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Openness, Vulnerability, and Growth*

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Abstract

External vulnerability can be measured by the sensitivity of first and second moments of economic growth to openness and foreign shocks. This paper provides an empirical evaluation of external vulnerability using panel methods for a large cross-country dataset. Controlling for domestic conditions, the paper examines the growth and volatility effects of both outcome and policy measures of trade and financial integration as well as four types of foreign shocks: terms of trade, trading partners' growth rates, foreign real interest rate, and net regional capital inflows. We analyze the possibility of non-linearities by allowing the growth and volatility effects of openness to vary with the general level of economic development and by letting the effects of foreign shocks to depend on the degree of trade and financial integration. The findings point toward strong non-monotonic effects of openness and external shocks on growth and volatility.

Key Words: External Shocks, Openness, Volatility, Growth
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I. Introduction

A central dimension of globalization is the world trend toward larger financial and trade openness, observed in most industrial and developing economies. Openness leads to higher integration of world goods and capital markets, contributing to potential gains in growth and welfare. However, higher integration also may lead to heightened vulnerability to external shocks. This vulnerability may be particularly important in developing countries, due to their production specialization, non-diversified sources of income, unstable policies, incomplete financial markets, and/or weak institutions.

A growing empirical literature is addressing the links between openness and external shocks, on one side, and macroeconomic performance – reflected in average growth and growth volatility, for example – on the other side. At this stage of the available cross-country and panel data research, neither financial openness (FO) nor trade openness (TO) show a linear or even monotonic relationship with economic growth.

However, the existing literature does not provide a systematic and symmetric empirical analysis of: (i) the relationships between economic growth and both policy and outcome measures for both FO and TO, (ii) the relationships between growth volatility and both policy and outcome measures for both FO and TO, (iii) the role of external vulnerability reflected by foreign shocks (financial and real, price and exogenous determinants of quantity) and their influence on growth and growth volatility, and (iv) the interaction effects between openness measures (FO and TO) and the corresponding foreign shocks on growth and growth volatility. The purpose of this paper is to fill this void.

Section II provides a selective review of the relevant literature. Section III presents the empirical methodology, the data sample, and the panel-data regression results for growth and growth volatility. There we report first the simple linear effects of policy and outcome measures of trade and financial openness as well as various external shocks; second, the dependence of the effect of trade and financial openness on the level of per capita income; and third, the amplification or dampening of the effects of external shocks depending on the degree of trade and financial openness. Section IV concludes briefly.

II. Review of Previous Empirical Literature

A growing empirical literature has analyzed the effects of financial openness, trade openness, and foreign shocks on growth and macroeconomic volatility. In this section we proceed to review briefly the analytical underpinnings and existing empirical results on the core relations that are the focus of this paper: those between financial openness, trade openness, foreign shocks, GDP growth, and GDP growth volatility.

A. Financial Openness and Growth

The empirical literature on financial openness (FO) – as well as the research on trade openness (TO) reviewed below – is based on two classes of openness measures. Policy or legal measures reflect policy and regulatory restrictions or barriers imposed domestically on international trade volumes and financial flows and/or holdings. In contrast, outcome or *de facto* measures reflect actual trade volumes and financial flows or stocks between the domestic economy and the rest of the world. On one hand, the strength of the first class of FO / TO measures is that it reflects policy restrictions while the second class is influenced by country-specific features – including size, distance, production specialization, and risk – in addition to domestic restrictions. Hence the first class may represent more exogenous policy conditions while the second class of FO /TO measures is likely to be endogenous to variables that are often explained by integration, including growth. On the other hand, outcome measures may reflect more truly country integration into world markets, while policy measures may not reflect binding policy restrictions and be subject to measurement bias. Moreover, outcome indicators represents continuous variables that are more easily measured and are more widely available than the discrete measures of policy restrictions.

The policy measure of FO is largely based on information on capital controls in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions, which has spawned construction of several discrete indicators of capital-flow restrictions on cross-border or cross-residence flows.[1] The outcome measure reflects an actual measure of FO, based on cross-country capital flows or capital stocks, defined as ratios to GDP.[2] [3]

[1] Policy or legal measures of capital-flow restrictions include a dummy variable based directly on the IMF measure, the Share measure reflecting the number of years of IMF-measured restrictions, the Quinn index that allows varying degrees of restrictions based on the IMF information (Quinn 1997), all available for varying

There is a growing literature on the effects of capital-account liberalization and FO on growth – Edison, Klein et al. (2002) provide an excellent survey. Here we discuss the previous work only briefly, in those dimensions that are relevant to this paper. (See Table 1 for a selective summary).

Preceding studies diverge significantly in FO measures, empirical methods, data samples, and results. The studies conducted during the past decade – most of them on measures based on the *de jure* IMF restrictions – show mixed results. While Quinn (1997) and Edison, Klein et al. (2002) report positive significant growth effects of IFI for the world at large, many others do not find any evidence or reject robust evidence of FO growth effects, including Grilli and Milesi-Ferretti (1995), Kraay (1998), Rodrik (1998), O'Donnell (2001), Edison, Levine et al. (2002). Other studies have tested for FO measures and their interaction with third variables, in order to reflect non-linearities and non-monotonicities in the relationship between growth and FO. Here the general finding is that FO and external financial liberalization tend to reduce growth in countries that are either not industrialized (Klein and Olivei 2000), feature ethnic heterogeneity (Chanda 2001), have low income (Edwards 2001), or exhibit high black-market premiums (Arteta et al. 2001), while FO raises growth in countries with the opposite features. Klein (2003) reports quadratic interaction terms of FO with government quality and with per capita GDP, implying that FO only raises growth in middle-income countries and reduces growth in low- and high-income countries.

Therefore the latter evidence suggests strongly that FO and growth display a non-monotonic relationship. At low levels of development – for several measures of development – financial liberalization and/or FO tend to lower growth, while the opposite is observed in developed nations, where FO contributes to growth. This result should not come as a surprise. It reflects that international financial liberalization in non-OECD countries – frequently hampered by low-quality governments, poor institutions, or lack of

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country and annual samples. The OECD measure for 21 OECD countries also allows for varying degrees of restrictions. Montiel and Reinhart (1999) compute an index of restrictions for 15 emerging economies. For detailed discussion of legal and actual measures of IFI see Edison, Klein et al. (2002).

[2] Actual measures of FO include large country samples for capital flows (Kraay 1998) and stocks on gross capital flows accumulated from flows (Lane and Milesi-Ferretti 2001, 2003, Kose, Prasad and Terrones 2004).

effective banking regulation and supervision – takes place jointly with domestic financial liberalization. After the boom phase of massive credit growth, capital inflows, and domestic spending, frequently a hard landing ensues, reflected in a banking crisis and domestic recession, and hence depressing medium-term growth.

Finally Kose et al. (2004) do not find any robust growth effects of FO separately but, interestingly, show that FO interaction with growth volatility turns the negative effect of volatility on growth into a positive one. This suggests that FO may alleviate adverse growth level effects stemming from high GDP volatility by strengthening access to external counter-cyclical lending and raising international portfolio diversification by domestic agents.

B. Trade Openness and Growth

Like FO measures, policy or legal measures of TO are based on measures of trade policy or trade restrictions and the standard measure of outcome or *de facto* TO is the GDP share of total trade (exports plus imports).

As compared to the empirical literature on IFI and growth, there is a longer and broader cross-country growth literature on the effects of trade liberalization and TO. Edwards (1993) is an excellent survey of the older literature. Again, here we discuss the previous work only briefly, in those dimensions that are relevant to this paper. (See Table 2 for a selective summary).

Previous work differs strongly in many dimensions – dependent variable (GDP growth, per capita income level, per capita income convergence), TO measures, controls, data samples, and econometric techniques. Earlier work finds significant, positive, and often very large effects of TO on growth, income levels, or income convergence (Dollar 1992, Ben-David 1993, Sachs and Warner 1995, Edwards 1998, Frankel and Romer 1999). Much of the latter research has been subsequently criticized for possible bias stemming from endogeneity of trade to income levels or GDP growth, lack of robustness due to exclusion of relevant controls and/or use of inadequate data samples and estimation techniques. Rodrik and Rodriguez (2000) report that TO effects on growth are not robust to

[3] More partial dimensions of financial restrictions and liberalization, even if they have some bearing for FO, are not considered in this paper. This includes measures of stock market liberalization and the literature on the effects of the latter on growth, reviewed in Edison, Klein et al. (2002).

inclusion of geographic latitude and Rodrik et al. (2003) find that TO is not robust to inclusion of institutional quality. Rigobon and Rodrik (2004), based on a technique of identification through heteroskedasticity, is the only recent study reporting negative significant effects of ITI on per capita income levels, controlling for institutions and geography.

On the other side of the distribution of recent work, there is much recent research that finds significant and robust effects of TO on growth or income levels (Wacziarg 2001, Irwin and Terviö 2002, Alcala and Ciccone 2004, Kose et al. 2004). Some other recent work reports more qualified results: TO effects are not robust in cross-section estimations they are significant in panel studies and robust to inclusion of institutional variables (Dollar and Kraay 2003, Wacziarg and Welch 2003). The latter study, focusing on trade liberalization country episodes, shows that trade shares and growth increase significantly and substantially after trade is liberalized. Finally, two recent studies look at interaction effects between TO measures and other variables. Kose et al. (2004), complementing their research on FO and growth, report robust positive effects of TO on growth and find that TO turns the negative effect of volatility on growth into a positive one. Alesina et al. (2004), controlling for country size and interaction effects between TO and size, find that TO has large effects in small countries but these effects become zero as country size tends to maximum size.

C. Foreign Shocks and Growth

Foreign variables relevant to open economies comprise financial and real variables associated to capital flows and trade flows, respectively. They include price variables (international interest rates, terms of trade) and quantity variables (capital flows to emerging economies). For truly small countries (those facing infinite demand/supply elasticities for their exports/imports of capital and goods), only price variables matter for determining domestic performance, including growth. For countries that have some monopolic or monopsonic power in international markets – reflecting their size and/or their specialization in trading differentiated goods under conditions of monopolistic competition – quantities matter for domestic performance too. However here it is important to isolate the exogenous determinant (or the instrument) of quantities as the relevant predetermined

quantity variable. In this vein, the world or regional supply of capital could be an adequate instrument for the supply of capital to the domestic economy, while average growth of all trading partners could be an adequate instrument for the foreign demand of exports by the domestic economy.

Foreign shocks are measured in two ways: the rate of growth or deviation of a foreign variable from its preceding level and the standard deviation of the variable in a given time period. Most empirical growth studies include one or two variables that reflect foreign shocks as the first measure, typically as control variables. We briefly refer to recent cross- country empirical studies that quantify the effects of terms of trade, foreign interest rate, and trading partner growth on domestic growth.

Among the latter variables, the rate of growth of the terms of trade is the most widely used measure of foreign shocks (among representative studies, see Easterly, Loayza, and Montiel 1997, Fernández-Arias and Montiel 2002, Loayza, Fajnzylber, and Calderón 2004, Barro and Sala-i-Martin 2004). In most studies terms-of-trade shocks turn out to be significantly positive determinants of growth.

Other studies have included the ratio of private capital inflows to GDP as a growth determinant and have also evaluated the impact of different types of capital flows on growth **(**Bosworth and Collins 1999, Mody and Murshid 2002, Calderón and Schmidt-Hebbel 2003**).** Most of these studies have found a positive impact of private capital inflows on growth, with a stronger effect in the case of foreign direct investment.[4]

Foreign real interest rates are also an important mechanism for transmitting international shocks to open economies. Blankenau et al. (2001) find that foreign real interest rate shocks explain almost one-third of output fluctuations in small open economies as well as more than half of their fluctuations in net exports and net foreign assets. Calderón, Chong, and Loayza (2002) report that shifts in foreign real interest rates have a direct relationship with the current account among developing nations. In response to reductions in foreign interest rates, they argue that net debtor countries —as is the case of most developing countries— widen their demands for foreign capital, while world investors would look for investment opportunities in developing countries. In a highly integrated world, open economies are also influenced by growth in the rest of the world. Arora and

Vamvakidis (2004) find that a that a 1 percent increase in economic growth of the country's trading partners leads to an increase in domestic growth of 0.8 percentage points. They argue that this result is consistent with the literature on the impact of cross-country spillovers (Arora and Vamvakidis, 2003; Ahmed and Loungani, 1999).

D. Average Growth and Growth Volatility

Since the influential work by Ramey and Ramey (1995) that pointed out the negative cross-country relation between average GDP growth and GDP volatility, research has focused on providing explanations and more evidence on this negative relation found for the world sample and among low-income countries but not among industrial economies. Elbadawi and Schmidt-Hebbel (1998) provide evidence that measures of macroeconomic volatility and low macroeconomic performance have a negative effect on growth, hypothesizing that the latter is behind the changing sign in the volatility-growth relation between low-income and high-income countries. Hnatkovska and Loayza (2004) provide robust evidence for the negative effect of GDP volatility on growth. By including interaction effects between volatility and relevant variables, they report that the negative effect of growth volatility on output is larger in economies with low-income levels and weak institutions and policies, and that the negative effect has grown in recent decades due to deep recessions.

Regarding the influence of openness on the effect of volatility on growth, we mentioned above that Kose et al. (2004) found that both FO and TO turn the latter negative effect into a positive one. Hnatkovska and Loayza (2004), however, reject an ameliorating influence of ITI on the negative volatility-growth effect.

Finally, Kose et al. (2003) report panel evidence for the behavior of GDP volatility. None of four FO and TO measures has any robust effect on volatility. However terms of trade volatility, financial depth, and M2 volatility raise output volatility in the world.

[4] Most of these studies instrumentalize capital inflows using lagged values, legal origin variables or investor protection measures in order to avoid endogeneity bias from the response of capital flows to growth.

E. Summing Up and Open Questions

A rich empirical literature has developed on the relations between TO, FO, foreign shocks, growth, and growth volatility. At this stage of the cross-country and panel data research we conclude that neither FO nor TO does show a linear or even monotonic relation with economic growth. Financial liberalization and FO tend to lower growth at low levels of development while the opposite is observed in developed economies. In the case of TO and trade liberalization, the non-monotonicity with growth is not quite so strong as for FO and financial liberalization, as all studies, less one, show that the lower bound of growth effects of TO is zero. Non-monotonicities between openness and growth show up as strong interaction effects between measures of openness and various measures of development (per capita income, institutional quality, growth volatility, among others) and country size. Yet the discussion about inclusion of adequate controls and their possible interaction with measures of openness, and their implications for the robustness of the role of the latter in determining growth, is still raging.

There seems to be slightly more agreement regarding growth effects of foreign relevant variables. The terms of trade are a frequently-used control in empirical studies, while the foreign interest rate and trading-partner growth are more exceptionally included in cross-country growth estimations.

It is well known that growth and growth volatility are positively associated among industrial countries and negatively associated among developing countries and in the world at large. Yet few studies have explored what is behind the latter non-monotonicity and what determines growth volatility. One has shown that the negative effect of growth volatility on growth fades away with economic and institutional development. Another study has reported that growth volatility is not affected by IFI and ITI but rises with volatility of the terms of trade.

Therefore, in the light of this review we conclude that the existing literature does not provide a systematic and symmetrical empirical analysis of:

- relationships between economic growth and both policy and outcome measures for both FO and TO,
- relationships between growth volatility and both policy and outcome measures of both FO and TO,

- foreign shocks (financial and real, price and exogenous determinants of quantity) and their influence on growth and growth volatility, and
- interaction effects between openness measures (FO and TO) and the corresponding foreign shocks on growth and growth volatility.

The next section of the paper is devoted to conduct this analysis.

III. Empirical Analysis

We conduct two analogous empirical analyses. The first focuses on economic growth and the second on macroeconomic volatility. In both cases, the dependent variable is constructed using the annual per capita real GDP growth rate as the main input. For economic growth, the dependent variable is the *average* rate of growth over a medium-run time window; and for macroeconomic volatility, the dependent variable is the *standard deviation* of the growth rate over the same time window.

For both empirical analyses, our objective is to study, first, the simple linear effects of trade and financial openness as well as various external shocks; second, the dependence of the effect of trade and financial openness on the level of per capita income; and third, the amplification or reduction of the effect of external shocks depending on the degree of trade and financial openness. By conducting these exercises, we aim at providing a comprehensive empirical assessment of openness and external vulnerability for macroeconomic performance.

A. Methodology

We work with a pooled data set of cross-country and time-series observations (data details are given below). We use an estimation method that is suited to panel data, deals with static or dynamic regression specifications, controls for unobserved time- and country-specific effects, and accounts for some endogeneity in the explanatory variables. This is the generalized method of moments (GMM) for dynamic models of panel data developed by Arellano and Bond (1991) and Arellano and Bover (1995).

The general regression equation to be estimated is the following

$$y_{i,t} = \beta' X_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \qquad (1)$$

where the subscripts *i,t* represent country and time period, respectively. y is the dependent variable of interest, that is, economic growth or macroeconomic volatility. X is a set of time- and country-varying explanatory variables that may include a lagged dependent variable, proxies of trade and financial openness, measures of various external shocks, interaction terms, and control variables, while β is our vector of coefficients to be estimated. Finally, μ_t is an unobserved time-specific effect, η_i is an unobserved country-specific effect, and ε is the error term.

The method deals with unobserved time effects through the inclusion of period-specific intercepts. Dealing with unobserved country effects is not as simple given the possibility that the model is dynamic and contains endogenous explanatory variables. Unobserved country effects are controlled for by differencing and instrumentation. Likewise, the method relies on instrumentation to control for joint endogeneity. Specifically, it allows relaxing the assumption of strong exogeneity of the explanatory variables by allowing them to be correlated with current and previous realizations of the error term ε.

Parameter identification is achieved by assuming that future realizations of the error term do not affect current values of the explanatory variables, that the error term ε is serially uncorrelated, and that *changes* in the explanatory variables are uncorrelated with the unobserved country-specific effect. As Arellano and Bond (1991) and Arellano and Bover (1995) show, this set of assumptions generates moment conditions that allow estimation of the parameters of interest. The instruments corresponding to these moment conditions are appropriately lagged values of both levels and differences of the explanatory and dependent variables (the latter if the model is dynamic). Since typically the moment conditions over-identify the regression model, they also allow for specification testing through a Sargan-type test.

B. Growth Regressions

We estimate economic growth regressions on a pooled (cross-country, time-series) data set consisting of 76 countries and, for each of them, at most 8 non-overlapping five-year periods over 1960-2000. See Appendix 1 for the list of countries in the sample. Appendix 2 provides full definitions and sources of all variables used in the paper, and

Appendixes 3 and 4 present basic descriptive statistics for the data used in the growth and growth volatility regressions, respectively.

As is standard in the literature, the dependent variable is the average rate of real per capita GDP growth. The regression equation is dynamic in the sense that it includes the initial level of per capita GDP as an explanatory variable. As additional control variables, the regression includes the average rate of secondary school enrollment to account for human capital investment, the average ratio of private credit to GDP as a measure of financial depth, the average inflation rate to account for monetary discipline, and the average ratio of government consumption to GDP as a measure of government burden. The regression equation also allows for both unobserved time-specific and country-specific effects.

The explanatory variables of interest are measures of trade and financial openness, measures of external shocks, and various interaction terms. We consider the two classes of trade and financial openness measures discussed above: outcome and policy measures. The outcome measures are the ratio of exports and imports to GDP in the case of trade, and the ratio of portfolio and FDI liabilities to GDP in the case of financial openness. The policy measures are an updated version of the Sachs and Warner binary variable of trade liberalization (Wacziarg and Welch 2003) and the IMF binary variable of capital account restrictions (Prasad et al. 2003). The original data for these policy measures are presented annually; we normalize them so that 0 represents close and 1, open; and we then take averages corresponding to our 5-year periods.

We consider four types of external shocks; the first two primarily related to trade in goods and the latter two mainly related to financial transactions. All of them are defined so that they can be considered as exogenous to the country in question. They are the average growth of the terms of trade, the average weighted output growth rate of trade partners, the average amount of capital flows to the region where the country is located, and the average change of the international interest rate. Whereas the first two variables vary by country and time period, the third varies only by *region* and period, and the fourth varies only by time period. Because of its limited sample variation, the effect of the international interest rate shock cannot be distinguished from the unobserved time-specific effect; however, its interaction with the measures of trade and financial openness can be considered.

Linear Effects of Openness and External Shocks

The regression equation we estimate in this case is the following,

$$y_{i,t} = \beta_0 'CV_{i,t} + \beta_1 'OPE_{i,t} + \beta_2 'EXT_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (2)$$

where CV is the set of control variables, OPE is the set of openness variables, and EXT is the set of foreign-shock variables.

The estimation results are presented in Table 4, with outcome openness measures used in column 1 and policy openness measures, in column 2. We find that both trade and financial openness, whether measured as outcomes or policies, are positively related to economic growth. Likewise, an increase in favorable terms of trade, the growth rate of trade partners, and capital flows to the region produce an increase in average economic growth.

All control variables carry significant coefficients of expected signs. The Sargan and serial-correlation specification tests do not reject the null hypothesis of correct specification, lending support to our estimation results. This is the case in all exercises presented below, and to avoid redundancy we only mention it here.

The Effect of Openness Depending on the Level of Income

Here we allow the effect of each measure of openness to vary with the level of real per capita GDP in the country at the start of the corresponding period. We do this by interacting each openness measure with linear and quadratic per capita GDP (*Inc*). The regression equation we estimate in this case is the following

$$y_{i,t} = \beta_0 'CV_{i,t} + \beta_1 'OPE_{i,t} + \beta_2 'EXT_{i,t} + \beta_3 'OPE_{i,t} * Inc_{i,t} + \beta_4 'OPE_{i,t} * Inc_{i,t}^2 + \mu_t + \eta_i + \varepsilon_{i,t} \quad (3)$$

Table 5 presents the estimation results, with the first two columns employing outcome measures of openness and the last two, policy measures. We consider the interaction between per capita GDP and the openness variables one at a time; we do this in order to both simplify the interpretation of the results and do not overextend the parameter requirements on the data. Figure 1 takes the regression point estimates to graph the growth effect of each openness indicator as a function of per capita GDP. The regression results are *qualitatively* similar whether we deal with financial or trade openness and whether they are outcome or policy measures. The coefficient on the openness indicator by itself is negative and significant, and the coefficients on the linear and quadratic interaction terms

are significantly positive and negative, respectively. Figure 1 illustrates what this pattern of coefficients implies for the growth effect of a one-standard deviation increase in each measure of openness. In the cases of outcome financial and trade openness, their growth effect is nearly zero for low levels of per capita GDP, it increases at a decreasing rate as income rises, and it reaches a maximum but only at high levels of income (higher in the case of trade openness). In the cases of policy financial and trade openness, the effect is negative for low levels of per capita GDP; it then increases becoming positive at medium income levels and reaching a maximum at high stages of income development.

The Interaction Between Openness and External Shocks

The last group of results deals with the question as to how openness makes the economy more or less vulnerable to external shocks. We address this question by considering interaction terms between each of the shocks and the openness variables. The regression equation we estimate in this case is the following,

$$y_{i,t} = \beta_0' CV_{i,t} + \beta_1' OPE_{i,t} + \beta_2' EXT_{i,t} + \beta_3' OPE_{i,t} * EXT_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \qquad (4)$$

There are a large number of possibilities for these interactions, but in order to avoid overextending the parameter requirements on the data, we focus on the relationships that are most directly related to the objective of assessing vulnerability. First, we only use the *outcome indicators* of openness since they directly represent the economy's actual exposure to outside conditions. Second, we consider the interactions between financial and trade openness indicators with the external shocks *one at a time*. This allows us to simulate the effect of each shock independently. The results are presented in Table 6, with each column devoted to the interactions with each of the four external shocks. Figure 2 graphs the growth effect of one-standard deviation increase in each shock as a function of, first, trade openness and, then, financial openness (in the former case, we use the sample average of financial openness in the calculation of the partial effects; and in the latter, the sample average of trade openness).[5] The two shocks related to international trade, the growth of terms of trade and the GDP growth of trade partners, have qualitatively similar interactions with openness. In both cases higher trade openness decreases the growth effect of the shocks while larger financial openness amplifies it. For the terms of trade shock, its growth

[5] For these simulations, we restrict the range of the financial openness indicator to values where the stock of foreign liabilities is non-zero (positive).

effect changes signs at medium levels of trade openness; while for the trade partners growth shock, the effect on domestic growth is always positive. In the case of the international interest rate shock, its direct impact on growth cannot be separated from the time effects; however, based on an exercise where we compare the period shifts with and without the interest rate shock interactions, we estimate that this direct impact is negative. Once we take into account the interactions, the total growth effect of interest shocks continues to be negative, but it approaches zero as either type of openness rises. Finally, regarding the capital flow shock, its direct impact is negative; however, once the openness interactions are taken into account, the total effect is positive on growth, with larger trade openness increasing its growth effect while financial openness reducing it.

All these results challenge the conventional wisdom that trade openness increases the vulnerability of trade-related shocks and that financial openness does likewise with financial-related shocks. The channels of transmission seem to be more complex.

As we will see below, external shocks have a significant effect on macroeconomic volatility, and this in turn has been found elsewhere to have a harmful influence on economic growth (see Fatás 2002, and Hnatkovska and Loayza 2003). Therefore, there is the possibility that the growth effects of external shocks that we just described occur through their impact on macroeconomic volatility. To consider and dispel this possibility, we add the standard deviation of economic growth as an additional explanatory variable. The results are presented in Table 7, and although growth volatility carries the expected negative and significant coefficient, the coefficients on all other relevant variables retain their sign, significance, and, to a large extent, size. Therefore, the growth effects of openness, external shocks, and their interactions can be considered independently of their volatility effects, to which we turn next.

C. Volatility Regressions

As in the case of economic growth, the volatility regressions are estimated on a panel data set consisting of 76 countries and, for each of them, at most 8 non-overlapping five-year periods over 1960-2000.

The dependent variable is the standard deviation of annual real per capita GDP growth, calculated over each 5-year period. The control variables represent some of the

main sources of domestically induced volatility and are calculated over the same periods. They are the standard deviation of annual inflation, an average index of real exchange rate overvaluation, and the average number of years under systemic banking crisis. The volatility regression equation also allows for both unobserved time-specific and country-specific effects.

The explanatory variables of interest are measures of trade and financial openness, the volatility of external shocks, and various interaction terms. The outcome and policy measures of trade and financial openness are the same as those described above for the case of growth. Note, however, that for macroeconomic volatility regressions, the relevant indicator of the external shock is given by its volatility. Therefore, we use the *standard deviation* of each external shock as the measure of interest (and not its *average* value, as we did in the case of growth regressions).

Linear Effects of Openness and External Shocks

The regression we estimate in this case is analogous to equation (2). The estimation results are presented in Table 8, with outcome openness measures used in column 1 and policy openness measures, in column 2. In the case of outcome measures, we find that whereas financial openness tends to reduce volatility, trade openness increases it. When we switch to policy measures, both trade and financial openness have the effect of reducing macroeconomic volatility. Regarding external shocks, we find that an increase in the volatility of terms of trade changes, the growth rate of trade partners, and capital flows to the region produce an increase in the volatility of economic growth, as expected.

All control variables carry positive coefficients and they are significant, except for inflation volatility when we use the policy openness measures. The Sargan and serial-correlation specification tests do not reject the null hypothesis of correct specification, lending support to our estimation results. This is also the case in all remaining volatility regressions presented below.

The Effect of Openness Depending on the Level of Income

We consider now the possibility that the volatility effect of each measure of openness vary with the level of real per capita GDP in the country at the start of the corresponding period. As in the case of growth regressions, we do this by interacting each

openness measure with linear and quadratic per capita GDP. Then, the regression we estimate in this group of exercises can be represented by equation (3).

Table 9 presents the estimation results, with the first two columns employing outcome measures of openness and the last two, policy measures. As with growth regressions, we consider the interaction between per capita GDP and the openness variables one at a time. Figure 3 takes the regression point estimates to graph the volatility effect of each openness indicator as a function of per capita GDP. There is a remarkable degree of similarity in the pattern of coefficients related to the various openness indicators. The coefficient on the openness in question by itself is always negative, and the coefficients on the linear and quadratic interaction terms are positive and negative, respectively. All of them are statistically significant. As Figure 3 illustrates, except for outcome trade openness, the total volatility effect of openness is negative at low levels of income, increases concavely reaching a maximum at medium levels of income, and then decreasing again. In the case of policy financial openness, the effect on volatility even becomes positive at medium income levels, but then become negative again once income increases enough. The inverted U shape of the volatility effect of openness is consistent with some of the recent literature surveyed above, according to which openness leads to macroeconomic fragilities in emerging economies but only until they reach a certain level of maturity, after which openness is unambiguously beneficial. As noted above, the case of outcome trade openness is different as its effect on volatility is always positive, although it does decrease as income rises. This result is also consistent with some work that points out the destabilizing effect of international trade, particularly for low- and medium-income countries.

The Interaction Between Openness and External Shocks

The last exercise considers to what extent the volatility effect of external shocks depends on the economy's trade and financial openness. To do so, we include, in the volatility regression, interaction terms between each of the shocks and the openness variables. Then, the regression we estimate in this case is analogous to equation (4).

As in the case of growth, we concentrate on the relationships that are most directly related to the objective of assessing external vulnerability by only using the *outcome indicators* of openness and considering their interactions with the external shocks *one at a*

time. The results are presented in Table 10, with each column devoted to the interactions with each of the four external shocks. Figure 4 illustrates how the volatility effects of each shock vary with the level of, first, trade openness and, then, financial openness. We find that the interaction between any shock and financial openness always carries a significantly negative coefficient, which would imply that financial openness helps reduce the volatility effect of all shocks considered. Trade openness, on the other hand, reduces the volatility effect of terms of trade shocks only, increases the volatility effect of the growth rate of trade partners, and has no significant interaction with interest rate and capital flow shocks.

IV. Conclusions

The goal of the present paper is to provide a systematic assessment of the impact of openness (trade and financial) and external shocks —as well as their interactions— on growth and volatility. To accomplish this task we use a set of policy and outcome measures of trade and financial openness for a large set of countries over the 1970-2000 period. Among our main results, we have:

First, we find robust evidence of a non-linear relationship between growth, (trade and financial) openness and income per capita. According to our result, upper-middle-income countries appear to reap the most growth benefits from trade and financial openness.

Second, the growth effects of external shocks related to international trade —say, changes in terms of trade and growth in main trading partners— are attenuated by the degree of trade openness, and they are amplified by the degree of financial openness. The converse takes place for the growth effects effects of external shocks related to world capital markets (say, changes in the world real interest rate and regional capital inflows). That is, the growth effects are amplified by the degree of trade openness and decreased by the degree of financial openness.

Third, we also find robust evidence of non-linear relationship between growth volatility, (trade and financial) openness and income per capita. In this case, the pattern of signs found indicates that macroeconomic fragilities in emerging market economies due to increasing openness may disappear once they reach a certain level of maturity.

Finally, we find robust evidence that financial openness helps reduce the impact of the volatility of shocks, either real of financial, on the aggregate macroeconomic volatility. On the other hand, trade openness only helps attenuate the impact of terms of trade volatility on the aggregate macroeconomic volatility.

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Table 1: Literature on Financial Openness (FO) and Growth			
Authors	Main findings on FO effects on growth	FO measures	Largest sample
Grilli and Milesi-Ferretti (1995)	No robust evidence	Share measure, other measures	Cross-section (five sub-periods in 1971-94), 61 countries
Quinn (1997)	Positive effects	Quinn restrictions	Cross-section (1958-88), 58 countries
Kraay (1998)	No effects. Positive effects of FO interactions with capital flow measures	Share measure, Quinn restrictions	Cross- section (1985-97), 100 countries
Rodrik (1998)	No evidence	Share measure	Cross- section (1975-95), 100 countries
Klein and Olivei (2000)	Positive significant effect of FO on financial depth (FD) in OECD countries, but not in non-OECD countries. FD has positive significant effect on growth.	Share measure	Cross-section (1976-95), 67 countries
Chanda (2001)	Significant interaction of FO and ethnic heterogeneity; FO lowers (raises) growth in ethnically heterogeneous (homogeneous) countries	Share measure	Cross-section: 57 non-OECD countries
Edwards (2001)	Negative effect of FO and positive effect of FO interaction with pc GDP; FO lowers (raises) growth in low- (high-) income countries.	Share measure (not significant) Quinn restrictions (significant)	Cross- section (1980-89), 62 countries
Arteta et al. (2001)	Negative effect of FO and negative effect of FO inter-action with black-market premium; FO lowers (raises) growth in countries with high (low) black premiums.	Quinn restrictions	Cross-section and pooled data (1973-92), 59 countries
O'Donnell (2001)	No robust results for FO and for FO interaction with financial depth	Share measure (not significant) capital flows (significant)	Cross- section (1971-94), 94 countries
Edison, Levine et al. (2002)	Considering interaction with several variables, no robust findings	IMF restrictions, Quinn restrictions, LM capital flows and stocks	Panel: 57 countries, 25 years
Edison, Klein et al. (2002)	Positive in world, OECD, East Asia; negative in non-OECD.	IMF restrictions (share); Quinn restrictions; others	Cross-section (1976-95), 89 countries
Klein (2003)	Considering quadratic interaction with pc GDP and government quality, only positive effect on middle-	IMF restrictions (share); Quinn restrictions	Cross-section (1976-95), 85 countries

	income countries, zero for others		
Kose et al. (2004)	FO has no robust effect but FO turns the negative effect of volatility on growth into a positive one.	LM and KPT capital flows	Cross-section and panel: 85 countries, 1960-2000

Notes: all effects refered to in this table are statistically significant effects. Quinn restrictions based on Quinn (1967), Share measure is based on number of years of IMF restrictions in place, LM is Lane and Milesi-Ferretti's (2002) measure of capital flows or stocks, KPT is Kose, Prasad and Terrones' (2004) measure of capital flows or stocks.

Table 2: Literature on Trade Openness (TO) and Growth			
Authors	Main findings on TO effects on growth	TO measures	Largest sample
Dollar (1992)	Positive effect of TO	Measure based on international price deviations	
Ben-David (1993)	TO causes absolute convergence in income levels while trade closeness precludes convergence	Binary measure based on trade restrictions	Cross section: 1970-1989
Sachs and Warner (1995)	TO leads to 2% higher growth than in closed economies	Binary trade restrictions	
Edwards (1998)	Positive effects of eight out of nine TO measures on total factor productivity	Nine measures of trade restrictions and trade shares	93 countries
Frankel and Romer (1999)	Correcting for endogeneity of trade to per capita income, a 1% increase in trade volume raises level of per capita income by about 2%	Trade share	Cross section: 1985, 100 countries
Rodrik and Rodríguez (2000)	TO effects on growth are not robust to inclusion of other variables, including geographic latitude. However, the lower bound of TO effects is zero.		
Wacziarg (2001)	One standard deviation rise in trade volume to GDP increases growth by 1%	Trade share	
Irwin and Terviö (2002)	Confirms qualitative results of Frankel and Romer (1999). But TO effect on per capita income is not robut to inclusion of latitude		8 annual cross sections between 1913 and 1990, 146 countries
Rodrik, Subramanian, and Trebbi (2003)	TO effects are not robust to controlling for institutional quality		

Dollar and Kraay (2003)	In cross-section estimations TO is not robust to inclusion of institutions. In panel-data estimations TO effects are as (more) important as (than) institutions in determining long-run (decadal) growth	Trade share	Cross-section and panel: 154 countries, 1970-2000
Wacziarg and Welch (2003)	Updating Sachs and Warner's (1995) study, no significant effect of trade policy measure on economic growth in cross sections. Trade liberalization raises growth by 1.5-2% after liberalization, compared to pre-liberalization period. Liberalization raises trade share by 5 pp.	Trade policy measure and trade share	Cross-section, panel, and country case studies: 116 countries, 1950-1998
Álcala and Ciccone (2004)	TO effects are significant and robust to controlling for institutional quality	Trade share in PPP US$	
Frankel (2004)	One pp. increase in trade volume increases growth by 0.4%		
Alesina et al. (2004)	Controlling for country size and interaction effects between size and TO, TO has large effects in small countries that effects become zero in large countries	Trade share at current prices and in PPP US$	
Rigobon and Rodrik (2004)	TO has a negative effect on per capita income controlling for institutions and geography	Trade share	Cross section: 86 countries, 1990s
Kose et al. (2004)	TO has robust positive effect and TO turns the negative effect of volatility on growth into a positive one.	Binary trade policy measure (trade share measure not robust)	Cross-section and panel: 85 countries, 1960-2000

Notes: all effects refered to in this table are statistically significant effects.

Table 3: Literature on Growth, Growth Volatility, Openness, and Foreign Variables			
Authors	Main findings on effects on growth and volatility	Key variables	Largest sample
1. Growth and growth volatility			
Ramey and Ramey (1995)	Growth and growth volatility are positively (negatively) correlated across industrial (developing) countries.		
Elbadawi and Schmidt-Hebbel (1998)	Growth and growth volatility are positively (negatively) correlated across industrial (developing) countries. Macroeconomic volatility and bad macroeconomic performance lower growth	Average and standard deviation of growth. Standard deviation of macro performance variables and macroeconomic crises	Panel: 56 countries, 1961-94
Hnatkovska and Loayza (2004)	Growth volatility lowers growth robustly. The latter negative effect is larger in low-income economies, and countries with institutional and policy weaknesses.	Output volatility measured as standard deviation of output gap and of per capita GDP growth.	Panel: 79 countries, 1960-2000.
2. Growth volatility, Openness, and Foreign Variables			
Kose et al. (2003)	Not one of four measures of FO and TO has effects on GDP volatility. Terms-of-trade volatility raises GDP volatility.	Volatility measured by standard deviation of growth rates. Two (policy and outcome) measures for IFI and ITI.	Panel: 55 countries, 1960-99.

Notes: all effects refered to in this table are statistically significant effects.

Table 4
Economic Growth, Trade Openness, Financial Openness and Foreign Shocks
Sample of 76 Countries, 1970-2000 (5-year period observations)
Dependent Variable: Growth in real GDP per capita
Estimation Method: GMM-IV System Estimator

Measures of Trade and Financial Openness:	[1] Outcome Measures	[2] Policy Measures
Constant	7.142 **	1.504
	(2.25)	(1.21)
Control Variables		
Initial GDP per capita	-0.177 **	-0.526 **
	(0.09)	(0.11)
Human Capital Investment	1.058 **	0.751 **
	(0.16)	(0.17)
Financial Depth	0.631 **	1.271 **
	(0.10)	(0.06)
Inflation Rate	-2.275 **	-0.193
	(0.37)	(0.22)
Government Burden	-1.488 **	-1.934 **
	(0.22)	(0.21)
Openness:		
Trade Openness (TO)	0.403 **	0.998 **
	(0.13)	(0.03)
Financial Openness (FO)	0.051 **	0.107 **
	(0.01)	(0.03)
Foreign Shocks:		
Terms of Trade Changes	0.038 **	0.049 **
	(0.01)	(0.01)
Foreign Growth	1.536 **	1.504 **
	(0.17)	(0.08)
Regional Capital Inflows	0.098 **	0.135 **
	(0.02)	(0.01)
Period Shifts		
- 76-80 Period:	-1.119 **	-1.179 **
- 81-85 Period:	-1.284 **	-1.317 **
- 86-90 Period:	-1.865 **	-1.782 **
- 91-95 Period:	-0.517 *	-0.533 **
- 96-00 Period:	-1.843 **	-1.957 **
Countries	76	76
Observations	438	438
Specification Tests (p-values)		
- Sargan Test	(0.41)	(0.64)
- 2nd. Order Correlation	(0.90)	(0.58)

*Numbers in parenthesis are robust standard errors. * (**) denotes statistical significance at the 10 (5) percent level.*

Table 5
Economic Growth and the Interaction between Openness and Real GDP Per Capita
Sample of 76 Countries, 1970-2000 (5-year period observations)
Dependent Variable: Growth in real GDP per capita
Estimation Method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998)

	Outcome Measures of Openness		Policy Measures of Openness	
	[1]	[2]	[3]	[4]
Variable	**Financial**	**Trade**	**Financial**	**Trade**
Constant	2.105	23.419 **	1.845 **	18.342 **
	(2.57)	(2.37)	(0.90)	(2.12)
Control Variables				
Initial GDP per capita (ypc)	-0.704 **	-2.883 **	-0.323 *	-0.877 **
	(0.24)	(0.27)	(0.18)	(0.14)
Human Capital Investment	2.443 **	2.062 **	0.522 **	0.623 **
	(0.24)	(0.15)	(0.19)	(0.14)
Financial Depth	0.354 **	0.402 **	0.501 **	0.544 **
	(0.15)	(0.13)	(0.12)	(0.09)
Inflation Rate	-1.434 **	-1.605 **	-0.776 **	-2.031 **
	(0.43)	(0.34)	(0.20)	(0.38)
Government Burden	-1.184 **	-1.460 **	-0.776 **	-2.458 **
	(0.24)	(0.32)	(0.32)	(0.29)
Openness and Interactions:				
Trade Openness	0.449 **	-8.214 **	1.936 **	-84.741 **
	(0.10)	(0.77)	(0.16)	(6.44)
Financial Openness	-2.274 **	-0.050 **	-17.205 **	0.920 **
	(0.35)	(0.01)	(7.02)	(0.24)
Openness * ypc	0.562 **	1.832 **	3.913 **	18.566 **
	(0.10)	(0.19)	(1.68)	(1.50)
Openness * ypc squared	-0.031 **	-0.089 **	-0.219 **	-0.990 **
	(0.01)	(0.01)	(0.10)	(0.09)
Foreign Shocks:				
Terms of Trade Shocks	0.041 **	0.055 **	0.054 **	0.008
	(0.01)	(0.01)	(0.01)	(0.01)
Foreign Growth	1.749 **	1.666 **	1.750 **	0.994 **
	(0.12)	(0.11)	(0.10)	(0.09)
Regional Capital Inflows	0.115 **	0.115 **	0.101 **	0.074 **
	(0.03)	(0.03)	(0.02)	(0.02)
Period Shifts				
- 76-80 Period:	-1.359 **	-1.110 **	-1.044 **	-0.986 **
- 81-85 Period:	-1.627 **	-1.099 **	-0.932 **	-2.047 **
- 86-90 Period:	-2.322 **	-1.873 **	-1.815 **	-1.944 **
- 91-95 Period:	-0.832 **	-0.260	-0.278	-1.656 **
- 96-00 Period:	-2.610 **	-1.609 **	-1.774 **	-2.641 **
Countries	76	76	76	76
Observations	438	438	438	438
Specification Tests (p-values)				
- Sargan Test	(0.18)	(0.45)	(0.50)	(0.32)
- 2nd. Order Correlation	(0.94)	(0.79)	(0.53)	(0.45)

*Numbers in parenthesis are robust standard errors. * (**) denotes statistical significance at the 10 (5) percent level.*

Table 6
Economic Growth and the Interaction between Openness and Foreign Shocks
Sample of 76 Countries, 1970-2000 (5-year period observations)
Dependent Variable: Growth in real GDP per capita
Estimation Method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998)

	[1]	[2]	[3]	[4]
Foreign Shock:	**Terms of Trade Changes**	**Foreign Growth**	**World Int. Rate Changes**	**Regional Capital Inflows**
Constant	5.242 **	12.005 **	9.444 **	10.804 **
	(2.41)	(2.94)	(2.44)	(3.06)
Control Variables				
Initial GDP per capita	-0.138 *	-0.280 **	-0.176 *	-0.152 *
	(0.09)	(0.13)	(0.11)	(0.09)
Human Capital Investment	1.284 **	1.419 **	1.110 **	0.977 **
	(0.19)	(0.19)	(0.17)	(0.16)
Financial Depth	0.592 **	0.669 **	0.578 **	0.628 **
	(0.07)	(0.14)	(0.11)	(0.10)
Inflation Rate	-1.786 **	-3.936 **	-2.400 **	-2.733 **
	(0.39)	(0.33)	(0.42)	(0.49)
Government Burden	-1.597 **	-1.523 **	-1.547 **	-1.384 **
	(0.24)	(0.28)	(0.26)	(0.23)
Openness:				
Trade Openness (TO)	0.133 *	1.227 **	0.404 **	-0.190
	(0.08)	(0.46)	(0.12)	(0.15)
Financial Openness (FO)	0.080 **	-0.159 **	0.071 **	0.146 **
	(0.01)	(0.04)	(0.01)	(0.02)
Foreign Shocks:				
Terms of Trade Changes	1.175 **	0.033 **	0.050 **	0.039 **
	(0.12)	(0.01)	(0.01)	(0.01)
Foreign Growth	1.703 **	2.756 **	1.499 **	1.618 **
	(0.17)	(0.75)	(0.16)	(0.19)
Regional Capital Inflows	0.025	0.057 **	0.086 **	-0.374 **
	(0.02)	(0.01)	(0.02)	(0.12)
Interaction: Openness and Foreign Shock				
TO * Foreign Shock	-0.276 **	-0.361 *	0.397 **	0.151 **
	(0.03)	(0.19)	(0.11)	(0.03)
FO * Foreign Shock	0.010 **	0.067 **	0.118 **	-0.043 **
	(0.00)	(0.02)	(0.02)	(0.01)
Period Shifts				
- 76-80 Period:	-1.239 **	-1.087 **	-5.122 **	-0.993 **
- 81-85 Period:	-1.413 **	-1.290 **	-2.605 **	-1.099 **
- 86-90 Period:	-2.495 **	-1.807 **	-3.443 **	-1.638 **
- 91-95 Period:	-0.564 **	-0.545 *	-1.359 **	-0.169
- 96-00 Period:	-1.900 **	-1.911 **	-3.075 **	-1.604 **
Countries	76	76	76	76
Observations	438	438	438	438
Specification Tests (p-values)				
- Sargan Test	(0.22)	(0.38)	(0.37)	(0.38)
- 2nd. Order Correlation	(0.81)	(0.59)	(0.96)	(0.67)

*Numbers in parenthesis are robust standard errors. * (**) denotes statistical significance at the 10 (5) percent level.*

Table 7
Economic Growth and the Interaction between Openness and Foreign Shocks: Controlling for Macroeconomic Volatility
Sample of 76 Countries, 1970-2000 (5-year period observations)
Dependent Variable: Growth in real GDP per capita
Estimation Method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998)

	[1]	[2]	[3]	[4]
Foreign Shock:	**Terms of Trade Changes**	**Foreign Growth**	**World Int. Rate Changes**	**Regional Capital Inflows**
Constant	0.139	1.107	2.011	4.385 **
	(1.85)	(1.81)	(2.08)	(1.91)
Control Variables				
Initial GDP per capita	-0.284 *	-0.226 *	-0.342 *	-0.351 **
	(0.16)	(0.13)	(0.18)	(0.13)
Human Capital Investment	1.233 **	0.861 **	0.821 **	0.836 **
	(0.20)	(0.12)	(0.19)	(0.12)
Financial Depth	0.670 **	0.826 **	1.080 **	0.972 **
	(0.18)	(0.15)	(0.18)	(0.16)
Inflation Rate	-0.390	-1.138 **	-0.522 *	-0.999 **
	(0.32)	(0.17)	(0.35)	(0.23)
Government Burden	-1.622 **	-1.583 **	-1.660 **	-1.345 **
	(0.26)	(0.22)	(0.30)	(0.22)
Openness:				
Trade Openness (TO)	0.573 **	1.380 **	0.616 **	0.118
	(0.13)	(0.33)	(0.13)	(0.15)
Financial Openness (FO)	0.029 **	-0.203 **	0.034 **	0.111 **
	(0.01)	(0.03)	(0.01)	(0.01)
Foreign Shocks:				
Terms of Trade Changes	0.917 **	0.038 **	0.042 **	0.036 **
	(0.15)	(0.01)	(0.01)	(0.01)
Foreign Growth	1.457 **	2.573 **	1.457 **	1.477 **
	(0.17)	(0.50)	(0.16)	(0.16)
Regional Capital Inflows	0.029	0.049 **	0.063 **	-0.233 *
	(0.03)	(0.02)	(0.03)	(0.14)
Interaction: Openness and Foreign Shock				
TO * Foreign Shock	-0.215 **	-0.346 **	0.311 **	0.105 **
	(0.04)	(0.12)	(0.13)	(0.04)
FO * Foreign Shock	0.004 **	0.089 **	0.101 **	-0.039 **
	(0.00)	(0.01)	(0.02)	(0.01)
MacroeconomicVolatility				
Std. Dev. Growth	-0.380 **	-0.401 **	-0.354 **	-0.395 **
	(0.02)	(0.02)	(0.02)	(0.02)
Period Shifts				
- 76-80 Period:	-1.324 **	-1.187 **	-4.458 **	-1.252 **
- 81-85 Period:	-1.704 **	-1.491 **	-2.587 **	-1.486 **
- 86-90 Period:	-2.624 **	-2.099 **	-3.512 **	-2.043 **
- 91-95 Period:	-0.974 **	-0.629 *	-1.306 **	-0.497
- 96-00 Period:	-2.457 **	-2.173 **	-3.200 **	-2.093 **
Countries	76	76	76	76
Observations	438	438	438	438
Specification Tests (p-values)				
- Sargan Test	(0.22)	(0.27)	(0.24)	(0.46)
- 2nd. Order Correlation	(0.94)	(0.62)	(0.78)	(0.74)

*Numbers in parenthesis are robust standard errors. * (**) denotes statistical significance at the 10 (5) percent level.*

Table 8
Growth Volatility, Trade Openness, Financial Openness and Foreign Shocks
Sample of 76 Countries, 1970-2000 (5-year period observations)
Dependent Variable: Standard Deviation of Growth in Real GDP per capita
Estimation Method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998)

Measures of Trade and Financial Openness:	[1] Outcome Measures	[2] Policy Measures
Constant	-0.682 **	1.778 **
	(0.30)	(0.18)
Control Variables		
Inflation Volatility	0.006 **	0.001
	(0.00)	(0.00)
RER Overvaluation	0.004 **	0.005 **
	(0.00)	(0.00)
Systemic Banking Crises	1.303 **	1.142 **
	(0.13)	(0.09)
Openness:		
Trade Openness (TO)	0.543 **	-0.828 **
	(0.07)	(0.12)
Financial Openness (FO)	-0.088 **	-0.110 **
	(0.01)	(0.05)
Volatility of Foreign Shocks		
Volatility of Terms of Trade Changes	0.075 **	0.076 **
	(0.00)	(0.01)
Foreign Growth Volatility	0.246 **	0.165 *
	(0.07)	(0.10)
Volatility of Regional Capital Inflows	0.350 **	0.249 **
	(0.04)	(0.03)
Period Shifts		
- 81-85 Period:	-0.286	-0.097
- 86-90 Period:	-0.533	-0.418 **
- 91-95 Period:	-0.223	0.136 *
- 96-00 Period:	-1.101 **	-0.729 **
Countries	76	76
Observations	371	371
Specification Tests (p-values)		
- Sargan Test	(0.21)	(0.23)
- 2nd. Order Correlation	(0.92)	(0.84)

*Numbers in parenthesis are robust standard errors. * (**) denotes statistical significance at the 10 (5) percent level.*

Table 9
Growth Volatility and the Interaction between Openness and Income Per Capita
Sample of 76 Countries, 1970-2000 (5-year period observations)
Dependent Variable: Standard Deviation of Growth in Real GDP per capita
Estimation Method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998)

	Outcome Measures of Openness		Policy Measures of Openness	
	[1]	[2]	[3]	[4]
Variable	Financial	Trade	Financial	Trade
Constant	-1.254 **	0.773 *	1.933 **	1.600 **
	(0.37)	(0.44)	(0.23)	(0.24)
Control Variables				
Inflation Volatility	0.007 **	0.005 **	0.004 **	0.003 *
	(0.00)	(0.00)	(0.00)	(0.00)
RER Overvaluation	0.003 **	0.003 **	0.005 **	0.003 **
	(0.00)	(0.00)	(0.00)	(0.00)
Systemic Banking Crises	1.341 **	0.973 **	0.862 **	0.944 **
	(0.14)	(0.14)	(0.10)	(0.13)
Openness and Interactions				
Trade Openness	0.664 **	-0.658 *	-0.967 **	-65.363 **
	(0.08)	(0.39)	(0.17)	(5.14)
Financial Openness	-4.206 **	-0.097 **	-108.789 **	0.482 **
	(0.32)	(0.01)	(11.15)	(0.11)
Openness * ypc	0.977 **	0.277 **	25.419 **	14.989 **
	(0.09)	(0.11)	(2.55)	(1.21)
Openness * ypc squared	-0.057 **	-0.020 **	-1.466 **	-0.866 **
	(0.01)	(0.01)	(0.14)	(0.07)
Volatility of Foreign Shocks				
Volatility of Terms of Trade	0.075 **	0.072 **	0.060 **	0.066 **
Changes	(0.00)	(0.00)	(0.01)	(0.01)
Foreign Growth Volatility	0.312 **	0.109	-0.015	0.381 **
	(0.07)	(0.12)	(0.15)	(0.15)
Volatility of Regional Capital	0.332 **	0.322 **	0.301 **	0.265 **
Inflows	(0.04)	(0.04)	(0.04)	(0.04)
Period Shifts				
- 81-85 Period:	-0.093	-0.081	-0.042	0.033
- 86-90 Period:	-0.339 **	-0.436 **	-0.366 **	-0.092
- 91-95 Period:	-0.053	-0.096	0.327 **	0.358 **
- 96-00 Period:	-0.869 **	-0.977 **	-0.510 **	-0.362 **
Countries	76	76	76	76
Observations	371	371	371	371
Specification Tests (p-values)				
- Sargan Test	(0.728)	(0.518)	(0.424)	(0.482)
- 2nd. Order Correlation	(0.855)	(0.990)	(0.691)	(0.450)

*Numbers in parenthesis are robust standard errors. * (**) denotes statistical significance at the 10 (5) percent level.*

Table 10
Growth Volatility and the Interaction between Openness and the Volatility of Foreign Shocks
Sample of 76 Countries, 1970-2000 (5-year period observations)
Dependent Variable: Standard Deviation of Growth in Real GDP per capita
Estimation Method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998)

	[1]	[2]	[3]	[4]
Foreign Shock:	**Terms of Trade Changes**	**Foreign Growth**	**World Int. Rate Changes**	**Regional Capital Inflows**
Constant	-2.005 **	1.995 **	-0.142	-1.917 **
	(0.32)	(0.67)	(0.41)	(0.44)
Control Variables				
Inflation Volatility	0.007 **	0.006 **	0.004 **	0.008 **
	(0.00)	(0.00)	(0.00)	(0.00)
RER Overvaluation	0.002 **	0.003 **	0.004 **	0.002 **
	(0.00)	(0.00)	(0.00)	(0.00)
Systemic Banking Crises	1.346 **	1.360 **	1.228 **	1.391 **
	(0.10)	(0.12)	(0.14)	(0.10)
Openness:				
Trade Openness (TO)	0.941 **	-0.266 *	0.438 **	0.919 **
	(0.08)	(0.16)	(0.13)	(0.11)
Financial Openness (FO)	-0.092 **	-0.018	-0.018	-0.138 **
	(0.01)	(0.02)	(0.01)	(0.01)
Volatility of Foreign Shocks				
Volatility of Terms of Trade Changes	0.079 **	0.077 **	0.074 **	0.072 **
	(0.00)	(0.00)	(0.00)	(0.00)
Foreign Growth Volatility	0.237 **	-2.147 **	0.432 **	0.315 **
	(0.07)	(0.50)	(0.10)	(0.07)
Volatility of Regional Capital Inflows	0.325 **	0.413 **	0.331 **	0.366 *
	(0.03)	(0.05)	(0.04)	(0.23)
Interaction: Openness and Vol. Foreign Shock				
TO * Vol(Foreign Shock)	-0.010 **	0.727 **	-0.128	0.005
	(0.00)	(0.12)	(0.15)	(0.06)
FO * Vol(Foreign Shock)	-0.006 **	-0.146 **	-0.152 **	-0.019 **
	(0.00)	(0.02)	(0.01)	(0.00)
Period Shifts				
- 81-85 Period:	-0.361 **	-0.181 **	0.217	-0.315 **
- 86-90 Period:	-0.587 **	-0.461 **	-0.372 **	-0.523 **
- 91-95 Period:	-0.366 **	-0.187 **	0.162	-0.221 **
- 96-00 Period:	-1.289 **	-0.904 **	-1.250 **	-1.111 **
Countries	76	76	76	76
Observations	371	371	371	371
Specification Tests (p-values)				
- Sargan Test	(0.22)	(0.37)	(0.48)	(0.19)
- 2nd. Order Correlation	(0.85)	(0.86)	(0.84)	(0.88)

*Numbers in parenthesis are robust standard errors. * (**) denotes statistical significance at the 10 (5) percent level.*

Figure 1
Growth Effect of Openness as a function to GDP per capita

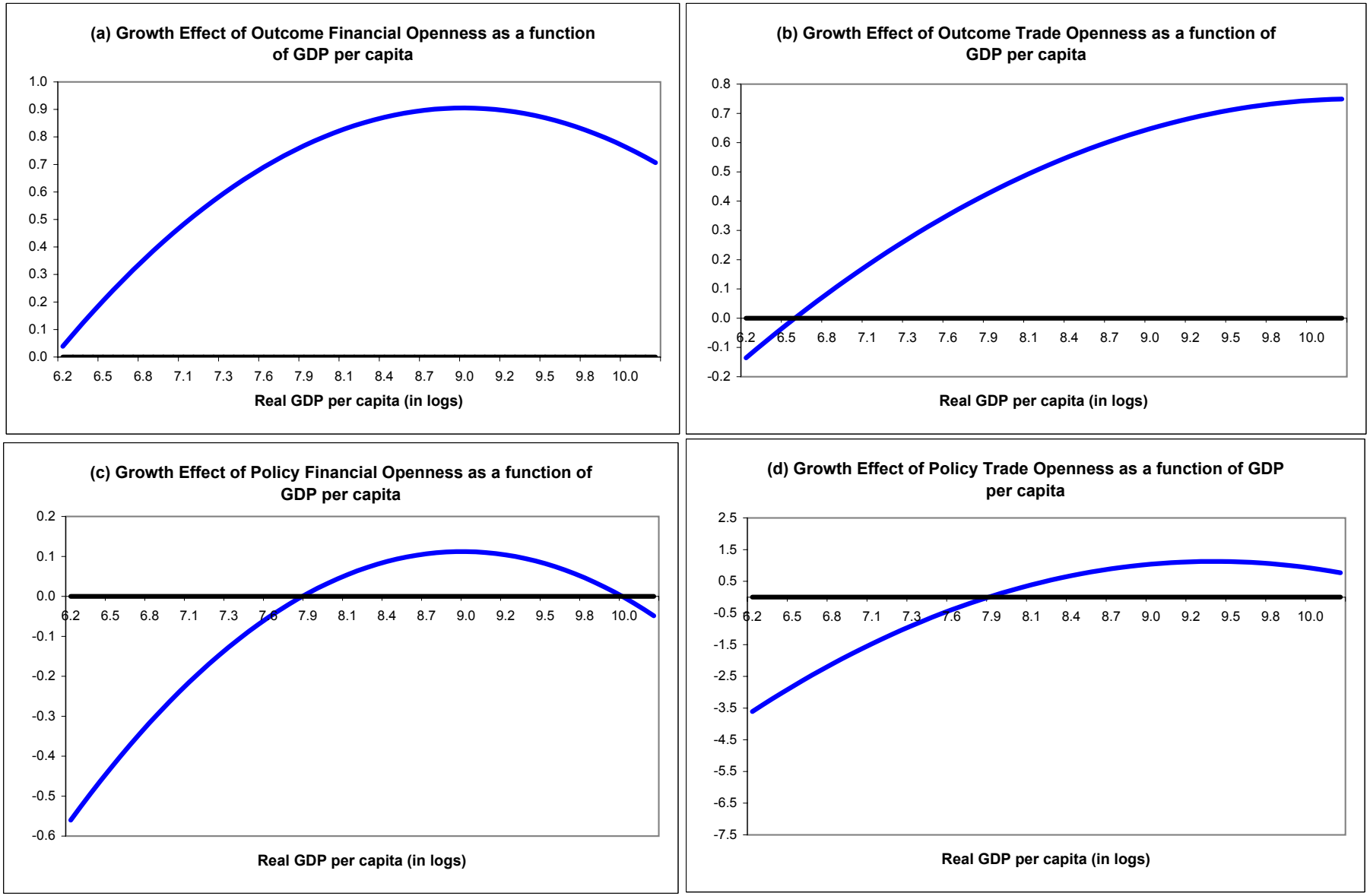
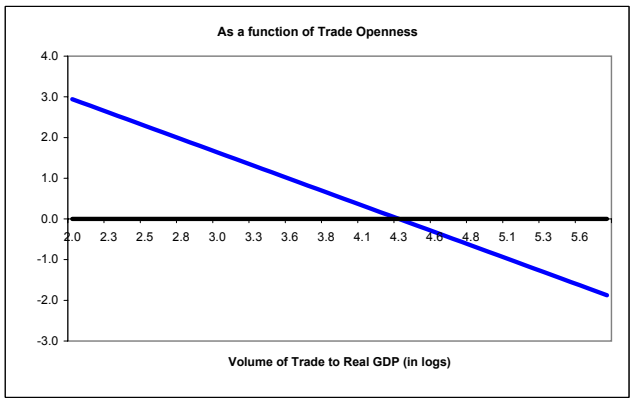
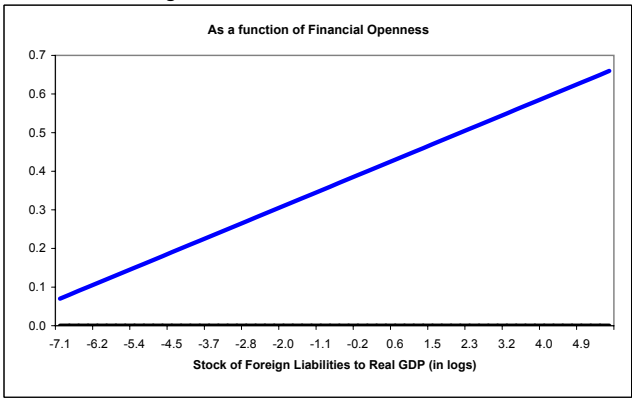


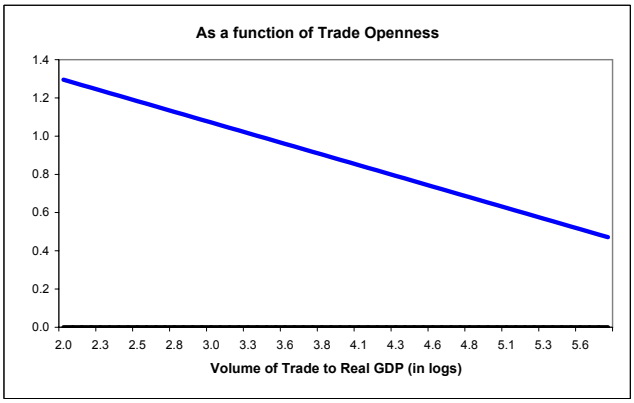
Figure 2
Growth Effect of External Shocks as a Function of Openness

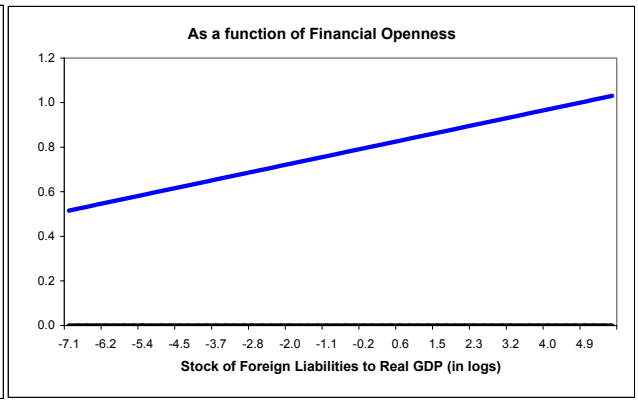
(a) Growth Effect of Terms of Trade Changes



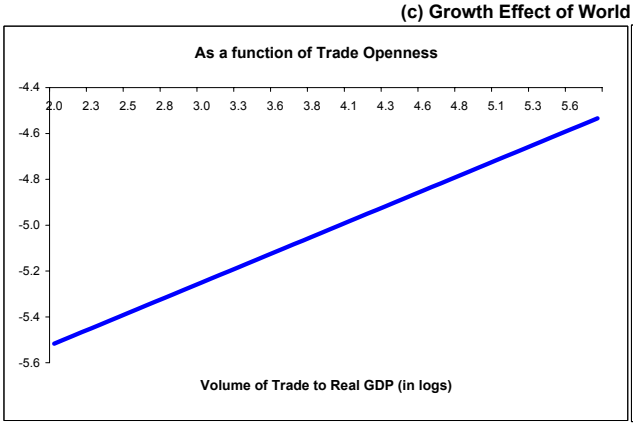


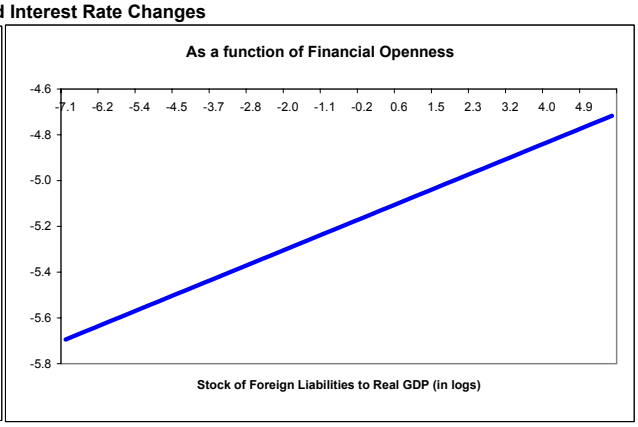
(b) Growth Effect of Foreign Growth



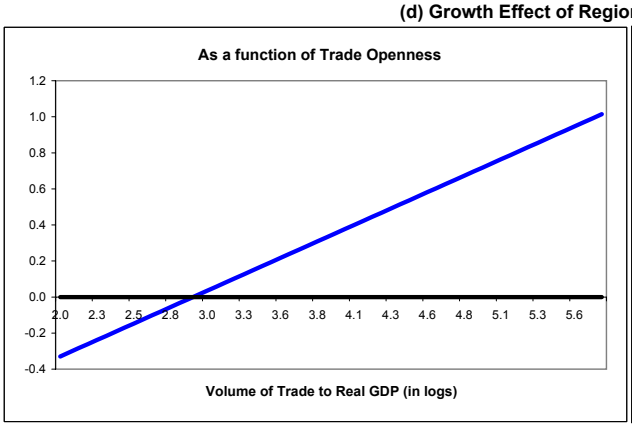


(c) Growth Effect of World Interest Rate Changes





(d) Growth Effect of Regional Capital Flows



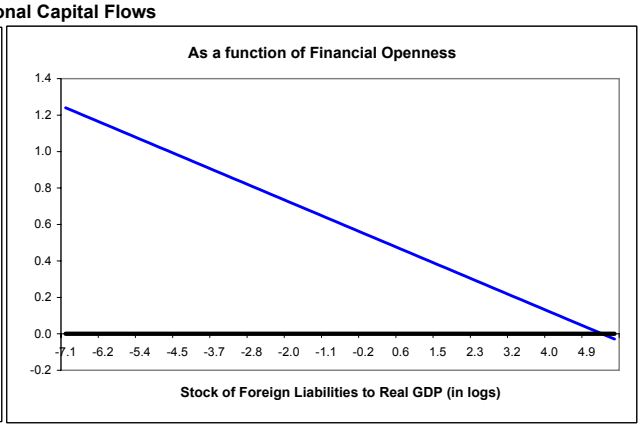


Figure 3
Volatility Effect of Openness as a function to GDP per capita

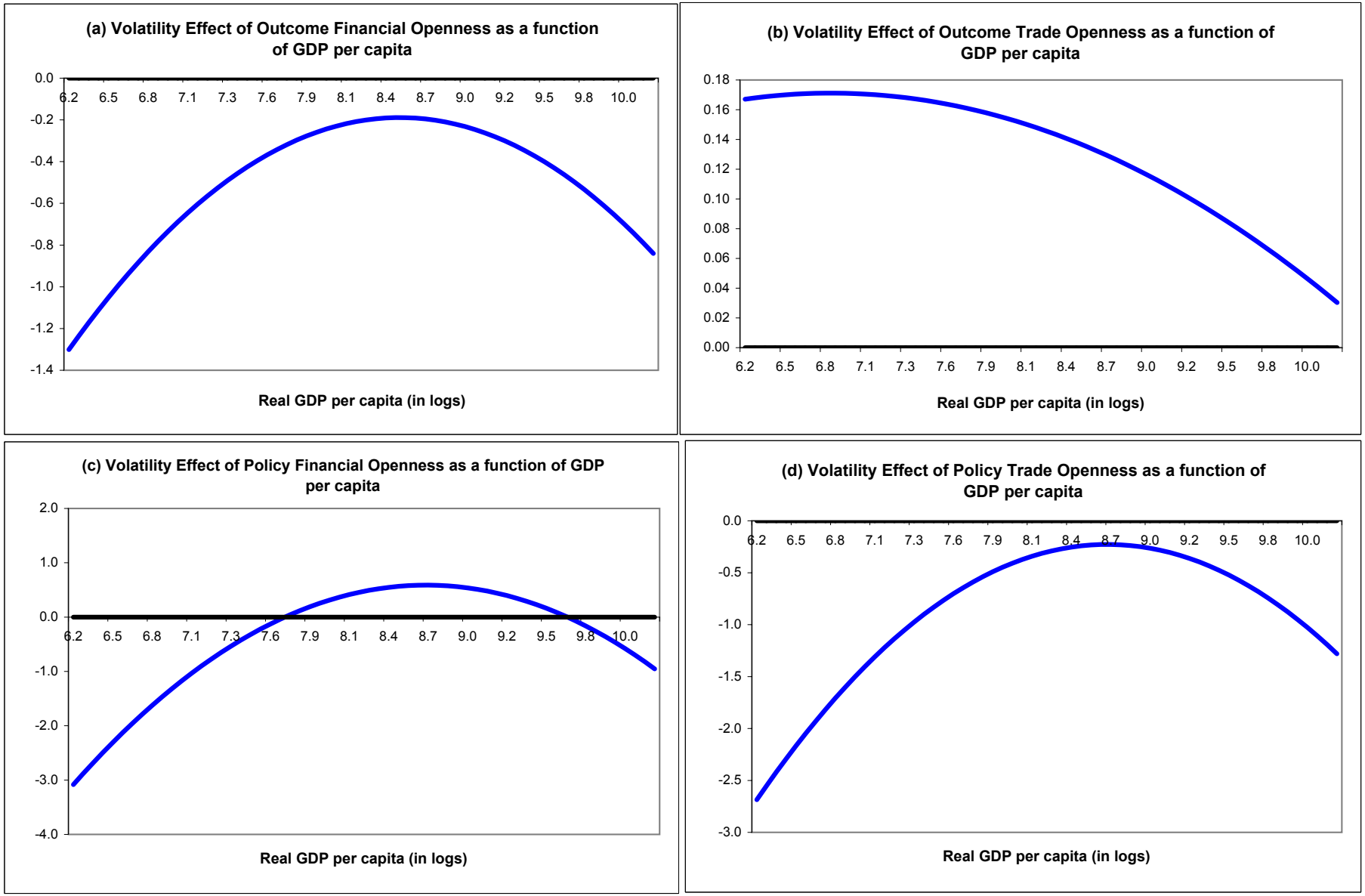
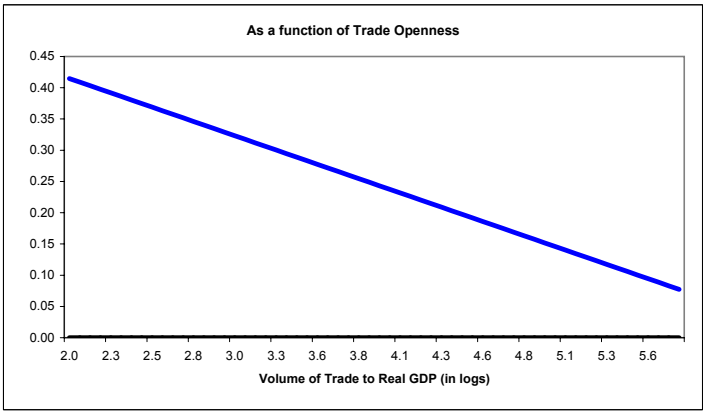
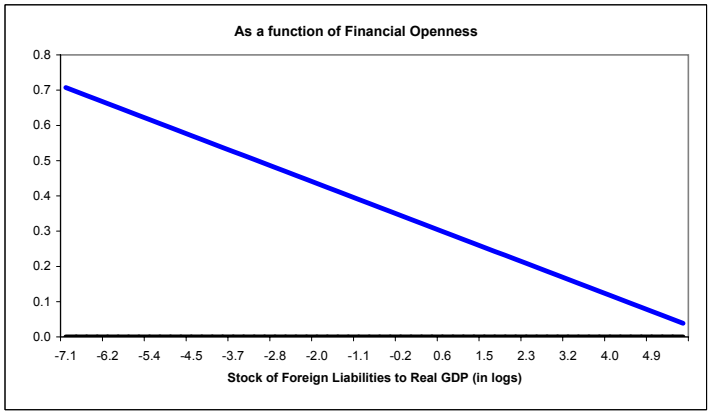


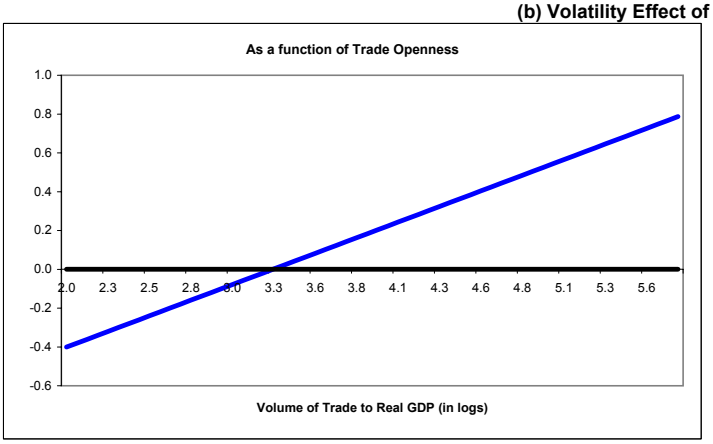
Figure 4
Volatility Effect of External Shocks as a Function of Openness

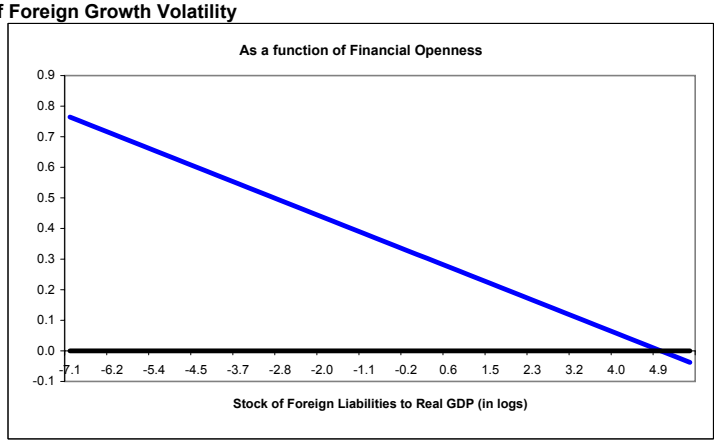
(a) Volatility Effect of Volatility in Terms of Trade Changes



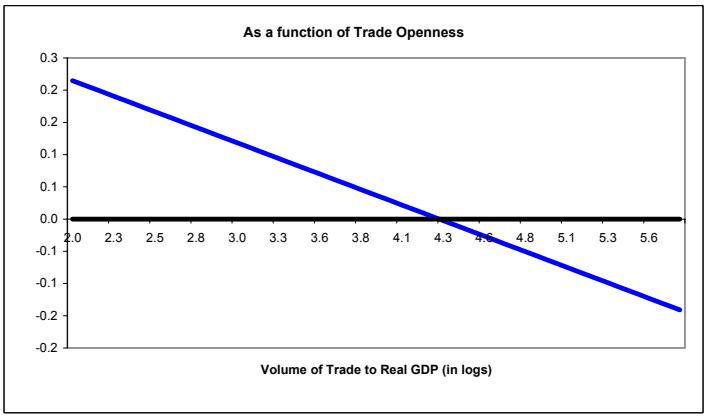


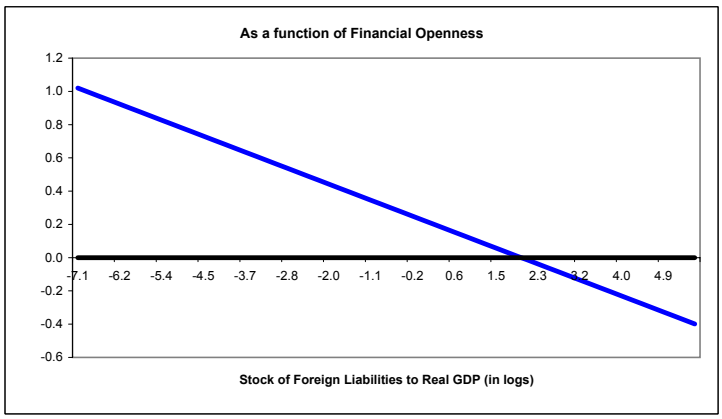
(b) Volatility Effect of Foreign Growth Volatility



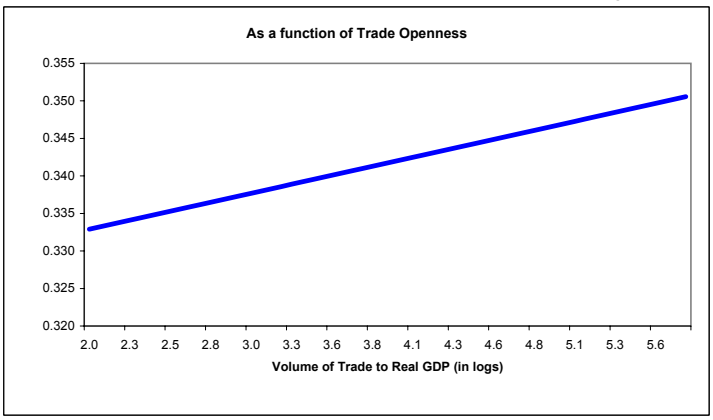


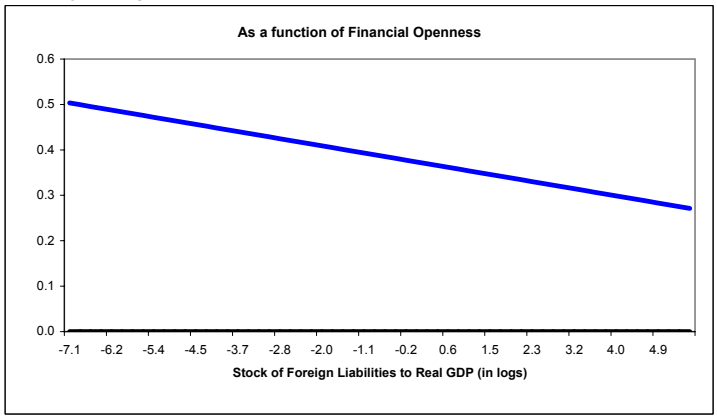
(c) Volatility Effect of Volatility of World Interest Rate Changes





(d) Volatility Effect of Volatility of Regional Capital Flows





Appendix 1: Sample of countries

I.	**Industrial Economies (22 countries)**		
	Australia	Germany	Norway
	Austria	Greece	Portugal
	Belgium	Iceland	Spain
	Canada	Ireland	Sweden
	Denmark	Italy	Switzerland
	Finland	Japan	United Kingdom
	France	Netherlands	United States
		New Zealand	
II.	**Latin America and the Caribbean (21 countries)**		
	Argentina	Ecuador	Nicaragua
	Bolivia	El Salvador	Panama
	Brazil	Guatemala	Paraguay
	Chile	Haiti	Peru
	Colombia	Honduras	Trinidad and Tobago
	Costa Rica	Jamaica	Uruguay
	Dominican Republic	Mexico	Venezuela, RB
III.	**East Asia and the Pacific (8 countries)**		
	China	Malaysia	Singapore
	Indonesia	Papua New Guinea	Thailand
	Korea, Rep.	Philippines	
IV.	**Middle East and North Africa (7 countries)**		
	Algeria	Israel	Tunisia
	Egypt, Arab Rep.	Jordan	Turkey
		Morocco	
V.	**South Asia (3 countries)**		
	India	Pakistan	Sri Lanka
VI.	**Sub-Saharan Africa (15 countries)**		
	Botswana	Madagascar	Sierra Leone
	Cote d'Ivoire	Malawi	South Africa
	Gambia, The	Niger	Togo
	Ghana	Nigeria	Zambia
	Kenya	Senegal	Zimbabwe

Appendix 2: Definitions and Sources of Variables Used in Regression Analysis

Variable	Definition and Construction	Source
GDP per capita	Ratio of total GDP to total population. GDP is in 1985 PPP-adjusted US$.	Authors' construction using Summers and Heston (1991) and The World Bank (2002).
GDP per capita growth	Log difference of real GDP per capita.	Authors' construction using Summers and Heston (1991) and The World Bank (2002).
Initial GDP per capita	Initial value of ratio of total GDP to total population. GDP is in 1985 PPP-adjusted US$.	Authors' construction using Summers and Heston (1991) and The World Bank (2002).
Human Capital Investment	Ratio of total secondary enrollment, regardless of age, to the population of the age group that officially corresponds to that level of education.	World Development Network (2002) and The World Bank (2002).
Financial Depth	Ratio of domestic credit claims on private sector to GDP	Author's calculations using data from IFS, the publications of the Central Bank and PWD. The method of calculations is based on Beck, Demiguc-Kunt and Levine (1999).
Trade Openness: Outcome Measure	Log of the ratio of exports and imports (in 1995 US$) to GDP (in 1995 US$).	World Development Network (2002) and The World Bank (2002).
Trade Openness: Policy Measure	Average years of trade openness according to Sachs and Warner criteria.	Sachs and Warner (1995), Wacziarg and Welch (2003).
Financial Openness: Outcome Measure	Log of the Stock of Equity-based Foreign Liabilities to GDP (both expressed in 1995 US$). Following Eichengreen and Irwin (1998), we add the value of 1 to the stock in order to include the cases where the stock of foreign liabilities is 0.	Lane and Milesi-Ferreti (2001, 2003), IMF's Balance of Payments Statistics
Financial Openness: Policy Measure	Average years of absence of controls on capital account transactions during the corresponding 5-year period.	IMF's Exchange Arrangements and Exchange Restrictions (Various Issues), and Prasad, Rogoff, Wei and Kose (2003).
Government Burden	Log of the Ratio of government consumption to GDP.	The World Bank (2002).
CPI	Consumer price index (1995 = 100) at the end of the year	Author's calculations with data from IFS.
Inflation rate	Annual % change in CPI	Author's calculations with data from IFS.
Real Exchange Rate Overvaluation	Real Effective Exchange Rate, with the level adjusted such that the average for 1976-85 equals Dollar's (1992) index of overvaluation (based on the ratio of actual to income-adjusted Summers-Heston purchasing power parity comparisons).	Easterly (2001)
Terms of Trade	Net barter terms of trade index (1995=100)	World Development Network (2002) and The World Bank (2002).
Terms of Trade Changes	Log differences of the terms of trade index	Authors' construction using The World Bank (2002).
Foreign Growth	Growth in main trading partners calculated as the trade-weighted growth for the main trading partners of the corresponding country.	Authors' construction using Summers and Heston (1991), The World Bank (2002), and the IMF's Direction of Trade Statistics.
World Nominal Interest Rate	G-3 (U.S., Germany and Japan) Money Market Rate (period average)	Author's calculations with data from IFS.
World Inflation	G-3 (U.S., Germany and Japan) Consumer Price Index (CPI) Inflation rate	Author's calculations with data from IFS.
World Real Interest Rate	World Nominal Interest Rate minus World Inflation.	Author's calculations with data from IFS.
Regional Capital Inflows	(Gross) Capital Inflows (FDI, portofolio-equity, loans) to the region of the corresponding country.	Author's calculations with data from the IMF's Balance of Payments Statistics.
Inflation Volatility	Measured by the standard deviation of the rate of change in the consumer price index.	Authors' construction using The World Bank (2002).
Systemic Banking Crises	Number of years in which a country underwent systemic banking crisis, as a fraction of years in the corresponding period.	Author's calculations using data from Caprio and Klingebiel (1999), and Kaminsky and Reinhart (1998).
Volatility of Terms of Trade Changes	Standard deviation of the log difference of the terms of trade.	Authors' construction using The World Bank (2002).
Foreign Growth Volatility	Measured by the standard deviation of the trade-weighted growth of the main trading partners of the corresponding country.	Authors' construction using Summers and Heston (1991), The World Bank (2002), and the IMF's Direction of Trade Statistics.
Volatility of World Real Interest Rates	Measured by the standard deviation of the world real interest rate.	Author's calculations with data from the IMF's Balance of Payments Statistics.
Volatility of Regional Capital Inflows	Measured by the standard deviation of the capital inflows to region of the corresponding country.	Author's calculations with data from the IMF's Balance of Payments Statistics.
Period-specific Shifts	Time dummy variables.	Authors' construction.

Appendix 3: Descriptive Statistics for Growth Regressions

Data in 5-year period averages, 76 countries, 438 observations

(a) Univariate

Variable	Mean	Std. Dev.	Minimum	Maximum
Growth rate of GDP per capita	1.422	2.642	-7.944	10.128
Initial GDP per capita (in logs)	8.522	0.989	6.243	10.240
Secondary enrollment (in logs)	3.739	0.788	0.113	4.923
Private domestic credit/GDP (in logs)	3.485	0.844	0.568	5.435
Inflation (in log [100+inf. rate])	4.743	0.175	4.585	6.135
Government consumption /GDP (in logs)	2.680	0.371	1.475	3.637
Outcome Trade Openness	3.948	0.594	2.024	5.787
Outcome Financial Openness	1.689	3.779	-21.044	5.536
Policy Trade Openness	0.538	0.487	0.000	1.000
Policy Financial Openness	0.285	0.426	0.000	1.000
Terms of Trade Changes	-0.424	4.644	-18.859	21.415
Foreign Growth	2.244	0.606	0.834	3.833
World Int. Rate Changes	-0.017	0.658	-0.975	1.505
Regional Capital Flows	3.419	2.359	-1.635	10.336

(b) Bivariate Correlations between Growth and Determinants

Variable	Growth rate of GDP per capita	Initial GDP per capita (in logs)	Secondary enrollment (in logs)	Private domestic credit/GDP (in logs)	Inflation (in log [100+inf. rate])	Government consumption /GDP (in logs)	Outcome Trade Openness	Policy Trade Openness	Outcome Financial Openness	Policy Financial Openness	Terms of Trade Changes	Foreign Growth	World Int. Rate Changes	Regional Capital Inflows
Growth rate of GDP per capita	1.00													
Initial GDP per capita (in logs)	0.19	1.00												
Secondary enrollment (in logs)	0.22	0.80	1.00											
Private domestic credit/GDP (in logs)	0.25	0.71	0.61	1.00										
Inflation (in log [100+inf. rate])	-0.29	-0.10	0.00	-0.35	1.00									
Government consumption /GDP (in logs)	-0.03	0.36	0.29	0.35	-0.10	1.00								
Outcome Trade Openness	-0.04	-0.14	-0.13	0.01	-0.30	0.27	1.00							
Policy Trade Openness	0.30	0.57	0.60	0.52	-0.22	0.20	0.02	1.00						
Outcome Financial Openness	0.15	0.34	0.44	0.28	0.04	0.03	-0.11	0.33	1.00					
Policy Financial Openness	0.05	0.39	0.31	0.36	-0.20	0.05	0.08	0.30	0.18	1.00				
Terms of Trade Changes	0.10	0.07	0.03	0.04	-0.12	-0.04	0.08	0.06	0.06	0.06	1.00			
Foreign Growth	0.28	-0.14	-0.24	-0.12	-0.17	-0.15	-0.12	-0.13	-0.23	-0.07	0.08	1.00		
World Int. Rate Changes	0.04	-0.01	-0.02	0.00	0.03	0.05	-0.01	-0.09	0.03	-0.04	0.20	0.29	1.00	
Regional Capital Inflows	0.19	0.44	0.34	0.41	-0.29	0.18	0.12	0.36	0.17	0.41	0.11	-0.14	0.06	1.00

Appendix 4: Descriptive Statistics for Growth Volatility Regressions

Data in 5-year period averages, 76 countries, 371 observations

(a) Univariate

Variable	Mean	Std. Dev.	Minimum	Maximum
Growth Volatility	2.887	2.190	0.314	16.053
Inflation Volatility	8.681	19.193	0.198	168.127
RER Overvaluation	107.417	44.123	47.192	555.027
Systemic Banking Crises	0.138	0.286	0.000	1.000
Outcome Trade Openness	3.968	0.569	2.249	5.781
Policy Trade Openness	0.571	0.482	0.000	1.000
Outcome Financial Openness	2.085	3.027	-21.044	5.536
Policy Financial Openness	0.305	0.434	0.000	1.000
Volatility of Terms of Trade Changes	8.476	8.628	0.000	56.323
Foreign Growth Volatility	1.000	0.434	0.214	2.438
Volatility of World Int. Rate Changes	1.056	0.737	0.303	2.849
Volatility of Regional Capital Inflows	1.424	0.969	0.139	4.444

(b) Bivariate Correlations between Growth Volatility and Determinants

Variable	Growth Volatility	Inflation Volatility	RER Overvaluation	Systemic Banking Crises	Outcome Trade Openness	Policy Trade Openness	Outcome Financial Openness	Policy Financial Openness	Volatility of Terms of Trade Changes	Foreign Growth Volatility	Volatility of World Int. Rate Changes	Volatility of Regional Capital Inflows
Growth Volatility	1.00											
Inflation Volatility	0.24	1.00										
RER Overvaluation	0.08	0.13	1.00									
Systemic Banking Crises	0.11	0.24	0.04	1.00								
Outcome Trade Openness	0.05	-0.24	0.09	-0.09	1.00							
Policy Trade Openness	-0.36	-0.20	0.01	-0.02	0.05	1.00						
Outcome Financial Openness	-0.30	-0.03	-0.09	0.07	-0.05	0.33	1.00					
Policy Financial Openness	-0.20	-0.17	0.12	-0.11	0.08	0.34	0.22	1.00				
Volatility of Terms of Trade Changes	0.36	0.27	0.16	0.03	0.01	-0.46	-0.30	-0.23	1.00			
Foreign Growth Volatility	0.18	0.02	-0.05	-0.14	-0.15	-0.28	-0.18	-0.15	0.12	1.00		
Volatility of World Int. Rate Changes	0.15	0.02	-0.05	-0.16	-0.13	-0.21	-0.24	-0.16	0.15	0.87	1.00	
Volatility of Regional Capital Inflows	0.12	0.16	0.10	0.19	0.04	-0.09	0.10	0.08	-0.08	-0.07	-0.23	1.00