflation. Of course, this does not prove that favorable supply shocks caused inflation to fall. However, this view seems consistent with the Federal Reserve's public discourse, which did not include concerns for inflation during the period, but rather warnings of the possible effects of the Asian crisis, the risks associated with the collapse of the Long Term Capital hedge fund in 1997 and the "millennium effect" associated with the year 2000.[16]

According to Sargent (2002), regardless of changes in perceptions on the interactions between nominal and real variables, a rigorous analysis of the results shown by the U.S. economy should take into consideration that the nature of the shocks faced in the macro environment in each decade was quite different. This hypothesis has also been defended by Stock and Watson (2003), who have attributed the Great Moderation—which started in the early 1990s and lasted through the middle of the last decade—more to the different nature and magnitude of the macroeconomic shocks seen in each period, than to variations in the degree of effectiveness and/or the monetary policy approach.

13. In other words, it was possible to achieve a substantial improvement in activity and employment levels with only a moderate inflation increase.
14. On this topic, see IMF (2006).
15. The average of the three prior years was 4.5%.
16. Regarding the Fed's perspective, see Greenspan (2007).

Table 2. Macroeconomic Performance of the U.S., 1990-2005

	GDP growth (%)	*Inflation (end of period) (%)*	*6-month LIBOR 6 months (%)*	*Money (M2), annual growth (%)*	*Money and quasi-money, annual growth(%)*
1990	1.9	5.8	8.4	5.5	2.7
1991	-0.2	2.9	6.1	3.7	1.5
1992	3.4	3.1	3.9	1.8	-0.2
1993	2.9	2.7	3.4	1.0	0.6
1994	4.1	2.7	5.1	1.3	0.4
1995	2.5	2.7	6.1	2.1	6.9
1996	3.7	3.0	5.6	4.8	7.9
1997	4.5	1.7	5.9	5.0	8.0
1998	4.4	1.6	5.6	7.1	9.6
1999	4.8	2.9	5.5	7.4	9.5
2000	4.1	3.4	6.6	6.0	8.1
2001	1.1	1.6	3.7	8.7	7.5
2002	1.8	2.6	1.9	7.5	4.4
2003	2.5	1.9	1.2	6.9	4.5
2004	3.6	3.2	1.8	4.7	5.7
2005	3.1	3.7	3.8	4.3	8.2

Sources: Federal Reserve and International Monetary Fund.

Sims (1980) and Bernanke and Mihov (1998) provide important evidence on the influence of the macroeconomic environment on the activist policies to manage aggregate demand in the U.S. In line with the results of Sargent and Stock and Watson, their evidence suggests that changes in the Volcker-Greenspan period correspond essentially to differences in the magnitude and variance of the macro innovations that took place in that period. It is important to consider this hypothesis, both for analyzing the U.S. experience—in terms of the changes observed in indicators of macroeconomic stability—as well as in small economies such as Chile, where a qualitatively similar process has been observed in recent decades.

2. An Overview of Chile's Inflation History

Even prior to the creation of the Central Bank in 1925, inflation was a characteristic trait of the Chilean economy. In fact, in the first quarter of the 20th century—before the Central Bank was founded—average inflation rate was close to 6%.[17] The inflation trend became steeper in the mid-1950s, as monetary policy became subordinated to the public finance situation. To gauge the magnitude of the inflation process in Chile, it is interesting to note that while cumulative inflation in the U.S. was close to 188%[18] in the period known as the "Great Inflation"—from 1967 to 1982—, in Chile it topped 1,300%,[19] an extraordinarily high figure that highlights the complete absence of monetary discipline.

Chile's monetary history in the 20th century contains numerous episodes of stabilization programs[20]—more or less one in each government—, reflecting that inflation was a persistent topic on the public agenda. Nevertheless, this concern on the costs of inflation was never strong enough so as to generate sustained support for stabilization, so once the real costs of any given program became evident, those programs were abandoned.

Of course, the fight against inflation became easier during periods in which the price of copper was high, which reduced the need for monetary support for fiscal policy and made it possible to withstand a delay in the pace of currency devaluation. Intuitively, the reverse held during periods in which terms of exchange deteriorated.

In the early 1970s, inflation began to accelerate rapidly in Chile as a result of a dramatic monetary expansion which was largely explained by a significant increase in the fiscal deficit. Evidently, the economic authorities of the socialist government that took office in 1970 were not followers of the monetarist theory of inflation, as money expanded by 438% between 1971 and 1972[21]. The use of international reserves, supported by the availability of external

17. Source: Cliolab UC.
18. The average inflation rate in the U.S. economy was 7.4% in the cited period, a figure that is indeed high for an economy whose currency is used as a medium of exchange in international trade.
19. This results in an annual average around 128%.
20. On this topic, see for example Ffrench-Davis (1973) and Arbildúa and Lüders (1968).
21. If 1973 is included, this growth – also from December to December of each year – is 2,196%: Source, Central Bank of Chile, Indicadores Económicos y Sociales 1960-2000 (Economic and Social Indicators 1960-2000).

resources resulting from the unilateral default on payments to service external debt instituted by the government in the second half of 1971, delayed the inflationary outburst but left the country at the edge of hyperinflation in 1973.

It is difficult to explain, from a strictly economic perspective, the rationale behind monetary policy in this period. It probably involves the government's objective of installing a socialist economy as quickly as possible, as well as a certain degree of ignorance and/or carelessness about the consequences of a large-scale fiscal deficit —25% of GDP in 1973—and an unprecedented monetary expansion, which reached growth of 326.7% that year.

Given the magnitude of these inflationary pressures, inflation control became a priority for the military government installed in September, 1973. This led to a significant fiscal adjustment in 1975,[22] jointly with a more complex process of controlling monetary expansion and inflation expectations. The main difficulties for monetary supply arose from the expansionary pressures associated to an incipient financial market, whose development was part of the package of reforms promoted by the government. New financial intermediaries —the so called "financieras"—contributed to an abundant supply of liquid liabilities, which generated several episodes in which some institutions collapsed, including several banks. Controlling their growth represented a significant challenge for the Central Bank.[23]

Different stabilization strategies were implemented since the mid 70s.[24] A common denominator across these stages was the primary role given to nominal exchange rate. In effect, the implementation of a preannounced rate of devaluation first, followed by two revaluations of the peso, and the adoption of a fixed exchange rate, were all designed to make inflation converge to a low, stable level through a break in the inflation expectations dynamic. This objective seemed within reach in 1981, when the economy began to suffer the consequences of the drastic monetary shock applied in the United States in mid-1979. In particular, the sharp increase in international interest rates that followed the U.S. stabilization program was a huge shock for the Chilean economy, whose Current Account Deficit was close to 14% of GDP in 1981. The other side of this rapid growth in external liabilities was a weak position of the financial sector.

22. In this regard, see Edwards and Edwards (1991).
23. On this topic, see De la Cuadra and Valdés (1992).
24. A description of this plan can be found in Edwards (2000).

The fragility of the financial system forced the government to devaluate the peso in 1982, abandoning the fixed exchange rate. In that scenario, controlling inflation—which had declined drastically in the first months of 1982—was no longer a priority, as overcoming a severe financial and balance-of-payments crisis became the main policy concern.

In 1983, an indexed exchange rate was adopted as a device to stimulate exports, with inflation returning to annual rates around 20%. Specifically, the authorities targeted a high real exchange rate, after the successive devaluations in the aftermath of the collapse of the exchange rate peg. Despite the implementation of rigorous fiscal discipline from 1985 to 1989,[25] the growing wealth of households and private firms—whose counterpart was a significant decline in external debt as a percentage of GDP[26]—led to a recovery in domestic demand, and in turn to a decline in the equilibrium real exchange rate. The existent "real exchange rate rule" lead to an increasing imbalance between supply and demand conditions of an economy in recovery and the real exchange rate level,[27] causing an increase in inflation towards the end of the 1980s.[28] A significant real revaluation of the peso became inevitable in the early 1990s.

In December 1989 a new institutional framework establishing the independence of the Central Bank—was set in place.[29] At that time, only a few weeks after taking office, the new authorities of the now independent Central Bank implemented a severe monetary adjustment to restrain an accelerating inflation rate, in a context of strong growth in domestic spending. The strategy used was a sharp

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25. In this adjustment process, an active agenda of "supply policies" was carried out to increase the aggregate productivity of the economy. In addition, there was a major program to reconvert external debt to internal debt or assets, which contributed to a rapid adjustment process in the problem of high indebtedness seen in the Chilean economy.

26. This was a consequence of an active "supply policies" agenda, in addition to an effective program to convert external debt to capital. On this topic, see Fontaine (1988).

27. As is logical, in a context of widespread indexation of salaries and the exchange rate, inflation remained unanchored and was determined fundamentally by the shocks that could affect both prices. Let's consider this case in an inflation equation such as $\pi_t = \lambda \pi_{t-1} + \alpha x_t + u_t$, where x_t is the "foundations" of inflation in period t, and u_t is a random cost shock with a mean of zero and finite variance. In this case, the trajectory of inflation will be defined by $\pi_t = \alpha \sum_{i=0} \lambda^i x_{t-i} + \sum_{i=0} \lambda^i u_{t-i}$. The stability of the system requires that $\lambda < 1$.

28. An analysis of this scenario can be found in Rosende (1985).

29. This institutional framework closely resembles the prestigious Bundesbank's mandate and organization.

increase in the real interest rate of long-term internal debt of the Central Bank.[30]

Table 3 shows how the relationship between aggregate expenditure (AE) and GDP grew—first gradually and then more rapidly—between 1986 and 1989, which according to the most common real equilibrium exchange rate models should have led to a decline in that rate. However, the reverse occurred, as the table 3 illustrates. In a context of decreasing unemployment, inflation surged, with the exception of 1988, when the value-added tax was reduced from 20 to 16%, and average tariffs fell from 20 to 15%.[31]

The combination of a significant undervaluation of the peso and high real interest rates on the Central Bank's long-term debt accentuated a process of capital inflows that could no longer be contained by a declining flow of debt conversion operations.[32] In this scenario, a significant drop in inflation and the real exchange rate, as the one that actually occurred, seemed highly probable.[33] On the other hand, regardless of the efficiency of the monetary strategy it adopted, the energy and speed of the response of the Central Bank Board probably contributed to build a "hawkish" reputation, coherent with the price stability mandate granted by the new legal text.

The process of inflation reduction in Chile was accentuated in the 1990s, until inflation converged to the levels observed in the industrialized world. This decline was contemporary to strong GDP and domestic demand growth. As mentioned, the reduction in inflation was stimulated by persistent capital inflows, which appreciated the exchange rate in a global context in which inflation pressures seemed to be contained.

30. As expected, a consequence of this decision was an important increase in capital inflows to the Chilean economy, increasing the degree of misalignment of the real exchange rate. On this topic, see Rosende (1990).

31. That year, the international price of oil fell substantially, by almost 30%, contributing to deceleration of inflation. For more information on this process, see Rosende (1990).

32. The attraction of debt conversion operations led to high demand for dollars in the "unofficial" currency market for the purpose of repurchasing external debt. This scenario can be viewed as one of a high premium for this type of saving—reduction and/or transformation of liabilities—which temporarily supported a higher real exchange rate.

33. The existence of a managed exchange rate scheme, in terms of a floating band around a central level of the same that was adjusted according to a real exchange rate rule, conspired against monetary policy in that a gradual decline in the dollar in relation to the development unit (*unidad de fomento*, or UF) accentuated the influx of capital in this period. Among the government's reactions were to establish a reserve of the influx of short-term capital and make periodical adjustments to the exchange rate rule. On this subject, see Valdés and Soto (1996).

Table 3. Macroeconomic Performance of Chile, 1985-1991

	GDP growth (%)	AE / GDP (1985=100)	Real Exchange Rate (1985=100)	Inflation (%)	Unemployment rate (%)
1985	3.5	100.00	100.00	26.4	12.0
1986	5.6	99.35	110.06	17.4	10.4
1987	6.6	102.32	114.84	21.5	9.6
1988	7.3	102.65	122.35	12.7	8.0
1989	10.6	105.18	119.47	21.4	7.1
1990	3.7	104.35	124.04	27.3	7.4
1991	8.0	102.60	117.08	18.7	7.1

Source: Central Bank of Chile.
Note AE: is aggregate expenditure.

Table 4 shows some indicators related to the disinflation process in the 1990s. It illustrates the persistent lag of variations in the nominal exchange rate with respect to inflation, which was only reversed when external financial turbulence associated with the "Asian Crisis" erupted at the end of the decade, the Chilean economy with significant excess aggregate expenditure. The direction of monetary policy was initially described by the rate of its 90-day debt, or PRBC[34]—defined in real terms[35]—which began to decline in 1991 and remained below real GDP growth. After the "Asian Crisis", which forced a significant monetary adjustment between 1998 and 1999, monetary policy rates—this time using the nominal rate of overnight interbank loans, expressed in annual terms, as the reference rate—dropped sharply, coinciding with a new drop in inflation and positive GDP growth.

As shown in table 4, the reduction in inflation coincided with a persistent surplus in the balance of payments—in response to large capital inflows—and also with a prolonged government surplus, which only changed sign, temporarily, with the Asian Crisis at the end of that decade.

To put these events in perspective, it is important to analyze what was going on in the rest of the world in terms of inflation and GDP

34. The Central Bank's indexed promissory notes.
35. In development units (UF).

growth. According to International Monetary Fund estimates (table 5), the global economy reduced its inflation rate from 25.8% in 1990 to 4.5% in 2000 and 4.1% in 2010. Similarly, the group designated by the IMF as "Emerging and Developing Economies" reduced inflation from 82.4% in 1990 to 8.1% in 2000 and 6.6% in 2010. As shown in table 6, this global disinflation occurred in a context of sustained GDP growth in the global economy. In some cases, such as Brazil and Chile, there was a virtuous combination of disinflation and high output growth, a rare event under demand driven stabilization process.

Table 4. Macroeconomic Performance of Chile, 1990-2005

	Inflation (end of year) (%)	GDP growth (%)	Nominal exchange rate, mean devaluation (%)	General government (% of GDP)	Balance of payments (% of GDP)	Monetary policy rate (%, annual)*	Interest rate on 90 days Central Bank bonds PRBC (%, anualized)**
1990	26.0	3.8	14.3	0.8	7.8	-	7.6
1991	21.8	7.9	14.6	1.5	3.8	-	6.1
1992	15.4	12.2	3.9	2.3	6.0	-	5.4
1993	12.7	7.0	11.5	2.0	1.3	-	6.5
1994	11.4	5.7	4.0	1.7	6.2	-	6.4
1995	8.2	10.5	-5.6	2.6	1.6	-	6.1
1996	7.4	7.4	3.9	2.3	1.7	-	7.3
1997	6.1	6.6	1.71	2.0	4.1	6.87	6.8
1998	5.1	3.3	9.8	0.4	-2.8	9.01	-
1999	3.3	-0.7	10.6	-2.1	-1.0	5.87	-
2000	3.8	4.5	5.9	-0.7	0.4	5.26	-
2001	3.6	3.3	17.7	-0.5	0.9	5.07	-
2002	2.5	2.2	8.6	-1.2	-0.3	4.05	-
2003	2.8	4.0	0.3	-0.4	0.5	2.73	-
2004	1.1	6.0	-11.9	2.1	0.0	1.87	-
2005	3.1	5.6	-8.2	4.7	1.5	3.44	-

Sources: Central Bank of Chile and Chilean Budget Division.
Note: In August 2001 the Central Bank of Chile introduced a change in the scheme of monetary policy rate setting. Instead of using a real rate—through adjustments in the nominal rate in order to achieve the given real target—the new procedure sets the nominal interest rate as the main instrument and indicator of monetary policy.
Column * corresponds to the new monetary policy regime. Column ** corresponds to the old monetary policy regime, where the real rate of 90 days central bank's domestic debt was the key reference.

Table 5. CPI Inflation in Selected Regions and Countries, 1990-2005 (%)

	World	*Developed countries*	*Emerging countries*	*Chile*	*United States*	*Brazil*
1990	25.9	5.9	82.4	27.2	5.8	1,621.0
1991	18	4.0	52.4	18.8	2.9	562.2
1992	36.8	3.0	129.5	13.0	3.1	1,119.1
1993	37.2	2.9	128.3	12.6	2.7	2,477.2
1994	22.7	2.5	69.3	9.2	2.7	916.4
1995	11.4	2.5	29.1	8.3	2.7	22.4
1996	7.5	2.5	16.7	6.6	3.1	9.6
1997	5.4	1.9	11.7	6.0	1.7	5.2
1998	6.5	1.4	16.0	4.7	1.6	1.7
1999	4.5	1.8	9.4	2.3	2.9	8.9
2000	4.5	2.5	8.1	4.6	3.4	6.0
2001	3.6	1.4	7.3	2.7	1.6	7.7
2002	4	2.1	7.0	2.9	2.6	12.5
2003	3.3	1.6	5.9	1.1	1.9	9.3
2004	3.9	2.3	6.2	2.4	3.2	7.6
2005	3.8	2.5	5.6	3.7	3.7	5.7

Source: International Monetary Fund.
Note: inflation rates at end of year.

The global combination of high growth[36] and rapid disinflation suggests that, at least partially, the reduction of inflation in Chile in the 1990s was associated to external factors linked to supply shocks, and not exclusively to a drastic decrease in the Central Bank's tolerance to inflation. Something similar seems to have occurred in other economies, in light of the global nature of the disinflation process described in table 5.

As Alan Greenspan pointed out in 2005:

"Over the past two decades, inflation has fallen notably, virtually worldwide, as has economic volatility. Although a complete understanding of the reasons remains elusive, globalization and innovation would appear essential elements of any paradigm capable of explaining the events of the past ten years".[37]

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36. With the exception of 1999, when the effects of the Asian crisis manifested themselves in an economy that showed signs of excess expenditure in its current account position in terms of balance of payments and fiscal accounts.

37. Greenspan (2005). See also Greenspan (2007).

Table 6. Real GDP Growth in Selected Regions and Countries, 1990-2005 (%)

	World	*Developed countries*	*Emerging countries*	*Chile*	*United States*	*Brazil*
1990	3.2	3.1	3.4	3.6	1.9	-4.2
1991	2.2	1.5	3.8	8.0	-0.2	1.0
1992	2.2	2.2	2.3	12.3	3.4	-0.5
1993	2.1	1.5	3.3	7.0	2.9	4.9
1994	3.4	3.4	3.4	5.7	4.1	5.9
1995	3.3	2.9	4.0	10.6	2.5	4.2
1996	3.8	3.0	5.1	7.4	3.7	2.2
1997	4.1	3.5	5.6	6.7	4.5	3.4
1998	2.6	2.6	2.5	3.2	4.4	0.0
1999	3.6	3.7	3.2	-0.4	4.8	0.3
2000	4.8	4.2	5.8	4.5	4.1	4.3
2001	2.3	1.4	3.7	3.5	1.1	1.3
2002	2.9	1.7	4.7	2.2	1.8	2.7
2003	3.6	1.9	6.2	4.0	2.5	1.1
2004	4.9	3.2	7.5	6.0	3.6	5.7
2005	4.6	2.7	7.3	5.5	3.1	3.7

Source: International Monetary Fund.

In his memoirs[38] Greenspan states that a panorama of deflationary forces, strong activity, and asset price indicators indicating a vigorous economy, was a conundrum for monetary policy. Such a combination of events can be explained by supply shocks, mainly associated to the entry of China, India, and the former Soviet republics in the international economy, and reinforced by significant productivity gains in the information technology industry.

The idea of a worldwide disinflation phenomenon was raised by economists of the Bank for International Settlements[39] as well as by economists of the International Monetary Fund. However, this hypothesis has not played an important role in the economic

38. See Greenspan (2007).
39. Borio and Filardo (2007).

discussion of emerging economies like the Chilean one. In this case, as in many others, the most popular theories of the so called "conquest of the Chilean inflation", stressed the role of changes introduced in the Central Bank's institutional setting as well as in the monetary policy framework. Certainly we do not dismiss such aspects of the explanation of the recent evolution of the rate of inflation in Chile. However, a careful analysis of the numbers suggests the role of external factors in the Chilean disinflation process.

3. THE INSTITUTIONAL FRAMEWORK

One of the possible causes of the inflation movements observed in Chile is the evolution in the legal mandate guiding the Central Bank. From this perspective, it would be reasonable to relate the reduction in inflation to the institutional shift to central bank independence at the end of 1989.

In fact, the bank's autonomy from political interference was ill-defined from the 1925 law that created it, and subsequently declined over time. In effect, the initial institutional design proposed an administration and ownership structure that sought to reduce the government's influence on the Central Bank's decisions. The law established a board of directors of 10 members, only three of whom were appointed by the country's president. As for the other board members, two were appointed by the domestic banks, one by foreign banks, two by industry groups, one by worker organizations and one by private shareholders.[40] Regardless, the statutes of the nascent central bank did not define its objectives clearly or with precision, a flaw that would contribute to a sustained deterioration in the institutional commitment to a stable currency. As shown in Carrasco (2009), the same ambiguity on the guidelines for the operation of the Central Bank led to policies that were increasingly determined by fiscal needs.

One of the reasons behind the creation of the Central Bank in 1925 was to establish an institutional framework to organize the process of creating means of payments and for many, to reestablish the gold standard system. Moreover, there was already evidence of

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40. As for the Bank's capital, the law approved in 1925 creating the entity indicates that the state's share would be 13%, domestic banks would contribute 32%, foreign banks were responsible for 9% and the share of private shareholders was 46%. Corbo and Hernández (2005).

significant inflation pressures, which contributed to shaping a climate of conflict and social instability.

As pointed out in Carrasco (2009), the creation of the Central Bank of Chile was a complex process, as it faced an unstable political environment and intense disagreement between those in favor of strict rules for liquidity supply and those who wanted a more flexible monetary policy, capable of adapting to changes in liquidity.[41] It is interesting to note that the notion of establishing an independent central bank to shelter monetary policy from being subordinated to the needs of public finances already existed in the first proposed laws to create a central bank in the country. Thus, in Carrasco op. cit. the author points out that an important milestone within this debate was reached during "Currency Week," organized in Santiago's Municipal Theater by the School of Commerce at the Universidad Católica de Chile. Some important conclusions drawn at this forum were: …" c) The proposed creation of a central institution to address regularization of the money supply;[42] d) This institution should be absolutely independent from fiscal and political interests; nor should the field of activities of private banks have any influence."

Although there was substantial initial support to focus the Central Bank's efforts on achieving stability of process and balance of payments, the consensus later shifted to interpret monetary and credit management as instruments for economic stimulus[43] rather than economic stability. In fact, since the 1930s monetary policy became so dissociated from maintaining stable prices that price stability was targeted directly by microeconomic interventions through price setting agencies, a severe distortion that would become increasingly prevalent.

The increasing deterioration in the anti-inflation commitment of monetary policy during the Great Depression was accompanied by

41. The former were known as the "*oreros*" because of their preference for strict adherence to the discipline of the gold standard. The latter were known as "papeleros" since their proposal was closer to what could be called adhesion to a fiduciary money system with flexibility in monetary policy to adjust instruments in order to achieve stability.

42. This was after a period in which the wars Chile had been involved in led to the creation of bank money that was not pegged to the gold standard, upon request from the Treasury, in consideration of circumstances qualified as "exceptional" but which curiously had become relatively frequent. In this period, the Chilean monetary debate, described by Carrasco op. cit. and Millar (1994), took place amidst the unpleasant memories of painful adjustments imposed by the gold standard and the inflation pressures of the paper-money system.

43. Regardless of the implication of the monetary policy of this mandate.

a systematic loss in the already weak Bank's autonomy, along with a more active role in regulatory tasks, particularly in the currency and credit markets.[44]

As the Central Bank began to lay an active role as instrument for development, the presence within the Board of representatives of the different branches of production, only exacerbated the pressures for more expansionary monetary management.[45]

This new understanding of the responsibilities of Central Bank as a development bank was expressed in the 1953 reform to its organic law, which states: "The aim of the Central Bank of Chile is to foster the orderly and progressive development of the national economy through a monetary and credit policy that, seeking to avoid inflationary and depressive trends, allows for the best use of the country's productive resources."[46]

The shaping of a development goal for monetary policy was strongly influenced by the Great Depression and the popularization of the "real bills doctrine."[47] According to this doctrine, the macroeconomic impact of monetary policy did not depend on how much money was issued, but on the way in which it was done. Thus, money provided for "productive credit," has different effects than money generated to finance the fiscal deficit or speculative stock market operations.[48]

In 1960, the authority of the central government over the Central Bank power was formally consolidated through the enactment of a new Organic Law for the institution. The law increased the number of government appointed representatives in the Central Bank board to four of a total of eleven members. In addition, a new provision established that the Governor and Vice governor of the Central Bank had to be ratified by a presidential decree. Somewhat unsurprisingly,

44. The Central Bank's obligation to control currency was established in 1960; prior to that, the International Exchange Commission (Comisión de Cambios Internacionales) held that responsibility.

45. It should be noted that in 1946 a law was passed to include members of Congress in the board of directors of the Central Bank, which evidently made it more difficult to focus the bank on the objectives of macroeconomic stability, as the high discount rate inherent in the political process dominated its decision-making.

46. Article 2 of Decree with Force of Law 106, of July 28, 1953. Cited in Carrasco (2009) op.cit.)

47. As pointed out by Lüders and Rosende (2007), the real bills doctrine had a significant influence on the focus of monetary policy implemented by the Central Bank of Chile almost until the end of the 1950s.

48. Carrasco, op. cit.; Millar op. cit.

designating the Minister of Finance as Central Bank Governor became the usual practice after these reforms, highlighting with no subtlety who was in charge.

In 1989, a new institutional framework, modeled essentially on the successful experience of Germany's Bundesbank,[49] granted the Central Bank autonomy from the central government. The new law defined stability in currency value and the operation of the system of payments as the CB's main goals. Over the years, this mandate came to be interpreted—by the Central Bank itself—as an inflation target range between 2% and 4%.

The decline of inflation in Chile since 1990 suggests that the new institutional framework has been successful.[50] Nevertheless, assuming a direct causality might appear as overly simplistic, as the evidence suggests a weak relationship between the legal and the effective degree of central bank independence[51] in developing countries. In the specific case of Chile, the first 20 years of Central Bank independence have been characterized by a broad political agreement over the benefits of this framework, and of making inflation the CB's main concern. This agreement, however, has been certainly strengthened by the fact that, during the last 2 decades, there have been very few occasions in which the control of inflation has posed a significant cost in terms of output and unemployment. Throughout most of its independent era, the Central Bank has faced favorable macroeconomic conditions. Perhaps the biggest exception was the severe monetary adjustment carried out in 1999, when the Central Bank acted swiftly to put the brakes on the economy's excessive spending,[52] in a context of difficult credit conditions in international markets as a consequence of the Asian financial crisis. This brief episode led to widespread criticism of monetary policy decisions, placing it in evident conflict with fiscal policy. Of course, more time, and probably more adverse shocks, will be needed to prove how solid is the anti-inflation commitment of the Chilean political

49. A review of the debate over the proposed law to establish the autonomy of the Central Bank can be found in *Cuadernos de Economía* 77 of 1989. Also see Fontaine (2000).

50. Regardless of the strong variability seen from one year to the next.

51. Of course, in this second case—when an effective autonomy of monetary policy in regard to the needs of public finances prevails—the inflation rate is lower. On this subject, see Cukierman, Neyapti, and Webb (1993).

52. The current account deficit in the balance of payments reached 6.2% of GDP in 1998.

system, and how much support will be given to CB independence if conditions turn sour. If anything, international experience has shown that such support is not guaranteed.[53]

Finally, we highlight the significant complementary role played by the reforms to banking regulation introduced in 1987. The purpose of these reforms was to establish some early warnings indicators of solvency for the banking system, in order to minimize the magnitude and frequency of government and central bank interventions during episodes of financial stress. Also, private adjustment mechanisms were developed to address deficiencies in banking capital, while at the same time the Central Bank became the lender of last resort in the event of liquidity problems.[54]

4. Inflation and Fiscal Finances

The "passive" nature of monetary policy with respect to fiscal needs can be described simply by using the government's budget constraint, as shown in equation (1). This equation indicates that the government deficit $(G - T)$ can be financed by printing money[55] (dM/P), domestic debt, (dB/P), and net foreign debt (dD/P); that is, by taking on foreign debt or using international reserves.

Equilibrium in the money market implies that: $dM / P = m\left(\pi + \eta_y^m g\right)$ where g is the growth rate of real GDP and η_y^m is the income elasticity of money demand. It is obvious that $m = f(\pi^e)$, where $f' < 0$, imposing a limit on the capacity of the Central Bank to raise revenue through inflation.

In regard to domestic debt, we can assume that there is demand for public debt of the government and/or the Central Bank, which is described by:

$$dB / P = b(\pi + \eta_y^b g).$$

This demand reflects institutional investors—essentially insurance companies and pension fund managers—and banks that seek to

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53. On this topic, see Posen (1993).
54. On this subject, see Ramírez and Rosende (1992) and Reinstein and Rosende (2000).
55. For simplicity's sake, we can assume that the multiplier of the monetary base is equal to one.

maintain a certain proportion of their portfolio in sovereign debt. This demand constitutes a kind of seigniorage associated with the issuance of non-monetary debt. In what follows, we assume for the sake of simplicity that $\eta_y^m = \eta_y^b = 1$.

For tax revenue (T), we assume that it is positively related to the level of real output, so that given an initial product we will associate it with a growth rate (g), and with the level of terms of trade (q). In the Chilean case the copper price is a key determinant of government's current incomes, either through specific taxes on mining activities as well as the profits of Codelco, a state owned copper producer enterprise.

In (2) we derive the inflation rate required to completely finance fiscal expenditure, given a certain level of fiscal deficit, net foreign debt, and domestic debt. Of course, the government could face its budget imbalance by taking more debt from the private sector. In that case, inflation would not rise in the short term, although interest rates would increase, generating larger inflation pressures in the medium term:

$$G - T(q,g) = dD / P + dM / P + dB / P, \tag{1}$$

$$\pi = \left[1 / m(\pi^e)\right]\left[(G - T(q,g)) - dD / P - g(m + b)\right]. \tag{2}$$

According to equation (2), adverse terms of trade shocks—shocks lower level of q—increased the fiscal deficit and the extent of use of international reserves; this lasted until devaluation became inevitable, thereby boosting inflation.[56]

The same equation (2) described above reveals the aggregate relationship between inflation and accumulation of international reserves, making it clear that this accumulation can be financed with resources from the inflation tax.

Viewing the period of high inflation in the Chilean economy from the public finance perspective—at least for the period that would be our Great Inflation between 1953[57] and 1994[58]—gives relevance to the view proposed by Cukierman, Edwards and Tabellini (1992), who

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56. These habitual traits of Chilean economic cycles are described in Cortés (1984).

57. That year, inflation jumped to 53%, the highest ever figure for inflation in Chile until this point.

58. Since that year, inflation has been maintained below 10% annually.

see it as the result of a scenario of political conflict that prevented the establishment of more efficient taxes or adjustments in spending. This is an interesting interpretation of the Latin American political and economic reality in the 1960s, which was marked by increasing social effervescence and political conflict. This took place in a scenario of growing public spending, which did not affect the overall equilibrium as long as terms of trade were high, but which did have an impact on it later.

Equation (2) can also be written as:

$$\pi_t = \theta d_t + \lambda \pi_t^e, \tag{3}$$

where d_t is the rate of monetary expansion required to finance the fiscal deficit, given the use made of international reserves and debt. This is for a certain level of inflationary expectations. This expression can be written as:[59]

$$\pi_t = \theta E_t \left(\sum_{i=0}^{\infty} \lambda^i d_{t+i} \right). \tag{4}$$

According to equation (4), an inflation process with a fiscal origin can only be controlled by making significant adjustments to the level of public expenditures and/or the tax system, as well as to the institutional framework that determines fiscal management.

While the influence of fiscal factors during a large part of Chile's inflation history is unquestionable, it is interesting to note (as discussed in Morandé and Noton, 2004) that regardless of the profound adjustments made in 1975 to the tax system, government spending levels, and the institutional framework for budgeting, inflation remained high—although far from a hyperinflation scenario—in the following years. One possible explanation for the persistence of inflation was the absence of a nominal anchor in a context in which the exchange and wages were indexed until the early 1990s.[60] Another possible source of inflation persistence is the presence of a quasi-fiscal deficit caused by the bailout of the

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59. The term E_t indicates the expectation conditional on information available at t.
60. During the 1990s, the Central Bank made successive changes in exchange policy to give greater flexibility to the exchange rate and regain control over monetary policy and inflation. On this topic, see Vergara (1994) and Rosende (1998).

banking industry in the early 1980s. While it is true that the bailout was handled without major difficulties by the Central Bank, one can't ignore the fact that its presence could have been a source of macroeconomic destabilization if the economy had suffered an adverse shock that would have reduced the rate of growth of real output.

5. An Examination of the Debate About Inflation and Monetary Policy

As indicated, the Great Depression led to an environment in which monetary strategies of the kind inherent in the gold standard were severely questioned. The rise of Keynesian thought, mixed with theories such as the real bills doctrine, provoked a significant decline in the priority given by the authorities to the goal of controlling inflation starting in the 1930s. From this perspective, monetary policy tools were to be essentially aimed at supporting government and private sector financing.

From the mid-1930s to the 1950s, public policies showed greater tolerance for inflation, with most of the attention on the role of institutions such as the Corfo,[61] a state agency created to simulate development of productive activity along guidelines determined by the central government. This was part of a more general shift towards protectionism and a more active role for the State in the economy.

In this period, the "structuralist approach" to inflation became popular in Chile and other nations in the region, promoted strongly by the Economic Commission for Latin America and the Caribbean (ECLAC). In ECLAC's view, inflation was a symptom of weaknesses in the operation of the economy, causing bottlenecks that triggered an increase in overall price levels. From this perspective, inflation could only be contained by correcting those issues, which implied a more difficult and complex effort than merely managing the movements of aggregate demand.[62] Thus, for example, in Sunkel (1958) four structural

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61. Corporación de Fomento de la Producción.
62. As pointed out in Lüders (1970), some inflation theories—which we can place in the structuralism category—stressed the political causes of inflation, which in general were not well specified, but in terms of modern literature can be associated with institutional development models such as those posed by Acemoglu and others (2004) or the perspective proposed by Cukierman, Edwards and Tabellini (1992).

imbalances are identified as causes for money growth and inflation: i) stagnation in the availability of food; ii) inability to increase, through diversification, the purchasing power of exports; iii) an inadequate capital formation rate; and iv) deficiencies in the tax system.[63]

Toward the late 1960s, there was an intense debate about the causes of inflation in Chile and in Latin America in general, which pitted as the structuralism vision against what was called the "monetary approach." As is well known, the monetary theory viewed the high money growth rate, stimulated by fiscal deficits and expansive domestic credit policies, as the main cause of inflation. From this perspective, inflation control would be achieved essentially through the implementation of measures aimed at imposing discipline and austerity on public finance and through that, managing the monetary policy. This approach generally led to the adoption of some kind of exchange rate peg.

The academic debate on inflation was relatively limited in Chile until the mid-1960s, and focused the discussion on conceptual aspects rather than empirical evidence, thus leaving plenty of room for the influence of ideological perspectives. Among the first efforts to carry out rigorous studies on this process using the latest econometric instruments available at the time were those of Harberger (1963), Luders (1970) and Corbo (1974).

In parallel, starting in the late 1960s a series of papers provided empirical estimates of money demands. Of course, an important goal of this research was to identify inflation pressures, through the prism of the monetary theory of nominal income.[64] Important studies along these lines were those of Deaver (1960), Ossa (1964), Reichmann (1965), and Cortés and Tapia (1970), among others.

In the second half of the 1960s, the macroeconomic debate became more sophisticated, reflected in the adoption of more rigorous and formal models for inflation control. An important contribution was provided by the "costs of inflation" model developed by Cauas (1970), which gave the rationale for the stabilization plan used in the first part of the 1966/1970 Frei presidency. The model tried to identify the pressures faced by the economy's most important prices aligning monetary and fiscal policy behind certain inflation objectives. This exercise combined a rigorous evaluation of the cost pressures with

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63. Ossa (1964) explains the failure of some efforts to control inflation, which was due to the deepening of the imbalances mentioned.

64. Friedman (1971).

an estimate of money demand, with the aim of establishing a money growth rate that was compatible with the proposed inflation target. This model was successful in moderating the pace of inflation during the first part of Frei's government, although in the second part it was overwhelmed by intense fiscal spending pressures.

The tremendous monetary and fiscal pressure generated during the socialist government in the early 1970s left the Chilean economy at the threshold of hyperinflation, making it essential to immediately apply an effective stabilization program.

The military government that took power in mid-1973 displayed some doubts about the correct strategy to confront inflation. However, in 1975 a drastic monetary and fiscal adjustment was chosen, instead of a more heterodox program of gradual adjustment based on price controls.[65] This strategy was triggered by a complex balance-of-payments scenario, provoked by an almost 40% decline in terms of trade, in circumstances where the country's political-institutional reality hindered access to external financing.

Many articles and documents describe and discuss the strategy used to confront the serious inflation problem of the 1970s, however it is worth mentioning the letter sent by Milton Friedman to General Pinochet summarizing his recommendations for reaching this objective. That letter describes the classical monetarist recipe for attacking a high inflation scenario. Even though that approach was not fully adopted—mainly because the exchange rate assumed a critical role in the stabilization program—Friedman's view contributed to support the reduction of monetary growth and the adoption of a shock treatment for adjusting public finances as the key ingredients of the stabilization program, dismissing heterodox alternatives.[66]

After a significant decline from inflation levels of three and almost four digits to levels around 40%, there was a perceived barrier to achieving further progress. This could reasonably be assumed to be related to some stickiness in inflation expectations, reflecting a credibility problem about the possibility of achieving greater progress in inflation control. In order to chip away at the skepticism of inflation expectations, and reduce the high degree of inertia in inflation that prevailed in price and wage movements, in June 1979 the government

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65. On the internal controversies regarding how to address the problem of inflation, see Arancibia and Balart (2007) and Fontaine (1988).

66. This letter was published in Friedman and Friedman (1998).

decided to fix the nominal exchange rate.[67] This occurred in the context of a strong influence of the "monetary approach to the balance of payments."[68] As previously stated, this strategy sought to establish a credible commitment to low inflation (in the medium term), which would help contain the inflationary dynamic incorporated into price and salary movements. In fact, the same empirical research on the Chilean inflationary dynamics reveals the importance of movements in the nominal exchange rate. Thus, it is understandable that this variable would play an important role in stabilization programs.

However, as mentioned before, the fixed exchange rate rule, as a central element for inflation control, suffered a severe blow as consequence of the strict stabilization program implemented in the United States in 1979. This stimulated a substantial increase in international interest rates, causing a sharp balance-of-payments and financial crisis in economies with significant excess expenditures, like the Chilean.

Although concern about the consequences of a high degree of price and salary indexation in the Chilean economy was one of the justifications for imposing a fixed exchange rate as a nominal anchor and using it to break down inflationary inertia, the financial and balance-of-payments crisis that followed the collapse of that regime made it necessary to overlook this concern, and led to the adoption of a "real exchange rate policy" to stimulate expansion of the tradable sector.

Abandonment of the fixed exchange rate rule and the adoption of an exchange rate indexation scheme to address balance-of-payment problems not only downgraded the importance of inflation in the government's objective function,[69] but also led to the loss of the nominal anchor that guaranteed a certain medium-term stability for inflation.

It is important to note that until the end of the 1990s, the Central Bank had to reconcile the inflation objective with the restriction

67. This occurred after two devaluations of the peso, which moderated the pace of inflation, although it still remained at a relatively high level. On the other hand, different analysts put forward the hypothesis that the high level of real interest rates reflected the rebelliousness of expectations and inflationary inertia, which did not change substantially with the aforementioned devaluations.

68. Frenkel and Johnson (1976).

69. This was despite the fact that application of a rigorous adjustment program supervised by the International Monetary Fund involved the establishment of a related monetary program with a certain itinerary for inflation. This occurred in a context in which the priority objective was to put external accounts in order.

represented by an exchange rate band, which frequently led to a significant accumulation of international reserves. In mid-1999, the Central Bank adopted a floating exchange rate scheme, which together with the ban on providing loans to the central government included in the constitution of an independent Central Bank in 1989, created, for the first time in several decades, a scenario where monetary policy could be concentrated exclusively—or at least preferentially—on achieving a given inflation objective.

Inflation targeting is without a doubt a contribution to the design and evaluation of monetary policy. Nevertheless, it is difficult to assume that the decline in inflation in Chile starting in 1990 was solely a consequence of its adoption. That was insofar as the true commitment of the monetary authority to this result—and consequently the costs of not complying—were not clearly shown until the full adoption of the scheme, with the abandonment of the exchange rate band after the Asian Crisis in the late 1990s. In fact, it is here when the Central Bank decided to adopt a severely contractive monetary stance to contain a significant aggregate excess demand where a fiscal stimulus combined with aggressive adjustments in the minimum wage and public sector salaries had an important responsibility.

Starting with this episode, inflation continued to fall rapidly. This was at least partially the result of the above mentioned global environment of disinflation, which was supported domestically by the energy with which the Central Bank reacted in the face of signals of excess expenditures. The global financial crisis of 2007-2009 accentuated the deflationary pressures on Chile's economy, thus containing a resurgence that had pushed this variable to 7.8% in 2007, well past the Central Bank's target range for inflation.

In relation to the inflationary dynamics of the last decades, Morandé, García, and Johnson (1995) find that until the mid-1990s no changes were observed in the inflationary trend or dynamics, suggesting that the change in inflationary dynamics occurred later. In fact, they find that inflation appears as exogenous to the set of variables selected in a vector autoregressive exercise, which—in their opinion—would confirm how rooted this process was in policies and institutions sustained for a long period. Rojas, Rosende, and Vergara (1995) find a similar result.

Available empirical research provides a series of interesting clues for designing a general framework for studying inflation in Chile. On one hand, what it reveals is that the pace of inflation showed

significant fluctuations over time, with particularly sharp movements between 1970 and 1990. The studies of Rosende and Guier (1994) and Belaisch and Soto (1998) find evidence of inflation's anti-cyclical behavior, which seems to reinforce the importance of the public finance considerations described previously in the explanation of movements of this variable. The study by Restrepo and Soto (2006) confirms the finding of a negative contemporary correlation between activity cycles and inflation, which is especially clear in the case of underlying inflation. This was true for the period 1986-2005. While this result seems to contradict inflation theories based on a Phillips curve of the type shown in equation (5), Restrepo and Soto argue the contrary, finding a positive and significant correlation between activity cycles and inflation (measured by underlying inflation) three quarters later. They also find a negative correlation between the preceding inflation and cycles of activity and employment in period t.

$$\pi_t = \alpha \pi_t^e + \lambda (y - y^*)_{t-k} + \gamma \pi_{t-1}. \tag{5}$$

While a more detailed analysis of the inflation process is needed to draw more solid conclusions about the main features of the process—which we do in section 7—a review of macroeconomic data from Chile in the transition process toward low inflation suggests that a major role has been played by the behavior of the nominal exchange rate and changes in the global economy during that period, shown in tables 5 and 6. The hypothesis of a favorable external environment, which made it possible for movements of the nominal exchange rate to decisively contribute to controlling inflation, has been put forward by Calvo and Mendoza (1999).

An alternate view of the nature of the inflation control process in Chile—arriving at the levels of an industrialized economy—highlights the effect on expectations of the maintenance of economic guidelines after the political change in 1990, including the new autonomy of the Central Bank. This situation would have shaped a scenario of favorable expectations regarding growth and stability, making possible a credible disinflation process à-la-Lucas-Sargent, which prevented the appearance of any significant real costs.

To be fair, this line of argument does not contradict the one which emphasizes the "stroke of luck" caused by a favorable external scenario that was adverse for inflation. In fact, it would be sufficient that the belief in the strength of institutions and the anti-inflationary commitment were credible to the markets in order to attract capital

for investment in the country, which by pushing down the exchange rate helps to contain inflation. Moreover, it is important to recall that until 1989 a strong tension was maintained between the tendency to grow from investment and capital inflows with a real exchange rate policy. As this was inconsistent with inflation control—a priority objective of the newly autonomous Central Bank—it was to be expected that there would be strong downward pressure on the nominal exchange rate, which would confirm that it was technically under control, but sustained by the indexation mechanisms in place.

6. EMPIRICAL ANALYSIS

This section provides an analysis of the evolution of Chilean inflation dynamics since 1977, following some of the recent literature that has done similar exercises for the U.S. and G7 nations (among others, Cogley, Primiceri, and Sargent (2010), Stock and Watson (2007), Cechetti and others (2007)). This exercise tries to evaluate the changes in the behavior of inflation in Chile and place them in an international context, and is an initial step towards a formal evaluation of the causes underlying these changes.

We start by providing some statistics of inflation in the sample period, and across subsamples chosen on the basis of the previous discussion. We then estimate a simple inflation equation, and check for structural changes using the methodology developed in Bai and Perron (1998, 2003). Finally, we follow the state-space methodology in Stock and Watson (2007) to decompose the inflation path into a time varying-trend and a transitory component, each of them with time-varying volatility.

6.1 Simple Descriptive Statistics on Inflation

Our analysis uses quarterly CPI data from 1977 to 2011. This allows us to have a long series (more than 120 observations), and is an interesting sample for various reasons. On one hand, starting in 1977 allows us to avoid the hyperinflation episodes of the early 1970s, and to focus our attention on a period characterized by overall sound macroeconomic policy, in which the fiscal imbalances that historically caused high inflation are largely absent (Morandé and Noton, 2004). The period is still very interesting because there is still significant variance in the policy framework across time, as

the country moved from the fixed peg of the late 70s and early 80s, to the relatively loose monetary policy with a clear exchange rate objective in the mid-1980s, to Central Bank independence and the gradual abandonment of the exchange rate band in the 1990s, to the adoption of full-fledged inflation targeting in early 2000.

Table 7 describes the mean and standard deviation of CPI inflation for the whole sample, and for three subsamples: pre and post Central Bank independence, and after the adoption of free float[70] for the exchange rate after the Asian crisis, which has been identified as a period of consolidation of the inflation targeting regime that was gradually adopted during the 1990s (see, for example, Corbo, Landerretche, and Schmidt-Hebbel, 2002, and Aguirre and Schmidt-Hebbel, 2007).

The behavior of inflation in Chile over the sample period is very similar to what has occurred in many other economies: inflation has become significantly lower and more stable. This has made inflation, according to Stock and Watson (2007), both simpler and harder to forecast. On one hand, the stability of inflation implies that naïve inflation models, such as a simple average over the last four quarters, have become increasingly better forecasting devices. On the other hand, more complicated multivariate models have a harder time providing better forecasts than their naïve counterparts (Atkeson and Ohanian, 2001), as short term variations in inflation appear to be increasingly associated to transitory, unpredictable shocks.

Table 7. Mean and Standard Deviation of Annualized Quarterly Inflation in Chile, 1977-2011

	Mean inflation (%)	*Standard deviation (%)*
Full sample	11.90	10.56
1977-1990	21.32	9.70
1990-2011	6.34	6.32
1990-2000	11.10	6.63
2000-2011	2.94	3.00

Source: Calculated using seasonally-adjusted quarterly CPI data.

70. While the ER float has been largely clean, the Central Bank has intervened the exchange rate market in four limited periods during the last decade.

6.2 Looking for Structural Changes: Has the Inflation Process Changed in Time?

The descriptive statistics presented above suggest that the behavior of inflation in Chile has changed over time, particularly since the 1990s. Thus, our first strategy is to evaluate whether the data suggests the presence of significant changes in the statistical process governing inflation.

In order to do so, we estimate a simple AR(1) model of inflation, traditionally used in the literature, and use the methodology developed by Bai and Perron (1998, 2003)[71] to test for the presence of multiple structural changes. The main advantage of the Bai and Perron tests is that the number and dates of the potential breaks are not set exogenously by the researcher, but are determined endogenously from the data using a sequential process. The method allows the identification of up to 5 structural breaks.

Results are presented in table 8. The procedure identifies two breaks, and dates them in the second quarter of 1982 and the second quarter of 1991. Both dates seem to make sense from an ex ante perspective, as the first break coincides with the June 1982 devaluation of the peso that put an end to the peg set in 1979 and the second break is associated to the start of the decline of Chilean inflation during the 1990s. This date is also consistent with the adoption of a disinflation strategy by the newly independent Central Bank and also to the start of the worldwide disinflation process. Somehow surprisingly, the procedure suggests that there were no breaks at other dates that would have appeared suggestive ex ante, such as the aftermath of the September 1998 aggressive monetary policy response against the peso devaluation or the adoption of "full-fledged" inflation targeting in 2000. Interestingly, the procedure suggests that there are no breaks when we allow for a linear time trend. This indicates that much of the action in Chilean inflation during the last 30 years has been its (relatively smooth) decline from values close to 30% to its current 3%. However, a model with a linear time trend is evidently not a particularly interesting description of the inflation process, especially when, as is the case of Chile's, observing further permanent reductions in the inflation rate seems highly unlikely.

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71. In fact, an AR(1) inflation model for the UK is exactly one of the applications discussed in Bai and Perron (2003).

Table 8. Inflation in Multiple Structural Change Test Results for Chile, 1977-2011

Inflation model	Number of Suggested Breaks	Suggested Break Dates
$\pi_t = c + \beta \pi_{t-1}$	2	1982.Q2 1991.Q2
$\pi_t = c + \beta \pi_{t-1} + yt$	0	-

Source: Calculated with quarterly seasonally-adjusted inflation using the R algorithm that implements the methodology in Bai and Perron (1998, 2003).

Thus, the evidence suggests that, as expected, the statistical process governing inflation has changed in time. However, it is possible that a better representation is obtained not by assuming discrete, occasional changes, but a continuous process in which inflation dynamics are evolving at every moment across time, and in which the volatility of inflation is not constant, but behaves like a stochastic variable. This approach to the inflation process, which comes from the asset pricing literature, has received significant attention over recent years (Cogley and Sargent (2005), Sims and Zha (2006), Stock and Watson (2002, 2007). We follow this approach in the next section.

6.3 An Unobserved Components Model With Stochastic Volatility for Inflation

Stock and Watson (2007) decompose inflation into the sum of a time varying trend τ_t, and a transitory component that behaves like a martingale difference innovation, ε_t. This is,

$$\pi_t = \tau_t + \eta_t, \tag{6}$$

$$\tau_t = \tau_{t-1} + \varepsilon_t, \tag{7}$$

$$\eta_t = \sigma^2_{\eta,t} \xi_{\eta,t}, \tag{8}$$

$$\varepsilon_t = \sigma^2_{\varepsilon,t} \xi_{\varepsilon,t}, \tag{9}$$

where $\xi_{\eta,t}$ and $\xi_{\varepsilon,t}$ are mutually independent i.i.d. N(0,1) stochastic processes.

The trend component is stochastic, and behaves like a driftless random walk. This a state-space representation of the inflation process, with equation (6) being a measurement equation and equation (7) describing the state.

Inflation is thus represented as the sum of a random walk component (the trend or permanent component, which in a general equilibrium model should be anchored by monetary policy) and a random transitory disturbance. The relative importance of trend and transitory disturbances depend on the variances $\sigma_{\eta,t}^2$ and $\sigma_{\varepsilon,t}^2$, which are described by

$$ln\left(\sigma_{\eta,t}^2\right) = ln\left(\sigma_{\eta,t-1}^2\right) + \nu_{\eta,t}, \tag{10}$$

$$ln\left(\sigma_{\varepsilon,t}^2\right) = ln\left(\sigma_{\varepsilon,t-1}^2\right) + \nu_{\varepsilon,t}, \tag{11}$$

where $\nu_{\eta,t}$ and $\nu_{\varepsilon,t}$ are mutually and serially independent zero-mean variables.

There are two important implications of this representation. First, it assumes that inflation has a unit root, which comes from the trend component, and whose importance varies over time. While this may appear odd, many recent papers agree that a driftless random walk is a reasonable approximation to the behavior of trend inflation (among others, Cogley and Sargent (2005), Cogley, Primiceri, and Sargent (2010), Smets and Wouters (2003)). Notice that assuming a unit root in inflation does not imply that the central bank has no weapons to control inflation, as the unit root comes precisely from a trend component that in general equilibrium depends directly on monetary policy. This is, the empirical characteristics of the univariate process are not defined in a vacuum outside of policy influence, but are conditional on policy actions and all the variables that are relevant for inflation in a structural model. Secondly, if are constant, the UC-SV becomes a IMA(1,1) model, a representation that has been traditionally used in the literature. Thus, the UC-SV is locally a IMA (1,1) model, with a moving average coefficient that depend on the evolution of the relative variances.

Table 9 presents estimated autocovariances for the first differences of inflation over different subsamples. In a IMA (1,1) model, the first-autocorrelation should be negative and all other autocorrelations should be zero.

Table 9. First Difference Autocorrelations for the Change in Inflation in Chile, 1977-2011

	First lag	*Second lag*	*Third lag*	*Fourth lag*
Full sample	**-0.234**	-0.012	0.03	**-0.208**
1977-1990	**-0.20**	0.07	-0.001	**-0.24**
1990-2011	**-0.38**	-0.06	0.08	-0.11

Source: Calculated using CPI inflation data. Bold numbers significant at 5% level.

The first autocorrelation is always negative and significant, as suggested by the model. The fourth autocorrelation is also significant in part of the sample, probably reflecting some seasonal component that was not captured by the seasonal adjustment procedure. This exercise suggests that the UC-SV model is a reasonable approximation to the inflation process.

The UC-SV model is estimated using the algorithm in Stock and Watson (2007), based on 1000 Markov Chain Monte Carlo draws, using non-informative initial priors. As we have not checked how the estimates change if different priors are used, our results must be seen as preliminary in nature. Figure 1 presents the smoothed estimate for the stochastic inflation trend, τ_t.

The results are consistent with what we already know about Chile's inflation history. On average, trend inflation has decreased over time (and thus, a linear trend is not a bad approximation), but has suffered some significant fluctuations along the way. Our estimate falls abruptly after the adoption of a fixed exchange rate in 1979, to reverse course and recover strongly during the mid-1980s, approaching a peak at the end of the decade. The trend falls smoothly across the 1990s, much less rapidly than its decrease during the late 1970s-early 1980s. The 2008 inflation outburst is captured partially as change in trend inflation that is quickly reversed.

Table 10 compares our results with those in Cechetti and others (2007), who perform a similar exercise for the G7 economies for the period 1970-2006. As we already know, the decline in trend inflation over the last decades is hardly a unique feature of the Chilean experience. Across all countries, trend inflation falls across time, although only Italy comes somewhere close to the extent of the decline observed in Chile.

Figure 1. Estimated Stochastic Inflation Trend in Chile, 1977-2009
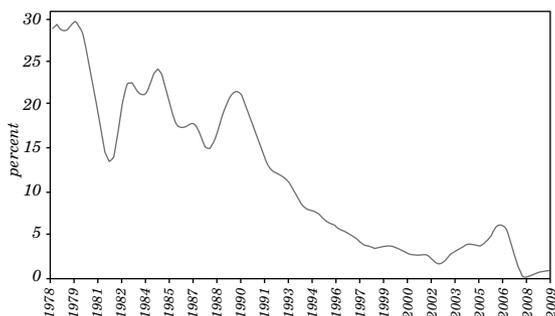
Source: Estimated by the authors using CPI data and the methodology described in Stock and Watson (2007).

## Table 10. International Comparison of Estimated Inflation Trends, 1980-2006 (%)

	1980-1989	*1990-1999*	*2000-2006*
Canada	5.3	1.9	2.4
France	6.7	1.5	1.6
Germany	3.0	1.9	0.7
Italy	10.8	4.1	2.4
Japan	2.4	0.2	-1.3
United Kingdom	6.6	3.3	2.4
United States	4.4	2.1	2.3
G7 Average	**5.6**	**2.1**	**1.5**
Chile	**19.5**	**9.9**	**2.9**

Sources: Data for G7 countries taken from Cechetti and others (2007); data for Chile estimated by the authors using CPI data and the methodology described in Stock and Watson (2007).

Figures 2 and 3 present the median estimates for the variance of the trend and transitory components. Both series exhibit a similar behavior, being much lower after 1990, although the variance of the transitory component grows again during the last decade. The variance of the transitory component is always larger, and seems to

have become relatively more important in the last decade (table 11). This is qualitatively similar to the result found in Cechetti and others (2007) for the G7. Inflation has become more stable because both of its components have become more stable, and in relative terms transitory disturbances have become more important.

Figure 2. Median of Estimated Trend Volatility in Chile, 1977-2009
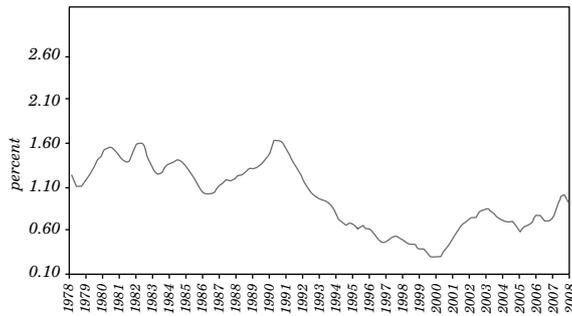
Source: Estimated by the authors with CPI data and the methodology described in Stock and Watson (2007).

Figure 3. Estimated Median of the Disturbance Volatility in Chile, 1977-2009
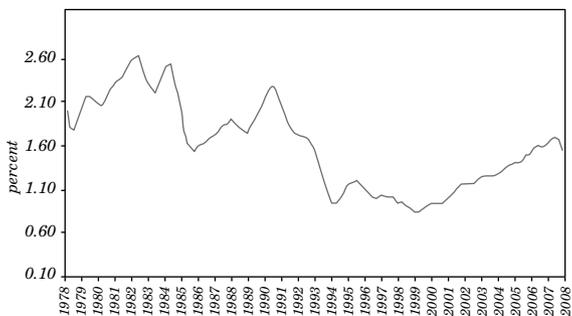
Source: Estimated by the authors using CPI data and the methodology described in Stock and Watson (2007).

Table 11. Estimated Trend and Disturbance Volatility in Chile, 1980-2008 (%)

	Average of median volatility		*Ratio of trend volatility to disturbance volatility*
	Trend	*Disturbance*	
1980-1989	1.25	2.05	0.61
1990-1999	0.84	1.35	0.62
2000-2008	0.65	1.26	0.51

Source: Estimated by the authors with CPI data and the methodology described in Stock and Watson (2007).

7. CONCLUSIONS

This paper has provided an overview on the behavior of inflation in Chile over the last decades, placing it in the context of the inflationary experience in other parts of the world. One of our main conclusions is that the behavior of inflation in Chile over the last 30 years has striking similarities to the experience of many industrialized (and developing) economies. In that sense, the discussion of the factors underlying the reduction of inflation in Chile can be complemented with the insights obtained from the theoretical and empirical analysis of what happened in other countries, and especially in the U.S. As suggested by that literature, the successful reduction of inflation, in a context of healthy GDP growth, probably reflects a combination of factors, ranging from better policies (both in terms of objectives and actual policy management) to a global supply shock that reduced inflation everywhere. Thus, the reduction of inflation in Chile was not solely luck or solely inspiration from the monetary authorities, but rather a (successful) combination of both.

The second part of the paper uses recent empirical methodologies to replicate some of the statistical results obtained for the U.S. and other developed countries. We present two main empirical exercises. The first one, using the structural break methodology developed by Bai and Perron, suggest that the inflation process has changed twice since 1977, both changes roughly coinciding with relevant changes in both the monetary policy framework and international conditions, although somehow surprisingly there is no evidence change after the adoption of "full-fledged" inflation targeting in 2000, when inflation stabilized around 3%, ending the disinflation

process started in 1990. The second exercises uses the UC-SV model developed by Stock and Watson (2007) to show that the reduction of the level and volatility of inflation can be decomposed into the reduction of its trend, and a reduction of the volatility of its trend and temporary components. Comparing our results for Chile with a similar exercise for the G7, we confirm the strong similarities between the timing and characteristics of the inflation process in Chile and the industrialized world.

This paper can be seen as the first part of a wider agenda that tries to understand the features of inflation in Chile, with an emphasis on placing them on an international context. In that sense, we have provided a detailed statistical description of inflation, and a conceptual discussion of the mechanisms underlying the inflationary process over the last two decades. Future research will try to empirically analyze those mechanisms, shedding some light on the competing hypotheses and their relative weight.

REFERENCES

Acemoglu, D., S. Johnson, and J. Robinson. 2004. "Institutions as the Fundamental Cause of Long-Run Growth." NBER Working Paper 10481.

Aguirre, A. and K. Schmidt-Hebbel. 2007. "Structural Changes from Partial to Full-Fledged Inflation Targeting in Chile." In *Monetary Policy in Emerging Markets and Other Developing Countries*, edited by N. Batini. New York, NY: Nova Science Publishers.

Arancibia, P. and F. Balart. 2007. *Sergio de Castro: El Arquitecto del Modelo Económico Chileno*. Santiago: Editorial Biblioteca Americana.

Arbildúa, B. and R. Lüders. 1968. "Una Evaluación Comparada de Tres Programas Anti-Inflacionarios en Chile: Una Década de Historia Monetaria: 1956-1966." *Cuadernos de Economía* 5(14): 25–105.

Atkeson, A. and L. Ohanian. 2001. "Are Phillips Curves Useful for Forecasting Inflation?" *Federal Reserve Bank of Minneapolis Quaterly Review* 25(1): 2–11.

Bai, J. and R. Perron. 1998. "Estimating and Testing Linear Models with Structural Changes." *Econometrica* 66(1): 47–78.

—————. 2003. "Computation and Analysis of Multiple Structural Change Models." *Journal of Applied Econometrics* 18(1): 1–22.

Barro, R.J. and D.B. Gordon. 1983. "Rules, Discretion and Reputation in a Model of Monetary Policy." *Journal of Monetary Economics* 12(1): 101–21.

Belaisch, A. and C. Soto. 1998. "Empirical Regularities of Chilean Business Cycles." Working Paper 41, Banco Central de Chile.

Bernanke, B. and I. Mihov. 1998. "Measuring Monetary Policy." *Quarterly Journal of Economics* 113(3): 869–902.

Borio, C. and A. Filardo. 2007. "Globalization and Inflation: New Cross-Country Evidence on Global Determinants of Domestic Inflation." Working Paper 227, BIS.

Calvo, G. and E.G. Mendoza. 1999. "Empirical Puzzles of Chilean Stabilization Policy." In *Chile: Recent Policy Lessons and Emerging Challenges*, edited by G. Perry and D.M. Leipziger. Washington, DC: World Bank Institute.

Carrasco, C. 2009. *Banco Central de Chile 1925-1964: Una Historia Institucional*. Santiago: Central Bank of Chile.

Cechetti, S., P. Hooper, B. Kasman, K. Schoenholtz, and M. Watson. 2007. "Understanding the Evolving Inflation Process." Report presented at the 2007 meeting of the U.S. Monetary Policy Forum, March 9th.

Cogley, T. and T. Sargent. 2005. "Drift and Volatilities: Monetary Policies and Outcomes in the Post WWII U.S." *Review of Economic Dynamics* 8(2): 262–302.

Cogley, T., G. Primiceri, and T. Sargent. 2010. "Inflation-Gap Persistence in the U.S." *American Economics Journal: Macroeconomics* 2(1): 43–69.

Corbo, V. 1974. *Inflation in Developing Countries: an Econometric Analysis of Chilean Inflation*. Amsterdam: North Holland.

Corbo, V. and L. Hernández. 2005. "Ochenta Años de Historia del Banco Central de Chile." *Economía Chilena* 8(3): 5–27.

Corbo, V., O. Landerretche, and K. Schmidt-Hebbel. 2002. "Does Inflation Targeting make a Difference?" In *Inflation Targeting: Design, Performance, Challenges*, edited by N. Loayza and R. Soto. Santiago: Central Bank of Chile.

Cortés, H. 1984. "Lecciones del Pasado: Recesiones Económicas en Chile: 1926-1982." *Cuadernos de Economía* 21(63): 137–68.

Cortés, H. and D. Tapia. 1970. "La Demanda de Dinero: Un Informe Preliminar." *Estudios Monetarios II*, Central Bank of Chile.

Cukierman, A., S. Edwards, and G. Tabellini. 1992. "Seigniorage and Political Instability." *American Economic Review* 82(3): 537–55.

Cukierman, A., B. Neyapti, and S. Webb. 1993. "Measuring the Independence of the Central Bank and Its Effect on Policy Outcomes." *World Bank Economic Review* 6(3): 353–98.

Deaver, J. 1960. "La Inflación Chilena y la Demanda por Dinero." Unpublished manuscript, CIEUC.

De la Cuadra, S. and S. Valdés. 1992. "Myths and Facts about Financial Liberalization in Chile: 1974-1983." In *If Texas Were Chile: A Primer on Banking Reform*, edited by Philip L. Brock. Fremont, CA: A Sequoia Seminar Publication.

Edwards, S. 2000. "Veinticinco Años de Inflación y Estabilización en Chile (1973-1998)." In *La Transformación Económica de Chile*, edited by F. Larraín and R. Vergara. Santiago: Centro de Estudios Públicos.

Edwards, S. and A. Cox Edwards. 1991. *Monetarism and Liberalization: The Chilean Experiment*. Chicago, IL: University of Chicago Press.

Ffrench-Davis, R. 1973. "*Políticas Económicas en Chile*." Santiago: Ediciones Nueva Universidad.

Fontaine, J.A. 1988. "Los Mecanismos de Conversión de Deuda en Chile." *Estudios Públicos* 30, Fall.

————. 2000. "Banco Central Autónomo: En Pos de la Estabilidad." In *La Transformación Económica de Chile*, edited by F. Larraín and R. Vergara. Santiago: Centro de Estudios Públicos.

Frenkel, J. and H.G. Johnson. 1976. *The Monetary Approach of the Balance of Payments*. London: George Allen & Unwin.

Friedman, M. 1968. "The Role of Monetary Policy." *American Economic Review* 58(1): 1–17.

————. 1971. "A Monetary Theory of Nominal Income." *Journal of Political Economy* 79(2): 323–37.

————. 1977. "Nobel Lecture: Inflation and Unemployment." *Journal of Political Economy* 85(3): 451–72.

Greenspan, A. 2005. "Globalization." Remarks given at the Council of Foreign Relations, New York, 10 March, Federal Reserve Board.

————. 2007. *The Age of Turbulences, Adventures in a New World.* London: The Penguin Press.

Harberger, A.C. 1963. "The Dynamics of Inflation in Chile." In *Measurement in Economics: Studies in Mathematical Economics and Econometrics*, edited by C. Christ. Palo Alto, CA: Stanford University Press.

International Monetary Fund. 2006. "How Has Globalization Affected Inflation?" *World Economic Outlook*, April.

Lucas, R. and T.J. Sargent. 1981. "After Keynesian Macroeconomics." In *Rational Expectations and Econometric Practice*, edited by R.E. Lucas and T.J. Sargent. Minneapolis, MN: University of Minnesota Press.

Lüders, R. 1970. "Una Historia Monetaria de Chile." *Cuadernos de Economía* 7(20): 4–28.

Lüders, R. and F. Rosende. 2007. "La Teoría Monetaria de Chicago." In *La Escuela de Chicago: Una Mirada Histórica a 50 años del Convenio Chicago/Universidad Católica: Ensayos en Honor a Arnold C. Harberger*, edited by F. Rosende. Santiago: Ediciones Universidad Católica.

Millar, R. 1994. *Políticas y Teoría Monetaria en Chile, 1810-1925*. Santiago: Universidad Gabriela Mistral.

Mishkin, F.S. and K. Schmidt-Hebbel. 2007. "A Decade of Inflation Targeting in the World: What Do We Know and What Do We Need to Know?" In *Monetary Policy Strategy*, edited by F.S. Mishkin. Cambridge, MA: MIT Press.

Morandé, F., C. García, and C. Johnson. 1995. "La Inflación en Chile: Una Nota Estadística." In *Análisis Empírico de la Inflación en Chile*, edited by F. Morandé and F. Rosende. Santiago: Pontificia Universidad Católica de Chile.

Morandé, F. and C. Noton. 2004. "La Conquista de la Inflación en Chile." *Estudios Públicos* 95: 119–68.

Orphanides, A. 2002. "Monetary Policy Rules and the Great Inflation." *American Economic Review* 92(2): 115–20.

————. 2003. "Historical Monetary Policy Analysis and the Taylor Rule." *Journal of Monetary Economics* 50(5): 983–1022.

Ossa, C. 1964. "La Política Monetaria y la Programación del Desarrollo Económico." *Cuadernos de Economía* 1(3): 7–62.

Phelps, E.S. 1968. "Money Wage Dynamics and Labor Equilibrium." *Journal of Political Economy* 76(4): 678–711.

Posen, A. 1993. "Why Central Bank Independence Does Not Cause Low Inflation: There Is No Institutional Fix For Politics." *Finance and International Economy* 7: 41–65.

Ramírez, G. and F. Rosende. 1992. "Responding to the Collapse: Chilean Banking Legislation after 1983". In *If Texas Were Chile: A Primer on Banking Reform*, edited by P.L. Brock. Fremont, CA: A Sequoia Seminar Publication.

Reichmann, T. 1965. "La Demanda de Dinero: Un Intento de Cuantificación." Unpublished manuscript, Universidad de Chile.

Reinstein, A. and F. Rosende. 2000. "Reforma Financiera en Chile." In *La Transformación Económica de Chile*, edited by F. Larraín and R. Vergara. Santiago: Centro de Estudios Públicos.

Restrepo, J.E. and C. Soto. 2006. "Regularidades Empíricas de la Economía Chilena 1986-2005." *Economía Chilena* 9(2): 15–40.

Rojas, P., F. Rosende, and R. Vergara. 1995. "Dinámica de la Inflación en Chile: Elementos Para el Análisis." In *Análisis Empírico de la Inflación en Chile*, edited by F. Morandé and F. Rosende. Santiago: Pontificia Universidad Católica de Chile.

Romer, C.D. and D.H. Romer. 2002. "The Evolution of Economic Understanding of Postwar Stabilization Policy." In *Rethinking Stabilization Policy*, Federal Reserve Bank of Kansas City Jackson Hole Symposium.

Rosende, F. 1985. "Tipo de Cambio y Salarios Reales: Consideraciones sobre el Caso Chileno." *Cuadernos de Economía* 22(67): 343–56.

————. 1990. "Análisis de la Situación Económica. El Ajuste: Orígenes, Políticas y Resultados." Working Paper 138, Pontificia Universidad Católica de Chile.

————. 1998. "Política Monetaria en Chile en los Noventa: Un Ejercicio 'No Neutral.'" *Perspectivas en Política, Economía y Gestión* 2(1): 157–89.

Rosende, F. and J.C. Guier. 1994. "Comportamiento de los Precios en el Ciclo Económico." *Estudios Públicos* 53(Summer): 55–82.

Sargent, T.J. 1999. *The Conquest of American Inflation*. Princeton, NJ: Princeton University Press.

————. 2002. "Commentary: The Evolution of Economic Understanding and Postwar Stabilization Policy". In *Rethinking Stabilization Policy*, Federal Reserve Bank of Kansas City Jackson Hole Symposium.

Sargent, T.J. and N. Wallace. 1975. "Rational Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule." *Journal of Political Economy* 83(2): 241–54.

Sims, C.A. (1980) "Comparison of Interwar and Postwar Business Cycles: Monetarism Reconsidered." *American Economic Review* 70(2): 250–57.

Sims, C.A. and T. Zha. 2006. "Does Monetary Policy generate Recessions?" *Macroeconomic Dynamics* 10(2): 231–72.

Smets, F.R. and R. Wouters. 2003. "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area." *Journal of the European Economic Association* 1(5): 1123–75.

Stock, J.H. and M.W. Watson. 2002. "Has the Business Cycle Changed and Why?" NBER Working Paper 9127.

————. 2003. "Has the Business Cycle Changed? Evidence and Explanations." In *Monetary Policy and Uncertainty: Adapting to a Changing Economy*, Federal Reserve Bank of Kansas City Jackson Hole Symposium.

————. 2007. "Why Has the U.S. Inflation Become Harder to Forecast?" *Journal of Money, Credit, and Banking* 39(1): 3–33.

Sunkel, O. 1958. "La Inflación en Chile: Un Enfoque Heterodoxo." *El Trimestre Económico* 100.

Taylor, J.B. 1993. "Discretion versus Policy Rules in Practice." *Carnegie Rochester Conferences Series on Public Policies* 39: 195–214.

————. 1999. "The Robustness and Efficiency of Monetary Policy Rules as Guidelines for Interest Rate Setting by the European Central Bank." *Journal of Monetary of Economics* 43(3): 655–79.

Valdés, S. and M. Soto. 1996. "New Selective Capital Controls in Chile: Are they Effective?" *Cuadernos de Economía* 33(98): 77–108.

Vergara, R. 1994. "Política Cambiaria en Chile: La Experiencia de una Década 1984-1994." *Estudios Públicos* 56(Spring): 85–112.

Too Poor to Grow

Humberto López
World Bank

Luis Servén
World Bank

Development theorists have long been intrigued by a variety of mechanisms capable of generating vicious cycles of poverty and stagnation—broadly referred to as poverty traps. These mechanisms highlight different ways in which poverty may deter growth and become self-perpetuating. Such situation may arise through a number of channels (see Azariadis and Stachurski, 2005 for a survey). A prominent one involves *threshold effects*, resulting for example from indivisibilities or increasing returns to scale. When these are coupled with credit constraints, the result is that below a certain level of income or wealth, economic agents may be too poor to afford the investments (in human or physical capital) or the technologies necessary to raise their income. One example along these lines is provided by Galor and Zeira (1993) who present a model in which credit constraints and indivisibilities in human capital investment hamper aggregate growth. The reason is that only sufficiently wealthy individuals can afford education, which is the force driving growth in the model.[1]

Another poverty-perpetuating mechanism is related to risk. As noted by Banerjee (2000), the poor are typically more risk averse than the rich because losses hurt them more severely. In the absence of

    1. See also Dasgupta and Ray (1986), who develop a model focused on investments in health; and Banerjee and Newman (1993).

well-functioning insurance and credit markets, the poor will skip profitable investment opportunities that they deem too risky. Such behavior makes poverty self-reinforcing as the poor minimize risk at the expense of their mean earnings.[2] In this vein, Dercon (2005) notes that existing empirical estimates (typically based on country case studies) suggest that if the poor could shelter themselves from shocks as well as the rich do, their incomes could be on average 25 to 50 percent higher.

Institutional arrangements that place economic opportunities beyond the reach of the poor can also result in reduced income growth. Along these lines, Mookherjee and Ray (2002) show that when employers or lenders have all the bargaining power in contracts with workers or borrowers, contractual distortions resulting from moral hazard can give rise to poverty traps. In turn, Engerman and Sokoloff (2006) argue that persistent poverty in former European colonies can be traced to the exclusionary institutional arrangements originally created by the colonial powers.

In spite of the diversity and popularity of these analytical models, evidence on their empirical relevance remains largely inconclusive (Durlauf, 2006). To assess it, some empirical studies have taken an indirect route. For example, Quah (1993) and Azariadis and Stachurski (2004) have explored the existence of convergence clubs by assessing the bimodality (or multi-modality) of the cross-country distribution of per capita income. On the whole, their findings lend support to the existence of rich and poor clubs at the two ends of the income distribution, although the robustness of this result remains disputed (Kremer, Onatski, and Stock, 2001).[3]

Strictly speaking, however, this could at most be viewed as consistent with, rather than proof of, the existence of poverty traps. An alternative, more direct empirical strategy is to investigate specific poverty trap mechanisms. One such approach is the calibration of macroeconomic models featuring threshold effects consistent with the poverty trap hypothesis. For example, Graham and Temple (2006) calibrate a two sector variable-returns-to-scale model. The model can account for some 40 to 50 percent of the observed variation in per capita income, which appears to lend some support to the poverty

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2. The argument that risk aversion leads to underinvestment goes back to Stiglitz (1969). See also Agénor and Aizenman (2010), who argue that aid volatility could influence poverty traps in poor countries through a similar mechanism.

3. Bloom, Canning and Sevilla (2003) also find evidence of bimodality of the world distribution of per capita income after controlling for a number of exogenous geographic variables (such as distance from the equator, rainfall, temperature, etc.).

trap notion. In contrast, Kraay and Raddatz (2007) calibrate simple aggregate models capable of generating poverty traps through low saving and/or low technology at low levels of development. Their results cast doubt on the empirical relevance of these mechanisms for the existence of poverty traps. Calibration exercises reported by Caucutt and Kumar (2005) yield a similar conclusion.

Poverty traps arising from threshold effects have often been offered as a rationale for a *big push* approach to policy, and in particular for large aid programs, to engineer growth takeoffs. Easterly (2006) finds little support for these views in aggregate cross-country data. Takeoffs are rare, and in general they are not associated with surges in aid, investment, or educational spending.

At the micro level, Jalan and Ravallion (2002), using household panel data from China, find (at the local level) a significant role of aggregate physical and human capital endowments for household consumption growth, which could be consistent with the existence of geographic poverty traps. Taking a more direct approach, McKenzie and Woodruff (2004) search for non-convexities in the production function generated by fixed investment costs. Using Mexican microenterprise data, they find little evidence in favor of this particular poverty trap mechanism. Similarly, Antman and McKenzie (2007) find no support for poverty traps in their analysis of the income dynamics of Mexican households. More recently, Dercon and Christiansen (2011) report evidence that lack of insurance mechanisms deters the adoption of modern production techniques by poorer Ethiopian farmers, leaving them trapped in low-risk low-return agriculture.

This paper takes a different approach to testing for the self-perpetuating effects of poverty. Its starting point is the observation that, if poverty hampers growth, then, *ceteris paribus,* countries with higher initial poverty should grow less rapidly than comparable countries with lower poverty. This hypothesis can be viewed as a weaker version of the poverty trap hypothesis, in that to support it we do not need to find evidence of multiple equilibria or income stagnation, but just empirical proof that poverty tends to hold back growth.[4]

The paper is also related to two other strands of empirical literature. One has explored the growth-poverty link focusing on

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4. A related approach is that of Ravallion (2009), who is concerned with the lack of global poverty convergence.

the poverty-reducing effect of growth and the factors that shape it (Bourguignon, 2004; Ravallion, 2004; Kraay, 2006). This is exactly the reverse of the question pursued in this paper. The other strand of literature has been concerned with the growth impact of inequality, with less than unanimous conclusions.[5]

The paper's empirical strategy relies on the estimation of a reduced-form growth equation with poverty added to an otherwise standard set of growth determinants. We estimate the resulting specification on a large country panel data set, using a generalized method of moments approach to attempt to control for the potential endogeneity of the regressors.

On the whole, we find that poverty has a significant negative association with subsequent growth. This result holds irrespective of whether inequality is also added in the regressions, and hence we interpret it as representing a pure poverty effect rather than an indirect inequality effect on growth. Moreover, the result is robust to a variety of departures from the basic specification, namely: (i) the use of alternative poverty lines, (ii) the use of alternative poverty measures, (iii) the use of alternative sets of control variables in the regression, (iv) the use of alternative sets of instruments in the estimation, (v) the use of alternative estimation techniques, and (vi) allowing for non-linear effects of inequality on growth. When we go one step further and try to identify the specific mechanisms behind this poverty effect on growth, we find that it appears to operate through investment: poverty deters investment and thereby growth, and the effect is bigger at low levels of financial development.

The rest of the paper is structured as follows. In section 1 we illustrate how poverty can be a growth deterrent, using a simple model based on that of Aghion, Caroli and García-Peñalosa (1999), extended to include a minimum consumption subsistence level. In section 2 we describe our empirical strategy to test for the effect of poverty on growth in a panel context. Section 3 reports estimation results for the basic model and performs a variety of robustness checks. Section 4 explores the mechanism responsible for the effects of poverty on growth identified in section 3. Finally, section 5 concludes.

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5. For example, Alesina and Rodrik (1994) and Perotti (1996) found a negative relationship between inequality and growth on the basis of cross section data, but subsequently Li and Zou (1998) and Forbes (2000) obtained the opposite result using aggregate panel data. In turn, Barro (2000) found that inequality might affect growth in different directions depending on the country's level of income, while Banerjee and Duflo (2003) concluded that the response of growth to inequality changes has an inverted U- shape.

1. AN ILLUSTRATIVE MODEL

To illustrate the effects of poverty on growth, we sketch a model in the spirit of Aghion and others (1999), who introduce learning-by-doing and knowledge spillovers in a simple overlapping generations framework. We modify their basic setup by adding a minimum consumption requirement in the model. In such setting, poor consumers (defined as those whose initial endowment is below the minimum consumption level) do not save and, in the absence of capital markets, cannot invest either.[6] Thus they do not contribute to the economy's aggregate growth.

1.1 Individuals

There is a continuum of non-altruistic overlapping generation individuals, indexed $i \in [0, 1]$, who live for at most two periods. Individuals born at time t have a random endowment w_t^i. Survival into the second period entails a minimum consumption requirement $\overline{c}$ (possibly reflecting nutritional needs), which can exceed the original endowment. We denote λ as the share of the population with initial endowment below survival needs, to whom we shall refer as the poor. It is given by

$$\lambda = p(w_t^i \leq \overline{c}) = F(\overline{c}) = \int_0^{\overline{c}} f(w_t^i) dw_t^i, \tag{1}$$

where p is probability, $f(.)$ and $F(.)$ respectively are the probability density function and the cumulative distribution functions of w_t^i. It follows that the poverty rate λ must be increasing (strictly speaking, non-decreasing) in the minimum consumption requirement $\overline{c}$. The utility of the *i-th* individual of generation *t* is given by:

$$U_t^i = c_t^i \ \text{ if } \ c_t^i < \overline{c} \tag{2}$$

$$= \overline{c} + \ln(c_t^i - \overline{c}) + \rho \ln c_{t+1}^i \quad \text{if } \ c_t^i > \overline{c} \ ,$$

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6. More precisely, for this result to obtain, we do not need to rule out capital markets altogether. It would suffice to assume that lenders impose on borrowers a collateral requirement, which individuals below the minimum consumption level would be unable to meet.

where c_t and c_{t+1} denote consumption when young and old, respectively.[7]

1.2 Production

Individual i uses his/her saving to purchase physical capital k_t^i, which fully depreciates within the period. Production takes place according to the technology:

$$y_t^i = A_t(k_t^i)^\alpha, \tag{3}$$

where A_t is the level of technical knowledge available to all individuals at time t, and $0<\alpha<1$. Like in Aghion and others (1999), we assume that there are learning-by-doing spillovers, so that $A_t = y_{t-1}$. Thus, an increase in the production of individual i raises the level of knowledge available to all individuals in the next period. Therefore, aggregate growth g depends on the distribution of individual investments, and is given by:

$$g_t = \ln(y_t / y_{t-1}) = \ln \int (k_t^i)^\alpha di = \ln E[(k_t^i)^\alpha]. \tag{4}$$

Notice that if all individuals invest the same amount, say k, then growth is just:

$$g_t = \ln \int k_t^\alpha di = \ln k^\alpha. \tag{5}$$

1.3 Consumption, Saving, and Growth

To sharpen the argument, we assume that capital markets do not exist. In their absence, the equilibrium levels of consumption and saving will vary across individuals depending on their initial endowments. In particular, for non-poor individuals (i.e., those with $w_t^i > \overline{c}$) we have:

$$c_t^i = \overline{c} + (1+\alpha\rho)^{-1}(w_t^i - \overline{c}), \tag{6}$$

$$k_t^i = \alpha\rho(1+\alpha\rho)^{-1}(w_t^i - \overline{c}) = s(w_t^i - \overline{c}), \tag{7}$$

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7. Strictly speaking, we should add a constant in the second line of (2) to prevent the utility level from declining when first-period consumption rises marginally above the subsistence level. We ignore this technical issue for simplicity; see Gollin, Parente and Rogerson (2002) for a similar approach.

where s is the saving rate; hence, saving and investment of the non-poor is just proportional to their initial wealth. In turn, poor individuals (i.e., those with $w_t^i < \overline{c}$) do not save and simply consume all their endowment:

$$c_t^i = w_t^i, \tag{8}$$

$$k_t^i = 0. \tag{9}$$

Aggregate investment is given by:

$$k_t = E[k_t^i] = (1 - \lambda)E[k_t^i \mid w_t^i > \overline{c}] = (1 - \lambda)E[s(w_t^i - \overline{c}) \mid w_t^i > \overline{c}], \tag{10}$$

which reflects the fact that only a fraction (1-λ) of the population invests. From (4), growth is given by:

$$g_t = \ln(1 - \lambda) + \ln(s^\alpha E[(w_t^i - \overline{c})^\alpha \mid w_t^i > \overline{c})]). \tag{11}$$

It is clear from (11) that the growth rate depends on two factors. First, the poverty rate: given expected per capita investment of the non-poor—the second term on the right-hand side of (11)—higher poverty (as determined by, e.g., a higher minimum consumption requirement) will unambiguously lead to lower growth. Second, the expected output generated by the investment of the non-poor, which in turn depends on three other ingredients: (i) the initial endowments relative to the minimum consumption requirement —higher endowments yield higher investment and growth, for a given poverty rate; (ii) the distribution of the endowments among the non-poor—decreasing returns imply that, for given aggregate capital, a higher concentration of its ownership among fewer people will lower growth; and (iii) the preferences of individuals and the production technology—for a given poverty rate and endowment distribution, a higher ρ and/or higher α raise the propensity to save by the non-poor, and hence overall investment and growth.

1.4 Endowments, Inequality, and Growth

The effects of poverty and inequality on growth in this economy can be illustrated considering three different cases: (i) λ =1; (ii) λ =0; and (iii) 0<λ <1.

i) λ =1

When $\lambda = 1$ all households are poor, and therefore investment and growth equal zero—an extreme version of a poverty trap. In such circumstances, an increase in initial endowments sufficient to bring some households out of poverty results in positive capital accumulation and growth.

Note also that for a given aggregate endowment, a higher level of inequality may also result in higher growth.[8] For example, consider the simple endowment rule:

$$w_t^i = a + \sigma \varepsilon_t^i \,, \tag{12}$$

where $a > 0$, $\sigma > 0$ and ε_t^i is distributed independently across agents with mean 0 and standard deviation 1; thus a is the expected value of each individual's endowment and σ the dispersion of endowments across individuals (i.e., initial inequality). Then (5) can be rewritten as:

$$\lambda = p(\sigma \varepsilon_t^i \leq \overline{c} - a) = F\big((\overline{c} - a)/\sigma\big) = \int_{-\infty}^{(\overline{c}-a)/\sigma} f(\varepsilon_t^i)\, d\varepsilon_t^i. \tag{13}$$

For $\overline{c} > a$ (as would be the case in an economy where everybody is poor), this is decreasing in σ. Intuitively, in a very poor economy where the average per capita endowment is below survival needs, a perfectly egalitarian distribution would bring everybody below the poverty line and result in zero saving and zero growth. As inequality increases and an unchanged initial aggregate endowment is concentrated among fewer and fewer individuals, some of them will move above the poverty threshold and become able to invest; hence, growth is a positive function of σ.

ii) $\lambda = 0$

In this second scenario, all households are above the poverty line —because, e.g., the mean endowment a is sufficiently larger than $\overline{c}$. In this particular case, growth is given by an expression similar to that in Aghion and others (1999), who assume $\overline{c} = 0$:

$$g_t = \alpha \ln(s) + \ln E[(w_t^i - \overline{c})^\alpha]. \tag{14}$$

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8. Of course, the welfare consequences of an increase in growth arising from higher inequality would vary across individuals.

Here higher inequality reduces growth due to the concavity of the production function. Note, however, that as α approaches 1 in (3), so that the production technology shows constant returns to capital, growth tends to:

$$g_t \rightarrow \ln(s) + \ln(a - \bar{c}), \qquad (15)$$

so that in the limit, growth is unaffected by inequality. The reason is that as α approaches 1 the key determinant of growth is the aggregate stock of capital, irrespective of its distribution across individual investors; furthermore, when nobody is below the subsistence level, aggregate capital depends only on the aggregate endowment and not on its distribution among individuals.

iii) $0 < \lambda < 1$

In the general case, some, but not all, individuals are poor. A higher aggregate endowment, holding inequality constant (i.e., in terms of (12), an increase in a without change in σ) unambiguously leads to higher growth: it both reduces poverty and raises the investment of the non-poor.

In contrast, the impact on growth of changes in the inequality of the distribution of the endowment σ is less clear-cut: it depends on how inequality affects the two terms in (11). That is, whether higher inequality raises or lowers growth, depends on the sign of:

$$\frac{\partial g}{\partial \sigma} = -\frac{\partial \lambda / \partial \sigma}{(1 - \lambda)} + \frac{\partial E[(w_t^i - \bar{c})^\alpha \mid w_t^i > \bar{c}] / \partial \sigma}{E[(w_t^i - \bar{c})^\alpha \mid w_t^i > \bar{c}]}. \qquad (16)$$

Regarding the first term, from (13) we already know that $\partial \lambda / \partial \sigma$ is negative when $\bar{c} > a$ (i.e., the poverty line exceeds the mean endowment) and positive when $\bar{c} > a$ (when the poverty line is below the mean endowment). As for the second term, the sign $\partial E[(w_t^i - \bar{c})^\alpha \mid w_t^i > \bar{c}] / \partial \sigma$ of depends on two factors. On one hand, because the production function exhibits decreasing returns to capital, the higher the σ, the lower the expected value of the output associated with a given stock of aggregate capital. But, on the other hand, if $\bar{c} > a$, the overall capital stock of the non-poor rises along with σ, and this tends to affect growth in the opposite (i.e., positive)

direction.[9] Thus for $\bar{c} > a$ the impact of inequality changes on the conditional expectation in (16) is ambiguous, while for $\bar{c} > a$ it is assured to be negative and hence runs counter to the effect on the poverty rate, the first term in (16), resulting also in an ambiguous overall effect. On the whole, therefore, the effect of inequality on aggregate investment and growth is not determined *a priori,* and depends on the economy's initial conditions.

In summary, poverty is a growth deterrent in this model as the poor cannot contribute to the growth process through the creation of physical capital. The ingredient responsible for this result is the model's minimum consumption threshold, which is the cause of the differential saving and investing behavior of poor and non-poor individuals.[10] However, similar results would be obtained in the presence of threshold effects arising, instead, from some other source —e.g., investment indivisibilities (as in Azariadis and Drazen, 1990 for example) or increasing returns to scale, so that below a certain level of income or wealth, individuals are "too poor" to acquire growth-enhancing assets (human or physical capital) or technologies; see Azariadis and Stachursky (2005) for a variety of examples. In contrast, the relationship between inequality and growth can take on either sign, depending on parameter values.

2. EMPIRICAL IMPLEMENTATION

To explore the links between poverty and growth in the data, our empirical strategy is based on the addition of a suitable measure of poverty to an otherwise standard empirical growth regression:

$$(y_{it} - y_{it-1}) = \delta y_{it-1} + \omega' x_{it} + \beta p_{it-1} + \nu_i + \upsilon_{it}, \tag{17}$$

where y is the log of per capita income, p is a measure of poverty, x represents a set of control variables other than lagged income, which we shall discuss shortly, ν_i is a country-specific effect, and v_{it} is an i.i.d.

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9. Formally, $\partial E(k_i^i \mid w_i^i > \bar{c}) / \partial\sigma = \partial E\left(s(w_i^i - \bar{c}) \mid w_i^i > \bar{c}\right) / \partial\sigma = \partial E(s(w_i^i - \bar{c}) \mid e_i^i > (\bar{c} - a) / \sigma) / \partial\sigma$, so that the sign of the impact of inequality on the capital stock of the non-poor depends on the sign of $\partial[(\bar{c} - a) / \sigma] / \partial\sigma$, which is negative when $\bar{c} > a$ and positive when $\bar{c} < a$.

10. Atkeson and Ogaki (1996) and López, Schmidt-Hebbel and Servén (2000) offer empirical evidence supportive of this differing saving behavior of rich and poor individuals. The consequences for aggregate growth are stressed by Easterly (1994). See also Rebelo (1992).

error term. According to (17), growth depends on initial income, initial poverty, and current and/or lagged values of the control variables.

Our primary focus is the estimate of β in equation (17). If poverty is a growth deterrent, we should find β < 0.

However, even if poverty has no direct impact on growth, we might find β ≠ 0 if inequality has an independent growth effect, as argued by a sizable theoretical and empirical literature. The reason is that poverty itself can be generally expressed as a (non-linear) function of inequality and average income, and hence the poverty coefficient in (17) could be capturing the inequality effect.[11] Thus, to ensure that our estimates do capture the poverty effect, we also consider empirical specifications of the type:

$$(y_{it} - y_{it-1}) = \delta y_{it-1} + \omega' x_{it} + \beta p_{it-1} + \rho g_{it-1} + v_i + \upsilon_{it} \,, \tag{18}$$

where g is a measure of income inequality (specifically, below we shall use the Gini coefficient). Equation (18) is a generalization of the standard empirical specification used in the literature concerned with the impact of inequality on growth. Note that in this setting the relationship between inequality and growth depends on how inequality affects poverty:

$$\frac{\partial(y_{it} - y_{it-1})}{\partial g_{it-1}} = \rho + \beta \frac{\partial p_{it-1}}{\partial g_{it-1}}. \tag{19}$$

Still, one might object that a non-zero estimate of β in (18) could just be capturing a non-linear effect of inequality on growth (as suggested by Banerjee and Duflo, 2003) rather than a true poverty effect. To address this concern, we also consider a specification of the form:

$$(y_{it} - y_{it-1}) = \delta y_{it-1} + \omega' x_{it} + \beta p_{it-1} + h(g_{it-1}) + v_i + \upsilon_{it}, \tag{20}$$

where $h(g_{it-1})$ is a quadratic function of the Gini coefficient (i.e., it includes the lagged Gini coefficient and its square).

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11. See López and Servén (2011) for a detailed analysis of the relationship between the Gini coefficient and poverty measures of the Foster, Greer, and Thorbecke (FGT) (1984) class under the assumption of log normality.

2.1 Econometric Issues

One potential issue with our empirical strategy is the simultaneous determination of poverty and growth, which could result in biased estimates of β in the above equations. Our empirical setting, like the standard growth regression model, lacks obvious outside instruments to deal with this potential endogeneity. However, the fact that poverty is pre-determined in (17) should help alleviate these concerns. Moreover, it should be noted that even if poverty were endogenous rather than predetermined in the equation of interest, the parameters of the growth-poverty system would continue to be identified as long as the poverty measure is a non-linear function of income (and possibly other variables) as is the case under standard parameterizations of the distribution of income (e.g., lognormal, Pareto, Weibull) such as the one adopted below.[12]

Aside from these issues, estimation of (17) and related equations on a short panel—as will be the case here—still has to overcome two standard problems, namely the presence of country-specific effects potentially correlated with the explanatory variables, and the possible simultaneity of some of the contemporaneous control variables with growth. To address these problems in the absence of suitable external instruments, we employ the GMM estimator system of Blundell and Bond (1998), based on the use of internal instruments. It essentially amounts to estimation of (17), using lagged differences of the explanatory variables as instruments, jointly with a first-differenced version of (17)—to remove time-invariant country effects—using lagged levels of the explanatory variables as instruments. Thus, in the resulting two-equation system, predetermined and endogenous variables in first differences are instrumented with suitable lags of their own levels, while variables in levels are instrumented with suitable lags of their own first differences.

A well-known shortcoming of panel GMM estimators in small samples is their tendency to result in over-fitting and downward-biased standard errors—a consequence of the relatively large number of instruments available for estimation (see, e.g., Ziliak, 1997). To reduce this bias, in the estimations below we limit the number of over identifying restrictions by building only one instrument from each variable and lag distance rather than building one separate instrument from each variable and lag distance in each time period.

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12. Drawing from Fisher (1961), it can be shown that the identifying information follows from the very non-linearity of the poverty equation.

Consistency of the GMM estimator obviously depends on the validity of the instrument set constructed in this way, and this in turn is determined by the autocorrelation structure of the error term. For example, if v_{it} is serially uncorrelated then y_{it-2}, x_{it-2}, p_{it-2} and g_{it-2} and their earlier lags would be valid instruments for the variables in differences, but if v_{it} displays first order serial correlation, the instrument set would have to be restricted to y_{it-3}, x_{it-3}, p_{it-3}, g_{it-3} and earlier lags. To assess the validity of the proposed instrument sets, we report two standard specification tests. The first is Hansen's *J*-test of over identifying restrictions, which examines the correlation between the instruments and the regression residuals. The second test examines the autocorrelation structure of the regression residuals themselves.

2.2 Control Variables

Lastly, we need to specify the control variables included in x. The empirical growth literature has experimented with a vast number of alternative sets of explanatory variables.[13] Rather than adding to the already huge variety of growth models contributing yet another idiosyncratic set of regressors, we opt for considering three alternative growth specifications in order to explore the sensitivity of our results to the specific choice of variables.

The first set of control variables, taken from the empirical literature on inequality and growth, is that used by Perotti (1996), Forbes (2000), Banerjee and Duflo (2003), and Knowles (2005). It includes the average years of secondary education of the male population, the average years of secondary education of the female population, and a measure of market distortions given by the price of investment goods relative to that of the U.S.

The second specification we consider is focused on standard policy indicators. It includes the inflation rate as an indicator of macroeconomic stability, the adjusted volume of trade as an indicator of the degree of openness of the economy,[14] and the ratio of public consumption to GDP as an indicator of the burden imposed by the government on the economy.

13. As noted by Durlauf and Quah (1999), by 1998 the number of individual regressors that had been considered as potential explanatory variables in growth regressions exceeded the number of countries in the standard growth dataset.
14. We use the residuals of a regression of openness on country size and two dummies indicating whether the country is landlocked and whether it is an oil exporter.

Finally, the third model we consider includes two variables from the preceding specifications—female education and inflation—and adds infrastructure, whose empirical significance for growth has been recently stressed by Calderón and Servén (2010). In the empirical specification we use the number of main telephone lines per capita as an infrastructure measure.

2.3 Data

Despite the progress made in recent years, mainly through the expanding international coverage of LSMS and similar surveys, poverty data are still scarce, at least in relation to the size of the standard cross-country time-series growth dataset. In our case their scarcity becomes severely binding because GMM estimation requires a minimum of three poverty observations per country in order to allow generating instruments from the lagged values of the poverty measure.

To overcome this limitation, rather than using LSMS-based poverty data we construct a set of poverty figures using a lognormal approximation.[15] We base this choice on recent work by López and Servén (2011), who compare the quintile income shares generated by a lognormal distribution with their observed counterparts using data from over 1,000 household surveys. They find that the lognormal approximation fits the data extremely well, and are unable to reject the null hypothesis that per-capita income follows a lognormal distribution.

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15. The use of the lognormal approximation to the distribution of income dates back to Gibrat (1931). Under lognormality, given the Gini coefficient (g) it is possible to compute the standard deviation (σ) of the log of income as $\sigma = \sqrt{2}\Phi^{-1}\left(\dfrac{1+g}{2}\right)$, where $\Phi(.)$ is the standard normal cumulative distribution function. Using this expression and the log of per capita income (y), we can compute the FGT family of poverty measures for a given poverty line z as:

$$P_0 = \Phi\left(\frac{\log(z) - y}{\sigma} + \frac{\sigma}{2}\right),$$

$$P_1 = \Phi\left(\frac{\log(z) - y}{\sigma} + \frac{\sigma}{2}\right) - \frac{e^y}{z}\Phi\left(\frac{\log(z) - y}{\sigma} - \frac{\sigma}{2}\right),$$

$$P_2 = \Phi\left(\frac{\log(z) - y}{\sigma} + \frac{\sigma}{2}\right) - 2\frac{e^y}{z}\Phi\left(\frac{\log(z) - y}{\sigma} - \frac{\sigma}{2}\right) + \left(\frac{e^y}{z}\right)^2 e^{\sigma^2}\Phi\left(\frac{\log(z) - v}{\sigma} - \frac{3\sigma}{2}\right).$$

In view of these results, we construct our poverty figures on the basis of the observed per capita income levels and Gini coefficients —which are available much more widely than survey-based poverty data. The per capita income data is from the PWT 6.1, whereas the inequality data is taken from Dollar and Kraay (2002).[16] In our regressions, we use three alternative poverty measures constructed in this manner—the headcount (henceforth denoted P_0), the poverty gap (P_1) and the squared poverty gap (P_2). In each case we experiment with three alternative poverty lines (US\$ 2, US\$ 3 and US\$ 4 per person per day). The rest of the variables used in the regressions are taken from Loayza and others (2005), except for the education variables, which are from Barro and Lee (2001).

The regressions are conducted using an unbalanced panel of non-overlapping five-year periods spanning the years 1960-2000. The full sample comprises 85 countries and over 300 observations.

Table 1. Summary Statistics

	Median	Mean	Standard Deviation	Maximum	Minimum
Income	5,523	7,937	6,735	34,372	467
Inequality	0.384	0.391	0.100	0.765	0.178
$P_0(\$2)$	0.024	0.111	0.185	0.834	0.000
$P_0(\$3)$	0.068	0.179	0.248	0.937	0.000
$P_0(\$4)$	0.129	0.237	0.289	0.977	0.000
$P_1(\$2)$	0.004	0.046	0.091	0.507	0.000
$P_1(\$3)$	0.045	0.115	0.150	0.595	0.000
$P_1(\$4)$	0.099	0.173	0.195	0.637	0.000
$P_2(\$2)$	0.002	0.026	0.058	0.385	0.000
$P_2(\$3)$	0.006	0.047	0.088	0.484	0.000
$P_2(\$4)$	0.013	0.069	0.114	0.564	0.000

Notes: This table reports the summary statistics o income per capita, a measure o income inequality (the Gini coefficient) and all the poverty measures used in this paper: headcount ratio (P_0), poverty gap (P_1) and squared poverty gap (P_2). Each poverty measure is defined using three alternative poverty lines (\$2, \$3, and \$4 per person per day).

16. The income and inequality data used for this purpose pertain to the latest available year within each given period. The original data sources for the inequality indices show a high degree of diversity across countries. The data are sometimes based on income figures and other times on expenditure figures; income is net of transfers and taxes in some cases and not in others; the unit of analysis may be the individual or the household, etc. To correct at least in part for this heterogeneity, we adjust the original data following the approach of Dollar and Kraay (2002).

Table 1 presents summary statistics for income, inequality and the constructed poverty measures.[17] The table shows the wide range of per capita income levels in the sample—from less than $500 (Tanzania in the mid-1990s) to almost $35,000 (Luxembourg in the mid-1990s). The median observation corresponds to Mexico in the mid-1970s, with per capita income about $5,500.[18] Regarding inequality, the Gini indices range from a low 0.17 (the Slovak Republic in the early 1990s) to a high 0.76 (Namibia in the mid-1990s), with a median of 0.38. Regarding the poverty figures, by construction they must rise with the poverty line and decline as the poverty measure changes from P_0 to P_2 (i.e., as one considers more bottom-sensitive measures). Table 1 shows that, depending on the poverty line used, median headcount poverty ranges from 2.4 percent (using US$2 per day as the poverty line) to about 13 percent (with US$4 per day), whereas the median poverty gap ranges from less than 1 percent (US$2) to about 10 percent (US$4), and the square poverty gap from 0.1 percent (US$2) to slightly above 1 percent (US$4). In turn, the ranges of the various poverty measures run from a minimum of zero (reflecting the presence of some high-income countries in the sample) to a maximum whose value depends on the particular poverty measure under consideration—from 80 to 100 percent for P_0, 50 to 60 percent for P_1, and 40 to 60 percent for P_2.[19]

3. RESULTS

Table 2 reports estimates of the growth equation using Perotti (1996)'s set of control variables, and with poverty measured by the headcount ratio (P_0). The instrument sets for GMM estimation are constructed under the assumption that the time-varying disturbance is serially uncorrelated. The first three columns of the table report the estimates obtained using each of the poverty lines under consideration (US$2, US$3 and US$4 per day, respectively) to

17. Preliminary analysis prompted us to remove two outliers: Sierra Leone (1990-1995) and Moldova (1990-1995). Their inclusion or exclusion from the sample, however, is of no material consequence for the paper's main empirical results.

18. The figure in the text is the median income from the pooled (unbalanced) sample. However, the cross-country median (i.e., the median of the country averages) is very similar ($5,400).

19. The maximum corresponds in all cases to Tanzania.

construct the poverty figures, and employing specifications excluding inequality from the equation—i.e., based on equation (17).

The results in the first three columns of table 2 consistently show that higher initial poverty is associated with lower subsequent growth: in all three cases, the headcount ratio carries a negative and highly significant coefficient. The magnitude of the coefficient declines somewhat as the poverty line rises from US$2 per day in the first column to US$4 per day in the third. Furthermore, the effect of poverty also appears economically significant in all three cases: according to the estimates in the table, a 10 percentage point increase in poverty is associated with a decline of annual per capita growth by 0.8 to 1.1 percentage points.

Table 2. Estimation Results: Baseline Model

	(1)	(2)	(3)	(4)	(5)	(6)	7
Income (in logs) (t-1)	-0.009	-0.018	-0.020	0.021	-0.014	-0.021	-0.022
t-stat	-2.17	-3.84	-2.86	2.75	-3.20	-4.12	-4.04
Female education (t-1)	-0.009	-0.013	-0.017	-0.010	-0.017	-0.021	-0.024
t-stat	-1.25	-2.18	-2.83	-1.41	-2.50	-3.51	-4.48
Male education (t-1)	0.008	0.015	0.018	0.003	0.020	0.024	0.027
t-stat	1.28	2.87	4.00	0.38	3.26	4.73	6.14
PPP (t-1)	-0.022	-0.018	-0.018	-0.033	-0.024	-0.021	-0.023
t-stat	-5.76	-4.79	-3.71	-4.67	-5.54	-4.50	-4.79
Inequality (t-1)				0.071	0.061	0.045	0.052
t-stat				2.02	2.66	2.18	2.88
P_0($2) ($t$-1)	-0.106				-0.123		
t-stat	-4.84				-4.80		
P_0($3) ($t$-1)		-0.093				-0.104	
t-stat		-5.27				-5.75	
P_0($4) ($t$-1)			-0.083				-0.093
t-stat			-4.31				-5.71
Observations	325	325	325	325	325	325	325
Countries	85	85	85	85	85	85	85
Hansen Test p-value	0.23	0.18	0.14	0.46	0.31	0.31	0.31
AR(2) p-value	0.09	0.12	0.12	0.14	0.10	0.14	0.15

Source: Authors' estimations.
Notes: The table reports regression results with income growth as dependent variable; and income per capita (in logs), average years of secondary education of the female and male population, a measure of market distortion (given by the price of investment goods) and headcount poverty P_0 (corresponding to poverty lines of $2, $3, and $4) as explanatory variables. Regressions (4), (5), (6) and (7) also include a measure of income inequality (the Gini coefficient). All the explanatory variables are lagged one period. All regressions include a constant. The regressions are calculated using system GMM estimators and allowing the instrument set to start with lagged levels at t-1. Robust t-statistics are reported below the coefficients.

Regarding the coefficients of the other control variables, both lagged income and the market distortions proxy carry significant negative coefficients, as expected. In turn, the education variables carry coefficients of opposite signs, in line with the findings of other studies such as Perotti (1996), Forbes (2000) and Knowles (2005), in spite of the fact that their data samples are very different from the one employed here.[20]

We next assess whether our finding of a significant poverty coefficient is just a result of excluding inequality from the regression, so that we are forcing inequality's impact on growth to occur through poverty. Hence in columns (4) to (7) in table 2 we include inequality as an explanatory variable in the regression. In column (4) we omit poverty, i.e., we set $\beta = 0$ in (18); and hence, the specification is similar to that employed by Forbes (2000). The result is also similar to hers: inequality carries a positive and significant coefficient. In columns (5) to (7) we include both inequality and poverty in the regression. Inequality consistently exhibits a positive and significant coefficient, while the pattern of the other coefficients is very similar to that in the first three columns of the table. In particular, poverty continues to carry a negative and significant coefficient.

3.1 Robustness to Alternative Instruments

The last two rows of table 2 report the Hansen and second-order serial correlation tests, both of which provide an assessment of the validity of the instrument set employed in the GMM estimation. While the Hansen test shows no evidence against the null hypothesis that the instruments are valid, the test for second-order serial correlation comes close to rejecting the null at the 10 percent level in several cases, and it actually rejects the null in the specification reported in the first column. This suggests that the instruments underlying the estimations in table 2 might be invalid due to the presence of second-order serial correlation of the (differenced) residuals.

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20. See e.g., table 4 in Perotti (1996) and tables 1 and 3 in Knowles (2005). Forbes (2000, table 3) also obtains coefficients of opposite sign, but their sign pattern —a negative coefficient for male education and a positive one for female education—is reversed relative to ours, Perotti's and Knowles's.

Table 3. Estimation Results: Baseline Model - Alternative Instrument Set

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Income (in logs) (*t*-1)	-0.011	-0.024	-0.034	0.008	-0.003	-0.014	-0.025
t-stat	-2.36	-3.78	-4.15	1.91	-0.73	-2.46	-3.27
Female education (*t*-1)	-0.004	-0.004	-0.005	-0.001	-0.002	-0.001	-0.001
t-stat	-0.57	-0.65	-0.81	-0.21	-0.32	-0.17	-0.14
Male education (*t*-1)	0.003	0.006	0.009	-0.006	-0.002	-0.001	0.001
t-stat	0.50	1.03	1.49	-0.73	-0.25	-0.17	0.18
PPP (*t*-1)	-0.011	-0.008	-0.008	-0.015	-0.022	-0.021	-0.023
t-stat	-3.26	-2.39	-2.16	-2.54	-4.63	-4.50	-4.58
Inequality (*t*-1)				-0.065	-0.046	-0.058	-0.068
t-stat				-2.22	-1.68	-2.31	-2.94
$P_0(\$2)$ (*t*-1)	-0.109				-0.058		
t-stat	-3.90				-2.49		
$P_0(\$3)$ (*t*-1)		-0.110				-0.081	
t-stat		-4.95				-3.90	
$P_0(\$4)$ (*t*-1)			-0.121				-0.097
t-stat			-5.54				-4.41
Observations	325	325	325	325	325	325	325
Countries	85	85	85	85	85	85	85
Hansen Test *p*-value	0.23	0.19	0.15	0.62	0.43	0.45	0.46
AR(3) *p*-value	0.40	0.52	0.66	0.56	0.45	0.50	0.57

Source: Authors' estimations.
Notes: The table reports regression results with income growth as dependent variable; and income per capita (in logs), average years of secondary education of the female and male population, a measure of market distortion (given by the price of investment goods) and headcount poverty P_0 (corresponding to poverty lines of $2, $3, and $4) as explanatory variables. Regressions (4), (5), (6) and (7) also include a measure of income inequality (the Gini coefficient). All the explanatory variables are lagged one period. All regressions include a constant. The regressions are calculated using system GMM estimators and allowing the instrument set to start with lagged levels at *t*-2. Robust *t*-statistics are reported below the coefficients.

To explore this further, in table 3 we repeat the estimations lagging the instruments one more period than in the previous exercises so that the instrument set remains valid even in the presence of second (but no higher) order serial correlation of the residuals. The results reported in the table confirm the basic result found above regarding the estimated poverty coefficient, which remains negative and highly significant, and in most cases (i.e., except for column (6) of the table) of the same magnitude as in table 2. As before, this result holds irrespective of the poverty line chosen and regardless of the inclusion or exclusion of inequality in the regression. In contrast, the

parameter estimate of the inequality variable is now negative and significant in all the specifications in table 3, regardless of whether poverty is included in the regression, and of the specific poverty measure selected. As for the other control variables, the distortions proxy continues to carry a negative and significant coefficient, while the coefficients of the two education variables become small and insignificant. Finally, the two test statistics show little evidence against the model's specification. Thus, we conclude that the poverty coefficient estimate is robust to the use of alternative instruments. This, however, is not the case for the estimated impact of inequality on growth, which changes drastically with the instrument set.

3.2 Robustness to Different Control Variables

Given the huge variety of explanatory variables considered in the empirical growth literature, one may wonder if the above results are driven by our particular choice of control variables. To explore this issue, in table 4 we experiment with two alternative sets of control variables. The top panel reports estimates obtained using a model that includes as regressors the inflation rate, trade openness and government size (in logs). The bottom panel reports results for an alternative model including inflation, female education, and lagged infrastructure. Since the coefficient estimates on the controls themselves are of no direct interest here, they are omitted from the table to save space.[21]

Preliminary experiments with both specifications again suggested the presence of second-order autocorrelation of the (differenced) residuals, and hence the instrument sets for the estimations in table 4 allow for this fact. Focusing first on the top panel, the parameter estimates of the poverty headcount continue to be negative and highly significant in all cases—regardless of whether inequality is included in the regression. Furthermore, their magnitude is very similar to that obtained in the preceding models. In contrast, the parameter of the inequality variable in the last four columns changes sign across specifications and is not estimated precisely.

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21. Note that sample sizes decline somewhat relative to tables 2 and 3, due to the limited availability of some of the explanatory variables.

Table 4. Estimation Results: Alternative Control Variables

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Model with inflation, trade (in logs), and government size (in logs)							
Inequality (t-1)				-0.039	0.051	0.017	-0.010
t-stat				-0.67	1.15	0.47	-0.26
P_0($2) ($t$-1)	-0.086				-0.098		
t-stat	-2.57				-3.34		
P_0($3) ($t$-1)		-0.080				-0.091	
t-stat		-3.17				-4.04	
P_0($4) ($t$-1)			-0.070				-0.089
t-stat			-3.23				-4.25
Observations	289	289	289	289	289	289	289
Hansen Test p-value	0.27	0.35	0.46	0.66	0.43	0.52	0.58
AR(3) p-value	0.80	0.81	0.79	0.71	0.76	0.76	0.77
Model with inflation, lagged female education, and lagged infrastructure							
Inequality (t-1)				0.004	0.040	0.000	-0.021
t-stat				0.09	1.01	-0.01	-0.56
P_0($2) ($t$-1)	-0.123				-0.149		
t-stat	-3.37				-4.24		
P_0($3) ($t$-1)		-0.127				-0.129	
t-stat		-4.45				-5.31	
P_0($4) ($t$-1)			-0.132				-0.124
t-stat			-4.81				-5.34
Observations	306	306	306	306	306	306	306
Hansen Test p-value	0.41	0.43	0.41	0.44	0.47	0.47	0.47
AR(3) p-value	0.82	0.67	0.55	0.92	0.80	0.61	0.51

Source: Authors' estimations.
Notes: The table reports regression results with income growth as dependent variable; and the lagged income per capita (in logs), headcount poverty P_0 (corresponding to poverty lines of $2, $3, and $4) and two sets of control variables. The top panel includes as control variables the inflation rate, the adjusted volume of trade (in logs), and the ratio of public consumption to GDP (in logs). The second panel includes as control variables the inflation rate, the average years of secondary education of the female population (lagged) and an infrastructure measure (lagged average number of telephone lines). The coefficients of the control variables are not reported. Regressions (4), (5), (6) and (7) also include a lagged measure of income inequality (the Gini coefficient). All regressions include a constant. The regressions are calculated using system GMM estimators and allowing the instrument set to start with lagged levels at t-2. Robust t-statistics are reported below the coefficients.

The bottom panel of table 4 tells a very similar story, in spite of the different choice of control variables: poverty consistently retains a negative and significant coefficient, while that of inequality is sometimes positive, sometimes negative, and always insignificant. Finally, the specification tests at the bottom of table 4 fail to show any sign of misspecification.

3.3 Robustness to Non-Linearities

The results presented so far are in line with the analytical model outlined in section 2, which predicts a negative effect of poverty on growth, along with an ambiguous impact of inequality. However, one might wonder if, rather than capturing a true poverty effect, the negative coefficient on the poverty measure may just be capturing a non-linear effect of inequality on growth.[22] To explore this issue, we estimate equation (20) using a quadratic specification for $h(g_{it-1})$:

$$h(g_{it-1}) = h_1 g_{it-1} + h_2 g_{it-1}^2,$$ (21)

where h_1 and h_2 are parameters to be estimated. If the poverty coefficient in the previous regression is really capturing non-linear effects of inequality, we should expect its significance (and perhaps also its size) to decline in these specifications. Table 5 reports the results obtained with each of the three sets of control variables considered.

Two results from these experiments are worth stressing. First, in all specifications the parameter estimate of the poverty variable is negative, significant and of comparable magnitude to those reported previously. Second, the opposite happens with the inequality parameter estimates: they are not robust across specifications. With the first set of controls, the growth effect of the level of inequality is significantly positive and that of its square is significantly negative. With the second set of controls, the sign pattern is reversed, although the precision of the estimates declines. In particular, for the models in columns (5) and (6) we cannot reject the joint null hypothesis that h_1 and h_2 in (21) are both equal to zero (i.e., that inequality does not belong in the regression). The third set of controls, shown in columns (7)-(9), again yields a negative coefficient for the level of inequality and a positive one for its square, although neither is individually significant, and they are jointly significant only in column (9).

22. Recall that, as discussed earlier, the poverty measures we are using can be expressed as non-linear functions of both per capita income and inequality.

Table 5. Estimation Results: Non Linear Effects of Inequality

	Baseline model			Model with inflation, trade (in logs), and government size (in logs)			Model with inflation, lagged female education, and lagged infrastructure		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inequality $(t\text{-}1)$	0.408	0.328	0.233	-0.179	-0.232	-0.275	-0.147	-0.160	-0.201
t-stat	2.52	2.03	1.47	-0.97	-1.50	-1.91	-0.80	-0.84	-0.99
Squared inequality $(t\text{-}1)$	-0.605	-0.526	-0.415	0.287	0.283	0.292	0.162	0.106	0.134
t-stat	-2.99	-2.58	-2.12	1.40	1.61	1.78	0.68	0.45	0.54
$P_0(\$2)$ $(t\text{-}1)$	-0.059			-0.132			-0.162		
t-stat	-3.41			-5.68			-4.79		
$P_0(\$3)$ $(t\text{-}1)$		-0.085			-0.117			-0.137	
t-stat		-5.47			-6.12			-6.47	
$P_0(\$4)$ $(t\text{-}1)$			-0.104			-0.109			-0.141
t-stat			-6.25			-6.15			-6.82
Observations	325	325	325	289	289	289	306	306	306
Countries	85	85	85	80	80	80	85	85	85
Hansen Test p-value	0.20	0.19	0.17	0.30	0.40	0.51	0.33	0.33	0.36
AR(3) p-value	0.59	0.58	0.61	0.82	0.82	0.85	0.97	0.80	0.65
Ho: $h_1 = h_2 = 0$	0.00	0.00	0.00	0.03	0.25	0.15	0.64	0.06	0.01

3.4 Robustness to Alternative Poverty Measures

The empirical exercises reported so far take the poverty headcount as the preferred measure of poverty. However, the headcount is just one among many possible poverty measures. To assess whether our results are robust to the use of alternative poverty measures, we next re-estimate the empirical growth equation using, instead, the poverty gap and the squared poverty gap, and employing the three alternative sets of control variables considered above.

Tables 6 and 7 report the results obtained using the poverty gap and the squared poverty gap, respectively. They are easily summarized. With very few exceptions, poverty generally carries a negative and significant coefficient regardless of the poverty measure chosen, the poverty line considered, the control variable set employed, and whether inequality is included or not in the regression. There are a few cases in which the poverty coefficient loses significance (two in table 6 and three in table 7, using 10 percent significance as the benchmark), but its sign is always negative. As for inequality, its parameter estimate is affected by the choice of control variables and poverty measure. When poverty is measured by the poverty gap (table 6), the inequality coefficient is positive in five instances (and significant at the 10 percent level or better in two of them) and negative in four (significant in two). When poverty is measured instead by the squared poverty gap, the estimate is positive in six instances (five significant) and negative in three (of which one significant). Moreover, the estimates are always negative when using Perotti's (1996) control variable set and positive in most cases when using the alternative sets of control variables.

3.5 Robustness to Alternative Estimation Methods

The empirical experiments reported so far strongly suggest that poverty belongs in the growth equation with a negative sign. However, one might still doubt the ability of the GMM estimation approach to deal with potential simultaneity biases, especially if poverty is highly persistent at the 5 to 10-year horizon. This, of course, should have been flagged by the specification tests reported above, but the skeptical reader might doubt their small sample power.

Table 6. Estimation Results: Poverty Measured by the Poverty Gap

	(1)	(2)	(3)	(4)	(5)	(6)
Baseline model						
Inequality (t-1)				-0.039	-0.055	-0.063
t-stat				-1.59	-2.49	-2.34
P_0($2) ($t$-1)	-0.186			-0.067		
t-stat	-2.75			-1.29		
P_0($3) ($t$-1)		-0.218			-0.169	
t-stat		-5.14			-4.05	
P_0($4) ($t$-1)			-0.183			-0.181
t-stat			-5.02			-4.42
Observations	325	325	325	325	325	325
Model with inflation, trade (in logs), and government size (in logs)						
Inequality (t-1)				0.086	0.013	0.022
t-stat				1.72	0.35	0.58
P_0($2) ($t$-1)	-0.103			-0.187		
t-stat	-1.40			-2.57		
P_0($3) ($t$-1)		-0.138			-0.160	
t-stat		-3.00			-3.78	
P_0($4) ($t$-1)			-0.086			-0.123
t-stat			-2.63			-3.48
Observations	289	289	289	289	289	289
Model with inflation, lagged female education, and lagged infrastructure						
Inequality (t-1)				0.112	0.007	-0.029
t-stat				2.52	0.19	-0.76
P_0($2) ($t$-1)	-0.199			-0.341		
t-stat	-2.45			-3.70		
P_0($3) ($t$-1)		-0.235			-0.241	
t-stat		-4.49			-5.82	
P_0($4) ($t$-1)			-0.210			-0.194
t-stat			-4.82			-5.09
Observations	306	306	306	306	306	306

Source: Authors' estimations.
Notes: The table reports regression results with income growth as dependent variable; and the lagged income per capita (in logs), the poverty gap P_1 (corresponding to poverty lines of $2, $3, and $4) and three sets of control variables. The first panel includes as control variables lagged average years of secondary education of the female and male population and a lagged measure of market distortion (given by the price of investments goods). The second panel includes as control variables the inflation rate, the adjusted volume of trade (in logs), and the ratio of public consumption to GDP (in logs). The third panel includes as control variables the inflation rate, the lagged average years of secondary education of the female and the lagged infrastructure measure. The coefficients of the control variables are not reported. Regressions (4), (5), and (6) include also also the Gini coefficient. All regressions include a constant. The regressions are calculated using system GMM estimators and allowing the instrument set to start with lagged levels at t-2. Robust t-statistics are reported below the coefficients.

Table 7. Estimation results: Poverty Measured by the Squared Poverty Gap

	(1)	(2)	(3)	(4)	(5)	(6)
Baseline model						
Inequality (t-1)				-0.039	-0.036	-0.037
t-stat				-1.83	-1.50	-1.54
P_0($2) ($t$-1)	-0.191			-0.058		
t-stat	-1.71			-0.64		
P_0($3) ($t$-1)		-0.211			-0.096	
t-stat		-2.99			-1.70	
P_0($4) ($t$-1)			-0.192			-0.110
t-stat			-3.63			-2.45
Observations	325	325	325	325	325	325
Model with inflation, trade (in logs), and government size (in logs)						
Inequality (t-1)				0.096	0.083	0.070
t-stat				1.94	1.70	1.55
P_0($2) ($t$-1)	-0.071			-0.239		
t-stat	-0.57			-1.91		
P_0($3) ($t$-1)		-0.124			-0.205	
t-stat		-1.58			-2.70	
P_0($4) ($t$-1)						-0.181
t-stat						-3.19
Observations	289	289	289	289	289	289
Model with inflation, female education, and lagged infrastructure						
Inequality (t-1)	-0.246			0.139	0.104	0.073
t-stat	-1.89			2.81	2.41	1.80
P_0($2) ($t$-1)				-0.528		
t-stat				-3.11		
P_0($3) ($t$-1)		-0.193			-0.366	
t-stat		-2.39			-3.91	
P_0($4) ($t$-1)			-0.216			-0.291
t-stat			-3.23			-4.46
Observations	306	306	306	306	306	306

Source: Authors' estimations.
Notes: The table reports regression results with income growth as dependent variable; and the lagged income per capita (in logs), the square poverty gap P_2 (corresponding to poverty lines of $2, $3, and $4) and three sets of control variables. The first panel includes as control variables lagged average years of secondary education of the female and male population and a lagged measure of market distortion (given by the price of investments goods). The second panel includes as control variables the inflation rate, the adjusted volume of trade (in logs), and the ratio of public consumption to GDP (in logs). The third panel includes as control variables the inflation rate, the lagged average years of secondary education of the female and the lagged infrastructure measure. The coefficients of the control variables are not reported. Regressions (4), (5), and (6) include also also the Gini coefficient. All regressions include a constant. The regressions are calculated using system GMM estimators and allowing the instrument set to start with lagged levels at t-2. Robust t-statistics are reported below the coefficients.

Table 8. Estimation Results: Cross Section with Robust Standard Errors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Income (in logs) (t-1)	-0.016	-0.023	-0.030	-0.002	-0.013	-0.019	-0.023
t-stat	-2.64	-3.24	-3.35	-0.62	-2.39	-3.02	-2.69
Female education (t-1)	-0.004	-0.003	-0.005	-0.010	-0.006	-0.005	-0.006
t-stat	-0.56	-0.55	-0.74	-1.48	-0.87	-0.88	-1.07
Male education (t-1)	0.011	0.012	0.013	0.011	0.010	0.010	0.012
t-stat	1.77	2.03	2.26	1.69	1.63	1.84	2.02
PPP (t-1)	-0.017	-0.017	-0.017	-0.019	-0.017	-0.017	-0.018
t-stat	-2.45	-2.45	-2.53	-2.95	-2.65	-2.67	-2.73
Inequality (t-1)				-0.063	-0.051	-0.051	-0.046
t-stat				-2.61	-2.23	-2.13	-1.83
P_0($2) ($t$-1)	-0.063				-0.049		
t-stat	-2.73				-2.49		
P_0($3) ($t$-1)		-0.068				-0.055	
t-stat		-3.13				-2.80	
P_0($4) ($t$-1)			-0.076				-0.058
t-stat			-3.17				-2.36
Observations	75	75	75	75	75	75	75
R^2	0.24	0.25	0.25	0.25	0.30	0.31	0.30

Source: Authors' estimations.
Notes: The table reports regression results with income growth as dependent variable; and income per capita (in logs), average years of secondary education of the female and male population, a measure of market distortion (given by the price of investment goods) and headcount poverty P_0 (corresponding to poverty lines of $2, $3, and $4) as explanatory variables. Regressions (4), (5), (6) and (7) also include also the Gini coefficient. All regressions include a constant. Robust t-statistics are reported below the coefficients. Niger has been removed from the sample.

To fully address this concern we would need a set of valid external instruments, which unfortunately is not available. As an alternative, table 8 reports the results of re-estimating equations (17) and (18) exploiting only the cross section dimension of the data. Specifically, we regress the average growth rate over the period 1960-2000 (or longest available span) on the set of controls in 1960, plus initial poverty.[23] This specification should help mitigate concerns with reverse causality stemming from the persistence of poverty since it amounts to lagging the poverty variable further relative to the

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23. To save space, we only report estimates using the baseline model. However, the use of other sets of control variables does not change the qualitative conclusions. The results in table 8 are based on 75 observations out of a potential 76. This is due to the elimination of a big outlier (Niger) from the sample.

dependent variable. In exchange, the cross-country regression may suffer from heterogeneity bias due to the presence of unobserved country-specific factors for which we cannot control without making use of the time-series dimension of the data (as done in the GMM procedure). This exercise is similar to the one reported by Perotti (1996), but in this case the emphasis is on the growth impact of poverty, rather than inequality.

The results in table 8 echo the GMM estimates. Initial poverty deters growth, regardless of the specific poverty line chosen and irrespective of whether inequality is included in the regression. The main difference relative to the panel results in table 3 is the smaller magnitude of the estimated poverty coefficients shown in table 8.

4. UNCOVERING THE TRANSMISSION CHANNEL

The previous section has presented fairly robust evidence suggesting that, other things being equal, poverty deters growth. What is the mechanism responsible for such effect? One way to approach this question is in terms of the stylized model introduced in section 2. In the model, poverty affects growth only through its negative impact on investment, and such impact arises because of the absence of well-developed capital markets. This amounts to three testable predictions. First, poverty is negatively associated with investment. Second, if this is the relevant mechanism at work, then poverty should not belong in the growth regression once we control for investment. Third, the negative relation between poverty and investment is driven by financial market imperfections—with perfect capital markets, poverty should have no impact on growth. Below we offer a preliminary assessment of these three hypotheses. Throughout we focus on headcount poverty P_0; results with the other poverty measures are qualitatively similar and thus not reported to save space.

4.1 Income, Poverty, and Investment

Before proceeding with the formal econometric tests, we document some stylized facts on investment, poverty, and income levels. Little is known about the impact of poverty on investment, and as a first approximation to the issue we follow an approach similar to that of Ben-David (1998). We rank 99 countries for which we have income,

poverty and investment data according to their per capita income in the mid-1990s.[24] Then we partition those countries into 10 groups of 10 countries each (with the exception of the last group that has 9 countries only). The poorest countries in the sample are in the first group, the next 10 countries are in group 2, and so on; thus the 10 richest countries form group 10.

Figure 1 plots median (log) income for each group (figure1.A), poverty (US$2 poverty line) in figure1.B, and gross fixed capital formation relative to GDP (GFCF) in figure1.C.[25] Inspection of this figure reveals a clear non-linear pattern in the relationship between income, poverty and investment. For example, headcount poverty falls dramatically between the first and fourth group—from about 66 percent to less than 8 percent, but after that it declines much more modestly as we move further up along the income group classification. Similarly, investment increases from 14 to about 22 percent of GDP between the first and fourth group, and then remains virtually constant between the fourth and tenth group. Note that these non-linearities are not driven by the underlying income data (figure1.A), whose association with investment seems to be well described by a linear pattern.

As a result, there seems to be a closer association between poverty and investment than between income levels and investment. In fact, the correlation coefficient between the income series in figure 1.A and the investment series in figure 1.C is about 0.55 (i.e., investment tends to be higher in richer countries), whereas the correlation coefficient between the investment series and the poverty series in figure 1.B is - 0.77.

4.2 Poverty, Investment, and Growth

The first issue we explore is whether investment may be behind the negative association between poverty and growth. The empirical growth models estimated in the previous section follow the conventional approach in which investment has been "substituted out." A considerable literature (e.g., Levine and Renelt, 1992; Hendry and Krolzig, 2004) finds that investment is one of the few robust determinants of long-term

24. We pick the 1990s because it is the period over which more poverty observations are available.

25. The results remain virtually unchanged if one uses gross capital formation (GCF) as investment measure.

growth. Thus, we proceed to re-estimate (17) adding investment back to the set of regressors.

Table 9 reports the results for the three sets of controls used in the growth regressions and the two definitions of investment. In figure 1.A we report the results for fixed investment (GFCF) and in figure 1.B for total investment (GCF). Inspection of the table suggests the investment rate belongs to the growth equation regardless of the definition used. Its estimated coefficient ranges between 0.20 and 0.25, which is fully consistent with earlier literature. Poverty, however, does not enter significantly in any equation, with column (6) of figure 1.B as the only exception, with a p-value of 0.10.[26]

4.3 Poverty and Investment

The fact that poverty drops out of the investment—augmented growth equation strongly suggests the need to examine the association between investment and poverty. Since this task would well merit a separate paper, we limit ourselves to a brief empirical illustration. We follow a strategy similar to that in the previous section and estimate a simple equation of the type

$$I_{it} = \eta_i + \alpha I_{it-1} + \psi' z_{it} + \pi P_{it} + u_{itj}, \tag{22}$$

where I is the investment rate, z represents a set of control variables and P is a measure of poverty. Here η_i denotes a country-specific effect, and u_{it} is an i.i.d. error term. If poverty deters investment, we should find that $\pi < 0$.

To implement (22), we consider a basic investment model with the following control variables: (i) the GDP growth rate, consistent with the simple accelerator model; (ii) the initial level of per capita GDP; (iii) the price of investment goods; and (iv) the terms of trade changes, which capture the economy's external conditions.[27]

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26. Other empirical experiments, not reported to save space, investigated possible effects of poverty on the efficiency of investment, adding to these specifications an interaction between investment and poverty. Its coefficient estimate, however, was never significant.

27. Formally speaking, (17) and (22) form a two-equation (sub) system, whose identifiability would need to be considered. Given the illustrative character of (22), we do no pursue this issue here. Note, however, that the specifications employed in the text would yield enough exclusion restrictions to identify both equations.

Figure 1. Income Poverty and Investment

A.
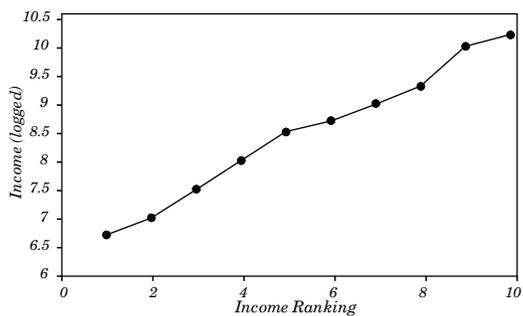
B.
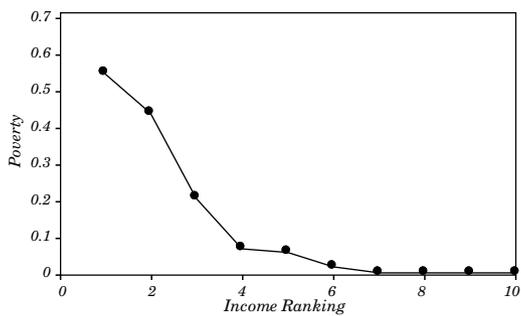
C.
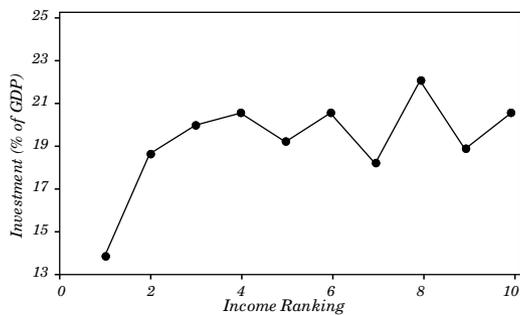
Source: Authors' calculations.

Table 9. Estimation Results: Investment as an Extra Control Variable

	Model with lagged female and male education, and lagged market distortions proxy			Model with inflation, trade (in logs), and government size (in logs)			Model with inflation, lagged female education, and lagged infrastructure		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GFCF (t)	0.237	0.238	0.237	0.211	0.210	0.221	0.238	0.234	0.231
t-stat	9.27	9.53	9.92	12.84	11.50	10.96	8.93	8.71	8.48
$P_0(\$2)$ (t-1)	-0.002			0.000			0.009		
t-stat	-0.10			-0.02			0.56		
$P_0(\$3)$ (t-1)		0.003			0.005			0.006	
t-stat		0.17			0.35			0.42	
$P_0(\$4)$ (t-1)			0.007			0.020			0.008
t-stat			0.42			1.14			0.51
Observations	316	316	316	284	284	284	301	301	301
Countries	84	84	84	80	80	80	84	84	84
Hansen Test p-value	0.25	0.23	0.26	0.22	0.21	0.23	0.45	0.43	0.45
AR(2) p-value	0.54	0.52	0.52	0.12	0.11	0.11	0.23	0.22	0.22

Table 9. (continued)

	Model with lagged female and male education, and lagged market distortions proxy			Model with inflation, trade (in logs), and government size (in logs)			Model with inflation, lagged female education, and lagged infrastructure		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GFCF (t)	0.231	0.236	0.236	0.214	0.218	0.235	0.265	0.259	0.254
t-stat	10.25	10.34	10.55	11.84	10.73	10.24	9.78	9.94	9.86
P_0($2) (t-1)	0.003			0.002			0.022		
t-stat	0.20			0.16			1.20		
P_0($3) (t-1)		0.008			0.009			0.019	
t-stat		0.51			0.68			1.19	
P_0($4) (t-1)			0.014			0.028			0.020
t-stat			0.81			1.63			1.03
Observations	321	321	321	287	287	287	303	303	303
Countries	84	84	84	80	80	80	84	84	84
Hansen Test p-value	0.21	0.20	0.23	0.28	0.29	0.36	0.43	0.43	0.44
AR(2) p-value	0.31	0.30	0.30	0.09	0.09	0.09	0.22	0.20	0.19

Source: Authors' estimations.

Notes: The table reports regression results with income growth as dependent variable; and the lagged income per capita (in logs), investment (i.e., gross fixed capital formation), headcount poverty P_0 (corresponding to poverty lines of $2, $3, and $4) and three sets of control variables. The first panel includes as control variables lagged average years of secondary education of the female and male population and a lagged measure of market distortion (given by the price of investments goods). The second panel includes as control variables the inflation rate, the adjusted volume of trade (in logs), and the ratio of public consumption to GDP (in logs). The third panel includes as control variables the inflation rate, the lagged average years of secondary education of the female and the lagged infrastructure measure. The coefficients of the control variables are not reported. All regressions include a constant. The regressions are calculated using system GMM estimators and allowing the instrument set to start with lagged levels at t-1. Robust t-statistics are reported below the coefficients.

The first six columns of table 10 report the results of estimating equation (22). Columns 1-3 use the GFCF definition of investment, while columns 4-6 use GCF. In every case, the estimates show that higher poverty is associated with lower investment, subsequently, regardless of the poverty line used, the headcount ratio carries a negative and significant coefficient in all specifications.

The estimates of the other control variables are in line with those reported by existing studies, except for the initial income level, for which we find a negative parameter in contrast with the positive coefficient commonly encountered in the literature. Note, however, that there is another indirect effect of income on investment operating in the opposite direction through the impact of income on poverty.

4.4 Poverty, Investment, and Financial Sector Development

Finally, we check if the poverty-investment relation depends on the degree of financial sector development, as assumed by the analytical model in section 2. For this purpose we consider the following variation of (22):

$$I_{it} = \eta_i + \alpha I_{it-1} + \psi' z_{it} + \pi_{LFD} P_{it-1}^{LFD} + \pi_{HFD} P_{it-1}^{HFD} + u_{itj}, \tag{23}$$

where P_{it-1}^{LFD} and P_{it-1}^{HFD} now distinguish poverty levels according to the degree of financial sector development of the country under consideration. The superscripts *LFD* and *HFD* denote low and high degrees of financial sector development, respectively. The underlying idea is that the higher the degree of financial sector development, the easier it will be for the poor to borrow and take advantage of their investment opportunities. Hence, in (23) we would expect $\pi_{LFD} < \pi_{HFD}$.

In order to empirically implement (23) we need to assign the different observations to the two states of financial sector development—low and high. To do so we take the stock of credit to the private sector relative to GDP as a yardstick. When the value of this variable is below its sample median we assign the observation to the low financial sector development state. Conversely, values above the median are classified as belonging to the high financial sector development state.

Table 10. Estimation Results: Investment as the Dependent Variable

	Model 1						Model 2					
	GFCF				GCF		GFCF			GCF		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Investment (t-1)	0.658	0.691	0.717	0.652	0.664	0.690	0.721	0.716	0.735	0.653	0.656	0.674
t-stat	11.15	11.17	11.63	19.05	17.03	16.64	16.36	15.99	16.23	24.34	22.86	22.03
Income (in logs) (t-1)	-0.009	-0.014	-0.019	-0.012	-0.018	-0.020	-0.005	-0.011	-0.010	-0.005	-0.006	-0.002
t-stat	-1.58	-2.07	-2.30	-2.29	-2.66	-2.27	-1.55	-2.60	-1.68	-1.61	-1.23	-0.31
Growth (t)	0.539	0.512	0.498	0.550	0.549	0.547	0.524	0.507	0.498	0.620	0.616	0.612
t-stat	8.87	8.36	8.16	9.28	9.10	8.95	14.59	14.29	12.87	14.39	13.67	13.28
PPP (t-1)	-0.010	-0.010	-0.011	-0.014	-0.014	-0.017	-0.004	0.001	-0.001	0.000	0.000	-0.001
t-stat	-1.66	-1.62	-1.80	-1.84	-1.87	-2.29	-0.81	0.21	-0.27	-0.06	0.03	-0.15
Terms of trade (t)	0.064	0.074	0.078	0.132	0.133	0.133	0.079	0.089	0.100	0.071	0.078	0.079
t-stat	1.60	1.87	2.00	3.02	3.07	3.09	3.97	4.28	4.52	3.02	3.15	3.05
$P_0(\$2)$ (t-1)	-0.079			-0.105	-0.088							
t-stat	-1.88			-2.74	-2.48							
$P_0(\$3)$ (t-1)		-0.065										
t-stat		-1.81										
$P_0(\$4)$ (t-1)			-0.064			-0.073						
t-stat			-1.80			-1.92						
$P_0^{\text{HFD}}(\$2)$ (t-1)							0.031			0.016		
t-stat							0.90			0.47		
$P_0^{\text{LFD}}(\$2)$ (t-1)							-0.055			-0.057		
t-stat							-2.03			-2.52		

Table 10. (continued)

| | Model 1 | | | | | | Model 2 | | | | | |
| | GFCF | | | GCF | | | GFCF | | | GCF | | |
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$P_0^{\mathrm{HFD}}(\$3)$ (t-1)								-0.002			0.011	
t-stat								-0.08			0.41	
$P_0^{\mathrm{LFD}}(\$3)$ (t-1)								-0.059			-0.038	
t-stat								-2.47			-1.70	
$P_0^{\mathrm{HFD}}(\$4)$ (t-1)									0.003			0.025
t-stat									0.13			0.97
$P_0^{\mathrm{LFD}}(\$4)$ (t-1)									-0.039			-0.010
t-stat									-1.43			-0.40
Observations	338	338	338	345	345	345	308	308	308	311	311	311
Countries	108	108	108	108	108	108	103	103	103	103	103	103
Hansen Test p-value	0.29	0.32	0.37	0.34	0.34	0.39	0.47	0.57	0.59	0.28	0.31	0.37
AR(2) p-value	0.33	0.33	0.32	0.30	0.28	0.27	0.36	0.36	0.35	0.43	0.42	0.40

Source: Authors' estimations.
Notes: The table reports regression results with investment (i.e., gross fixed capital formation or gross fixed capital), as dependent variable; and lagged investment, the lagged per capita income (in logs), the income growth rate, a lagged measure of market distortion (given by the price of investments goods), the terms of trade, the lagged measure of credit to private sector (in logs), and neither the lagged headcount poverty P_0 (corresponding to poverty lines of \$2, \$3, and \$4) or the lagged upper and lower headcount poverty P_0 (corresponding to poverty lines of \$2, \$3, and \$4) taking into account the median of the credit to private sector to divide the samples. The coefficients of the control variables are not reported. All regressions include a constant. The regressions are calculated using system GMM estimators and allowing the instrument set to start with lagged levels at t-1. Robust t-statistics are reported below the coefficients.

Columns 7 to 9 and 10 to 12 in table 10 report the results of estimating (23) using as dependent variable the gross fixed capital formation and gross capital formation measures of investment, respectively. On the whole, the estimates imply that the negative relation between initial poverty and investment arises only in conditions of low financial development, which appears broadly consistent with the model in section 2. In fact, poverty does not seem to have any effect on investment at high levels of financial sector development. However, when the poverty line is set at US$4 a day the estimates cease to be significant even at low levels of financial development—perhaps reflecting the need for a more flexible parameterization of the relation between financial development and poverty effects on investment.

5. CONCLUSIONS

An abundant theoretical literature has suggested a variety of mechanisms through which poverty may deter growth and become self-perpetuating. However, the growth consequences of poverty have attracted only limited interest in the empirical literature. This stands in contrast with the ample attention devoted by recent empirical work to closely related issues such as the poverty-reducing effects of growth or the consequences of inequality for growth.

This paper has attempted to shed light on a simple hypothesis consistent with the growth-deterrent effect of poverty advanced by the theoretical literature—namely that, other things being equal, higher poverty should be reflected in slower growth. The paper's strategy is based on the estimation of a growth equation with poverty added to an otherwise standard set of growth determinants. Thus, the framework is similar to that employed in empirical studies of the effects of inequality on growth, but shifting the emphasis from inequality to poverty.

The resulting empirical specifications are estimated on a large panel dataset. On the whole, the results reveal a consistently negative and strongly significant association between the level of poverty and subsequent growth, which is also economically significant: the estimates suggest that a ten percentage-point increase in the headcount poverty rate is associated with a decline in annual per capita growth by about one percentage point.

The negative poverty-growth link survives a battery of robustness checks, including (i) the use of alternative poverty lines, (ii) the use of alternative poverty measures, (iii) the use of alternative sets of control variables in the regression, (iv) the use of alternative sets of instruments in the estimation, (v) the use of alternative estimation methods, and (vi) allowing for linear and non-linear effects of inequality on growth. When we add inequality to the regressions, the sign, significance and magnitude of the poverty effect remain essentially unchanged, suggesting that it does capture a true poverty effect rather than an inequality effect. In contrast, the link between inequality and growth is empirically fragile, consistent with the mixed findings of earlier literature.

The paper has also attempted to shed light on the mechanism underlying the negative poverty-growth link. While tentative, the evidence in the paper is consistent with the view that poverty deters investment, especially when the degree of financial development is limited. This result is in line with stylized theoretical models in which financial market imperfections prevent the poor from taking advantage of their investment opportunities in human and/or physical capital.

REFERENCES

Agénor, R. and J. Aizenman. 2010. "Aid Volatility and Poverty Traps." *Journal of Development Economics* (91): 1–7.

Aghion, P., E. Caroli, and C. García-Peñalosa. 1999. "Inequality and Economic Growth: The Perspective of the New Growth Theories." *Journal of Economic Literature* (37): 1615–60.

Alesina, A. and D. Rodrik. 1994. "Distributive Policies and Economic Growth." *Quarterly Journal of Economics* (109): 465–90.

Antman, F. and D. McKenzie. 2007. "Poverty Traps and Non-linear Income Dynamics with Measurement Error and Individual Heterogeneity." *Journal of Development Studies* (43): 1057–83.

Atkeson, A. and M. Ogaki. 1996. "Wealth-Varying Intertemporal Elasticities of Substitution: Evidence from Panel and Aggregate Data." *Journal of Monetary Economics* (38): 507–34.

Azariadis, C. and A. Drazen. 1990. "Threshold Externalities in Economic Development." *Quarterly Journal of Economics* (105): 501–26.

Azariadis, C. and J. Stachurski. 2004. "A Forward Projection of the Cross Country Income Distribution." Unpublished manuscript, Université Catholique de Louvain.

————. 2005. "Poverty Traps." In *Handbook of Economic Growth*, edited by P. Aghion and S. Durlauf. Amsterdam: Elsevier.

Banerjee, A. 2000. "The Two Poverties." Working Paper 01–16, Department of Economics, M.I.T.

Banerjee, A. and E. Duflo. 2003. "Inequality and Growth: What Can the Data Say?" *Journal of Economic Growth* (8): 267–99.

Banerjee, A. and A. Newman. 1993. "Occupational Choice and the Process of Development." *Journal of Political Economy* (101): 274–98.

Barro, R. 2000: "Inequality and Growth in a Panel of Countries." *Journal of Economic Growth* (5): 5–32.

Barro, R. and J.W. Lee. 2001. "International Data on Educational Attainment Updates and Implications." *Oxford Economic Papers* 53(3): 541–63.

Ben-David, D. 1998. "Convergence Clubs and Subsistence Economies." *Journal of Development Economics* (55): 155–71.

Bloom, E., D. Canning and J. Sevilla. 2003. "Geography and Poverty Traps." *Journal of Economic Growth* (8): 355–78.

Bourguignon, F. 2004. "The Poverty-Growth-Inequality Triangle." Unpublished manuscript, World Bank.

Blundell, R. and S. Bond. 1998. "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models." *Journal of Econometrics* (87): 115–43.

Calderón, C. and L. Servén. 2010. "Infrastructure in Latin America." Policy Research Working Paper 5317, World Bank.

Caucutt, E. and K. Kumar. 2005. "Evaluating Explanations for Stagnation." 2005 Meeting Papers 387, Society for Economic Dynamics.

Dasgupta, P. and D. Ray. 1986. "Inequality as a Determinant of Malnutrition and Unemployment: Theory." *Economic Journal* 96(384): 1011–34.

Dercon, S. 2005. "Risk, Poverty and Vulnerability in Africa." *Journal of African Economies* (14): 483–88.

Dercon, S. and L. Christiansen. 2011. "Consumption Risk, Technology Adoption and Poverty Traps: Evidence from Ethiopia." *Journal of Development Economics* (96): 159–73.

Dollar, D. and A. Kraay. 2002. "Growth is Good for the Poor." *Journal of Economic Growth* (7): 195–225.

Durlauf, S. 2006. "Groups, Social Influences, and Inequality." In *Poverty traps*, edited by S. Bowless, S. Durlauf, and K. Hoff. Princeton, NJ: Princeton University Press.

Durlauf, S. and D. Quah. 1999. "The New Empirics of Economic Growth." In *Handbook of Macroeconomics*, edited by J. Taylor and M. Woodford, Amsterdam: North-Holland.

Easterly, W. 1994. "Economic Stagnation, Fixed Factors, and Policy Thresholds." *Journal of Monetary Economics* (33): 525–57.

————. 2006. "Reliving the 1950s: the Big Push, Poverty Traps, and Takeoffs in Economic Development". *Journal of Economic Growth* (11): 289–318.

Engerman, S. and K. Sokoloff. 2006. "The Persistence of Poverty in the Americas: The Role of Institutions." In *Poverty traps*, edited by S. Bowless, S. Durlauf, and K. Hoff. Princeton, NJ: Princeton University Press.

Fisher, F. 1961. "Identifiability Criteria in Non-linear Systems." *Econometrica* (29): 574–90.

Forbes, K. 2000. "A Reassessment of the Relationship between Inequality and Growth." *American Economic Review* 90(4): 869–87.

Foster, J., J. Greer, and E. Thorbecke. 1984. "A Class of Decomposable Poverty Measures." *Econometrica* (52): 761–66.

Galor, O. and J. Zeira. 1993. "Income Distribution and Macroeconomics." *Review of Economic Studies* 60(1): 35–52.

Gibrat, R. 1931. *Les Inégalités Économiques.* Paris: Sirey.

Gollin, D., S. Parente, and R. Rogerson. 2002. "The Role of Agriculture in Development." *American Economic Review* 92(2): 160–64.

Graham, B. and J. Temple. 2006. "Rich Nations, Poor Nations: How Much Can Multiple Equilibria Explain?" *Journal of Economic Growth* (11): 5–41.

Hendry, D.F. and H-M. Krolzig. 2004. "'We Ran One Regression." *Oxford Bulletin of Economics and Statistics* (66): 799–810.

Jalan, J. and M. Ravallion. 2002. "Geographic Poverty Traps? A Micro Model of Consumption Growth in Rural China." *Journal of Applied Econometrics* 17(4): 299–314.

Kraay, A. 2006. "When is Growth Pro-Poor? Evidence from a Panel of Countries." *Journal of Development Economics* (80): 198–227.

Kraay, A. and C. Raddatz. 2007. "Poverty Traps, Aid and Growth." *Journal of Development Economics* (82): 315–47.

Kremer, M., A. Onatski, and J. Stock. 2001. "Searching for Prosperity." *Carnegie-Rochester Conference Series on Public Policy* 55(1): 275–303.

Knowles, S. 2005. "Inequality and Economic Growth: The Empirical Relationship Reconsidered in the Light of Comparable Data." *Journal of Development Studies* (41): 135–59.

Levine, R. and D. Renelt. 1992. "A Sensitivity Analysis of Cross-Country Growth Regressions." *American Economic Review* 82(4): 942–63.

Li, H. and H. Zou. 1998. "Income Inequality is not Harmful for Growth: Theory and Evidence." *Review of Development Economics* 2(3): 318–34.

Loayza, N., P. Fajnzylber, and C. Calderón. 2005. *Economic Growth in Latin America and the Caribbean.* Washington D.C.: The World Bank.

López, H. and L. Servén. 2011. "A Normal Relationship? Poverty, Growth and Inequality." Unpublished manuscript, World Bank.

López, H., K. Schmidt-Hebbel, and L. Servén. 2000. "How Effective is Fiscal Policy in Raising National Saving?" *Review of Economics and Statistics* (82): 226–38.

McKenzie, D. and C. Woodruff. 2006. "Do Entry Costs Provide an Empirical Basis for Poverty Traps? Evidence from Mexican Microenterprises." *Economic Development and Cultural Change* (55): 3–42.

Mookherjee, D. and D. Ray. 2002. "Contractual Structure and Wealth Accumulation." *American Economic Review* (92): 818–49.

Perotti, R. 1996. "Growth, Income Distribution and Democracy." *Journal of Economic Growth* (1): 149–87.

Quah, D. 1993. "Empirical Cross-section Dynamics in Economic Growth." *European Economic Review* (37): 426–34.

Ravallion, M. 2004. "Pro-Poor Growth: A Primer." Policy Research Working Paper 3242, World Bank.

————. 2009. "Why Don't We See Poverty Convergence?" Policy Research Working Paper 4974, World Bank.

Rebelo S. 1992. "Growth in Open Economies." *Carnegie-Rochester Conference Series on Public Policy* (36): 5–46.

Stiglitz, J. 1969. "The Effects of Income, Wealth and Capital Gains Taxation on Risk-Taking." *Quarterly Journal of Economics* (83): 263–83.

Ziliak, J. 1997. "Efficient Estimation with Panel Data when Instruments Are Predetermined: An Empirical Comparison of Moment-Condition Estimators." *Journal of Business and Economic Statistics* (15): 419–31.

Local Impacts of Trade Liberalization: Evidence from the Chilean Agricultural Sector

José Ignacio Cuesta
University of Chicago

Francisco A. Gallego
Pontificia Universidad Católica de Chile and EH Clio Lab

Felipe A. González
University of California at Berkeley

Protectionist trade policies aim at shielding some sectors—typically, but not exclusively, manufacturing—from international competition. In doing so, they may produce unintended consequences. In particular, they tend to create some taxed sectors that use protected inputs, usually in the agricultural sector, which end up facing a negative effective rate of protection (ERP hereafter). In this way, protectionism distorts the allocation of resources and creates disincentives for the production of some goods. This was the case of the tariff structure in Chile before the massive process of economic and trade liberalization that began in the mid-1970s. Before the liberalization reform, average tariffs were as high as 220%, aggravated by high dispersion and several non-tariff barriers

(NTBs hereafter) that were quickly eliminated after 1975.[1] This tariff structure created a lot of heterogeneity in the ERPs between and within sectors. For instance, according to Hachette (2011), while agriculture had negative ERPs of about 27% in 1960-1969, sectors outside agriculture had high positive ERPs of about 73%.

In this paper, we take advantage of this heterogeneity in ERPs across goods, and the fact that different areas in the country produced different goods, to study how the decrease in the level and dispersion of tariffs affected agricultural production and other outcomes at the local level. This way we exploit the fact that counties with different conditions for the production of different goods were heterogeneously affected by the decrease in tariffs. In this sense, we take a "differential exposure approach" (Goldberg and Pavcnik, 2007), which relies on the fact that counties are heterogeneously affected by the trade liberalization process, given their different production structures, and this is closely related to a paper by Topalova (2010), which studies the local effects of trade liberalization in India after trade was opened in the early 1990s.[2] The cost of using this approach, however, is that we cannot identify the effects of liberalization on the overall growth of the country. In particular, we study what happened to the production of sectors that were initially either taxed or protected by the tariff structure, through effects on either the intensive margin or productivity. Thus, we only address partial equilibrium effects of trade liberalization.

To measure agricultural output, we use agricultural census information to construct a measure of agricultural production at the county level for the pre-liberalization (1955 and 1965) and post-liberalization (1997 and 2007) periods. To measure the effective rates of protection, we use information for three subsectors (fruits, livestock, and primary products) from Hurtado, Muchnik and Valdés (1990) (HMV hereafter); and a fourth (forestry) from De la Cuadra (1974) (DLC hereafter). Next, using production information for each county, we construct an index of production-weighted ERPs for each county.

In terms of the main results of the paper, we find that ERPs have an economically and statistically significant effect on agriculture

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1. See Lederman (2005) for a detailed description of the liberalization process.

2. This approach assumes some degree of imperfect mobility of factors (in particular labor) across different sectors, which might be adequate in the case of developing countries (see Topalova, 2010, for a general discussion, and Bruhn and Gallego, 2012, for details on the case of the Americas).

output. Increasing the negative ERPs in the pre-liberalization period by one standard deviation increases post-liberalization output growth by about 12 log points when total output is considered. In contrast, a similar calculation for counties having positive ERPs before liberalization implies a slowdown in output growth of about 32 log points. This result confirms that some areas of the country were effectively protected before liberalization and that this protection implied producing more than efficient production levels. However, we find evidence that, in the case of the negative ERPs (i.e. initially taxed areas), the output expansion operates both through effects on the intensive margins and through total factor productivity (TFP) improvements. In the case of counties facing positive ERPs (i.e. initially protected areas), the output decrease is mostly due to effects on the intensive margin with no noticeable effects on TFP levels.

We also find that not only production increased in the counties benefiting from the elimination of negative ERPs, but also that there was an increase in output specialization. This presumably reflects the fact that these counties, when ruled by the right incentives in an open economy, moved towards higher specialization in the production of goods in which they had a comparative advantage. This is another positive effect of the trade liberalization process, as counties could benefit from this specialization. However, we cannot measure how much of this increase in output is due to increased efficiency.

This paper intends to complement three strands of the literature. First, it adds to incipient literature on the local effects of liberalization on economic activity and other broader development indicators. This strand includes papers by Topalova (2010), Edmonds, Pavcnik and Topalova(2010), and Khandelwal and Topalova (2011),[3] among others, all of which study the Indian case and exploit changes in tariff structure across time and industries in order to estimate the local impacts of trade reforms. The main difference between their approach and ours is that, in contrast to the case of India, in Chile the trade reform mostly took the negative pre-reform ERPsto zero, thus providing a cleaner experiment for testing the impact of tariff reductions in local contexts.

Second, we complement the empirical literature on the effects of liberalization on economic growth and other economic outcomes in Chile. This area is vast and takes different approaches from time-series

3. For instance, McCaig (2011) uses a similar approach for estimating the impact of tariff reduction in Vietnam over different poverty and demographic variables.

analyses (e.g., Rojas, López and Jiménez, 1997; Coeymans, 1999; Fuentes, Schmidt-Hebbel and Larraín, 2006; and Schmidt-Hebbel, 2006) to detailed studies using longitudinal information at the sectoral level (e.g. Corbo, Tybout and De Melo, 1991; Pavcnik, 2002; and Álvarez and Fuentes, 2003 for productivity effects in the manufacturing sector; and Beyer, Rojas and Vergara, 1999; and Gallego, 2012 for the effects of trade liberalization on the skill premium).[4]

This paper adds a new point of view to the empirical results by presenting empirical estimates of the effects of the trade reforms on agricultural output at the county level. We think this contribution is important as our analysis deals with endogeneity issues in a better way and also adds the regional dimension to an area with few studies examining the regional effects of the Chilean trade reform.[5] However, one limitation of our dataset is that we cannot clearly distinguish the effects of the trade reforms on productivity from the effects on total output.

Finally, we also contribute to the literature on the computation of ERPs for Chile in the agricultural-forestry sector (Balassa, 1971; Behrman, 1976; De la Cuadra, 1974; Varas, 1975; Hurtado and others, 1990; just to mention a few). In particular, we compute ERPs for different counties of the country. This contribution is important as we find significant variation across different sectors and present some empirical analyses to identify some empirical correlates to these measures.

The rest of the paper is organized as follows. Section 2 presents a brief description of the historical background of Chile's trade policies. Section 3 presents the data construction and section 4 presents some descriptive statistics of our measures of production and ERPs at the local level. Empirical results on the effect of the trade reform on agricultural output and other economic outcomes are given in section 5. Finally, a discussion of the results and concluding remarks can be found in section 6.

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4. Some papers going back to Harberger (1959), Varas (1975), and Coeymans (1978) use different types of models to compute the potential effects of trade liberalization on different economic outcomes such as input and output levels of growth.

5. One exception is the paper by Pardo and Meller (2002), who find that the speed of GDP convergence increases in regions with bigger increases in trade openness.

1. Historical Background of Chilean Trade Policy[6]

Before the 1950s, trade policy was characterized by multiple instruments (e.g. quotas, tariffs and multiple exchange rates) that aimed to protect the economy (Ffrench-Davis, 1973). According to Lederman (2005), this process started in the early to late 1920s, which is where, using econometric techniques, he found the main structural break in trade-related variables.

This process was consolidated in the so-called import-substitution industrialization (ISI) period during the Radical period covering 1938 to 1952 (with the radical governments of Pedro Aguirre Cerda, 1938–1941; Juan Antonio Ríos, 1942–1946; and Gabriel González Videla, 1946–1952).[7] The policy objective was to start a vigorous growth path (see Prebisch, 1950 as an example). However, only ten years into the program, there was a general feeling that protectionism was not the adequate policy to reach economic development. Even Raúl Prebisch, an enthusiastic advocate of protectionist policies after the Great Depression, acknowledged this a couple of years later when he argued that protectionism (excessive tariffs, duties and restrictions) "has deprived the Latin American countries of the advantages of specialization and economies of scale." (Prebisch, 1963, cited by Hirschmann, 1968). The first attempt to move towards a relatively open economy involved the Klein-Saks mission in the 1950s during the rule of Carlos Ibáñez del Campo. However, their recommendations were not particularly effective in terms of results (Ffrench-Davis, 1973). After several attempts to move away from protectionist policies, a liberalization process was launched during the mid-1970s.

Lederman (2005) classifies the period 1927–1956 as the institutionalization of protectionism, the period from 1956 to 1973 as one of macroeconomic instability and delegitimization of protectionism, and the period after 1973 as one of unilateral trade liberalization. Figure 1 presents the average tax on imports and

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6. This is only a brief description of the historical background of the Chilean trade policy. Many papers present more detailed description (e.g., Corbo and others 1995, Corbo 1997). The more up-to-date source of information is Lederman (2005). The latter book presents a detailed description of the political economy of trade policies in Chile since the beginning of the nineteenth century up to the present.

7. See Hirschman (1968) for the main characteristics of the ISI process in Latin America, its evolution, and the principal difficulties it encountered during its implementation.

exports during the twentieth century (Díaz, Wagner and Lüders, 2010). We can see the policy volatility during the 1950s and 1960s, partly reflecting different policies that did not have the expected results,coupled with a situation of serious macroeconomic instability.[8] The sharp liberalization process that reduced the average tax before 1980 is also evident.

Another central characteristic of trade policy during the pre-liberalization period is the high dispersion of tariffs and, therefore, ERPs in different sectors. Lederman (2005) finds that while the mode of tariffs in 1973 was about 90%, the maximum tariff could be as high as 220% (and covering about 8% of all products). In addition, there were a number of NTBs in operation. The rationale for this variance in the treatment of different sectors comes from the idea to favor some sectors: (i) manufacturing over agriculture, agriculture over mining, and industries producing intermediate goods (until the 1960s); (ii) import substitution over export promotion; and (iii) goods imports over non-goods international transactions (Behrman, 1976). In particular, the most protected subsectors tended to be the traditional, "easy" import-substitution ones. In most cases, these industries started to receive specific protection since the 1897 Tariff Act, and had been consolidating their protection levels even before World War Two (Behrman, 1976).

Figure 1. Average Tax on Imports and Exports
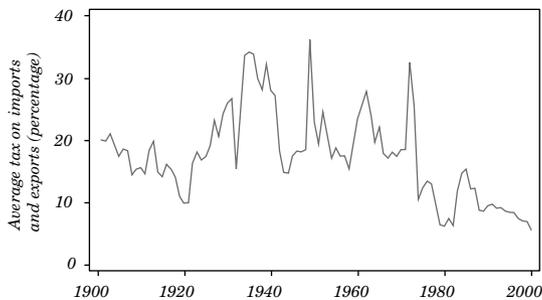
Source: Díaz and others (2010).

8. Actually, Lederman (2005) shows quantitative and qualitative evidence suggesting that governments, during the 1950s and 1960s, were very active in implementing policies that both decreased and increased trade protection.

While the trade reform was introduced in the mid-1970s under the Pinochet dictatorship, the antecedents to that policy change started some years earlier. The main economic program was developed some time after the right-wing candidate Jorge Alessandri lost the 1970 presidential election to the socialist candidate, Salvador Allende, in the midst of economic and social turmoil. The designers of this program included two economists who would become finance ministers during the Pinochet regime: Sergio de Castro and Sergio de la Cuadra. Reforms proposed in the so-called "Program for Economic Development" were radical in form and scope.

The liberalization process unfolded between 1974 and 1990. Although the government did not have a clear picture of the depth and timing of the liberalization at the beginning of the process, during the first five years all quantitative restrictions and exchange controls were reduced from 100% to a flat 10% tariff across the board (except for automobiles) in 1979 by the Finance Minister, Sergio de Castro. However, there was a brief period in which the tariff was raised to 35% after the financial crisis of 1983-1984. Tariffs were finally reduced to 11% in 1991 (Edwards and Lederman, 1998).[9]

This process was not isolated; it was implemented together with a massive privatization program and several reforms to eliminate a persistent inflationary process and modernize the financial sector.[10] The program to implement the reforms was divided into two parts: diagnosis and implementation. The specific points of the trade reform included: (i) engineering a real exchange rate depreciation, (ii) implementing a crawling peg exchange rate regime, (iii) reducing import tariffs to a uniform level, (iv) eliminating all import licenses and prohibitions, and (v) implementing export promotion schemes. However, it was not explicit about the timing and speed of these reforms (Corbo, Lüders and Spiller, 1995; Edwards and Lederman, 1998).

It is important to stress that the liberalization process in Chile was always thought to reduce tariffs towards a uniform structure. For instance, Harberger (1991) argues that the existence of different distortions across industries is costly because it enables different economic-interest groups to lobby for specific trade policies for their, supposedly, "strategic" sector. Thus, trade barriers were not only reduced, but also simplified in terms of their structure, reducing their dispersion across products.

9. This path of liberalization is clearly reflected in figure 1.
10. See Harberger (1985), Edwards and Edwards (1991), Bosworth, Dornbusch and Labán (1994) and, especially, Corbo and others (1995) for a deeper analysis of these reforms.

This big trade policy change that reduced the average and dispersion of tariffs provides us with a significant shock that affects different counties in different ways. In particular, as we document below, before the reform there was a high variance in effective rates of protection across sectors and, therefore, across counties. Thus, the liberalization period that drastically reduced most tariffs to a uniform level implies that different counties were affected by changes in trade policy with different intensities. We exploit precisely that cross-county variation to identify differential effects of the trade liberalization period on economic outcomes at the local level.

2. DATA CONSTRUCTION

2.1 Output and Specialization

We use output measures constructed using information available in the agricultural censuses of 1955, 1965, 1997 and 2007,[11] which were applied by the Chilean National Statistics Institute (INE); and information on prices taken from INE's wholesale prices series. The censuses provide information for a subset of products on quantity of production, and surface used in the production process, which we use to build county level measures of output for the sectors of forestry, fruits, livestock and primary products. We value each of the products at what we call long-term undistorted prices (i.e. the average price of each type of product over the 1993-2006 period) and use them to compute total and sectoral output changes and growth rates for all rural counties located between regions IV and X of Chile.[12] We focus on the rural counties in this part of the country because they hold almost all the agricultural activity of the country. We end up having information for about 214 counties.[13]

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11. These are the only censuses presenting county-level information. The agricultural censuses between 1965 and 1997 do not include county-level information.

12. Chile is geopolitically organized into 15 regions, generally denoted as I through XV. The capital city, Santiago, is located in region XIII, the Metropolitan Region (MR). With regions I, II, III, XI, XII, XIV, and XV being in the extremes of the country and having a nearly nonexistent agricultural sector, we focus the analyses of this paper in regions IV through X and the MR, which is where agricultural production is concentrated.

13. Given the changes in county boundaries and the creation and consolidation of some counties in Chile, we created a set of counties that keep the same information over the time period included in the analysis. This implies that in some cases we have to merge modern counties to make the data consistent with the 1955-1965 county definitions and boundaries.

Using this output dataset, we construct indicators of specialization for each county, which we will use to discuss the potential effects of trade liberalization on specialization patterns across counties. In particular, we construct two specialization variables: firstly, we simply use a dummy indicator for each sector that equals 1 when a county is specialized in a determined sector at a determined period (i.e., the sector with the highest share of production); and secondly, we build Herfindahl-Hirschman indices (HHIs) for sectoral output concentration in each county for each period.

2.2 Quantifying Agricultural Trade Distortions

In this subsection, we present the construction of an effective rate of protection (ERP) index at the county level. We use ERPs because they capture effects of tariffs on both final and input prices. In addition, the local dimension of the index is very important as trade barriers will unevenly affect production in different geographical zones depending on whether the goods produced are relatively protected or unprotected by trade tariffs. Thus, we construct a local ERP index that tries to capture the unequal effects of the tariffs on production in different counties within the country.

Effective Rates of Protection

Several papers have constructed ERPs for goods and sectors in Chile (a non-comprehensive list includes Balassa, 1971; De la Cuadra, 1974; Varas,1975; Behrman, 1976 and Hurtado and others, 1990). We base our computations on DLC and HMV.

ERPs are defined by the authors in the following way:

$$ERP = \frac{V_A^i - V_A^{i*}}{V_A^{i*}},$$

where V_A^i is value added per unit of product, at the prevailing prices $V_A^i = P_i - \sum_i P_j a_{ij}$; where P_i is actual price of the final good i, P_j is actual price of input j, and a_{ij} is the amount of input j needed to produce one unit of good i. On the other hand, $V_A^{i*} = P_i^* - \sum_i P_j^* a_{ij}$, where P_i^* is the undistorted price of final good i, and P_i^* is the undistorted price

of input *j*. The calculations also include adjustments for exchange rate differences, as follows:

$$P_i^* = \frac{P^i}{(1+t^i)} \frac{E^*}{E_0} \;,$$

$$P_j^* = \frac{P^j}{(1+t^j)} \frac{E^*}{E_0} \;.$$

With t^i and t^j being the import tariffs on good *i* and input *j* respectively. Given the way in which the ERPs are estimated, a negative value indicates a taxed industry and positive one a protected one. E^* and E_0 are introduced to account for the potential effects of liberalization on the exchange rate. HMV construct ERPs for 1969, which they argue is a "representative year in terms of output mix" and in their calculations they include 43% of the total agriculture production. Calculations by DLC for the forestry sector correspond to the second half of the 1960s, and are adjusted in order to make them comparable with HMV's calculations.

The Index

To obtain an index for each county we take the following steps:
1. Using the information from the agricultural censuses, we obtain the proportion of the total production that corresponds to each of the four subsectors we consider for each year.
2. We use the values calculated by HMV in order to obtain an ERP for Fruits, Livestock and Primary Products; and the values calculated by DLC to obtain an ERP for Forestry.
3. Finally, we calculated weighted averages of the ERPs across counties and time, where the weights are the shares of the total output represented by each subsector before the reform (i.e. including output information from the censuses of 1955 and 1965).
Therefore, the ERP index we use interacts differences in the output mix through counties and time with ERPs in each subsector:

$$\text{Index}_{ct} = \sum_s \omega_{sct} ERP_s \,,$$

where ω_{sct} is total production of sector *s* in county *c* during year *t* over total agricultural production in county *c* and year *t*, and *S* is the set

of four agricultural sectors. This index is an appropriate measure of agricultural trade distortions for each county in each period under the assumption that the products for which HMV and DLC built ERPs are representative of the output of the sectors covered by this study.

We do not construct specific indices for 1997 and 2007 because, as documented by Dornbusch and Edwards (1994) and Lederman (2005), trade tariffs in Chile had already been by then reduced to remarkably low levels and equalized through different products, which allows us to focus our empirical strategy on the initial levels of distortion (i.e. the indices from 1955 and 1965).

3. DESCRIPTIVE STATISTICS

3.1 Output and Specialization

We start by presenting some stylized facts about output levels and specialization. Figure 2 presents total agricultural output per county, per year. It is noticeable that agricultural output grew strongly over the 1955-2007 period and that southern counties' participation— counties in regions VI through X—in national agricultural output is remarkably larger than participation of counties located in the northern area—regions IV through the MR. Table 1 presents annual output growth across sectors and time, showing that both Fruits and Forestry grew strongly during the period of study with annual growth rates of 4.2% and 4.9%, respectively, while Primary Products grew remarkably less, reaching a growth rate of only 1%. Interestingly, these growth rates show substantial heterogeneity across counties, which reveals huge differences in terms of sectoral composition of output.

Figure 3 presents how sectoral composition varies over time. It is easy to note that Primary Products lost relevance in the counties' output mix, decreasing their participation from 45% to 8.5% between 1955 and 2007; Fruits in the northern counties and Forestry in the South strongly increased participation; Forestry increased output participation in both geographic areas from 39% to 51%; Livestock also increased participation from 7% to 31%. Specialization patterns vary between regions and time, with the most radical changes occurring between 1965 and 1997 as was expected, since this period is the longest, but also the period in which most of the trade liberalization process took place.

## Figure 2. Total Agricultural Output by County and Year
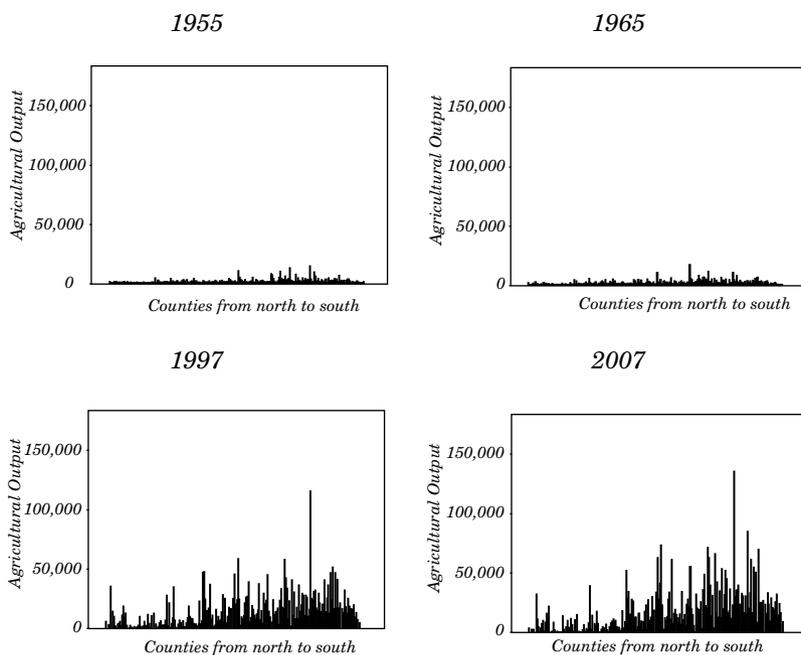
1955

1965

1997

2007

Source: Authors' elaboration.

Table 1. Annual Compounded Growth Rates by Sector

Sector	Years	Mean	SD	National
Forestry	1955-1965	-0.014	0.148	0.009
	1965-1997	0.052	0.107	0.062
	1997-2007	0.174	0.559	0.056
Fruits	1955-1965	0.02	0.148	0.010
	1965-1997	0.002	0.113	0.051
	1997-2007	0.124	0.444	0.049
Livestock	1955-1965	0.075	0.099	0.044
	1965-1997	0.096	0.051	0.115
	1997-2007	-0.118	0.198	-0.019
Primary products	1955-1965	0.011	0.054	0.017
	1965-1997	-0.005	0.038	0.017
	1997-2007	-0.040	0.098	-0.016

Source: Authors' elaboration.

Figure 3. Sectoral Composition of Agricultural Output by Region and Year
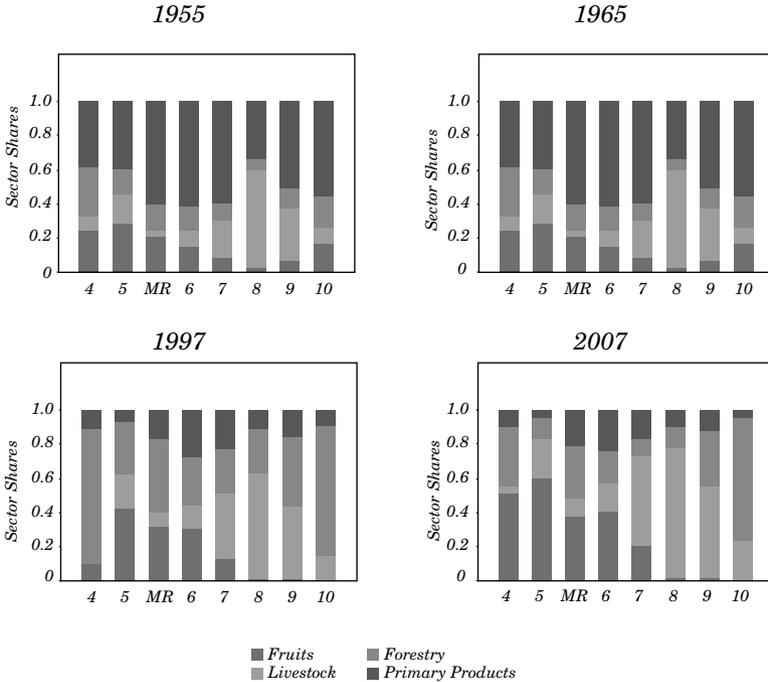
Source: Authors' elaboration.

This view of the Chilean agricultural sector development is reinforced by our calculations of the mean output shares represented by each of the four sectors considered in the study. This is shown in table 2, where additionally we can note that there is considerable variance in terms of agricultural output composition both across counties and over time.[14]

Moreover, when examining sectoral specialization at the county level (table 3), the above mentioned changes appear strongly: counties specialized in Primary Products decreased from 152 in 1955 to just16 in 1997; counties specializing in Forestry, Fruits and

14. This heterogeneity also appears when examining summary statistics for these output shares within regions, meaning that even between counties with somehow similar geographic characteristics, we observe non-trivial differences in terms of their agricultural output composition.

Livestock increased from 45, 8 and 9, respectively in 1955 to 86, 55 and 57 respectively in 2007, thus revealing production reallocation through the period of study.

Table 3 also presents summary statistics for the Herfindahl-Hirschman Indices (HHI) calculated at the county level for each year, which show a clear increase in the degree of specialization, moving up 17% from 0.54 in 1955 to 0.63 in 2007. This pattern suggests that the trade liberalization process may have induced switches in production decisions towards products for which different counties had a comparative advantage but were, formerly, strongly taxed or protected by trade tariffs that distorted production decisions. Besides, there is also heterogeneity in this dimension, implying there were both counties that were highly specialized, and others that held relatively more balanced compositions of their agricultural output.[15]

Table 2. Total Output by Sector

Sector	Years	Mean	SD
Forestry	1955	0.248	0.274
	1965	0.227	0.275
	1997	0.29	0.312
	2007	0.37	0.357
Fruits	1955	0.123	0.141
	1965	0.134	0.169
	1997	0.156	0.254
	2007	0.241	0.328
Livestock	1955	0.098	0.136
	1965	0.135	0.157
	1997	0.41	0.319
	2007	0.27	0.303
Primary products	1955	0.532	0.245
	1965	0.503	0.249
	1997	0.144	0.164
	2007	0.119	0.155

Source: Authors' elaboration.

15. In fact, results for calculations of these indexes show that for each year, there are both counties with HHIs under 30%, which implies a highly balanced output composition, and counties with HHIs of more than 95%, which implies almost complete specialization. This heterogeneity is observed within counties specialized in the same sector too, which implies that even between somehow similar counties, specialization levels vary substantially. Obviously, some of this variance may be related to the size of the county, therefore in some empirical analyses we control for proxies for the size of the county and results are robust in these controls.

Table 3. Number of Counties Specialized in Each Sector

Sector	1955	1965	1997	2007
Forestry	45	48	68	86
Fruits	8	15	35	55
Livestock	9	16	95	57
Primary products	152	135	16	16
Hirschman-Herfindahl	0.541	0.531	0.586	0.632
	(0.151)	(0.159)	(0.202)	(0.218)

Source: Authors' elaboration.

Figure 4. ERP Index Histograms per Year
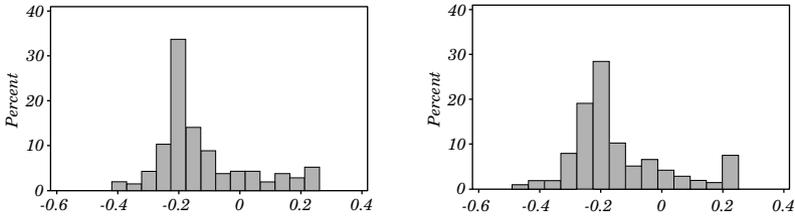
Source: Authors' elaboration.

3.2 Agricultural Trade Distortions

As explained in subsection 2.2, we built on ERPs constructed by previous research in order to generate measures of trade distortions in agriculture. The ERPs that we use for our calculations are 0.27 for Forestry, −0.51 for Livestock, −0.22 for Primary Products, and −0.20 for Fruits. Therefore, Forestry is the only sector that was relatively protected in the 1960s. On the other hand, the other three sectors are relatively taxed, with Livestock and Primary Products being more strongly taxed than Fruits. As mentioned before, we combine these differences in initial levels of sectoral trade distortions with the already described heterogeneity in the agricultural output composition in order to build a county level index of agricultural trade distortions.

Figure 4 shows the distribution of ERPs across counties for 1955 and 1965. According to our calculations, 15% and 12% of the counties in the sample were protected in 1955 and 1965, respectively—mainly those that were highly specialized in forestry—while the remaining ones were taxed.

Table 4. Descriptive Statistics of ERP Indices by Region and Sector of Specialization

	1955		*1965*	
	Mean	*SD*	*Mean*	*SD*
Panel A: Index by region and year				
4	-0.208	0.089	-0.262	0.087
5	-0.146	0.109	-0.177	0.095
MR	-0.225	0.083	-0.242	0.070
6	-0.185	0.089	-0.209	0.085
7	-0.121	0.157	-0.139	0.130
8	0.040	0.159	0.049	0.170
9	-0.073	0.146	-0.106	0.136
10	-0.200	0.075	-0.224	0.101
All	-0.125	0.150	-0.146	0.156
Panel B: Index by sector of specialization and year				
Forestry	0.122	0.094	0.098	0.109
Fruits	-0.179	0.026	-0.189	0.057
Livestock	-0.345	0.071	-0.352	0.072
Primary Products	-0.183	0.064	-0.203	0.059

Source: Authors' elaboration.

Table 4 complements the previous figures by presenting summary statistics at the county level for the ERP indices (in rows labeled "All"). As can be noted, the situation in 1955 and 1965 is almost the same in terms of trade distortions, reaching a mean ERP of −0.125 and −0.146 for the two years, respectively, meaning that counties in the sample were, on average, taxed by trade tariffs. Additionally, from the same table it is easy to observe that there is a high variation in the values of the index.

Regarding this heterogeneity, a relevant concern would be the amount of such variance that could be explained just by geographic or

climatic patterns. If this was the case, we would be partly capturing the huge dispersion in climate and geographic characteristics observed in Chile with our ERP index. In order to somehow rule out this possibility, we analyze the variation of the index, both by region and sector in which the counties are specialized. Panels A and B in table 4 show that, effectively, there are certain regularities in the values of the index that are related to geographic or productive characteristics, primarily that regions and counties more specialized in forestry are more protected than the other regions, as expected, but at the same time within each region, and within each sector of specialization, the index still vary substantially.

4. THE LOCAL IMPACTS OF TRADE LIBERALIZATION ON ECONOMIC OUTCOMES

4.1 Empirical Strategy

Using the theoretical and historical motivation described above, we develop in this section an empirical investigation of the local effects of trade liberalization on economic outcomes, in particular agriculture output, demand for inputs, productivity, patterns of specialization.

We first describe the empirical methodology we use to study these relationships. Our main estimating equations are as follows:

$$\hat{y}_i = D_i\alpha + D_i * PP_i\beta + X_i'\gamma + e_i, \tag{1}$$

where i refers to county, $\hat{y}$ is the change of the log of an economic outcome along the period of trade liberalization with respect to the previous period (i.e., agricultural output growth, proxies for input use, and proxies for production specialization, among other variables), D is the *absolute value* of the ERP in the pre-reform period, PP is a dummy taking the value of 1 if the ERP of the county is positive before liberalization and 0 if negative, X is a vector of control variables (including initial y, the intensity of the Chilean agrarian reform in the county, and region fixed-effects, among others),[16] and e is an error term.

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16. Notice that regions in Chile are composed of group of counties.

We use Huber-White robust standard errors to deal with potential heteroskedasticity.

The effect of initial negative ERPs is therefore captured by, which we expect to be positive as higher initial levels of protection implied that the reform decreased by more than the negative protection of the area. In turn, the effect of positive ERPs is captured by $\alpha + \beta$. The sign of this effect depends upon two sources with opposing potential effects: the size of the decrease in output because of the decreased protection, and the size of the productivity and re-allocation effects that trade liberalization may have produced.

Notice that we control for initial output levels and, therefore, our results are not driven by mean-reversion or conditional convergence effects after the liberalization period. In addition, by controlling for the Agrarian Reform Index (which measures the share of land that changed hands as a consequence of the agrarian reform at the county level), we aim to capture the extent of one of the main political reforms affecting agriculture in the same period. Similarly, we include other controls that may capture omitted variables correlated with the effects of the reform. Among these, we include a vector of climate and geographic controls at the county level (i.e., dummies for whether the county is outside the Chilean central valley or it is landlocked, annual rainfall, number of dry months, average temperature, and distance to the nearest port) and a vector of variables that may be correlated with initial levels of trade protection through political economy arguments such as the share of right wing votes, total votes, ratio of unskilled workers to total workers and total workers.

There are two data limitations we should mention: First, we do not have measures of NTBs at the county level. This is a limitation for our approach if changes in this variable are important and correlated with changes in our ERP index. Edwards and Lederman (1998) argue that the most important part of the trade reform was the decrease and homogenization of ERPs across sectors, and changes in NTBs were of secondary relevance. Thus, we consider this limitation as fairly unimportant, but still worth to be mentioned, and we leave a more detailed analysis for future research. Second, other than the agrarian reform, we do not have measures of other reforms at the county level. Again, the interpretation of our results would be affected if changes in other policies were correlated with changes in ERPs at the county level. We do not have evidence of this, but we think that by controlling for a vector of variables that includes political economy dimensions, we would probably capture the determinants

of changes in other policies. As we discuss below, our results remain mostly unchanged after doing this.[17]

4.2 Effects on Local Output

Table 5 presents the results of estimating equation (1) with agricultural output growth as the dependent variable. Results imply that counties that were initially more taxed, experienced higher levels of agricultural output growth throughout the liberalization period. The size of the impact is not only statistically significant, but also economically: a one standard deviation increase in the absolute value of the initial level of the negative ERP (equivalent to an increase of about 0.08 in the ERP) increases agricultural output by 13.6 log points (equivalent to 0.11 standard deviations of the variable). Inversely, the effect of liberalization for counties that were initially protected by the tariff structure is negative. In fact, we find that a one standard-deviation increase in positive ERPs decreased agricultural output growth by about 19.2 log points (equivalent to 0.16 standard deviations of that variable).

In column (2), we add a vector of additional geographic and climate controls and find that the main effects do not change. Finally, in column (3) we add control variables for relevant county level variables that may play a role in terms of determining agricultural output at the local level. We find that the main effects remain statistically significant, while the point estimate barely changes in size. This suggests that the effects we find are not driven by omitted variables that, through political economy channels, may affect our estimates. In our preferred specification in column (3), the effect of a one-standard-deviation change in the county ERP are 11.7 log points for initially taxed counties, and–32.2 log points for initially protected counties.

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17. Still, we have implemented a couple of robustness exercises in order to assess the importance of these data limitations. First, we have controlled for a proxy for price distortions in agriculture final goods and found that our results have not changed significantly. As price distortions in final goods should capture the impact of NTBs, we think that the absence of NTBs is not important for our results. Second, we have run regressions controlling for the share of votes supporting Pinochet in the 1988 plebiscite as a proxy for political economy factors affecting (or having been caused by) the implementation of other policies. Again, results do not change significantly.

Table 5. Effects on Local Agricultural Output

Dependent variable: Change in log Agricultural Output			
	(1)	*(2)*	*(3)*
Initial negative ERP (α)	1.794**	1.923**	1.548**
	(0.874)	(0.870)	(0.774)
Positive value of ERP (β)	-4.099***	-5.228***	-5.420***
	(0.733)	(0.866)	(1.031)
Initial positive ERP ($\alpha + \beta$)	-2.305***	-3.305***	-3.872***
F-test $\alpha + \beta$ (p-value)	0.010	0.000	0.000
Initial log output	-0.950***	-0.920***	-0.774***
	(0.227)	(0.236)	(0.252)
Agrarian reform index	-0.791**	-0.751**	-0.748**
	(0.329)	(0.341)	(0.332)
Land gini	-7.605***	-5.748**	-4.864*
	(2.208)	(2.528)	(2.672)
Right wing % votes			0.311
			(0.603)
Log total votes			-0.121
			(0.088)
Log (unskilled / total workers)			-0.098
			(0.084)
Log total workers			-0.212
			(0.171)
Region fixed effects	Yes	Yes	Yes
Geographic controls	No	Yes	Yes
Counties	188	182	182
R^2	0.382	0.410	0.432

Source: Authors' estimations.
Notes: Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1. All regressions include a constant term.

In all, results so far imply that, as expected, the distortions in operation under the pre-1975 tariffs structure had a significant impact on the cross-sectional growth rates of agricultural output: after the trade liberalization reforms, counties with initial negative ERPs grew faster than counties with an ERP of 0 and counties

with positive ERPs grew slower than counties with an ERP of 0, thus suggesting that reducing distortions imposed by the complex pre-reform tariffs structure might have led to a better allocation of resources in agricultural production.

4.3 Effects on Inputs Use, Productivity, and Specialization

Now we study the impact of trade liberalization on several other margins. In table 6, we analyze the impacts on input usage (in particular, labor, land use and tractors, as a proxy for capital use) and then on TFP—as computed using a trans-log production function with constant returns to scale on land, labor, and capital.[18] In columns (1) to (3), we find that the growth rate of labor use does not change significantly for counties with different levels of ERP in the pre-reform period. In the case of land, we find a decrease in land use for counties that were taxed relatively more in the pre-reform period. Valdés and Jara (2007) also document this pattern. In column (3), we find that capital use—tractors—move similarly to the patterns we found for output in table 5. These results suggest that the previous estimates reflect a significant effect on the intensive margin, with shifts in the use of both land and capital. Then, in column (4) we present regressions for the log change of TFP and, interestingly, we find that in the case of initially taxed counties, there was a significant TFP increase after the trade reforms and, therefore, an important part of the change in output documented before is related to increases in TFP; while in the case of initially protected counties, the effect is not statistically different from 0, thus suggesting that most of the effects we identify in table 5 for those counties were associated with impacts in the intensive margin and not with productivity effects.

Next, we study how the trade reform affected specialization at the county level. We implement this exercise because, as we discussed above, one of the margins of interest (probably affected by the elimination of trade distortions) is product specialization at the county level. Thus, in table 7 we study two proxies for specialization: (i) the

18. Estimates without imposing CRS yield similar results. See Corbo and Meller (1979) for an application of trans-log production functions for the case of Chilean establishments. A more general description of this function appears in Christensen, Jorgenson and Lau (1973) and Jorgenson (1988), and an application to the agriculture sector in Udry and others (1995).

Hirschman-Herfindahl Index (HHI) of product concentration, and (ii) the maximum share in the subsectors included in the sample at the county level. Columns (1) and (2) present results for both variables. The pattern in this case is not as clear. However, it is interesting to note that the reduced output growth in initially more protected sectors that we documented in table 5 seems to be associated with a higher specialization of productive structure in these counties posterior to the liberalization process. This is an expected consequence of the incentives created by a more open economy.

Table 6. Effects on Input Use and Productivity

	Dependent variable: $\Delta \log y$			
	Workers	Land	Capital	TFP
	(1)	(2)	(3)	(4)
Initial negative ERP (α)	0.449	-0.933*	1.430**	1.839***
	(0.679)	(0.546)	(0.629)	(0.527)
Positive value of ERP (β)	-0.671	1.900***	-3.315***	-3.209***
	(0.926)	(0.620)	(1.102)	(0.863)
Initial positive ERP ($\alpha + \beta$)	-0.222	0.967*	-1.885*	-1.370
F-test $\alpha + \beta$ (*p-value*)	0.811	0.068	0.093	0.149
Agrarian reform index	0.511**	0.134	0.453**	-0.349
	(0.204)	(0.234)	(0.217)	(0.289)
Initial land gini	4.484	-2.595	-5.062	-2.085
	(2.809)	(1.598)	(3.214)	(1.985)
Initial log y	-0.089	-0.115*	-0.010	-0.008
	(0.108)	(0.067)	(0.092)	(0.095)
Region fixed effects	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes
Counties	182	182	180	182
R^2	0.540	0.430	0.483	0.178

Source: Authors' estimations.
Notes: Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1. TFP stands for Total Factor Productivity.

Table 7. Effect on Input Use and Specialization

	HHI	Specialization	Plot size	Land Gini	Number of exploitations
	Dependent variable: Δ log y				
	(1)	(2)	(3)	(4)	(5)
Initial negative ERP (α)	0.472	0.965	-1.041*	-0.056**	0.587*
	(0.301)	(0.600)	(0.612)	(0.026)	(0.353)
Positive value of ERP (β)	2.814***	1.069	0.141	-0.040	-1.105*
	(0.422)	(0.964)	(0.807)	(0.051)	(0.620)
Initial positive ERP (α + β)	3.286***	2.034*	-0.900	-0.096*	-0.518
F-test α + β *(p-value)*	0.000	0.066	0.338	0.092	0.473
Agrarian reform index	-0.283**	-0.319*	-1.388***	-0.006	0.486***
	(0.113)	(0.171)	(0.347)	(0.007)	(0.165)
Initial land gini	-2.708***	4.342	-2.759	-0.046	1.439
	(1.000)	(2.811)	(2.206)	(0.168)	(1.589)
Initial log *y*	-2.124***	-0.599*	-0.000***		-0.013
	(0.240)	(0.316)	(0.000)		(0.067)
Region fixed effects	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes
Counties	188	188	188	188	188
R^2	0.641	0.353	0.332	0.328	0.191

Source: Authors' estimations.
Notes: Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1. All regressions include a constant term. HHI: Herfindahl-Hirschman Index, a measure of output concentration by sector.

Finally, the trade reform could affect another margin: the size and concentration of landholdings and the number of different agricultural firms (exploitations). This is expected as the decrease in distortions may change the marginal return to consolidate plots for agricultural production. We study this hypothesis in columns (3) through (5) in table 7. In both cases we find that, in counties that were initially more taxed, both the average size of plots and the Gini index for land concentration decreased significantly. Consistently, the number of agricultural exploitations follows the opposite pattern

through the post-reform period: counties that were initially more taxed, present post-reform increases in the number of agricultural firms, a development that is not observed for counties that were initially protected more.

These results probably reflect the changes in incentives that trade openness creates: while in the pre-liberalization period—with negative ERPs—the land value for agriculture use was very low; landowners tended to use land for other purposes that needed big shares of the land to be profitable (see, for instance, Robinson and Baland, 2008). Through the liberalization period, the decrease in negative ERPs produced changes in the extensive and intensive margins that, on average, decreased the size of the agricultural production and land concentration.[19]

5. CONCLUSIONS

The economic liberalization abruptly implemented in Chile during the 1970s offers a unique opportunity to study the impact of this process on several economic outcomes at the local level. We take advantage of the initial differences in agricultural production and specialization patterns across counties, and the different levels of effective rates of protection across sectors in order to construct a measure of tariff-related price distortions before trade liberalization took place. Then, we use the fact that effective rates of protection were dropped across different sectors to a low and uniform tariff structure to estimate how this process affected several economic outcomes across counties.

Besides contributing with the construction of a panel dataset of counties over a period of 50 years—primarily by merging different datasets related to one of Chile's most important economic sectors—we find, in line with the previous literature, that trade liberalization affected counties differently in several economic outcomes. Agricultural output grew faster in counties that were relatively more taxed in the pre-reform period, probably by allowing expansions on the extensive margin, but also more product specialization and a more efficient allocation of resources, which is reflected in increases in TFP in these counties. Conversely, we find that counties that

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19. Notice that we are already controlling for the intensity of the agrarian reform at the county level in these regressions in order to rule out its effect on these outcomes.

were relatively more protected in the pre-reform period grew slower through the post-reform period, which seems to be related mostly to changes in the intensive margin and not to productivity effects. These results not only contribute to different parts of the existing literature of the economic effects of liberalization, but also shed light on Chile's growth path during the last fifty years, mainly by analyzing trends across counties exposed differently to one of Chile's most emblematic economic policies of the past decades.

These results are relevant in terms of understanding the effects of economic policies such as trade liberalization on economic development, even though a number of questions remain open in two lines: First, we still need a better understanding of the economic mechanisms through which the effects we estimated were caused. Second, and related to Topalova (2010) and other papers, we also need more evidence on the impact of trade liberalization on broader development measures such as poverty and inequality, among others. While Topalova (2010) finds that labor immobility played a relevant role in explaining the increase that the Indian tariff reform caused on poverty in certain regions, it might be the case that the Chilean reform had different impacts on poverty in counties that were harmed by the reform (i.e. initially protected counties), mostly due to the fact that the Chilean economy operates under a more flexible structure. Both of these are relevant topics for future research.

REFERENCES

Álvarez, R. and J.R. Fuentes. 2003. "Trade Reforms and Manufacturing Industry in Chile." Working Paper 210, Central Bank of Chile.

Balassa, B. 1971. *The Structure of Protection in Developing Countries*. Baltimore, MD: Johns Hopkins Press.

Behrman, J. 1976. *Foreign Trade Regimes and Economic Development: Chile*. Washington, DC: National Bureau of Economic Research.

Beyer, H., P. Rojas, and R. Vergara. 1999. "Trade Liberalization and Wage Inequality." *Journal of Development Economics* 59(1): 103–23.

Bosworth, B., R. Dornbusch, and R. Labán (eds.) 1994. *The Chilean Economy: Policy Lessons and Challenges*. Washington, DC: Brookings Institution Press.

Bruhn, M. and F. Gallego. 2012. "Good, Bad, and Ugly Colonial Activities: Do They Matter for Economic Development?" *Review of Economics and Statistics* 94(2): 433–61.

Christensen, L., D. Jorgenson, and L. Lau. 1973. "Transcendental Logarithmic Production Frontiers." *Review of Economics and Statistics* 55(1): 28–45.

Coeymans, J. 1978. "Foreign Trade Liberalization and its Effects on Employment." Working Paper 59, Instituto de Economía, Pontificia Universidad Católica de Chile.

————. 1999. "Determinantes de la Productividad en Chile." *Latin American Journal of Economics* 36(107): 597–637.

Corbo, V. 1985. "Reforms and Macroeconomic Adjustments in Chile during 1974–1984." *World Development* 13(8): 893–916.

————. 1997. "Trade Reform and Uniform Import Tariffs: The Chilean Experience." *American Economic Review* 87(2): 73–7.

Corbo, V., L. Hernández, and F. Parro. 2005. "Institutions, Economic Policies, and Growth: Lessons from the Chilean Experience." Working Paper 317, Central Bank of Chile.

Corbo, V., R. Lüders, and P. Spiller. 1995. "The Institutional Foundations of Economic Reforms: The Case of Chile." Unpublished manuscript, Instituto de Economía, Pontificia Universidad Católica de Chile.

Corbo, V. and P. Meller. 1979. "The Translog Production Function: Some Evidence from Establishment Data." *Journal of Econometrics* 10(2): 193–9.

Corbo, V., J. Tybout, and J. De Melo. 1991. "The Effects of Trade Reforms on Scale and Technical Efficiency: New Evidence from Chile." *Journal of International Economics* 31(3): 231–50.

De la Cuadra, S. 1974. "La Protección Efectiva en Chile." Working Paper 22, Instituto de Economía, Pontificia Universidad Católica de Chile.

Díaz, J., G. Wagner, and R. Lüders. 2010. "La República en Cifras 1810-2000." Unpublished manuscript, Pontificia Universidad Católica de Chile.

Dornbusch, R. and S. Edwards. 1994. "Exchange Rate Policy and Trade Strategy." In *Chilean Economy: Policy Lessons and Challenges*, edited by B.P. Bosworth, R. Dornbusch, and R. Labán. Washington, DC: Brookings Institution Press.

Edmonds, E., N. Pavcnik, and P. Topalova. 2010. "Trade Adjustment and Human Capital Investments: Evidence from Indian Tariff Reform." *American Economic Journal: Applied Economics* 2(4): 42–75.

Edwards, S. and A. Edwards. 1991. *Monetarism and Liberalization: The Chilean Experiment.* Chicago, IL: University of Chicago Press.

Edwards, S. and Daniel Lederman. 1998. "The Political Economy of Unilateral Trade Liberalization: The Case of Chile." NBER Working Paper 6510.

Ffrench-Davis, R. 1973: *Políticas Económicas en Chile 1952-1970.* Santiago: Ediciones Nueva Universidad.

Fuentes, J.R., K. Schmidt-Hebbel, and M. Larraín. 2006. "Sources of Growth and Behavior of TFP in Chile." *Latin American Journal of Economics* 43(127): 113–42.

Gallego, F. 2012. "Skill Premium in Chile: Studying Skill Upgrading in the South." *World Development* 40(3): 594–609.

Goldberg, P. and N. Pavcnik. 2007. "Distributional Effects of Globalization in Developing Countries." *Journal of Economic Literature* 45(1): 39–82.

Hachette, D. 2011. *Latinoamérica en el Siglo XX.* Santiago: Ediciones UC.

Harberger, A. 1959. "Using the Resources at Hand More Effectively." *American Economic Review* 49(2): 134–46.

———. 1985. "Observations on the Chilean Economy 1973-1983." *Economic Development and Cultural Change* 33(3): 451–62.

———. 1991. "Towards a Uniform Tariff Structure." Unpublished manuscript, University of Chicago.

Hirschman, A. 1968. "The Political Economy of Import-Substituting Industrialization in Latin America." *Quarterly Journal of Economics* 82(1): 1–32.

Hurtado, H., E. Muchnik, and A. Valdés. 1990. "Trade, Exchange Rate, and Agricultural Pricing Policies in Chile." The Political Economy of Agricultural Policies, World Bank Comparative Studies, World Bank, I and II.

Jara, E. and A. Valdés. 2007. "Distortions to Agricultural Incentives in Chile." Working Paper 48391, Agricultural Distortions, World Bank.

Jorgenson, D. 1988. "Productivity and Postwar US Economic Growth." *Journal of Economic Perspectives* 2(4): 23–41.

Khandelwal, A. and P. Topalova. 2011. "Trade Liberalization and Firm Productivity: The Case of India." *Review of Economics and Statistics* 93(3): 995–1009.

Lederman, D. 2005. *"The Political Economy of Protection: Theory and the Chilean Experience."* Stanford University Press.

McCaig, B. 2011. "Exporting out of Poverty: Provincial Poverty in Vietnam and U.S. Market Access." *Journal of International Economics* 85(1): 102–13.

Pardo, A. and P. Meller. 2002. "El Rol de las Exportaciones en el Crecimiento Económico Regional." Unpublished manuscript, Universidad de Chile.

Pavcnik, N. 2002. "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants." *Review of Economic Studies* 69(1): 245–76.

Prebisch, R. 1950. *The Economic Development of Latin America and its Principal Problems.* ECLAC, United Nations.

————. 1963. *Towards a Dynamic Development Policy for Latin America*. ECLAC, United Nations.

Robinson, J. and J. Baland. 2008. "Land and Power: Theory and Evidence from Chile." *American Economic Review* 98(5): 1737–65.

Rojas, P., E. López, and S. Jiménez. 1997. "Determinantes del Crecimiento y Estimación del Producto Potencial en Chile: El Rol del Comercio." Working Paper 24, Central Bank of Chile.

Schmidt-Hebbel, K. 2006. "Chile's Economic Growth." *Cuadernos de Economía* 43 (May): 5–48.

Topalova, P. 2010. "Factor Immobility and Regional Impacts of Trade Liberalization: Evidence on Poverty from India." *American Economic Journal: Applied Economics* 2(4): 1–41.

Udry, C., J. Hoddinott, H. Alderman, and L. Haddad. 1995. "Gender Differentials in Farm Productivity: Implications for Household Efficiency and Agricultural Policy." *Food Policy* 20(5): 407–23.

Varas, J. 1975. "El Impacto de una Liberalización del Comercio en el Sector Agrícola Chileno." *Latin American Journal of Economics* 12: 121–34.

VITTORIO CORBO LIOI

Curriculum Vitae
October 2011

1. MAIN AFFILIATION

Senior Research Associate, Centro de Estudios Públicos (CEP)

2. EDUCATION

Post-Doctoral Fellow, Rockefeller Foundation, Massachusetts Institute of Technology, Cambridge, Massachusetts, Summer of 1972.

Ph.D. in Economics, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1971.

B.A. in Economics (equivalent), Universidad de Chile, Santiago, Chile, 1967. Highest honors.

3. FIELDS OF INTEREST

Stabilization and Economic Reforms; Adjustment; Open Economy Macroeconomics; Trade and Development.

4. LANGUAGES

Fluent in Spanish and English and a working knowledge of French.

5. FELLOWSHIPS AND RESEARCH GRANTS

Pontificia Universidad Católica de Chile, Department of Economics and Administration:

Research on Chilean Stabilization Policy, 1996-97.

Research on Monetary Policy, 1999-2000.

World Bank:

Research on determinants of capital inflows, 1995-96.

Research on adjustment to capital inflows, 1993.

Research on adjustment in Africa,1992-93.

Research on adjustment in South Korea,1985-87.

Research on adjustment in the southern cone (with Jaime de Melo), 1982-85.

National Science Foundation through NBER, New York: Research grant for the study of multinational firms and host-country technology, 1978.

Department of Communications, Ottawa: Research grant for studies on the telecommunications industry: 1973-74, 1975-76, 1976-77, 1977-78 and 1978-79.

National Bureau of Economic Research, New York: Research grant for the study of employment implications of trade strategies, 1975-78.

Economic Council of Canada, Ottawa: Research grant for the study of Canada's Trade Relations with Developing Countries, 1976-77.

Canada Council: General Research Grant of the Faculty of Arts and Sciences, Concordia University, 1977 (2 grants).

Ministry of Education of Quebec: Research grants for research on applied econometrics: 1973-74, 1974-75, 1975-76, 1976-77 and 1978-79.

Rockefeller Foundation: Postdoctoral fellowship, 1972.

Rockefeller Foundation: Fellowship, 1967-71.

6. AWARDS

World Central Banker of the Year, Global Finance, 2006.

Premio Italia: Vittoria Alata, Italian Embassy in Chile, 2006.

Outstanding Commercial Engineer of the Year, Alumni Association of the School of Economics and Business Administration of the University of Chile, 2004.

Economist of the Year, El Mercurio (the main Chilean newspaper), 2003.

7. UNIVERSITY POSITIONS AND FELLOWSHIPS

Part-time Professor, Pontificia Universidad Católica de Chile, Santiago, Chile, 2008 to present.

Part-time Professor of Economics, University of Chile, Santiago, Chile, 2011 to present.

Professor of Economics, Pontificia Universidad Católica de Chile, Santiago, Chile, 1981-2008 (on leave from December 1984 to March 1991 and May 2003 to December 2007).

Visiting Senior Research Fellow, Stanford University, Center for Research on Economic Development and Policy Reform, January to February 1999.

Professorial Lecturer, Georgetown University, Washington, D.C., June 1986 to March 1991.

Visiting Professor of Economics, University of Chile, Santiago, Chile, September 1979 to February 1981.

Professor of Economics, Concordia University, Sir George Williams Campus, Montreal, Canada, 1979-82.

Associate Professor of Economics, Concordia University, Sir George Williams Campus, Montreal, Canada, 1973-79.

Assistant Professor of Economics, Concordia University, Sir George Williams Campus, Montreal, Canada, 1972-73.

Assistant Professor of Economics, Clark University, Worcester, Massachusetts, spring 1972.

Assistant Professor of Economics, Pontifícia Universidad Católica de Chile, Santiago, Chile, 1971.

Research Assistant, Massachusetts Institute of Technology, Center for International Studies, Cambridge, Massachusetts, summer 1969.

Fellow, Rockefeller Foundation, 1967-71.

Assistant Professor, University of Chile, Graduate School of Economics, Santiago, Chile, 1965-67.

Teaching Assistant, Instituto Latinoamericano de Planificación Económica y Social, Santiago, Chile. 1966.

Teaching Assistant, University of Chile, Santiago, Chile, 1963-67.

8. Other Current Positions

Member of the Board of Directors, Banco Santander España, July 2011 to present.

Member of the Board of Directors, Banco Santander Chile, June 2008 to present.

Member of the Board of Directors, ENDESA-Chile, April 2010 to present.

President of the Board of Directors, ING Chile Seguros de Vida, May 2008 to present.

President and main shareholder, Vittorio Corbo & Asociados, January 1996 to present.

Economic Adviser, Banco Santander Chile, June 2008 to present.

Economic Adviser, ING Chile and AFP Capital, May 2008 to present.

Member of the Advisory Council of the Chief Economist of the World Bank. 2004 to present.

Member of the Advisory Council of the Monetary Studies and Capital

Market Department, International Monetary Fund, 2010 to present.
Member of the International Advisory Council of the Center for Social and Economic Research (CASE), Warsaw, Poland, 2002 to present.

9. Previous Executive Positions

Governor, Central Bank of Chile, April 2003 to December 2007.
Member of the Board of Directors, Global Development Network, 2000-03.
Member of the Board of Directors, Banco Santander Chile, 1996 to April 2003.
Member of the Board of Directors, Santander Chile Holding, 1996-97.
Division Chief, World Bank, Macroeconomic Adjustment and Growth Division, Country Economics Department, June 1988 to March 1991.
Division Chief, World Bank, Country Operations Division, Mexico, Central America and Panama, June 1987 to May 1988.
Acting Division Chief, World Bank, Macroeconomics Division, Development Research Department, January to June 1987.
Director, Institute of Applied Economic Research, Concordia University (formerly the International Institute of Quantitative Economics), 1976-79.
Acting Director, International Institute of Quantitative Economics, Concordia University, 1975-76.

10. Editorial and Professional Society Positions

Vice President, International Economic Association, 1999-2002.
Member, Council of the Econometric Society, representative for Latin America, 2000-02.
Executive Committee Member, International Economic Association, December 1995 to December 1999.
President, Latin American Standing Committee of the Econometric Society, 1985.

Secretary, Latin American Standing Committee of the Econometric Society, 1984.

Member, Latin American Standing Committee of the Econometric Society, 1983-85.

Chairman, Organizing Committee of the Fourth Latin American Regional Meetings of the Econometric Society, Santiago, Chile, July 19-22, 1983.

Editor, Cuadernos de Economía, August 1991 to December 1998.

Member of Editorial Board, Open Economies Review, December 1991 to December 2000.

Member of the Editorial Board, Journal of Development Economics, July 1995 to present.

Member of the Editorial Board, Journal of Policy Reform, 1997-2001.

Member of the Editorial Board, Journal of Applied Economics, 1998 to present.

Member of the Editorial Board, Cuadernos de Economía, 1982-91.

Co-editor, World Bank Research Observer, 1986 to March 1991.

11. COUNTRY WORK EXPERIENCE

Algeria, Argentina, Bolivia, Colombia, Costa Rica, Chile, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Japan, Mexico, New Zealand, Nicaragua, Panama, Peru, South Korea, Russia, The Philippines, Tunisia, and Venezuela.

12. POLICY ADVICE

President of the Advisory Committee for the Design of a Fiscal Policy of Structural Balance of Second Generation for Chile, Ministry of Finance, May 2010 to January 2011.

Consultant to the Government of Bolivia working under the auspicious of the Harvard Institute of International Development. 1992-1998.

Adviser to several Latin American governments sponsored by the Inter-American Development Bank, The World Bank, UNDP and USAID, April 1991 to 1997.

Head of Advisory Team on Adjustment and Growth Policies to the Government of Nicaragua funded by the Swedish International

Development Agency (SIDA). Other members of the team were Michael Bruno, Stanley Fischer, Raúl Laban and Patricio Rojas. 1991-1993.

Adviser to the Peruvian Government. 1992-1994.

Consultant to the Canadian Development Agency (CIDA), on Development Policies (1976-1978).

Adviser to the Ministry of Communications of Canada on Regulation Issues. 1973-1979.

Adviser to the Planning Institute of the Government of Tunisia. Project financed by the Canadian Development Agency. 1974-1976.

Technical Assistant to the Deputy Director. National Planning Office. Santiago, Chile. 1965-67.

13. ADVISER AND RESEARCH POSITIONS

Visiting Scholar, International Monetary Fund, Research Department, January to February 2000 and January to February 2003.

Economic Adviser, Santander Group, Santiago, Chile, April 1991 to April 2003.

Member of the Advisory Panel on Research Priorities, Inter-American Development Bank, 1995-96.

Member of the Academic Advisory Committee, Universidad de la Empresa, Economic Institute, Buenos Aires, Argentina, May 1995 to August 2000.

Member of the Academic Advisory Board, Universidad del CEMA, Buenos Aires, Argentina, February 2000 to present.

Member of the Advisory Board, African Economic Research Consortium, Nairobi, Kenya, 1995-98.

Consultant, Japanese Foundation for Advanced Studies in International Development, Tokyo. Project included co-directing and lecturing a course on macroeconomic management for Japanese government officials, in September 1992, January 1993, July 1993, July 1994 and July 1995.

Advisory Committee Member, Observatory on the International Economy, Center for International Studies on Economic Growth (CEIS), University of Rome and the Institute for Studies in Economic Planning of the Government of Italy, April 1991 to December 1995.

Scientific Committee Member, Center for Research in Economic Development, University of Montreal and Laval University, Canada, May 1992 to 1997.

Research Committee Member, World Bank, 1988 to March 1991.

Principal Economic Adviser, World Bank, Development Research Department, December 1984 to June 1987.

Consultant, World Bank, co-directing project on "Liberalization with Stabilization in the Southern Cone," 1981 to November 1984.

External Economic Advisor, Bank of Boston, Santiago, Chile, June 1982 to November 1984.

Research Associate, National Bureau of Economic Research, New York, 1978-80. Position involved working on Robert E. Lipsey's project on multinational firms and host-country technology.

Research Associate, National Bureau of Economic Research, New York, 1975-78. Position involved working on Anne Krueger's project on employment effects of trade strategies.

Visiting Scholar, Corporación de Investigaciones Económicas para Latinoamérica (CIEPLAN), Santiago, Chile, December 1978 to February 1979.

Project Associate. Economic Council of Canada. 1976-77. Project centered on a study of Canada's trade policies with less developed countries.

Senior Research Associate, International Institute of Quantitative Economics, Concordia University. 1972-75.

14. GUEST SEMINAR SPEAKER

Argentinean Economic Association Meetings, Mendoza, Argentina.
Arab Monetary Fund, Abu Dhabi, United Arab Emirates.
Asian Development Bank, Manila, The Philippines.
Australian National University.
Beijing University.
Bank of France.
Bank of Spain.
Boston University.
Central Bank of Argentina.
Central Bank of Bolivia.
Central Bank of Brazil.
Central Bank of the Check Republic.
Central Bank of Chile.

Central Bank of China.
Central Bank of Colombia.
Central Bank of Ecuador.
Central Bank of El Salvador.
Central Bank of Greece.
Central Bank of Guatemala.
Central Bank of Italy.
Central Bank of Ireland.
Central Bank of Mexico.
Central Bank of New Zealand.
Central Bank of Paraguay.
Central Bank of Peru.
Central Bank of Poland.
Central Bank of Uruguay.
Central Bank of Sweden.
Central Bank of Turkey.
Central University of Barcelona.
Centro de Estudios Macroeconómicos (CEMA), Buenos Aires, Argentina.
CIEPLAN, Chile.
Columbia University.
Concordia University, Montreal.
Deutsche Bundesbank.
Escuela Superior de Administración Nacional (ESAN), Peru.
Escuela Superior de Administración de Empresas (ESAE), Barcelona, Spain.
Export-Import Bank of Japan, Tokyo.
Federal Reserve Bank of Dallas.
FIEES, Panama.
Fundación Gobierno y Sociedad, Buenos Aires, Argentina.
Georgetown University, Washington, D.C.
George Washington University, Washington, D.C.
Harvard University.
Hebrew University, Jerusalem, Israel.
Hitotsubashi University, Tokyo, Japan.
Institute of Southeast Asian Studies, Singapore.
Instituto Tecnológico Autónomo de México.
International Monetary Fund.
Korea Development Institute.
Laval University, Laval, Quebec, Canada.
Massachusetts Institute of Technology.

Ministry of Finance, Algeria.
Ministry of Planning, Brazil.
Ministry of Trade and Commerce, Tokyo, Japan.
New Economic School, Moscow, Russia.
New York University.
Oberlin College, Oberlin, Ohio.
OECD Development Center, Paris, France.
Ohio State University.
Pontificia U. Católica Madre y Maestra, Dominican Republic.
Reserve Bank of Australia.
Stanford University.
Trinity College, Dublin, Ireland.
Tsokuba University, Tsokuba, Japan.
Tufts University, Medfor/Somerville, Massachusetts.
Universidad Argentina de la Empresa, Buenos Aires.
Universidad Complutense, Spain.
Universidad Nacional de Tucumán, Argentina.
University of California, Berkeley.
University of Chicago.
University of Manchester, U.K.
University of Maryland.
University of Montreal.
University of Pennsylvania.
University of The Philippines.
University of Rome.
University of Texas, Austin.
United Nations Economic Commission for Latin America and the Caribbean (ECLAC).
Waseda University, Tokyo, Japan.
Yale University.

15. CONFERENCE SPEAKER

Speaker at regional conferences in Abu Dhabi, Argentina, Austria, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Finland, Guatemala, France, Israel, Italy, Japan, Kenya, Kuwait, Mexico, New Zealand, Peru, Poland, Singapore, Spain, South Africa, South Korea, Sweden, Turkey, The Philippines, United States, and Venezuela.

16. PROFESSIONAL ORGANIZATIONS

American Economic Association.
Econometric Society.
International Economic Association.
Latin American and the Caribbean Economic Association.

17. PUBLICATIONS

Books

Latin American Macroeconomic Reforms: The Second Stage, editor (with J. A. Gonzalez, A. O. Krueger and A. Tornell), University of Chicago Press, 2003.

Adjustment Lending Revisited. Policies to Restore Growth, editor (with S. Fischer and S. Webb), World Bank, 1992.

Development Strategies and Economic Policies in Latin America: A Historical Perspective, Institute for Contemporary Studies, 1992.

Structural Adjustment in a Newly Industrialized Country: Lessons from Korea, editor (with Sang-Mok Suh), Johns Hopkins University Press, 1992.

Reforming Central and Eastern European Economies: Initial Results and Challenges, editor (with F. Coricelli and J. Bossak), World Bank, 1991.

Growth-Oriented Adjustment Programs, editor (with M. Goldstein and M. Khan), World Bank and International Monetary Fund, 1987.

Export-Oriented Development Strategies, editor (with A. O. Krueger and F. Ossa.), Westview Press, 1985.

Canada's Trade Relations with Developing Countries (with O. Havrylyshyn), Economic Council of Canada, Ottawa, 1980. Published in English and French.

Inflation in Developing Countries, Contributions to Economic Analysis Series, volume 84, North-Holland Publishing Co., Amsterdam, 1974.

Monographs and major research reports

Propuestas Para Perfeccionar la Regla Fiscal. Informe Final (with R. Caballero, M. Marcel, F. Rosende, K. Schmidt-Hebbel, R. Vergara, and J. Vial). Report of the Advisory Committee for the Design of a Fiscal Policy of Structural Balance of Second Generation for Chile, Ministry of Finance, 2011 (192 pages).

A Macroeconomic Assessment of the Bahamas, Report for IDB, Pontificia Universidad Católica de Chile, Instituto de Economía, 1993 (25 pages).

A Macroeconomic Assessment of the Dominican Republic, Report for World Bank and IDB, Pontificia Universidad Católica de Chile, Instituto de Economía, 1993 (34 pages).

An Economic Assessment of Nicaragua (with M. Bruno, S. Fischer, R. Labán and P. Rojas), with funding from the Swedish International Development Agency, 1993 (40 pages).

El Sistema Bancario Chileno: Desarrollos Recientes y sus Perspectivas (with A. Donoso, L. Hernández, F. Rosende and S. Valdés) Pontificia Universidad Católica de Chile, Instituto de Economía, 1992 (239 pages).

Adjustment Lending: Policies for the Recovery of Growth (lead author) Policy and Research Series 14, World Bank, 1990 (118 pages).

Scrambling for Survival: How Firms adjusted to the Recent Reforms in Chile, Uruguay and Argentina, editor (with J. de Melo), Staff Working Paper 764, World Bank, 1985 (226 pages).

Modelo Macroeconómico de Corto Plazo para la Economía Chilena: 1975-1981 (with R. Caballero, J. Desormeaux and L.F. Lagos), Pontificia Universidad Católica de Chile, Instituto de Economía, 1984 (228 pages).

A Simulation Model of Bell Canada: Phase II (with J. Breslaw, J.M. Dufour and J.M. Vrljicak), Report to the Department of Communications of the Canadian Government, 1979 (158 pages).

Canada's Economic Relations with Latin America (with J. Vrljicak, P. Preserve and O. Havrylyshyn), Report to the Canadian International Development Agency, 1979 (123 pages).

Economies of Scale and Economies of Scope in Bell Canada (with J.B. Smith), Report to the Department of Communications of the Canadian Government, 1979 (114 pages).

A Simulation Model of Bell Canada: Phase I (with J. Breslaw and J. Vrljicak), Report to the Department of Communications of the Canadian Government, 1978 (116 pages).

Le Tarif Extérieur Canadien et la Protection de l'Activité Manufacturière Québécoise: 1966-1974, (with A. Martens), Special Study 78-02, Concordia University, Applied Economic Research Institute; and Cahier 18, University of Montreal, Economic Development Research Center, 1978 (77 pages).

Chile: Alternative Trade Strategies and Employment Implications (with P. Meller), National Bureau of Economic Research, 1977 (draft, 238 pages).

Etude d'Evaluation d'Institutions Régionales en Amérique Latine (with Oli Havrylyshyn, J. Pérez and J. Vrljicak), Report to the Canadian International Development Agency, 1977 (244 pages).

Forecasting Techniques: Applications to the Telecommunications Industry (with J. I. Berstein and R. S. Pindyck), Report to the Department of Communications of the Canadian Government, 1977 (77 pages).

Sustitución de Importaciones, Promoción de Exportaciones y Empleo: El Caso Chileno (with P. Meller), Corporación de Investigaciones Económicas para Latinoamérica, 1977 (48 pages).

Rate Adjustment Guidelines for Regulated Industries: A Model of Bell Canada, Report to the Department of Communications of the Canadian Government, 1976 (74 pages).

A Socioeconomic Study of Bolivia (with L. Brault and O. Havrylyshyn), Canadian International Development Agency, 1975 (134 pages).

La Protection Effective des Branches d'Activités de l'Economie Tunisienne: Mesure et Analyse (with A. Martens), Report to the Ministry of Planning of Tunisia, 1975 (213 pages).

Economic Study of the Financial and Market Characteristics of the 16 Largest CATV Companies in Canada (with M. Munasinghe and R. Morin), Report to the Department of Communications of the Canadian Government, 1974 (144 pages).

Interprovincial Flows of Telephone Services, Report to the Department of Communications of the Canadian Government, 1974 (62 pages).

Survey of Two Gap Models in Development Planning (with H. Askari), Orange Cover Series, Publication 3, International Institute of Quantitative Economics, 1974.

Canadian International Telecommunications Demand Model (with M. Munasinghe), Report to the Department of Communications of the Canadian Government, 1973 (86 pages).

Problems Arising from the Estimation of the C.E.S. and V.E.S. Production Functions Using a Second-Order Approximation, Orange Cover Series, Publication 2, International Institute of Quantitative Economics, June 1973.

La Economía Chilena en 1971 y Perspectivas para 1972, editor (with J. Cauas), Pontificia Universidad Católica de Chile, Instituto de Economía, 1972 (92 pages).

El Significado Económico de los Precios Sociales, Staff Paper 1, Pontificia Universidad Católica de Chile, Instituto de Economía, 1971.

La Economía Chilena en 1971, Pontificia Universidad Católica de Chile, Instituto de Economia, 1971.

Un Estudio Econométrico del Consumo Agregado, Staff Paper 3, Pontificia Universidad Católica de Chile, Instituto de Economía, 1971.

Un Modelo de Programación de la Economía Chilena (with R. Beca), Chilean National Planning Office (ODEPLAN), 1966.

Papers

"La Gran Crisis Financiera de 2007-2009," (with Jorge Desormeaux M. and Klaus Schmidt-Hebbel), Estudios Públicos, no. 123, Winter 2011.

"The International Crisis and Latin America: Growth Effects and Development Strategies," (with Klaus Schmidt-Hebbel), in Managing Openess. Trade and Outward-Oiented Growth After Crisis (edited by Haddad M. and B Shepherd, The World Bank 2011.

"Transition Towards the Current Monetary System in Chile," In Monetary Policy under Uncertainty, Proceedings of the 2007 Money and Banking Seminar, Central Bank of Argentina, 2008.

"Latin America in the Global Economy: Challenges and Opportunities," Richard Snape Lecture, Australian Productivity Commission, 2008.

"América Latina en un Mundo Globalizado: Desafíos Futuros" (with A. Tokman), Estudios Públicos, no. 107, Winter 2007.

"Central Banks and Global Imbalances," in Central Banks in the 21st Century, edited by S. Fernández de Lis and F. Restoy, Bank of Spain, 2006.

"Latin America in a Global World: Challenges Ahead" (with A. Tokman), Economic Policy Paper 19, Central Bank of Chile, May 2006.

"Política Monetaria e Independiencia del Banco Central de Chile," in Estabilidad y Crecimiento Económico: El Papel del Banco Central, Bank of Mexico, November 2006.

"Successes and Failures in Real Convergence: The Case of Chile" (with L. Hernández T.), in Living Standards and the Wealth of Nations: Successes and Failures in Real Convergence, edited by L. Balcerowicz and S. Fischer (editors), MIT Press, 2006.

"Monetary Policy, Inflation and Economic Activity: The Case of Chile," Asian Journal of Latin American Studies, vol. 18, no. 2, Latin American Studies Association of Korea, 2005.

"Ochenta Años de Historia del Banco Central de Chile" (with L. Hernández T.), Revista Economía Chilena, vol. 8, no. 3, December 2005.

"Exchange Rate and Monetary Regimes," in Beyond Transition: Development Perspectives and Dilemmas, edited by M. Dabrowski, J. Neneman and B. Slay, CASE Foundation, Warsaw, Poland, Ashgate Publishing, August 2004.

"La Óptica de Chile," in Argentina: Crisis, Instituciones y Crecimiento. Conferencias FIEL 2003, vol. 2, Fundación de Investigaciones Económicas Latinoamericanas, 2004.

"Latin America and the External Crisis of the Second Half of the Nineties," in Latin American Economic Crisis: Trade and Labour, edited by E. Bour, D. Heyman and F. Navajas, Palgrave and International Economic Association, 2004.

"Policy Challenges of Population Aging and Pension Systems in Latin America," in Global Demographic Change: Economic Impacts and Policy Challenges, a symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, August 2004.

"Inflation Targeting: The Latin America Experience" (with Klaus Schmidt-Hebbel), in Latin American Macroeconomic Reforms: The Second Stage, edited by J. A. Gonzalez, V. Corbo, A. O. Krueger and A. Tornell, University of Chicago Press, 2003.

"Is It Time for a Common Currency for the Americas?," in The Dollarization Debate, edited by D. Salvatore, J. W. Dean and T. D. Willett, Oxford University Press, 2003.

"Macroeconomic Effects of the Pension Reform in Chile" (with K. Schmidt-Hebbel), in Pension Reforms: Results and Challenges,

International Federation of Pension Fund Administrators, October 2003. Available in English and Spanish.

"Exchange Rate Regimes in the Americas: Is Dollarization the Solution?" Monetary and Economic Studies, vol. 20, no. S-1 (special edition), Tokyo: Bank of Japan, December 2002.

"Does Inflation Targeting Make a Difference?" (with O. Landerretche and K. Schmidt-Hebbel), in Inflation Targeting: Design, Performance, Challenges, edited by N. Loayza and R. Soto, Central Bank of Chile, 2002.

"Growth and Adjustment in Chile: A Look at the1990s" (with Jose A. Tessada), in Economic Growth: Sources, Trends and Cycles, edited by N. Loayza and R. Soto, Central Bank of Chile, 2002.

"Monetary Policy in Latin America in the 1990s," in Monetary Policy Rules and Transmission Mechanisms, edited by N. Loayza and K. Schmidt-Hebbel, Central Bank of Chile, 2002.

"Assessing Inflation Targeting after a Decade of World Experience" (with O. Landerretche and K. Schmidt-Hebbel), International Journal of Finance and Economics, vol. 6, no. 4, 2001.

"Development Policies Beyond Export-Led Growth," in Advances in Macroeconomic Theory, edited by J. Drèze, Palgrave, 2001.

"Is It Time for a Common Currency for the Americas?" Journal of Policy Modeling, vol. 23, April 2001.

"Objetivos de Inflación en América Latina" (with K. Schmidt-Hebbel), Gaceta de Economía, Instituto Autónomo de México (ITAM), December 2001.

" "Coordinación de Políticas Macro en el Mercosur: Queda Mucho por Hacer antes de Avanzar a la Etapa que Sigue," in Coordinación de Políticas Macroeconómicas en el Mercosur, edited by J. Carrera and F, Sturzenegger, Fondo de Cultura Económica and Fundación Gobierno y Sociedad, 2000.

"Economic Policy Reforms in Latin America," in Economic Policy Reform: The Second Stage, edited by A. O. Krueger, University of Chicago Press, 2000.

"Private Capital Inflows and the Role of Economic Fundamentals" (with L. Hernández), in Capital Flows, Capital Controls and Currency Crisis: Latin America in the 1990s, edited by F. Larraín, Michigan University Press, 2000.

"Reducción de la Inflación: La Experiencia Chilena," Ensayos Sobre Política Económica, no. 36-37, December 1999 to June 2000. Central Bank of Colombia.

"Macroeconomic Policy and Exchange Rate Management: The Experiences of Chile and Mexico," in Macroeconomic Policy and Exchange Rate, edited by J. de Brun and R. Lüders, San Francisco: International Center for Economic Growth, 1999.

"Monetary Policy in Latin America: Underpinnings and Procedures" (with A. Elberg and J. A. Tessada), Cuadernos de Economía, December 1999.

"Stabilization Policies in Latin America: The Decade of Reckoning," in The Transformation of Latin America. Economic Development in the Early 1990s, edited by M. Feldspier and F. Foders, London: Edward Elgar, 1999.

"Economic Reforms in Latin America: The Decade of Changes," in Contemporary Economic Issues, edited by J Linn, Macmillan 1998.

"Government Policy, Saving and Growth in Latin America," in The Political Dimension of Economic Growth, edited by S. Bonner and M. Paldman, Macmillan, 1998.

"Industrial Interests versus Class Interests: Conflicts over Income Distribution in the Economic Development of Japan and Brazil: A Comment," in The Institutional Foundations of East Asian Economic Development, edited by Y. Hayami and M. Aoki, Macmillan Press. 1998.

"Macroeconomic Policy Issues Raised by Capital Inflows," in The Mixed Blessing of Financial Inflows, edited by J. Gács, R. Holzman and M. Wyzan, Edgard, 1998

"Reaching One-Digit Inflation: The Chilean Experience," Journal of Applied Economics, vol. 1, no. 1, November 1998.

"Remuneraciones de los Profesores en Chile: Un Comentario al Trabajo de Patricio Rojas," Estudios Públicos, no. 71, Winter 1998.

"Reorganization of Korea's Macroeconomic Management: A Comment," in Korea's Choices in Emerging Global Competition and Cooperation, edited by L. J. Cho and Y. H. Kim, Korea Development Institute Press, 1998.

"Some Lessons for Africa from Recent Reforms in Latin America," Journal of African Economies, vol. 7, sup. 2, 1998.

"Vulnerabilidad Financiera: Lecciones de la Crisis Asiática para América Latina," Revista de Análisis, vol. 1, no. 2, Central Bank of Bolivia, 1998.

"Exchange Rate Volatility, Investment and Growth" (with P. Rojas), in Exchange Rates, Capital Flows and Monetary Policy in a Changing World Economy: Proceedings of the 1995 Conference

on Exchange Rates Sponsored by the Federal Reserve Bank of Dallas, edited by Gruber et. al., Kluwer Academic Press, 1997.

"Trade Reform and Uniform Tariffs: The Chilean Experience," American Economic Review, vol. 87, no. 2, 1997.

"Estabilidad Macroeconómica como Condición Necesaria para el Crecimiento," Notas de Estudios, Central Reserve Bank of Peru, June 1997.

"Latin America: A New Model," in Markets and Government: In Search of Better Coordination, edited by K. Odaka and J. Teranishi, Tokyo: Maruzen Co. Ltd., 1997.

"Las Exportaciones en el Crecimiento Económico y el Empleo," in México: Transición Económica y Comercio Exterior, BANCOMEX, 1997.

"Experiencias y Lecciones de los Procesos de Internacionalización de la Banca," in Internacionalización de la la Banca Chilena en Latinoamerica. Colección de Economía y Finanzas, vol. 20, 1996.

"Macroeconomic Adjustment to Capital Inflows: Lessons from Recent Latin American and East Asian Experience" (with L. Hernández), in The World Bank Research Observer, vol. 11, no. 1, February 1996.

"Old and New Growth Theories: Some Illustrations for Latin America and East Asia," in Road Maps to Prosperity: Essays on Growth and Development, edited by A. Solimano, University of Michigan Press, 1996.

"Principales Determinantes del Crecimiento Latinoamericano," in Crecimiento Económico: Teoría, Instituciones y Experiencia Internacional, edited by M. Aparicio and W. Easterly, World Bank and Central Bank of Colombia, 1995.

"Reduciendo una Inflación Crónica: Un Modelo de la Inflación Chilena" (with B. Piedrabuena), in Análisis Empírico de la Inflación en Chile, edited by F. Morandé and F. Rosende, Pontificia Universidad Católica de Chile, Instituto de Economía 1995.

"Structural Adjustment, Stabilization and Policy Reform: Domestic and International Finance" (with S. Fischer), in Handbook of Development Economics, vol. 3B, edited by Behrman and T. N. Srinivasan, Amsterdam: North-Holland, 1995.

"Ajustes Macroeconómicos ante la Afluencia de Capitales en Cartera: Su Lógica y Algunas Experiencias Recientes" (with L. Hernández), Estudios Públicos, no. 56, 1994.

"Economic Policy and Performance in Latin America," in Handbook of Economic Development, edited by E. Grilli and D. Salvatore, Amsterdam: North-Holland, 1994.

"La Enfermedad Holandesa: Los Principales Problemas," in Cusiana: un Reto de Política Económica, pp. 34-37, Bogotá: National Planning Department and World Bank, 1994.

"Las Reformas Económicas en Chile: Una Síntesis," Economía, vol. 17, no. 33-34, Pontificia Universidad Católica del Perú, July-December 1994.

"Latín American Economic Growth" (With P. Rojas), in International Differences in Growth Rates, edited by M. Baldassarri, Luigi Paganetto and E. Phelps, ST. Martin's Press, 1994.

"Lessons from the Chilean Stabilization and Recovery" (with S. Fischer), The Chilean Economy: Policy Lessons and Challenges, in edited by B. Bosworth, R. Dornbusch and R. Labán, Washington, D.C.: Brookings, 1994.

"The Macroeconomics of Capital Inflows: Some Recent Country Experiences" (with L. Hernández), in Bridging the Americas: Re-Discovery, Understanding, Partnership, edited by A. Z. Vasquez-Parraga, pp. 215-29, Balas Proceedings, 1994.

"Un Descubrimiento de Petróleo: Implicaciones de Política Económica," in Cusiana: un Reto de Política Económica, pp. 208-11, Bogotá: National Planning Department and World Bank, 1994.

"Investment, Macroeconomic Stability and Growth: The Latin American Experience" (with P. Rojas) Análisis Económico, June 1993.

"Macroeconomic Adjustment to Capital Inflows: Rationale and Some Recent Experiences" (with L. Hernández), in Portfolio Investment in Developing Countries, edited by S. Claessens and S. Gooptu, World Bank, 1993.

"What Should Banks Do in the Financial Industry of the 1990s: The Case of Middle-Income Countries" (with L. Hernández), in Financial Sector Reforms in Asian and Latin American Countries, edited by S. Faruqi, World Bank, 1993.

"Adjustment Programs and Bank Support: Rationale and Main Results" (with S. Fischer), in Adjustment Lending Revisited: Policies for the Recovery of Growth, edited by V. Corbo, S. Fischer and S. Webb, World Bank, 1992. Also in Development Finance and Policy Reform, edited by P. Mosley, St. Martin Press, 1992.

"Ajuste de Empresas del Sector Industrial de Chile durante 1974-1982" (with J.M. Sánchez), in Estudios CIEPLAN, no. 35, Septiembre 1992.

"Controlling Inflation: The Recent Experience of the Republic of Korea" (with Sang-Woo Nam), in edited by V. Corbo and Sang-Mok Suh (editors), Structural Adjustment in a Newly Industrialized Country: Lessons from Korea, Johns Hopkins University Press, 1992.

"Crecimiento Económico en América Latina" (con P. Rojas), Cuadernos de Economía, August 1992.

"Economic Transformation in Latin America; Lessons for Eastern Europe," European Economic Review, vol. 36, no. 2-3, April 1992.

"Growth-Oriented Adjustment Programs: Lessons from the Recent Experience of the Republic of Korea" (with Sang-Mok Suh), in Structural Adjustment in a Newly Industrialized Country: Lessons from Korea, edited by V. Corbo and Sang-Mok Suh, Johns Hopkins University Press, 1992.

"Il Processo di Crescita Economica dei Paesi dell' America Latina" (with P. Rojas), Rivista di Politica Economica, December 1992.

"Los Determinantes del Crecimiento Económico" (con R. Vergara), Cuadernos de Economía, August 1992.

"The Recent Macroeconomic Evolution of the Republic of Korea: An Overview" (with Sang Woo Nam), in Structural Adjustment in a Newly Industrialized Country: Lessons from Korea, edited by V. Corbo and Sang-Mok Suh, Johns Hopkins University Press, 1992.

"World Bank-Supported Adjustment Programs: Country Performance and Effectiveness" (with P. Rojas), in Adjustment Lending Revisited: Policies for the Recovery of Growth, edited by V. Corbo, S. Fischer and S. Webb, World Bank, 1992.

"Adjustment Lending and the Restoration of Sustainable Growth" (with S. Webb), Journal of International Development, vol. 3, no. 2, 1991.

"Chile's Experience with Stabilization Revisited" (with A. Solimano), in Lessons of Economic Stabilization and Its Aftermath, edited by M. Bruno et al., MIT Press, 1991.

"Debt, Adjustment and Growth," Osservatorio sull'economia internazionale, December 1991.

"Economic Policy in Latin America," in Handbook of Comparative Economic Policies Series, vol. 1, edited by D. Salvatore, Amsterdam: North-Holland, 1991.

"Estrategias y Políticas de Desarrollo en América Latina: Una Perspectiva Histórica," Economía, vol. XIV, no. 27, June 1991.

"Public Policies and Saving in Developing Countries" (with K. Schmidt-Hebbel), Journal of Development Economics, vol. 36, July 1991.

"Structural Adjustment in the LDCs," in International Workshop on the Least Developed Countries, Vienna Institute for Development Cooperation, 1991.

"The Effects of Trade Reforms on Scale and Technical Efficiency: New Evidence from Chile" (with J. de Melo and J. Tybout), Journal of International Economics, vol. 31, no. 3-4, November 1991.

"World Bank-Supported Adjustment Programs: Lessons for Central and Eastern Europe," in Reforming Central and Eastern European Economies: Initial Results and Challenges, edited by V. Corbo, F. Coricelli and J. Bossak, World Bank, 1991.

"Chile's Economic Adjustment: A Comment," in Latin American Adjustment: How Much Has Happened?, edited by J. Williamson, Institute for International Economics, 1990.

"Exchange Rate-Based Disinflation, Wage Rigidity and Capital Inflows: Tradeoffs for Chile 1977-81" (with T. Condon and J. de Melo), Journal of Development Economics, January 1990.

"Public Finance, Trade and Development: The Chilean Experience," in Fiscal Policy in Open Development Economies, edited by V. Tanzi, International Monetary Fund, Washington, D.C., 1990.

"External Shocks and Policy Reforms in the Southern Cone: A Reassessment" (with J. de Melo), in Debt, Stabilization and Development, edited by G. Calvo et al., London: Basil Blackwell, 1989.

"The Effect of Real Exchange Rate Uncertainty on Exports: Empirical Evidence" (with R. Caballero), World Bank Economic Review, May 1989.

"The Pricing of Manufactured Goods during Trade Liberalization: Evidence from Chile, Israel and Korea" (with P. McNelis), Review of Economics and Statistics, August 1989.

"Korea's Macroeconomic Prospects and Policy Issues for the Next Decade" (with W. Nam), World Development, January 1988.

"Problems, Development Theory and Strategies of Latin America," in The State of Development Economics: Progress and Perspectives, edited by G. Ranis and T. P. Schultz, London: Basil Blackwell 1988.

"Korean Growth Policy: A Comment on Dornbusch and Park," Brookings Papers on Economic Activity, no. 2, 1987.

"Lecciones sobre las Reformas en el Cono Sur" (with J. de Melo), Revista de Economía, vol. 2, no. 1, Banco Central del Uruguay, August 1987.

"Lessons from the Southern Cone Policy Reforms," (with J. de Melo). World Bank Research Observer, vol. 2, no. 2, July 1987.

"The Use of the Exchange Rate for Stabilization Purposes: The Case of Chile," in Economic Reforms and Stabilization in Latin America, edited by M. Connolly and C. Gonzalez, Praeger, 1987.

"Análisis de la Balanza Comercial: Un Enfoque de Equilibrio General" (with R. Caballero), Cuadernos de Economía, December 1986.

"Comments on Paper by Professor Furtado," in Pioneers in Development II, edited by G. Mier, Oxford University Press, 1986.

"Measuring Technical Efficiency: A Comparison of Alternative Methodologies with Census Data" (with J. de Melo), in Measurement Issues and Behavior of Productivity Variables, edited by A. Dogramaci, Boston: Kluwer Nijhoff, 1986.

"What Went Wrong with the Recent Economic Reforms in the Southern Cone" (with J. de Melo and J. Tybout), in Economic Development and Cultural Change, April 1986. Spanish version: Estabilización y Ajuste Estructural en América Latina, edited by S. Roca, Lima: ESAN, 1987.

"Adjustments by Industrial Firms in Chile During 1974-82" (with J.M. Sánchez), chap. 3 in Scrambling for Survival: How Firms Adjusted to the Recent Reforms in Chile, Uruguay and Argentina, edited by V. Corbo and J. de Melo, Staff Working Paper 764, World Bank, 1985.

"Chile: Economic Policy and International Economic Relations since 1970," in National Economic Policies in Chile, edited by G. Walton, J.A.I. Press, 1985.

"Estrategias de Comercio Exterior y Desarrollo Económico," Estudios Públicos, no. 19, 1985.

"International Prices, Wages and Inflation in an Open Economy: A Chilean Model," Review of Economics and Statistics, November 1985.

"Liberalization with Stabilization in the Southern Cone of Latin America: Overview and Summary" (with J. de Melo), World Development, August 1985.

"Productivity Growth, External Shocks and Capital Inflows in Chile during 1977-81: A General Equilibrium Analysis" (with T. Condon and J. de Melo), Journal of Policy Modeling, 1985.

"Reforms and Macroeconomic Adjustments in Chile: 1974-82". World Development, August 1985.

"Small Open Economies: An Overview" (with F. Ossa), in Export-Oriented Development Strategies, edited by V. Corbo, A. O. Krueger and F. Ossa, Westview Press, 1985.

"Capital Flows, the Real Exchange Rate and Growth in Chile," in

Economic Liberalization and Stabilization Policies in Argentina, Chile and Uruguay: Applications of the Monetary Approach to the Balance of Payments, edited by N. Ardito-Barletta, M. Blejer and L. Landau, World Bank, 1984.

"Desarrollos Recientes en la Economía Chilena," Cuadernos de Economía, April 1983.

"Earnings Determination and Labor Markets: Gran Santiago, Chile 1978" (with M. Stelcner), Journal of Development Economics. February-April 1983.

"Un Modelo de Corto Plazo de la Economía Chilena," Cuadernos de Economía, August 1983.

"Desequilibrios de Stock, Shocks Monetarios y la Estabilidad de la Demanda por Dinero en Chile," Cuadernos de Economía, December 1982.

"Fuentes de Cambio en la Estructura Económica Chilena: 1960-1980" (with M. Pollack), Estudios de Economia, no. 18, First Half 1982.

"Inflación en una Economía Abierta y Pequeña: El Caso de Chile," Cuadernos de Economía, April 1982.

"Monetary Policy with an Overrestricted Demand for Money Equation: Chile in the 60s," Journal of Development Economics, February 1982.

"The Substitution of Labor, Skill and Capital: Its Implications for Trade and Employment" (with P. Meller), in Trade and Employment in Developing Countries, vol. 2, Factor Supply and Substitution, edited by Anne O. Krueger, University of Chicago Press, 1982.

"Chile, Alternative Trade Strategies and Employment Growth" (with P.Meller), chapter 3 in Trade and Employment in Developing Countries, vol. 1, Individual Studies, edited by Anne O. Krueger et al., University of Chicago Press for NBER, 1981.

"El Tiempo en la Economía," in El Tiempo en las Ciencias, edited by J. Gómez Millas et al., Santiago: Editorial Universitaria, 1981.

"Inflation Expectations and the Specification of Demand for Money Equations," Journal of Money, Credit and Banking, August 1981.

"Sustitución de Importaciones, Promoción de Exportaciones y Empleo: El Caso Chileno" (with P. Meller), El Trimestre Económico, vol. 48, no. 189, January-March 1981.

"The Impact of Minimum Wages on Industrial Employment in Chile," in The Economics of Legal Minimum Wages, edited by S. Rottenberg, American Enterprise Institute for Public Policy Research, 1981.

"Dos Ensayos sobre Protección" (with H. Askari), Estudios de Economía, no. 16, Second Half 1980.

"Expectativas Inflacionarias y Demanda por Dinero en una Economía con una Tasa Intermedia de Inflación; Chile en los 60," Cuadernos de Economía, August 1980.

"La Segmentación del Mercado Laboral Reconsiderada: El Caso de los Asalariados, Gran Santiago 1978" (with Mr. Stelcner), Estudios de Economía, no. 15, First Half 1980.

"Le Tarif Extérieur Canadien et la Protection de l'Activité Manufacturière Québécoise: Nouveaux Résultats (1966-1977) (with A. Martens), L'Actualité Economique, January-March 1980.

"The Other Side of Trade Flows in the New International Economic Order: A Case Study of Canadian Exports do Developing Countries" (with O. Havrylyshyn), Journal of Economic Development, vol. 5, no. 1, July 1980.

"Comercio Exterior y Empleo: Algunas Experiencias de Países en Desarrollo," Cuadernos de Economía, vol. 16, no. 47, April 1979.

"Confederation and Some Regional Implications of the Tariffs on Manufactures: A Comment," in The Political Economy of Confederation, edited by N. Swan, Ottawa: Economic Council of Canada, 1979.

"La Politique Commerciale Tarifaire Canadienne et L'Activité Manufacturière Québécoise: 1966-1974" (with A. Martens) in Economie de Québec et Choix Politique, edited by C. Montmarquette, Montreal: Les Presses de l'Université du Québec, 1979.

"Estrategias de Comercio Exterior y su Impacto sobre el Empleo: Chile en la Década del 60" (with P. Meller), en Estudios de Economía, no. 13, First Half 1979. Reprinted in América Latina y la Economía Mundial, edited by J. Donges et al., Buenos Aires: Instituto Torcuato di Tella, 1979.

"The Translog Production Function: Some Evidence from Establishment Data" (with P. Meller), Journal of Econometrics, vol. 10, June 1979.

"An Econometric Approach to Forecasting Demand and Firm Behavior: Canadian Telecommunications" (with R. S. Pindyck), in, Forecasting: Methods and Applicatinos, edited by S. G. Makridakis, S. C. Wheelwright and R. J. Hyndman, Amsterdam: North Holland, 1979.

"La Sustitución de Trabajo, Capital Humano y Capital Físico en la Industria Manufacturera Chilena" (with P. Meller), Estudios de Economía, no. 14, Second Half 1979.

"Trade and Employment: Chile in the 1960s" (with P.Meller), American Economic Review, vol. 68, no. 2, May 1979.

"Fonctions de Production de l'Economie de Québec" (with J.M. Dufour), L'Actualité Economique, vol. 54, no. 2, April-June 1978.

"The Demand for CATV Services in Canada" (with M.Munasinghe), Canadian Journal of Economics, vol. 11, no. 3, August 1978.

"The Demand for International Telecommunications Services and Their Policy Implications: The Case of Canada" (with M. Munasinghe), Telecommunications Journal, vol. 45, September 1978.

"A Search Procedure for Least Squares C.E.S. Estimates: A Monte Carlo Study," Southern Economic Journal, vol. 43, no. 4, April 1977.

"The Leontief Paradox and Identical Production Functions" (with H. Askari), Economia Internazionale, vol. 30, no. 2-3, March-August, 1977.

"Second-Order Approximations for Estimating a CES Production Function," Annals of Economic and Social Measurement, vol. 5, no. 1, January 1976.

"Export Promotion: Its Rationale and Feasibility" (with H. Askari), Pakistan Economic and Social Review, vol. 13, no. 2, Summer 1975.

"Un Procedimiento Simple para Calcular los Estimadores de Mínimos Cuadrados No Lineales de una Función C.E.S.: Algunas Propiedades en Muestras Pequeñas," Cuadernos de Economía, vol. 12, no. 35, August 1975.

"The Economic Cost of Military Expenditures in the Middle-East" (with H. Askari), Journal of Peace Research, October 1974.

"Una Revisión Crítica de la Literatura sobre Modelos de dos Brechas en la Planificación del Desarrollo" (with H. Askari), Cuadernos de Economía, vol. 11, no. 32, January 1974.

"Modelos Macroeconómicos de Brechas," Revista de Economía, University of Puerto Rico, April 1972.

"Precios y Salarios Industriales e Inflación en Chile, Un Modelo Trimestral," Cuadernos de Economía, vol. 9, no. 26, April 1972.

"Precios Sociales de los Factores Productivos," Hermes, 1966-67.

"Un Modelo de Programación Agrícola," Boletín Plandes, 1965.

Book Reviews

Easterly, W., The Elusive Quest for Growth: Economic Adventures and Misadventures in the Tropics, MIT Press, 1991. Reviewed in Economía Chilena. vol. 5, no. 1, pp. 97-100, April 2002.

Eckaus, R. S., and P. N. Rosentein-Rodan (editors), Analysis of Development Problems: Studies on the Chilean Economy. Amsterdam: North-Holland, 1974. Reviewed in Journal of Development Economics, vol. 2, pp. 81-83, 1975.

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