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WHAT DRIVES PRIVATE SAVING ACROSS THE WORLD?

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Resumen

La tasas de ahorro presentan significativas variaciones tanto a través del tiempo como entre países. Este trabajo investiga los factores detrás de estas disparidades. Para esto, utiliza una extensa base de datos de ahorro de corte transversal y serie de tiempo entre países elaborada para el Programa de Ahorro del Banco Mundial. Se calcula empíricamente los determinantes del ahorro, relacionados tanto a variables de política económica como a otro tipo de variables. Siguiendo la literatura empírica de ahorro, se utiliza un enfoque empírico que utiliza variables potencialmente relevantes en la determinación de las tasas de ahorro. Sin embargo, este trabajo avanza más allá de la literatura existente en divisas áreas. Utiliza la mayor base de datos de ahorro agregado generada hasta la fecha, estudia los determinantes del ahorro a nivel nacional y privado y utiliza una técnica de panel con datos instrumentales variables, lo que permite corregir por endogeneidad y heterogeneidad a través de variables “internas”. Finalmente, cabe destacar que en e trabajo además se realiza una serie de test de robustez a cambios en los procesos de estimación, en la muestra de datos y en la especificación del modelo.

Abstract

Saving rates display considerable variation across countries and over time. This paper investigates the factors behind these broad saving disparities using a large cross-country time-series data set constructed for the World Bank Saving project. The paper assesses empirically the policy and non-policy determinants of saving. It follows the empirical literature on saving by using an encompassing empirical approach including a number of potentially relevant saving determinants. However, the paper extends the literature in several dimensions. It uses the largest data set on aggregate saving measures assembled to date. It explores both national and private saving determinants. It uses panel instrumental variable techniques that allow correcting for endogeneity and heterogeneity through “internal” instruments. Finally, it performs a variety of robustness checks to changes in estimation procedures, data samples and model specification.

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1. Introduction

Over the last three decades the world has witnessed a marked divergence in saving rates, particularly dramatic within the developing world: saving rates have risen steadily in East Asia, stagnated in Latin America, and fallen in Sub-Saharan Africa. These regional saving disparities have been closely matched by diverging growth experiences: across world regions, higher saving rates tend to be correlated with higher income growth.

This large variation in saving performance across countries and over time raises a number of questions. Why do saving rates differ so much across countries and time periods? How much do public policies contribute to these saving disparities, in comparison to other structural and non-policy saving determinants?

From the policy perspective, there are serious questions about the size -- and sometimes even about the sign -- of the effects of policy variables on saving rates. How effective is fiscal policy in raising national saving? Does financial liberalization -- by raising interest rates, encouraging consumer and housing lending, and raising financial depth -- inhibit or encourage private saving? Does foreign lending crowd out national saving? Or perhaps growth-enhancing policies -- such as macro stabilization and structural reform -- would be more effective in raising saving through higher income and growth than any direct saving incentive?

In this paper we address the above questions empirically, by exploiting what we believe is the largest cross-country time-series macroeconomic data set on saving and related variables assembled to date. The data set is unique because of various features.[1] First, it encompasses industrial and developing countries and covers nearly 30 years of data. Second, it provides alternative saving measures (for the nation, the central government, the public sector, and the private sector separately; unadjusted and adjusted for inflation-related capital gains and losses). Third, it has been subject to extensive quality checks, which among other things allow us to identify problematic observations and set them aside if necessary.

The objective of the paper is to use this large data set to establish the stylized facts concerning the effects on the private saving rate of its key policy and non-policy determinants identified in the literature. To do this, the paper estimates a variety of empirical equations for the private saving rate. Private saving regressions are estimated for a worldwide sample of countries, as well as separately for industrial and developing country subsamples. For completeness, the paper also presents regression results for the national saving rate. In order to encompass a broad range of saving determinants, and hence theoretical views about saving, we use a variety of reduced-form linear specifications rather than one narrow model of saving derived from first principles.[2] We believe that this approach provides a useful first step to identify the key empirical regularities in need of structural explanation.

We estimate our empirical equations using various panel data procedures, paying particular attention to the issues of simultaneity and country heterogeneity that are mostly ignored in earlier studies. Specifically, our large panel data set allows the use of “internal” instruments to correct for these problems. This permits us to make some progress towards drawing inferences on the effects of policy and non-policy variables on private saving rates, rather than merely describing their association.

The paper is organized as follows. Section 2 summarizes briefly recent cross-country empirical studies of private saving. Section 3 presents our empirical strategy, describing the data set and estimation approach. Section 4 reports the econometric results for the private (and national) saving rate using a variety of samples, regression specifications, and estimation techniques. The paper closes with brief concluding remarks.

2. Determinants of Private Saving Rates in Previous Panel Studies

Table 1 summarizes potential determinants of private saving rates and lists their expected signs according to consumption theory.[3] A number of recent empirical studies have estimated the effect of various economic and demographic variables on private saving rates in cross-country time-series (panel) samples. In order to provide a summary on the empirical evidence related to each of the saving determinants under consideration, the last column in Table 1 lists the qualitative results of 6 recent studies using large panel data samples. They comprise studies for both industrial and developing countries (Masson, Bayoumi, and Samiei 1995; Edwards 1996; and Bailliu and Reisen 1998), for industrial-country samples (Haque, Pesaran, and Sharma 1999), and for developing-country samples (Corbo and Schmidt-Hebbel 1991; and Dayal-Ghulati and Thimann 1997).

The common feature of these papers is that they are based on reduced-form saving equations, not necessarily derived from first principles.[4] They differ widely in other dimensions, as they are based on different sample periods and countries as well as on different model specifications and estimation techniques. Not surprisingly, only a few saving determinants appear to be consistently significant across different studies and with their estimated signs according to theory. They include the terms of trade, domestic and foreign borrowing constraints, fiscal policy variables, and pension system variables. Regarding other determinants for which consumption theories either differ regarding their signs or point toward ambiguous signs, as in the case of income growth and interest rates, these empirical studies differ widely. They also differ in reported significance levels of variables for which theories tend to agree on expected signs, such as income level, inflation, and demographic dependency ratios.

3. Empirical strategy

The above empirical studies capture a number of factors relevant to saving decisions, but vary considerably in terms of data coverage and quality, empirical specification and econometric procedure. Our primary objective here is to extend this literature by providing a comprehensive characterization of the empirical association between private saving rates and a broad range of potentially important saving determinants using the best available data. To do this, we complement and extend previous work along three dimensions. First, we use the largest set of consistent macroeconomic data on saving assembled to date. Second, we adopt a reduced-form approach encompassing a variety of saving determinants identified in the literature – rather than adhere to one particular narrow structural model. Third, we employ a variety of estimation methods, but focus our attention on estimators that attempt to control for heterogeneity and simultaneity, two problems that likely plague most previous empirical studies.

3.1 The Data

Our basic data set draws from the saving database recently constructed at the World Bank, and described in detail in Loayza, López, Schmidt-Hebbel and Servén (1998a). To our knowledge, such database represents the largest macroeconomic data set on saving and related variables presently available. It comprises a maximum of 150 countries and spans the years 1965-1994. The data have been subject to extensive consistency checks, and hence they also represent an important improvement in terms of quality relative to other existing data sets.[5]

The data set excludes the countries for which we found inconsistencies in basic National Account, fiscal and financial data. These data limitations prevented the construction of reliable saving measures, their disaggregation into public and private saving, and/or the calculation of the inflation adjustments for the latter. For some of the key variables in this paper, the effective data coverage in countries and years is therefore limited. Nevertheless, for the "core" private saving regression, presented below, we initially count with 1,254 complete observations spanning the years 1966-95.

From this initial sample, we decided to exclude the observations corresponding to high inflation episodes. We base this decision on the fact that high inflation distorts severely measured public and private saving (particularly the inflation-adjusted saving measures).[6] Moreover, in general high inflation renders National Account statistics largely unreliable. For practical purposes, we set a threshold of +/- 50 percent annual inflation. We apply the same threshold to the real interest rate, which in cases of high inflation is mostly driven by inflation. For the "core" specification, these data adjustments lead to the direct loss of 49 observations.[7]

In order to achieve a minimum time-series dimension, as well as to reserve sufficient observations to implement our instrumental-variable estimators described below, we limit our sample coverage to those countries with at least 5 consecutive annual observations. After all these adjustments, the sample for our "core" specification consists of 1,148 observations. Since four observations per country must be set aside for the construction of instruments, the "core" regression sample consists of 872 observations for 69 countries – 20 industrial and 49 developing. As explained below, we also estimate regressions for the national saving rate and for private saving rates derived from a narrower definition of the public sector. For these regressions, the available sample comprises about

1,800 annual observations for 98 countries in the case of national saving rates and between 750-900 observations for 69countries in the case of private saving rates, depending on the precise definition of the private and public sectors.[8] This sample coverage exceeds that of Edwards (1996), who considers 32 countries, and Masson, Bayoumi and Samiei (1995), whose sample includes 61 countries.

Finally, note that these panel data sets are heavily unbalanced, with the number of time-series observations varying considerably across countries. The top panel of Table 1 provides information as to the composition of the "core" regression sample per decade and development stage. Developing countries account for over half of the total number of observations, and the 1980s are the decade most heavily represented in the data.

The precise definition of saving that we use also deserves comment. As in Loayza, López, Schmidt-Hebbel and Servén (1998b), for the nation as a whole our basic income measure is gross national disposable income (GNDI), equal to GNP plus all net unrequited transfers from abroad.[9] Gross national saving is then defined as GNDI minus consumption expenditure, with both measured at current prices.

In turn, for the private sector we implement four alternative measures of disposable income and gross saving. These follow from the definition chosen for the public sector (i.e., consolidated central government or broad public sector) and from whether the private and public income and saving figures are adjusted or not for capital gains and losses due to inflation. We respectively label the four alternatives that result as CU (unadjusted data corresponding to the central government definition), CA (same as CU but after adjusting for inflationary capital gains and losses), PU (unadjusted data corresponding to the public sector definition of the government), and PA (inflation-adjusted PU data). Notice that by construction the CA and CU configurations lump local governments and public enterprises together with the private sector. In turn, the PA and PU definitions of the public sector correspond to either the general government or, when available, the consolidated non-financial public sector, inclusive of public enterprises. Hence, of these four alternatives, the analytically preferable one is clearly PA. This is the private saving definition on which we base our "core" regression and most of our experiments. In contrast, most empirical studies use the more-readily available, but analytically problematic, CU measure.

In each case, gross private saving is computed as the difference between gross national saving and the relevant definition of gross public saving. Gross private disposable income (henceforth GPDI) is likewise measured as the difference between GNDI and gross public disposable income, itself equal to the sum of public saving and public consumption.

Table 2 presents descriptive statistics and pairwise correlations for the five saving ratios (national and the four alternative definitions of private saving). We report the full-sample correlations as well as their cross-section counterparts. As expected, the correlations are quite high in all cases (between 82 % and 97 %), with the correlations between the national saving ratio and the private saving ratios being the lowest ones. The five saving ratios also look very similar in their descriptive statistics (with a mean of about 20%, and standard deviations of 8 %). The table also highlights the wide dispersion of private saving ratios, which range from a minimum of –25 percent (Zambia 1985) to a maximum in excess of 46 percent (Singapore 1984).

3.2 Empirical specification

We adopt an encompassing approach based on reduced-form linear equations. This allows us to include a broad range of saving determinants. As dependent variables we use both private and national saving ratios (to gross private and gross national disposable income, respectively), although we concentrate on the former. We focus our attention on a "core" set of regressors selected on the basis of analytical relevance (as well as data availability); however, we also examine the empirical role of a number of less-standard saving determinants.[10]

Following previous literature, our core regressors include a standard group of income-related variables, namely the (log) level and the rate of growth of real per capita disposable income, and the terms of trade. To ensure cross-country comparability of real income figures, we convert the local-currency constant-price GNDI and GPDI data using World Bank Atlas exchange rates averaged over 1965-94.

In addition, our basic regressors include both price and quantity financial variables. The latter are the ratio of M2 to GNP, as standard indicator of financial depth, and the domestic (in national saving regressions) or private (in private saving regressions) credit flow relative to income, to capture consumers' access to borrowing.[11] The price variable is the real interest rate, defined as $ln[(1+i)/(1+p)]$. It is calculated using two alternative measures of inflation: the current rate and the average of current and one-period-ahead inflation. This yields two alternative real interest rate measures, of which our preferred one is that using the averaged forward-backward inflation just described; however, we also present empirical experiments using instead current inflation.

As conventional, we attempt to capture Ricardian effects in private saving equations by including as regressor the public saving ratio, measured in a way consistent with the definition of private saving under consideration; however, we also report some experiments adding the public investment / income ratio. In turn, demographic factors are represented by the old and young-age dependency ratios as well as the proportion of urban population in the total. Finally, we attempt to capture precautionary saving effects related to macroeconomic uncertainty adding the inflation rate $ln(1+p)$ among the regressors. In this regard, we follow a rather voluminous literature in which the inflation rate has been used as a proxy for price uncertainty (Deaton 1977) and, more generally, macroeconomic instability (e.g., Fischer 1993).

We perform additional empirical experiments using measures of trend and temporary income and the terms of trade, as well as measures of income uncertainty, constructed from our data. For this purpose, we use the time-series procedure introduced by Maravall and Planas (1999). This procedure yields separate series for the trend and temporary components of real income and the terms of trade. Combining the respective trend and temporary components, we can construct one-step ahead forecasts of the original variables. The dispersion of the corresponding one-step ahead forecast errors provides a measure of the volatility of the respective innovations and hence the desired measure of "uncertainty". As measure of dispersion we use the square of the forecast error.

Table 3 presents basic descriptive statistics and pairwise correlations (full-sample and cross-section) on the private (PA) saving ratio and the core explanatory variables.

3.3 Econometric Issues

The estimation procedure needs to tackle three issues. First, rather than distort the available information by phase averaging using an arbitrary phase length (e.g., computing 5 or 10-year averages), we choose to work with the original annual data in order to retain all the information. This in turn means that we need to use a dynamic specification in order to allow for inertia, very likely to be present in the annual information. Inertia in saving rates can arise from lagged effects of the explanatory variables on saving. Thus, considering a dynamic specification allows us to discriminate between short- and long-run effects on saving.[12] Second, some of the explanatory variables in the core specification above (e.g., the real interest rate, real income growth, etc.) are likely to be jointly determined with the saving rate; therefore, we must allow and control for the joint endogeneity of the explanatory variables. Third, we must also allow for the possible presence of unobserved country-specific effects correlated with the regressors.

To address these issues, our empirical analysis is based on Generalized-Method-of-Moments estimators applied to dynamic models using panel data. These estimators allow us to control for unobserved country-specific effects and potential endogeneity of the explanatory variables.[13]

Before we proceed, we must clarify the extent to which we control for joint endogeneity. Our panel estimator controls for endogeneity by using "internal instruments," that is, instruments based on lagged values of the explanatory variables. Through this method we can relax the assumption that the explanatory variables are strictly exogenous; however, we cannot allow for full endogeneity of the explanatory variables. To be precise, we must assume that the explanatory variables are "weakly exogenous," which means that they can be affected by current and past realizations of the saving rate but must be uncorrelated with future realizations of the error term. Conceptually, weak exogeneity does not mean that future saving rates cannot be correlated with current realizations of variables such as income growth or the interest rate (as would be predicted by most forward-looking models). Rather, weak exogeneity means that future *innovations* (or unforeseen changes) to the saving rate do not influence previous realizations of the saving determinants. We believe that conceptually this assumption is not particularly restrictive; furthermore, we can examine its validity statistically through several specification tests, as explained below.

The following is a brief presentation of our preferred methodology. Consider the following dynamic reduced-form saving regression equation,

$$s_{i,t} = a s_{i,t-1} + q' X_{i,t} + h_i + e_{i,t} \qquad (1)$$

where s is the saving rate, X represents a set of variables that potentially affect the saving rate, h represents a set of unobserved time-invariant country-specific effects, e is the error term, and the subscripts i and t represent country and time period, respectively. [14]

The usual method for dealing with the country-specific effect in the context of panel data has been to first-difference the regression equation (Anderson and Hsiao 1982). In this way the country-specific effect is directly eliminated from the estimation process. First-differencing equation (1), we obtain,

$$s_{i,t} - s_{i,t-1} = a(s_{i,t-1} - s_{i,t-2}) + q'(X_{i,t} - X_{i,t-1}) + (e_{i,t} - e_{i,t-1}) \qquad (2)$$

The use of instruments is required to account for two facts. First, differencing the saving regression introduces, by construction, a correlation between the differenced lagged saving rate and the differenced error term. Second, some of the explanatory variables, X, may be jointly endogenous with the saving rate. In particular, we would like to relax the commonly held assumption that all explanatory variables are strictly exogenous (that is, that they are uncorrelated with the error term, e, at all leads and lags). Relaxing this assumption allows for the possibility of simultaneity and reverse causality, which are very likely present in saving regressions. As explained above, we adopt the assumption of *weak* exogeneity of the explanatory variables, in the sense that they are assumed to be uncorrelated with future realizations of the error term (see Chamberlain 1984). In this presentation of the methodology, all variables are treated as weakly exogenous (with respect to e). In practice, however, we treat some variables as strictly exogenous (again, with respect to e); they are the young and old dependency ratios, the urbanization ratio, and the terms of trade.

Under the assumptions that (a) the error term, e, is not serially correlated, and (b) the explanatory variables, X, are weakly exogenous, the following moment conditions apply to the lagged saving rate and the set of explanatory variables,[15]

$$E\left[s_{i,t-s} \cdot (e_{i,t} - e_{i,t-1})\right] = 0 \quad \textit{for } s \geq 2; t = 3,...,T \qquad (3)$$

$$E\left[X_{i,t-s} \cdot \left(e_{i,t} - e_{i,t-1}\right)\right] = 0 \quad \textit{for } s \geq 2; t = 3,\ldots,T \qquad (4)$$

We use a consistent GMM estimator based on these moment conditions, that we label the *difference* estimator.

There are, however, conceptual and statistical shortcomings with this estimator. Conceptually, we would like to study not only the time-series relationship between the saving rate and its determinants but also their cross-country relationship, which is eliminated in the case of the simple *difference* estimator. Statistically, Alonso-Borrego and Arellano (1996) and Blundell and Bond (1997) show that when the explanatory variables are persistent over time, lagged levels of these variables are weak instruments for the regression equation in differences. The instruments' weakness has negative repercussions on both the asymptotic efficiency and the small-sample bias of the *difference* estimator.[16]

To confront these conceptual and statistical concerns, we use an alternative *system* estimator that reduces the potential biases and imprecision associated with the usual *difference* estimator (Arellano and Bover 1995, Blundell and Bond 1997). The alternative estimator combines, in a *system*, the regression in differences with the regression in levels. The instruments for the regression in differences are the same as above (i.e., the lagged *levels* of the corresponding variable), so that, the moment conditions in equations (3) and (4) apply to this first part of the system. For the second part of the system, the regression in levels, the instruments are given by the lagged *differences* of the corresponding variables. These are appropriate instruments under the following additional assumption: although there may be correlation between the levels of the right-hand side variables and the country-specific effect in equation (1), there is no correlation between the *differences* of these variables and the country-specific effect. This assumption results from the following stationarity property,

$$E\left[s_{i,t+p} \cdot h_i\right] = E\left[s_{i,t+q} \cdot h_i\right] \quad for \quad all \quad p \quad and \quad q \tag{5}$$

$$E\left[X_{i,t+p} \cdot h_i\right] = E\left[X_{i,t+q} \cdot h_i\right] \quad for \quad all \quad p \quad and \quad q \tag{6}$$

Therefore, the additional moment conditions[17] for the second part of the system (the regression in levels) are given by the following equations[18]:

$$E\left[(s_{i,t-1} - s_{i,t-2}) \cdot (h_i + e_{i,t})\right] = 0 \tag{7}$$

$$E\left[(X_{i,t} - X_{i,t-1}) \cdot (h_i + e_{i,t})\right] = 0 \tag{8}$$

We use the moment conditions presented in the above equations, and, following Arellano and Bond (1991) and Arellano and Bover (1995), we employ a Generalized Method of Moments (GMM) procedure[19] to generate consistent estimates of the parameters of interest.

The consistency of the GMM estimator depends on whether lagged values of the explanatory variables are valid instruments in the saving regression.[20] To address this issue we consider three specification tests suggested by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1997). The first is a Sargan test of over-identifying restrictions, which tests the overall validity of the instruments by analyzing the sample analog of the moment conditions used in the estimation process. Failure to reject the null hypothesis gives support to the model. The second test is the “difference-Sargan” test, which examines the null hypothesis that the lagged differences of the explanatory variables are uncorrelated with the residuals (which are the additional restrictions imposed in the system estimator with respect to the difference estimator).[21] The third test examines the hypothesis that the error term $e_{i,t}$ is not serially correlated or, if it is correlated, that it follows a finite-order moving average process. We test whether the differenced error term (that is, the residual of the regression in differences) is first-, second-, and third-order serially correlated. First-order serial correlation of the differenced error term is expected even if the original error term (in levels) is uncorrelated, unless the latter follows a random walk. Second-order serial correlation of the differenced residual indicates that the original error term is serially correlated and follows a moving average process at least of order one. If the test fails to reject the null hypothesis of absence of second-order serial correlation, we conclude that the original error-term is serially uncorrelated and use the corresponding moment conditions.[22]

Measurement error. The discussion above has abstracted from issues regarding measurement error. It is likely, however, that most variables in our econometric model suffer from measurement error. Given that our model is dynamic, not only errors in the explanatory variables will cause biased estimation but also errors in the saving rate, the dependent variable. We can deal with measurement error through our instrumental variable procedure. We allow for measurement error of two kinds. The first type is mostly constant over time but specific to each country. We group this type of error with the unobserved country specific effect and control for it accordingly. The second type of measurement error we allow for is the standard random error. If this is serially uncorrelated, it can be shown that the same lag structure for the instruments that control for endogeneity also deals with measurement error. If the random measurement error follows a moving average process of order 1, then we need to use instruments lagged one more period than what would be necessary if there were no measurement error (or if it were serially uncorrelated). In practice for all private saving rate regressions, we take the conservative approach of allowing for measurement error that follows an MA(1) process (see footnote 22). The specification tests for the validity of the instruments can also be used to assess whether the control for measurement error is appropriate.

4. Estimation results

We now present the estimation results for private and national saving rates. In each case, we organize our discussion around the core empirical specification introduced above. As noted earlier, the core regressors are the same for private and national saving rate regressions except for the fact that government saving is included only in private saving equations. We focus on the private saving rate, and concentrate on the private saving measure that is most analytically sound. This is the measure that corresponds to the public sector defined broadly to include regional and local governments and, where possible, public enterprises, and adjusting for capital gains and losses due to inflation.

In order to test the robustness of the basic results and to enlighten their interpretation, we also conduct experiments along four dimensions. First, we employ alternative econometric techniques. Second, we use alternative samples: we break the world sample into OECD and developing-country subsamples, and we also present a world sample that excludes potential outliers. Third, we work with alternative definitions of private saving. And, fourth, we explore the importance of additional explanatory variables. Finally, we consider national saving regression results obtained under various econometric techniques.

Before proceeding to the detailed discussion of the results in Tables 4-8, we note that the specification tests generally support our GMM-IV panel estimates. In all cases, the Sargan test of overidentifying restrictions cannot reject the null hypothesis that the instruments are uncorrelated with the error term. Likewise, the tests of serial correlation reject the hypothesis that the error term is third-order serially correlated (and, in most cases, that it is second-order serially correlated), giving additional support to the use of appropriate lags of the explanatory variables as instruments for the estimation. For the core regression (Table 4, column 6), we also conduct the Sargan-difference test, which as explained above tests the validity of the additional restrictions imposed by the system estimator relative to the difference estimator. In agreement with the conclusions of the other two specification tests, the Sargan-difference test does not reject the additional restrictions of the system estimator (p-value 0.59).

Prior to presenting the results, we must clarify their interpretation. Our econometric methodology is designed to isolate the effect of the exogenous component of each explanatory variable on the saving rate. To the extent that our assumptions regarding the instruments employed in the GMM procedures are correct, we succeed in isolating the effects going from the explanatory variables to the saving rate. The specification tests presented above support the validity of our instruments and, thus, allow us to draw inferences regarding the link between the exogenous component of policy and non-policy variables and saving rates. In the following, when we mention the *effect* of a given variable on the private saving rate, we are referring to the association between the exogenous component of that variable and the saving rate.

4.1 Basic results

Table 4 reports the results of the private saving rate regression using alternative estimators on the full sample and employing the core specification. While there are a number of similarities among the various estimates, as explained in the previous section our preferred estimation method uses the GMM system estimator. Hence we first discuss the results obtained with this estimator (column 6) and then compare them with those obtained with alternative estimation methods.

Persistence. The lagged private saving rate has a positive and significant coefficient, whose size (0.59) reveals a large degree of persistence. This, in turn, implies that the long-run effects of other private saving determinants are more than twice (2.44 times, to be exact) as large as their respective short-run effects -- *if* all changes in these variables were permanent.

Income. Both the (log) level and the growth rate of real per capita private disposable income have a positive and significant effect on the private saving rate --as private agents become richer or their incomes grow faster, their saving rate increases. According to the estimated coefficients, an increase in income by 10 percent raises the private saving rate by 0.47 percentage points on impact. In turn, the estimated growth coefficient indicates that an increase in the income growth rate by 1 percentage point leads to a private saving rate increase of 0.45 percentage points in the short run. Lastly, a 10 percent improvement in the terms of trade increases the private saving rate by 0.74 percentage points in the short run.

In our basic regression specification, we estimate the effect of changes in income levels and growth rates and in the terms of trade; however, we cannot tell whether the estimated effects are due to permanent or temporary changes in these variables. We return to this issue below, when we attempt a decomposition of these variables into their permanent and temporary elements. In so far as the estimated coefficients represent the saving effects of *temporary* changes in income levels and growth rates, their positive sign is consistent with standard intertemporal consumption theories. If they represent the effect of *permanent* changes in income levels and growth rates, their positive sign must be explained resorting to more recent theoretical developments. Thus, the positive income level effect would be consistent with models of subsistence consumption, while the positive income growth effect could be explained by a model featuring consumption habits or the life-cycle model where income growth accrues mostly across cohorts.

On the whole, the significant effects of income levels and growth rates imply that policies that spur development are an indirect but most effective way to raise saving. To the extent that a significant fraction of the increased saving is channeled into productive domestic investment in many countries (as suggested by the evidence in support of the co-movement of saving and investment first underscored by Feldstein and Horioka ,1980), successful growth policies may be able to set in motion a virtuous cycle of saving, capital accumulation, and growth.

Financial variables. The real interest rate has a negative impact on the private saving rate, suggesting that its income effect outweighs the sum of its substitution and human-wealth effects. A 1 percentage point increase in the real interest rate produces a private saving rate decline of about 0.25 percentage points in the short run. This result should be taken with some caution, however, in view of the strong negative correlation between inflation and the real interest rate (Table 3), which suggests that our real interest rate measure may reflect more the action of nominal interest rate controls and financial repression than consumers' intertemporal rate of substitution. In turn, our indicator of financial depth (M2/GNP) has a small and statistically insignificant impact on the private saving rate. Other experiments using instead credit ratios to measure financial depth led to similar results. Finally, the flow of private domestic credit relative to income carries a negative and significant coefficient, suggesting that the relaxation of credit constraints leads to decrease in the private saving rate (in agreement with evidence given by Japelli and Pagano 1995). When the flow of private credit rises by 1 percent of income, the private saving rate decreases by 0.32 percentage points on impact.

These results provide a bleaker view of the saving effects of financial liberalization than suggested by previous studies, in both the price and quantity dimensions: both higher interest rates and larger private domestic credit flows exert a negative effect on private saving rates. Although on the whole we do not find any positive, direct effects of financial liberalization on saving rates, there is considerable evidence that financial reform has a positive impact on growth (e.g., Levine, Loayza and Beck 1999) and, through this channel, a potentially important indirect effect on saving rates.

Fiscal policy. A rise in the public saving ratio leads to a statistically significant decline in the private saving rate. Specifically, the private sector reduces its saving rate by 0.29 percentage points for each 1 percentage point increase in the public saving ratio within the same year the policy change occurs. Over the long term, however, the offset coefficient rises to 0.69. Therefore a permanent rise in public saving by 4% of GNDI will raise national saving by 2.8% of GNDI within a year, but only by some 1.2% of GNDI in the long term. The former result is at the low end of previous estimates, while the latter is at the upper end, so that allowing for inertia in saving helps reconcile some conflicting estimates found in the literature (see López, Schmidt-Hebbel and Servén 1998). While our point estimates fall short of unity, a Wald test of the null of full long-run Ricardian offsetting yields a p-value of .10, which provides some evidence against the Ricardian hypothesis but fails to reject it at conventional significance levels.

Demographic variables. All three demographic variables under consideration, namely, the urbanization ratio and the young and old dependency ratios, have a significantly negative impact on the private saving rate. The negative effect of the urbanization ratio can be explained along the precautionary-saving motive -- lacking the means to diversify away the high uncertainty of their mostly agricultural income, rural residents tend to save a larger proportion of their income. The negative coefficients on the dependency ratios are consistent with standard life-cycle models of consumption. The null of equality of estimated coefficients is rejected -- the coefficient on the old dependency ratio is significantly larger than that on the young dependency ratio. This likely reflects the fact that the labor force effectively includes a non-negligible proportion of the population aged under 16 (the cutoff point for the young dependency ratio) in many countries.

Both urbanization and the old-age dependency ratio are strongly positively correlated with per capita income (Table 3), so that they contribute to dampen the positive effect of rising incomes on saving noted above. In turn, the negative saving effect of young-age dependency suggests that developing countries with young populations that aim at accelerating their demographic transition and speed up the decline in young-age dependency ratios, may witness a transitory increase in their saving ratios before reaching the next stage of demographic maturity. At this stage old-age dependency rises swiftly -- and saving rates level off again.

Macroeconomic uncertainty. Like in much of the recent growth literature, in the core specification our proxy for macroeconomic uncertainty is the inflation rate. We find that a rise in inflation has a positive coefficient: a reduction of inflation by 10 percentage points reduces the private saving by over 1 percentage point through this channel. This suggests that increased macro uncertainty (regarding for example nominal incomes, future policies and so on) induces people to save a larger fraction of their income for precautionary motives.[23] While one might be tempted to conclude that inflation stabilization could have an adverse effect on saving, it is important to keep in mind that stabilization also affects saving through other indirect channels that are likely to more than compensate for any negative direct effect of inflation. In this regard, there is systematic evidence that lower inflation raises growth (see Fischer 1993, Andrés and Hernando 1997, among many other studies) and, as discussed below, the latter has a major positive effect on private saving. Further, the fiscal-adjustment component of macroeconomic stabilization also has an unambiguously positive effect on national saving, as noted above.

4.2 Alternative Estimators

Table 4 also presents results obtained with alternative estimation techniques. The first two columns present static OLS estimates, using respectively the cross-section data (i.e., country averages) and the pooled annual data. Both specifications are often encountered in saving studies. The third column adds the lagged dependent variable to the second. It is important to keep in mind, however, that in all three cases OLS is likely biased and inconsistent because it ignores unobserved country-specific effects and joint endogeneity of the explanatory variables. In the fourth column, the Within estimator is used to control for country-specific effects, but still ignoring joint endogeneity. An additional problem already noted earlier is that the presence of a lagged dependent variable renders the within estimator inconsistent in short panels, although its fate in a heavily unbalanced panel such as ours is somewhat less clear. The fifth column presents the results obtained with the GMM estimator based on a regression in differences which, as explained earlier, deals with country-specific effects and joint endogeneity. However, the GMM difference estimator eliminates the cross-country variation of the data (like the Within estimator) and may suffer from small-sample bias due to the use of weak instruments. By contrast, the system GMM estimator in column 6 makes use of both cross-country and time-series information.

In many cases, the results obtained with our preferred estimation technique, the GMM system estimator, are qualitatively similar to those obtained with the alternative estimators shown in Table 4. All estimators yield positive effects of the (log) level and growth rate of real income and negative effects of public saving and the old dependency ratio – although the coefficients vary in size and statistical significance. Likewise, in all cases (with the obvious exception of the static OLS estimates) we find significant evidence of private saving inertia, although likely exaggerated in the pooled OLS estimates due to their lack of control for country-specific effects.

There are, however, some notable exceptions. For example, the use of time series information (columns 2-6) reverses the parameter signs of the terms of trade and credit flows relative to those found in the cross-section OLS estimates. By contrast, cross-section information (columns 1-3 and 6) is needed to obtain a significant negative effect of the urbanization ratio. In turn, controlling for country-specific effects (columns 4-6) reverses the sign of the M2/GDP ratio from positive to negative. In this regard, however, notice that M2/GNP is likely to be a better proxy for financial depth in the cross-section dimension than in the annual time-series dimension, where it may reflect mostly other short-term factors like monetary policy. Finally, the sign and significance of the coefficients of the inflation rate and the interest rate do not show a clear pattern across alternative estimators.

4.3 Alternative samples

In Table 5, we present the GMM system estimates for alternative samples of countries, namely, the sample of less-developed countries (LDC) and the sample of industrial countries (OECD), in addition to the full-sample estimates already described. We also present estimates for a sample that excludes outliers without resorting to bounds on inflation. We obtain this sample by restricting the observations of each variable in the core specification to lie between 4 standard deviations from the respective mean. The estimated results for the restricted sample are quite similar to those obtained with the full sample (which, as explained above, imposes a 50% bound on inflation). We take this similarity as evidence that our core regression results are not driven by outlier observations and that the inflation bound is not distorting the estimation results.

Qualitatively, the estimates obtained on the subsamples of developing and industrial countries are broadly similar to their full-sample counterparts, but there are two important exceptions. First, surprisingly, the coefficient on the real interest rate is not significant for either the OECD or LDC samples, while it was significantly negative in the full sample. This again raises the suspicion that the accuracy with which real interest rates measure intertemporal prices varies across the two subsamples.[24] Likewise, M2/GNP is the other variable whose sign is not robust across samples: negative and insignificant in the full sample, positive and insignificant in the LDC sample, and significantly positive in the OECD sample.

There are also some changes in the magnitude of the estimated coefficients across samples. The level of private income and its rate of growth are always positively related to the private saving rate, but their estimated coefficients are smaller in the OECD (where the level effect is in fact insignificant, a pattern already found by Modigliani 1992) than in the LDC sample. This seems consistent with subsistence-consumption theories, which predict a higher impact of income and growth on saving rates at low levels of income. The size of the estimated coefficients of the demographic variables is uniformly smaller in the case of the OECD sample than in the LDC and full samples. This result likely reflects non-linear saving effects of the demographic variables, as well as the greater homogeneity across OECD populations in terms of urbanization and age structure. The private credit flow ratio also carries a considerably larger coefficient in the LDC subsample than in the OECD subsample. This is possibly due to the fact that credit constraints in developed countries are mostly non-binding, and therefore increases in private credit flows in these countries do not reflect improved credit availability.

Finally, it is puzzling that the coefficient on the public saving rate is found to be larger in the group of developing countries than in the OECD subsample. We would expect that the conditions for Ricardian equivalence to hold are more prevalent in industrial than in developing countries. The large estimated coefficient on the public saving ratio for the group of LDCs may reveal that, despite our best efforts, measurement error is partly driving the negative correlation between private and public saving rates. This is a likely possibility given that private saving was derived as the difference between national and public saving --any error in public saving would translate mechanically in an error of the opposite sign in private saving. If we assume the estimated public saving coefficient for the OECD sample as mostly free from measurement error, then we find a larger effect of public saving on national saving than reported above. A permanent increase in public saving of 4% of GNDI would lead to an increase in national saving of 3.6% of GNDI in the short run and 2.6% of GNDI in the long run. Interestingly, for both the industrial and developing country subsamples, Wald tests allow clear rejection of full long-run Ricardian offsetting, with p-values below 1 percent.

4.4 Alternative definitions of the public sector

Table 6 presents full-sample system-GMM estimation results using the four alternative definitions of the public sector introduced earlier. Up to now we have focused on the public sector definition that includes the general government and, when available, public enterprises; furthermore, the related saving and income data have been adjusted to account for the inflationary erosion of privately-held public liabilities. The results of this core regression, discussed above, are reproduced in Table 6, column 4, under the heading of "PA." The other columns make use instead of the three alternative public- (and private-) sector saving measures introduced earlier corresponding to, respectively, unadjusted central government (CU, column 1), adjusted central government (CA, column 2), and unadjusted consolidated public sector (PU, column 3). [25] Performing this robustness check for alternative public-sector measures is important given that differences in empirical results across different studies have often been attributed to differences in public sector definition.

Surprising to us, the estimated results are remarkably robust across definitions of the public sector. Concerning the adjusted and unadjusted data, this is not all that striking given that we have dropped from the sample the observations corresponding to extreme inflation episodes. In any case, Table 6 shows only one exception that deserves discussion.[26] The estimated coefficient on public saving is larger in the central government regressions than in those corresponding to the consolidated public sector. In fact, the "offset" coefficient is about 25% larger in the case of the central government, so that in the long run it reaches 72% and 95% in the CU and CA specifications, respectively, in contrast with the 58% and 69% that results from the PU and PA estimates. The straightforward explanation of this result is that there is a larger degree of offset between the central government and other public-sector levels (provincial and state governments and public enterprises) than between the consolidated public sector and the private sector. This in turn implies that studies of Ricardian equivalence based on a central-government definition of the public sector tend to overstate the public-private saving offset.

4.5 Additional explanatory variables

In Table 7, we add other potential private saving determinants, excluded from the "core" set of explanatory variables because they are either less commonly used in the literature or not well justified conceptually. We consider each variable in turn. The first one is *the current account deficit* (relative to private disposable income). While popular in the literature, the current account deficit is a somewhat dubious regressor, as it is jointly determined with saving in countries and/or at time periods characterized by unrestricted access to net foreign lending, and is exogenously determined otherwise. Thus, it is difficult to interpret the results obtained with this variable when using samples that combine observations on the two regimes (like ours and most others). In our case, we try to correct at least in part for these problems by treating the current account ratio as an endogenous variable in our GMM-IV procedure. The resulting estimates show that an increase in external saving (i.e., a worsening of the current account deficit) is partly offset by a decline of private saving; the offset coefficient is on the order of 33% in the short run, and about 60% in the long run. At face value, the implication is that an increase by, say, 2% of GNDI in the exogenous component of foreign lending reduces private saving by approximately 1.2% of GNDI in the long run. With the important caveat just noted, this agrees with the standard view that external saving acts as a substitute rather than as a complement to domestic private saving. The remaining coefficients show little change, although that on income growth becomes smaller in size.

The second variable is the *ratio of public investment to private disposable income*. If public investment is perceived to be just like public consumption, its estimated coefficient would be of equal magnitude but opposite sign as that for the public saving ratio. If it is viewed as productive investment, its coefficient would be zero. What we obtain, however, is a significantly negative coefficient. This suggests a somewhat puzzling complementarity between public and private goods, in the sense that an increase in government investment leads to an increase in private consumption. As before, the rest of the parameter estimates show little variation.

The third variable is the proxy for *income uncertainty* mentioned earlier, constructed as the standard error of the one-period-ahead forecast error from a univariate time-series model for income based on Maravall and Planas (1999).[27] Although its estimated coefficient has the positive sign expected from the precautionary saving motive, it is not statistically significant, likely reflecting the rudimentary nature of our constructed proxy. Fourth, we consider the effect of the *oil shocks* on private saving by including dummy variables for the years 1973, 1974, 1979, and 1980. Although the estimated coefficients for the four years are found to be negative (reflecting the predominance of oil importers in our sample), only those for the years 1973 and 1974 are significantly so;[28] the remaining coefficients are mostly unchanged. This result indicates that for the typical (oil-importing) country the temporary income loss due to a rise in oil prices leads to a decrease in saving rather than a downward adjustment of consumption.

Next, in columns 5 and 6 we analyze the effects of the permanent and temporary components of, respectively, private disposable income and the terms of trade. Note that the decomposition procedure causes the loss of some observations, which are used to estimate the underlying univariate models. Remarkably, in both cases we find that the size of the coefficient on the temporary component is much larger than that of the permanent component (although the latter maintains a positive sign). In the case of income, neither coefficient is significant, while both are in the case of the terms of trade.[29] a The larger impact on the saving rate of temporary income is consistent with consumption smoothing by forward-looking agents. In turn, the fact that the permanent component of the terms of trade retains a significant positive coefficient (although much smaller than that on the temporary component) might reflect the lack of access to external borrowing that many developing countries suffered during much of our sample period.

Finally, in column 7 we reexamine the effect of the real interest rate on saving by using in its calculation the current inflation rate, rather than the average of the current and next-year inflation rates, as done up to now. The sign and significance of the real interest rate coefficient remain as before, though its magnitude is larger. The remaining parameters are mostly unaffected, but the inflation rate now adopts a negative, though insignificant, coefficient, reflecting the strong correlation (-0.70) between the *ex-post* real interest rate and the inflation rate. This suggests that the larger coefficient on the former variable may be capturing in part the positive effect of inflation on the private saving rate found earlier.

4.5 National saving rate

Table 8 presents the full-sample results for national saving rate regressions obtained with alternative estimators. The table is analogous to Table 4, on the private saving rate, except for the fact that in the national saving rate regressions we do not include the public saving ratio as an explanatory variable. The maintained assumption in the national saving rate regressions is that the public saving rate is driven by the same determinants as the private saving rate (excluding public saving itself, of course). In spite of the much larger data samples used here, close comparison between these results and those obtained with the private saving rate reveals a remarkable similarity in terms of sign and significance of the estimated coefficients. Indeed, our preferred (GMM-system) estimates are basically the same for the private and national saving rates, with three differences of some relevance. First, the real interest rate still carries a negative coefficient, but it is not significant in the national saving rate regressions; second, the effect of the level of income is much larger in the case of the national saving rate; and third, the degree of persistence is lower for national than for private saving rates. In turn, the results obtained using alternative estimators are also quite similar for both dependent variables. We take this broad similarity, along with the fact that the theoretical literature provides a framework for the analysis of private saving decisions, as supportive of our choice to concentrate on the empirical determinants of the private saving rate.

5. Concluding Remarks

Private and national saving rates display very large variation across countries and over time. This paper has explored empirically the roles of policy variables and other factors in these large saving disparities. The paper adds to the recent literature that investigates the determinants of saving by estimating linear saving models encompassing a broad range of saving determinants on cross-country time-series information.

This paper extends the literature in several dimensions. First, it makes use of a new data set on saving and related macroeconomic variables, whose coverage in terms of countries and years is considerably broader than those used in previous literature. Second, it explores different dimensions of saving -- of the private sector and the nation. Third, it tries to correct for issues such as simultaneity and unobserved country-specific effects, making use of instrumental variable estimators based on “internal” instruments. Fourth, it performs extensive robustness checks to changes in estimation procedures, country samples, private-saving measures, and empirical specifications.

The empirical findings reported in the paper point toward a number of variables that drive saving in both industrial and developing countries and provide support to inferences on the effects of policies and their interplay with other variables that affect saving. The results are, in general, robust to the use of alternative saving definitions, specifications, and data subsamples.

References

Ahn, S. and P. Schmidt (1995): “Efficient Estimation of Models for Dynamic Panel Data,” *Journal of Econometrics* 68 (1): 5-27.

Alonso-Borrego, C. and M. Arellano (1996): “Symmetrically Normalised Instrumental Variable Estimation Using Panel Data,” *CEMFI Working Paper* No. 9612, September.

Altonji, J. and L. Segal (1994): “Small Sample Bias in GMM Estimation of Covariance Structures,” *NBER Technical Working Paper* No. 156.

Andersen, T.W. and Hsiao, C. (1982): “Formulation and Estimation of Dynamic Models using Panel Data,” *Journal of Econometrics* 18: 47-82.

Andrés, J. and Hernando (1998): “Does Inflation harm Economic Growth? Evidence from the OECD”, *NBER Working Paper* No. 6062, June.

Arellano, M. and Bond, S. (1991): “Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations,” *Review of Economic Studies* 58: 277-297.

Arellano, M. and Bover O. (1995): “Another Look at the Instrumental Variable Estimation of Error-Component Models,” *Journal of Econometrics* 68: 29-51.

Bailliu, J. and H. Reisen (1998): “Do Funded Pensions contribute to Higher Savings? A Cross-Country Analysis,” *OECD Development Centre manuscript*, Paris.

Baltagi, B. (1995): *Econometric Analysis of Panel Data*, New York: Wiley.

Baltagi, B. and Griffin, J. (1997): “Pooled Estimators vs. their heterogeneous counterparts in the context of dynamic demand for gasoline,” *Journal of Econometrics* 77: 303-327.

Barro, R. (1974): “Are Government Bonds Net Wealth?”, *Journal of Political Economy* 82: 1095-1117.

Blundell, R. and S. Bond (1997): “Initial Conditions and Moment Restrictions in Dynamic Panel Data Models,” *University College London Discussion* Paper 97-07.

Caselli, F., G. Esquivel and F. Lefort (1996): “Reopening the Convergence Debate: A New Look at Cross-Country Growth Empirics,” *Journal of Economic Growth* 1: 363-389.

Chamberlain, G. (1984): “Panel Data,” in: Handbook of Econometrics, Vol. 2, Eds: Z. Griliches and M.D. Intriligator, Elsevier, Amsterdam, 1984, pp. 1247-1313.

Corbo, V. and K. Schmidt-Hebbel (1991): “Public Policies and Saving in Developing Countries,” *Journal of Development Economics* 36 (July): 89-115.

Dayal-Ghulati, A. and C. Thimann (1997): “Saving in Southeast Asia and Latin America compared: Searching for Policy lessons,” *IMF Working Paper* WP/97/110.

Deaton, A. (1977): “Involuntary Saving through Unanticipated Inflation,” *American Economic Review* 67(5): 899-910.

Deininger, K. and L. Squire (1995): “Measuring Income Inequality: A New Data-Base,” *manuscript The World Bank,* December.

Easterly, W., N. Loayza and P. Montiel (1997): “Has Latin America’s Post Reform Growth Been Disappointing?”, *Journal of International Economics* 43(3/4): 287-312.

Edwards, S. (1996): “Why Are Latin America’s Savings Rates So Low? An International Comparative Analysis,” *Journal of Development Economics* 51(1): 5-44.

Faijnzylber, P., D. Lederman and N. Loayza (1998): “What Causes Violent Crime?,” World Bank *manuscript*.

Feldstein, M. and C. Horioka (1980): “Domestic Savings and International Capital Flows”, *Economic Journal* 90: 314-29.

Fischer, S. (1993): “The Role of Macroeconomic Factors in Growth,” *Journal of Monetary Economics* 32 (3): 485-512.

Griliches, Z. and J. Hausman (1986): “Errors in Variables in Panel Data,” *Journal of Econometrics*, 31(1): 93-118.

Hansen, L. (1982): “Large Sample Properties of Generalized Method of Moments Estimators,” *Econometrica* 50: 1029-1054.

Haque, N.U., M.H. Pesaran, and S. Sharma (1999): “Neglected Heterogeneity and Dynamics in Cross-Country Savings Regressions”, *IMF Working Paper*, International Monetary Fund, Washington, DC, May.

Holtz-Eakin, D., W. Newey and H. Rosen (1990): “Estimating Vector Autoregressions with Panel Data,” *Econometrica* 56 (6): 1371-1395.

Japelli, T. and M. Pagano (1994): “Saving, Growth, and Liquidity Constraints”, *Quarterly Journal of Economics* 109: 83-109.

Kiviet, J.F. (1995): “On Bias, Inconsistency, and Efficiency of various Estimators in Dynamic Panel Data Models”, *Journal of Econometrics* 68: 53-78.

Levine, R., N. Loayza, and T. Beck (1999): “Financial Intermediation and Growth: Casusality and Causes”, *Journal of Monetary Economics*, forthcoming.

Loayza, N., H. López, K. Schmidt-Hebbel, and L. Servén (1998a): “The World Saving Database,” *World Bank manuscript*, The World Bank, Washington, DC.

Loayza, N., H. López, K. Schmidt-Hebbel, and L. Servén (1998b): “Saving in the World: Facts, Trends, Correlations,” *manuscript presented at the World Bank Conference on Saving in The World: Puzzles and Policies*, The World Bank, Washington, DC, Sep. 16-18.

Loayza, N., K. Schmidt-Hebbel and L. Servén (1998): ”What drives Saving across the World?”, *manuscript presented at the World Bank Conference on Saving in The World: Puzzles and Policies*, The World Bank, Washington, DC, Sep. 16-18.

López, H., K. Schmidt-Hebbel and L. Servén (1998): “How effective is Fiscal policy in raising National Saving?”, *manuscript presented at the World Bank Conference on Saving in The World: Puzzles and Policies*, The World Bank, Washington, DC, Sep. 16-18.

Maravall, A. and Planas, C. (1997): “Estimation Error and the Specification of Unobserved Component Models,” *Banco de Espana Documento de Trabajo* No. 9608.

Masson, P., T. Bayoumi and H. Samiei (1995): “Saving Behavior in Industrial and Developing Countries,” *IMF manuscript*.

Modigliani, F. “Saving in Developing Countries: Income, Growth and Other Factors”, *Pacific Basin Capital Markets Research* 3: 23-35.

Schmidt-Hebbel, K. and L. Servén (1997): “Saving across the World: Puzzles and Policies,” *World Bank Discussion Paper* No. 354.

Schmidt-Hebbel, K. and L. Servén (1999*): The Economics of Saving and Growth: Theory, Evidence, and Implications for Policy*. Cambridge: Cambridge University Press.

White, H. (1982): “Instrumental Variables Regression with Independent Observations,” *Econometrica* 50: 483-499.

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 (4).

Endnotes

[1] In a companion paper, López, Loayza, Schmidt-Hebbel and Servén (1998b) provide a detailed description of the basic data set, including descriptive statistics and stylized facts.
[2] We note from the outset that these equations are anchored in private consumption (or saving) theory. When applying the model to national saving measures we implicitly assume that public saving is determined by the variables that drive private saving. We, thus, abstract from a separate behavioral framework for public-sector saving. This is consistent with both the standard practice of empirical studies for aggregate (national) saving and the lack of an established theory of public saving.
[3] A detailed discussion of expected signs of saving determinants in Table 1 and how they relate to specific consumption theories is in Loayza, Schmidt-Hebbel and Servén (1998). Further reviews of consumption hypotheses and their relation to empirical findings can be found in Schmidt-Hebbel and Servén (1997, 1999).
[4] Like in other areas of empirical work, consumption studies face a steep trade-off in the choice between closed-form solutions rigorously derived from (typically narrow) consumption optimization models, and atheoretical specifications encompassing a large number of consumption determinants. In line with the objectives of this paper, here we limit our attention to international studies using panel data and based on the latter approach.
[5] Full details on data sources are given in the companion paper by Loayza et al. (1998a).
[6] The reason is that minor changes in the computation method (e.g., regarding the time within each year at which prices and public debt are measured) can result in huge changes in the adjusted saving measures.
[7] As robustness check, we worked with an alternative bound of 75% annual inflation. This reduces the number of observations discarded (14 instead of 49) and leads to estimates very similar to those reported in the paper, but at the cost of reduced precision. A second robustness check (presented in the section on "alternative samples" in the main text) consisted of restricting the sample so that the data points for *each variable* lie between 4 standard deviations from the respective mean. The corresponding estimation results are quite similar to those obtained with the 50% inflation bound. In turn, raising the threshold for each variable to 5 standard deviations leads to estimates and precision analogous to those obtained with the 75% inflation bound.
[8] In some variants of the basic specification, actual sample sizes are smaller (as reported in at the bottom of Tables 4-8 below) due to the more limited data availability on some of the 'additional' regressors.
[9] Qualitatively, this departs from convention by adding together current and capital transfers from abroad (typically, only the former are included in saving measures) -- a decision guided by the fact that they are not separately available until the late 1970s. Quantitatively, however, this makes little difference because in the light of the available data capital transfers from abroad appear insignificant for virtually every country and year, with the only exception of 17 observations, most of them from small-island economies that are anyway excluded form the samples used in this paper. See Loayza, López, Schmidt-Hebbel and Servén (1998a) for more details.
[10] The limited availability of good-quality annual information across countries on pension systems and measures of income inequality prevents us from including these variables in our core specification.
[11] Since stocks are typically measured at the end of the year, we compute our ratios to income using the average of the current and previous year stocks (the latter having being brought to current year prices). Flows are in turn obtained as differences of stocks for two consecutive years.
[12] While seldom considered in empirical studies, saving inertia can arise directly from consumption habits and even from consumption smoothing. For example, with a quadratic utility function *a la* Hall (1978), if income follows an AR(1) process then saving will also be AR(1). In our sample, the first-order autocorrelation coefficient of the private saving rate is 0.88.
[13] The Generalized Method of Moments (GMM) estimator was proposed by Chamberlain (1984), Holtz-Eakin, Newey and Rosen (1988), Arellano and Bond (1991), and Arellano and Bover (1995), and has been applied to cross-country studies by, among others, Caselli, Esquivel and Lefort (1996), Easterly, Loayza and Montiel (1997), and Fajnzylber, Lederman, and Loayza (1998). For a concise presentation of the GMM estimator, see chapter 8 of Baltagi (1995).
[14] Time dummies can also be included in equation (1) to account for time-specific effects.
[15] The assumption that the error term is not serially correlated can be relaxed and replaced by the assumption that it follows a finite-order moving average process. In this case, the moment conditions must be modified

accordingly. For example, if e is MA(1) (as it appears to be in some of our private saving regressions below) the moment conditions in equations (3) and (4) must be replaced by,

$$E\left[s_{i,t-s}\cdot(e_{i,t}-e_{i,t-1})\right] = 0 \quad for\ s\geq 3;\ t=3,\ldots,T \qquad (3')$$

$$E[X_{i,t-s}\cdot(e_{i,t}-e_{i,t-1})]=0 \quad for\ s\geq 3;\ t=3,\ldots,T \qquad (4')$$

[16] As the variables' persistence increases, the asymptotic variance of the coefficients obtained with the *difference* estimator rises (that is, the asymptotic precision of this estimator deteriorates). Furthermore, Monte Carlo experiments show that the weakness of the instruments produces biased coefficients in small samples. This bias rises with the variables' over-time persistence and the importance of the country-specific effect and declines with the size of the time-series dimension. An additional problem with the simple *difference* estimator relates to measurement error, namely, differencing may exacerbate the bias due to errors in variables by decreasing the signal-to-noise ratio (see Griliches and Hausman, 1986).

[17] Given that lagged levels are used as instruments in the differences specification, only the most recent difference is used as instrument in the levels specification. Using other lagged differences would result in redundant moment conditions (see Arellano and Bover 1995).

[18] Equations (7) and (8) give the appropriate moment conditions when the error term, e, is serially uncorrelated. If, however, the error term follows a moving average process of order 1, then the appropriate differences to be used as instruments must be lagged one more period.

[19] We are grateful to Stephen Bond for providing us with a computer program (DPD version 8/8/96) to apply his and Arellano's estimator to an unbalanced panel data set.

[20] In this paper the moment conditions are applied such that each of them corresponds to all available periods, as opposed to each moment condition corresponding to a particular time period. In the former case the number of moment conditions is independent of the number of time periods, whereas in the latter case, it increases more than proportionally to the number of time periods. Most of the literature dealing with GMM estimators applied to dynamic models of panel data treats the moment conditions as applying to a particular time period. This approach is advocated on the grounds that it allows for a more flexible variance-covariance structure of the moment conditions (see Ahn and Schmidt 1995); such flexibility is achieved without placing a serious limitation on the degrees of freedom required for estimation of the variance-covariance matrix because the panels commonly used in the literature have both a large number of cross-sectional units and a small number of time-series periods (typically not more than five). We have, however, chosen to work with the more restricted application of the moment conditions (each of them corresponding to all available time periods) because of a special characteristic of our panel, namely, its large time-series dimension (well in excess of the time dimension usually encountered in micro panels). This approach allows us to work with a manageable number of moment conditions, in a way such that the second-step estimates, which rely on estimation of the variance-covariance matrix of the moment conditions, do not suffer from over-fitting biases (see Altonji and Segal 1994, and Ziliak 1997).

[21] Both the Sargan statistic and the "difference" Sargan statistic are asymptotically distributed as Chi-square under the null hypothesis of validity of their respective instruments. The number of degrees of freedom of the Sargan test is equal to the number of overidentifying restrictions of the *system* estimator. The number of degrees of freedom of the "difference" Sargan test is given by the number of additional restrictions in the *system* estimator with respect to the *difference* estimator, that is, the difference between the number of overidentifying restrictions of the system estimator and that of the difference estimator.

[22] However, if the test rejects the null hypothesis of no second-order serial correlation but fails to reject the null of absence of third-order serial correlation, we conclude that the original error term is MA(1) and, therefore, use the moment conditions appropriate to this case. As shown below, in the private saving regressions we find in some cases evidence that the error term is MA(1) and, in others, that it is serially uncorrelated; for purposes of comparability across regressions we adopt the conservative strategy of choosing the instrument sets for the regressions as if the error term were always MA(1). In the case of national saving, we find that the error term can be well characterized as serially uncorrelated, and we choose the instrument set accordingly.

[23] Deaton (1977) finds the same result but proposes a somewhat different explanation: to the extent that the increase in inflation is unanticipated, a larger saving rate may result from confusing the increase in the overall price level with a rise in the relative prices of certain goods.

[24] It seems plausible that measured real interest rates are more closely related to intertemporal decisions in the industrial countries (where the sample mean of the real interest rate is positive) than in developing countries (where it is negative).

[25] The sources of central government data are different from those of public sector data. The former cover many more countries but fewer years (from 1970 on only). For comparability, all the regressions in the table use the same set of countries, and hence the central government-based saving regressions possess fewer observations.

[26] The second exception is that M2/GNP has a positive and significant coefficient only in the regressions corresponding to the central government definition of the public sector.

[27] Using instead the variance of the forecast error to measure uncertainty yielded similar results.

[28] Other year dummies, when added to the regressions, were likewise insignificant.

[29] Other experiments using instead the Hodrick-Prescott decomposition yielded qualitatively similar results: larger coefficients on the temporary than on the permanent components of both variables (the latter was in fact negative for the terms of trade), but in this case all significantly different from zero.

Table 1:Determinants of the Private Saving Ratio to Income in Previous Panel Studies

Variable Category	Specific Variable	Expected Sign	Empirical Findings
Income	Income level: actual Temporary / permanent	0 or + + / 0 or +	+ (1, 2 , 3, 4) 0 (5, 6)
	Terms of trade: actual Temporary / permanent	0 or + + / 0 or +	+ (2, 4, 6)
	Growth rate: actual	Ambiguous	+ (2, 3) 0 (4, 5, 6)
Rates of return	Interest rate	Ambiguous	0 (1, 3, 5, 6) + (2)
Uncertainty	Variance of innovations to saving determinants Inflation or other measures of macro instability Measures of political instability	+ + +	– (4) 0 (1, 2, 3, 6)
Domestic borrowing constraints	Private credit flows Broad money flows Income	– – –	+ (3)
Foreign borrowing constraints	Foreign lending Current account deficit	– –	– (1, 2, 3)
Financial depth	Private or domestic credit stocks Money stocks	Ambiguous Ambiguous	– (5) + (1, 3, 4)
Fiscal policy	Public saving Public surplus Public consumption	– – Ambiguous	– (1, 3) – (2, 5, 6) 0 (4) – (2, 6)
Pension system	Pay-as-you-go pension transfers to old Mandatory fully-funded pension system contributions Fully funded pension assets	0 or – 0 or + Ambiguous	– (3, 4, 5) + (4) 0 / + (5)
Demographics	Old and/or young-age population dependency Urbanization	– Ambiguous	– (2, 3, 4) 0 (5, 6) – (3)
Income and wealth distribution	Income concentration Wealth concentration Capital income share	+ + +	0 (3)

Note: the qualitative results listed in the last column of this table summarize significant signs of saving regressors in the corresponding tables and columns of the following five studies: 1. Corbo and Schmidt-Hebbel (1991) (Table 4); 2. Masson, Bayoumi, and Samiei (1995) (Table 2, "restricted model" column); 3. Edwards (1996) (Table 2, column 5); 4. Dayal-Ghulati and Thimann (1997) (Table 4, column 2); 5. Bailliu and Reisen (1998) (Table 1, columns 3 and 4); and 6. Haque, Pesaran, and Sharma (1999) (Table 6, columns 4 and 5). Significant coefficient signs are identified by a plus or a minus. Results identified by a zero mean either an insignificant coefficient in the corresponding column of the original study or, when the variable is omitted from the particular specification reported in the column, a significant or insignificant variable in a different column of the same table.

Table 2

(a) Sample composition

	All	LDC	OECD
1970-79	267	132	135
1980-89	436	251	185
1990-95	169	92	77
Total	872	475	397

(b) Correlation matrix of alternative saving rate definitions

(Full sample: upper triangle. Cross section: lower triangle)

	GNS / GNDI	GPS/ GPDI (PA)	GPS/ GPDI (PU)	GPS/ GPDI (CA)	GPS/ GPDI (CU)
GNS/GNDI	1.00	0.82	0.82	0.85	0.85
GPS/GPDI (PA)	*0.89*	1.00	0.95	0.94	0.91
GPS/GPDI (PU)	*0.92*	*0.96*	1.00	0.92	0.96
GPS/GPDI (CA)	*0.94*	*0.94*	*0.95*	1.00	0.97
GPS/GPDI (CU)	*0.94*	*0.91*	*0.97*	*0.98*	1.00

(c) Saving Ratios: Descriptive statistics

(Full sample)

	Mean	Std Dev	Min	Max
GNS/GNDI	0.206	0.075	-0.147	0.486
GPS/GPDI (PA)	0.193	0.083	-0.253	0.461
GPS/GPDI (PU)	0.215	0.081	-0.077	0.462
GPS/GPDI (CA)	0.210	0.085	-0.166	0.457
GPS/GPDI (CU)	0.226	0.084	-0.166	0.466

Note: Approximate standard errors are 0.031 for the full-sample correlations and 0.118 for the cross-section correlations.

GNS = Gross National Saving, GNDI = Gross National Disposable Income.
GPS = Gross Private Saving, GPDI = Gross Private Disposable Income (4 alternative definitions, as in the text).

Table 3

Correlation matrix of core private saving determinants

(Full sample: upper triangle. Cross section: lower triangle)

	GPS/GPDI	Real GPDI	Real GPDI growth	Real int. rate	M2/GNP	Terms of Trade	Urbanization ratio	Old dependency	Young dependency	Gvt. Saving / GPDI	Pr.Cr. Flow / GPDI	Inflation rate
GPS/GPDI	1.00	0.52	0.38	0.22	0.42	0.03	0.36	0.33	-0.51	-0.13	0.21	-0.36
Real GPDI	*0.66*	1.00	0.12	0.14	0.52	-0.11	0.84	0.83	-0.88	-0.11	0.16	-0.25
Real GPDI growth	*0.58*	*0.41*	1.00	0.25	0.14	0.14	0.10	0.06	-0.15	-0.09	0.22	-0.31
Real int. rate	*0.41*	*0.26*	*0.42*	1.00	0.20	0.03	0.12	0.14	-0.23	-0.25	0.23	-0.63
M2/GNP	*0.58*	*0.60*	*0.52*	*0.31*	1.00	-0.09	0.41	0.48	-0.62	-0.02	0.18	-0.36
Terms of Trade	*-0.26*	*-0.15*	*-0.01*	*0.00*	*-0.05*	1.00	-0.03	-0.13	0.10	0.17	0.04	-0.04
Urbanization ratio	*0.48*	*0.87*	*0.35*	*0.15*	*0.48*	*-0.09*	1.00	0.65	-0.75	-0.01	0.14	-0.16
Old dependency	*0.48*	*0.79*	*0.29*	*0.18*	*0.64*	*-0.11*	*0.62*	1.00	-0.85	-0.18	0.06	-0.24
Young dependency	*-0.63*	*-0.86*	*-0.46*	*-0.22*	*-0.70*	*0.12*	*-0.75*	*-0.87*	1.00	0.07	-0.18	0.28
Gvt. Saving / GPDI	*0.02*	*0.13*	*0.14*	*0.01*	*0.09*	*0.04*	*0.27*	*0.00*	*-0.07*	1.00	0.16	0.26
Pr. Credit flow / GPDI	*0.59*	*0.43*	*0.62*	*0.29*	*0.48*	*-0.05*	*0.43*	*0.25*	*-0.44*	*0.31*	1.00	-0.33
Inflation rate	*-0.36*	*-0.20*	*-0.31*	*-0.56*	*-0.48*	*-0.02*	*0.01*	*-0.20*	*0.18*	*0.03*	*-0.23*	1.00

Descriptive statistics

(Full sample)

	Mean	Std Dev	Min	Max
GPS/GPDI	0.201	0.081	-0.253	0.461
Real GPDI	7.898	1.314	4.655	9.729
Real GPDI growth	0.019	0.055	-0.317	0.374
Real int. rate	0.000	0.074	-0.404	0.262
M2/GNP	0.491	0.236	0.128	1.466
Terms of Trade	0.017	0.152	-0.765	0.705
Urbanization ratio	0.595	0.229	0.055	1.000
Old dependency	0.129	0.068	0.047	0.276
Young dependency	0.535	0.221	0.227	0.992
Gvt. Saving / GPDI	0.070	0.069	-0.112	0.475
Pr. Credit flow / GPDI	0.032	0.058	-0.210	0.496
Inflation rate	0.089	0.076	-0.379	0.401

Note: Approximate standard errors are 0.034 for the full sample correlations and 0.118 for the cross-section correlations.

Table 4

Private saving: Alternative estimators, full sample
(Dependent variable: Gross private saving/GPDI)

	1	2	3	4	5	6
Estimator	**OLS-CS**	**OLS-Static**	**OLS-Pool**	**Within**	**GMM-Diff**	**GMM-Syst**
Regression	Levels	Levels	Levels	Devia.	Differences	Levs - Diffs
Instruments	-	-	-	from mean	Levels	Diffs - Levs
Lagged private saving rate	-	-	0.832	0.570	0.302	0.587
			(28.12)	(14.699)	(3.855)	(9.254)
Real per-capita GPDI[a/]	0.046	0.048	0.010	0.068	0.069	0.049
	(3.925)	(4.108)	(2.868)	(4.914)	(2.877)	(2.458)
Real growth rate of per-capita GPDI[b/]	0.480	0.300	0.406	0.340	0.271	0.450
	(0.971)	(5.008)	(8.62)	(8.062)	(3.741)	(5.828)
Real interest rate[a/ c/]	0.154	-0.122	0.032	0.049	-0.401	-0.253
	(0.982)	(-1.964)	(1.347)	(1.242)	(-5.588)	(-5.011)
M2/GNP	0.041	0.044	0.012	-0.035	-0.171	-0.020
	(1.168)	(1.845)	(1.301)	(-2.227)	(-4.139)	(-0.562)
Terms of trade[a/]	-0.089	0.009	0.006	0.036	0.109	0.078
	(-3.142)	(0.468)	(0.848)	(3.661)	(5.676)	(5.096)
Urbanization ratio	-0.127	-0.115	-0.023	0.004	-0.070	-0.382
	(-2.5)	(-3.229)	(-1.939)	(0.045)	(-0.508)	(-3.538)
Old dependency ratio	-0.437	-0.623	-0.086	-0.249	-0.168	-0.655
	(-2.353)	(-3.477)	(-2.16)	(-2.252)	(-0.638)	(-3.069)
Young dependency ratio	-0.107	-0.143	-0.012	0.104	-0.155	-0.299
	(-1.685)	(-2.102)	(-0.815)	(2.437)	(-1.846)	(-4.017)
Government saving/GPDI	-0.201	-0.065	-0.057	-0.154	-0.203	-0.285
	(-0.976)	(-0.89)	(-2.367)	(-4.605)	(-2.618)	(-5.097)
Private credit flow/GPDI	0.904	-0.003	-0.129	-0.114	-0.192	-0.318
	(2.029)	(-0.058)	(-4.312)	(-3.772)	(-2.188)	(-3.989)
Inflation rate[a/ c/]	-0.031	-0.187	0.052	0.123	-0.134	0.143
	(-0.212)	(-2.918)	(1.61)	(2.503)	(-1.514)	(2.034)
Wald test of joint significance (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
Sargan test (p-value)	-	-	-	-	0.291	0.400
Test for 1st-order serial correlation (p-value)	-	0.000	0.095	0.000	0.033	0.001
Test for 2nd-order serial correlation (p-value)	-	0.000	0.578	0.922	0.081	0.121
Test for 3d-order serial correlation (p-value)	-	0.000	0.081	0.146	0.873	0.221
Number of observations (Number of countries)	72 (72)	1148 (69)	1079 (69)	1010 (69)	872 (69)	872 (69)

Notes: T-statistics (in brackets) computed with heteroskedasticity-consistent standard errors.

[a/] Expressed in logs (log of [1+x] for the real interest rate and the inflation rate)
[b/] Measured by the first difference of the log
[c/] Both the real interest rate and the inflation rate are bounded between -50% and 50%

Table 5

Private saving: Alternative samples, system estimator
(Dependent variable: Gross private saving/GPDI)

	1	**2**	**3**	**4**
Sample	**Full**	**Bounded***	**LDC**	**OECD**
Lagged private saving rate	0.587 (9.254)	0.494 (10.330)	0.476 (17.820)	0.674 (12.704)
Real per-capita GPDI[a/]	0.049 (2.458)	0.035 (2.408)	0.071 (7.473)	0.013 (0.382)
Real growth rate of per-capita GPDI[b/]	0.450 (5.828)	0.379 (6.103)	0.425 (13.282)	0.285 (2.036)
Real interest rate[a/ c/]	-0.253 (-5.011)	-0.162 (-3.408)	0.002 (.084)	0.020 (0.313)
M2/GNP	-0.020 (-0.562)	-0.007 (-0.262)	0.024 (1.001)	0.028 (1.989)
Terms of trade[a/]	0.078 (5.096)	0.060 (5.921)	0.044 (4.875)	0.068 (3.641)
Urbanization ratio	-0.382 (-3.538)	-0.241 (-3.452)	-0.240 (-5.101)	-0.080 (-1.751)
Old dependency ratio	-0.655 (-3.069)	-0.555 (-4.531)	-1.370 (-4.321)	-0.218 (-1.42)
Young dependency ratio	-0.299 (-4.017)	-0.275 (-5.607)	-0.279 (-5.816)	-0.068 (-0.639)
Government saving/GPDI	-0.285 (-5.097)	-0.172 (-3.782)	-0.238 (-8.333)	-0.112 (-2.782)
Private credit flow/GPDI	-0.318 (-3.989)	-0.316 (-5.791)	-0.508 (-9.955)	-0.085 (-2.427)
Inflation rate[a/ c/]	0.143 (2.034)	0.127 (3.325)	0.177 (4.181)	0.157 (2.963)
Wald test of joint significance (p-value)	0.000	0.000	0.000	0.000
Sargan test (p-value)	0.400	0.174	0.292	0.942
Test for 1st-order serial correlation (p-value)	0.001	0.001	0.000	0.013
Test for 2nd-order serial correlation (p-value)	0.121	0.362	0.690	0.157
Test for 3d-order serial correlation (p-value)	0.221	0.404	0.353	0.889
Number of observations (Number of countries)	872 (69)	845 (73)	475 (49)	397 (20)

Notes: T-statistics (in brackets) computed with heteroskedasticity-consistent standard errors.

* Observations more than 4 Standard Deviations away from mean of variables are dropped.
[a/] Expressed in logs (log of [1+x] for the real interest rate and the inflation rate)
[b/] Measured by the first difference of the log
[c/] Both the real interest rate and the inflation rate are bounded between -50% and 50%

Table 6

Private saving: Alternative definitions of the private sector, full sample, system estimator
(Dependent variable: Gross private saving/GPDI)

	1	2	3	4
Private sector definition	**CU**	**CA**	**PU**	**PA**
Lagged private saving rate	0.593	0.582	0.483	0.587
	(11.921)	(13.697)	(6.734)	(9.254)
Real per-capita GPDI[a/]	0.046	0.029	0.043	0.049
	(3.345)	(1.912)	(2.412)	(2.458)
Real growth rate of per-capita GPDI[b/]	0.481	0.493	0.472	0.450
	(8.943)	(9.969)	(6.274)	(5.828)
Real interest rate[a/ c/]	-0.135	-0.108	-0.249	-0.253
	(-2.165)	(-1.59)	(-4.949)	(-5.011)
M2/GNP	0.085	0.062	-0.026	-0.020
	(3.374)	(2.783)	(-0.787)	(-0.562)
Terms of trade[a/]	0.078	0.080	0.062	0.078
	(5.324)	(6.529)	(4.500)	(5.096)
Urbanization ratio	-0.197	-0.104	-0.337	-0.382
	(-3.207)	(-1.563)	(-3.481)	(-3.538)
Old dependency ratio	-0.873	-0.752	-0.578	-0.655
	(-4.934)	(-4.084)	(-3.273)	(-3.069)
Young dependency ratio	-0.148	-0.160	-0.321	-0.299
	(-2.411)	(-2.732)	(-4.375)	(-4.017)
Government saving/GPDI	-0.296	-0.388	-0.238	-0.285
	(-7.101)	(-10.982)	(-4.437)	(-5.097)
Private credit flow/GPDI	-0.297	-0.251	-0.245	-0.318
	(-4.624)	(-4.897)	(-3.392)	(-3.989)
Inflation rate[a/ c/]	0.219	0.247	0.164	0.143
	(3.636)	(4.17)	(2.548)	(2.034)
Wald test of joint significance (p-value)	0.000	0.000	0.000	0.000
Sargan test (p-value)	0.356	0.400	0.442	0.400
Test for 1st-order serial correlation (p-value)	0.000	0.000	0.002	0.001
Test for 2nd-order serial correlation (p-value)	0.168	0.190	0.159	0.121
Test for 3d-order serial correlation (p-value)	0.087	0.099	0.257	0.221
Number of observations (Number of countries)	774 (69)	746 (69)	880 (69)	872 (69)

Notes: T-statistics (in brackets) computed with heteroskedasticity-consistent standard errors.

[a/] Expressed in logs (log of [1+x] for the real interest rate and the inflation rate)
[b/] Measured by the first difference of the log
[c/] Both the real interest rate and the inflation rate are bounded between -50% and 50%

Table 7

Private saving: Additional explanatory variables, full sample, system estimator
(Dependent variable: Gross private saving/GPDI)

Additional variables	1 **Curr. Account Deficit**	2 **Govt. Investment**	3 **Income Uncertainty**	4 **Oil Crisis Dummy**	5 **Income Perm.- Temp.**	6 **TOT Perm.-Temp.**	7 **Ex-post Real interest**
Lagged private saving rate	0.435	0.587	0.529	0.614	0.615	0.702	0.577
	(10.873)	(14.233)	(13.733)	(12.069)	(12.818)	(17.109)	(9.362)
Real per-capita GPDI[a/]	0.049	0.025	0.033	0.042	-	0.037	0.038
	(3.535)	(1.240)	(1.847)	(2.469)		(2.647)	(1.640)
Real growth rate of per-capita GPDI[b/]	0.288	0.317	0.417	0.462	0.384	0.381	0.431
	(6.117)	(5.25)	(10.652)	(6.516)	(5.494)	(9.085)	(4.679)
Real interest rate[a/ c/]	-0.143	-0.242	-0.203	-0.223	-0.194	-0.072	-0.386
	(-3.774)	(-8.412)	(-6.178)	(-5.328)	(-7.235)	(-2.379)	(-4.213)
M2/GNP	0.028	-0.031	-0.045	-0.011	0.002	0.041	-0.052
	(1.192)	(-1.144)	(-1.649)	(-0.363)	(0.084)	(2.000)	(-1.481)
Terms of trade[a/]	0.041	0.093	0.068	0.069	0.084	-	0.047
	(3.946)	(7.374)	(5.747)	(5.960)	(8.469)		(3.605)
Urbanization ratio	-0.205	-0.271	-0.363	-0.347	-0.283	-0.274	-0.308
	(-2.848)	(-3.077)	(-4.269)	(-3.989)	(-3.846)	(-3.774)	(-3.553)
Old dependency ratio	-0.95	-1.009	-0.552	-0.593	-0.225	-0.593	-0.653
	(-5.841)	(-4.151)	(-4.486)	(-3.637)	(-1.401)	(-3.878)	(-2.510)
Young dependency ratio	-0.231	-0.454	-0.397	-0.294	-0.350	-0.204	-0.289
	(-5.021)	(-7.084)	(-7.426)	(-4.963)	(-6.424)	(-4.924)	(-3.746)
Government saving/GPDI	-0.306	-0.277	-0.251	-0.286	-0.156	-0.174	-0.297
	(-7.073)	(-5.034)	(-5.244)	(-5.423)	(-3.265)	(-4.307)	(-4.528)
Private credit flow/GPDI	-0.075	-0.290	-0.246	-0.266	-0.376	-0.378	-0.222
	(-1.364)	(-3.726)	(-5.896)	(-3.871)	(-5.805)	(-6.932)	(-2.409)
Inflation rate[a/ c/]	0.107	0.067	0.137	0.175	0.106	0.164	-0.104
	(2.506)	(1.525)	(2.893)	(2.742)	(2.556)	(4.420)	(-0.924)
Current account deficit/GPDI	-0.329	-	-	-	-	-	-
	(-9.443)						
Government investment/GPDI	-	-0.251	-	-	-	-	-
		(-6.802)					
Future income uncertainty proxy[d/]	-	-	0.007	-	-	-	-
			(0.049)				
Oil crisis dummy[e/]	-	-	-	-0.011	-	-	-
				(-3.770)			
Permanent (log) real per capita GPDI	-	-	-	-	0.005	-	-
					(0.277)		
Temporary (log) real per capita GPDI	-	-	-	-	0.160	-	-
					(1.404)		
Permanent (log) terms of trade	-	-	-	-	-	0.058	-
						(5.298)	
Temporary (log) terms of trade	-	-	-	-	-	0.177	-
						(9.974)	
Wald test of joint significance (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sargan test (p-value)	0.268	0.475	0.547	0.450	0.918	0.372	0.505
Test for 1st-order serial correlation (p-value)	0.001	0.001	0.000	0.000	0.000	0.000	0.002
Test for 2nd-order serial correlation (p-value)	0.378	0.159	0.328	0.127	0.287	0.196	0.229
Test for 3d-order serial correlation (p-value)	0.147	0.129	0.256	0.176	0.125	0.188	0.120
Number of observations (Number of countries)	872 (69)	673 (62)	777 (60)	872 (69)	779 (62)	858 (66)	872 (69)

Notes: T-statistics (in brackets) computed with heteroskedasticity-consistent standard errors.
[a/] Expressed in logs (log of [1+x] for the real interest rate and the inflation rate)
[b/] Measured by the first difference of the log
[c/] Both the real interest rate and the inflation rate are bounded between -50% and 50%
[d/] Square of one-period ahead forecast error
[e/] In the regression of Column 4, we considered 4 time dummies corresponding to the oil crisis years 1973, 1974, 1979 and 1980. Although all four coefficients were found to be negative, only those for the years 1973 and 1974 were significant. The coefficient reported in the table corresponds to the 1974 Dummy variable.

Table 8

National saving rate: Alternative estimators, full sample
(Dependent variable: Gross national saving/GNDI)

	1	2	3	4	5
Estimator	**OLS-CS**	**OLS-Pool**	**Within**	**GMM-Diff**	**GMM-Syst**
Regression	Levels	Levels	Devia.	Differences	Levs - Diffs
Instruments	-	-	from mean	Levels	Diffs - Levs
Lagged national saving rate	-	0.802	0.572	0.378	0.381
		(34.2)	(19.054)	(6.143)	(6.650)
Real per-capita GNDI[a/]	0.043	0.008	0.064	0.070	0.102
	(5.012)	(3.009)	(5.255)	(1.501)	(2.685)
Real growth rate of per-capita GNDI[b/]	0.878	0.285	0.271	0.249	0.447
	(3.216)	(9.459)	(10.07)	(2.573)	(4.831)
Real interest rate[a/ c/]	0.023	0.0121	0.016	-0.333	-0.136
	(0.288)	(0.669)	(0.649)	(-2.503)	(-1.215)
M2/GNP	0.089	0.021	-0.031	-0.154	-0.019
	(2.854)	(3.109)	(-2.236)	(-2.504)	(-0.410)
Terms of trade[a/]	-0.032	0.015	0.045	0.084	0.057
	(-1.242)	(2.031)	(4.746)	(5.753)	(5.243)
Urbanization ratio	-0.044	-0.020	-0.048	0.031	-0.500
	(-1.416)	(-2.062)	(-1.107)	(0.383)	(-3.373)
Old dependency ratio	-0.571	-0.133	-0.480	-0.343	-0.772
	(-3.537)	(-3.409)	(-4.599)	(-1.225)	(-1.687)
Young dependency ratio	-0.016	-0.020	0.051	-0.066	-0.156
	(-0.365)	(-1.985)	(2.100)	(-.823)	(-2.236)
Domestic credit flow/GNDI	0.061	-0.118	-0.107	-0.365	-0.359
	(0.209)	(-4.508)	(-4.473)	(-3.764)	(-4.136)
Inflation rate[a/ c/]	-0.012	0.104	0.148	-0.016	0.180
	(-0.131)	(3.977)	(4.232)	(-0.174)	(2.044)
Wald test of joint significance (p-value)	0.000	0.000	0.000	0.000	0.000
Sargan test (p-value)	-	-	-	0.070	0.156
Test for 1st-order serial correlation (p-value)	-	0.033	0.000	0.000	0.000
Test for 2nd-order serial correlation (p-value)	-	0.340	0.357	0.248	0.174
Test for 3d-order serial correlation (p-value)	-	0.189	0.610	0.149	0.260
Number of observations (Number of countries)	102 (102)	1836 (98)	1738 (98)	1640 (98)	1640 (98)

Notes: T-statistics (in brackets) computed with heteroskedasticity-consistent standard errors.

[a/] Expressed in logs (log of [1+x] for the real interest rate and the inflation rate)
[b/] Measured by the first difference of the log
[c/] Both the real interest rate and the inflation rate are bounded between -50% and 50%

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