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International Evidence on the
Determinants of Private Saving

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Abstract

A broad set of possible determinants of private saving behavior is examined, using data for a large sample of industrial and developing countries. Both time-series and cross-section estimates are obtained. Results suggest that there is a partial offset on private saving of changes in public saving and (for developing countries) in foreign saving, that demographics and growth are important determinants of private saving rates, and that interest rates and terms of trade have positive, but less robust, effects. Increases in per capita GDP seem to increase saving at low income levels (relative to the United States) but decrease it at higher ones.

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Summary

This paper extends our empirical knowledge of the determinants of private saving for a large sample of industrial and developing countries. Both time series and cross-section information is used, as the explanatory power of potential variables differs widely in those two dimensions.

Several conclusions emerge clearly from the regressions, despite some heterogeneity in the results. First, there seems to be a substantial offset, averaging 60 percent, of changes in the government fiscal position from private saving. This offset, although large, is considerably below unity, implying that changes in the government's fiscal position can have a significant impact on national saving. Moreover, the offset depends on whether those changes are due to government spending or tax changes.

Demographic effects are also an important determinant of private saving rates. This conclusion suggests that the projected aging of the population in most industrial countries will generate significant downward pressure on private saving rates over the next three decades. However, developing countries show an opposite trend in the overall dependency ratio, as an increase in those over the age of 65 will be offset by a decline in the proportion of those under the age of 20. Therefore, the net effect on world saving could be a small positive figure.

Other variables also influence saving, in particular income growth, which operates through several channels. A direct positive association between GDP growth and private saving emerges from most of the specifications, while increases in the level of per capita income (relative to the United States) tend to influence saving positively in low- to middle-income developing countries. Finally, a composition effect of changes in the relative sizes of the countries concerned can also affect the aggregate rate of saving. If countries with high saving rates continued to grow faster, their increasing share of world output could induce an upward trend in world saving of several percentage points.

The paper finds that the real interest rate has a positive, and significant, coefficient for industrial countries and for the combined panel of data; however, the results are not very robust, owing to data problems and shifts in the relationship due to financial liberalization. It was found that changes in the terms of trade have a significantly positive effect on saving for industrial countries, for which a longer sample (including the two major oil price shocks) was available, and that, for developing countries, higher foreign saving (a current account deficit) tends to depress private saving.

I. Introduction

Despite an extensive literature on saving behavior, 1/ there remain a number of empirical issues which have not been conclusively resolved, including the effects of real interest rates, demographic factors, and per capita income on private saving, the relationship between growth and saving, and the extent to which private saving offsets movements in public (dis)saving. This paper extends our empirical knowledge of private saving behavior by exploiting data for a large sample of industrial and developing countries, and by looking at a broad set of possible determinants of private saving. Both time-series and cross-section information is used, as the variability of potential explanatory variables is quite different in those two dimensions. In particular, some variables seem to explain persistent country differences (e.g. dependency ratios or relative per capita income) while others are correlated with year-to-year fluctuations (e.g. the terms of trade or GDP growth). Fiscal variables, for their part, seem to explain both some persistent long-term differences and short-term fluctuations.

The existing literature, with a few exceptions, 2/ has tended to be limited to one of these two dimensions. Conclusions concerning the significance of one or another factor have often depended importantly on the choice of time-series or cross-section estimation, as well as the country or countries included. For instance, time-series estimation has typically found evidence of demographic effects on private saving in Japan (Horioka, 1993) but not for the United States (Carroll and Summers, 1991), while cross-sectional estimates have yielded large effects (Modigliani, 1970; Graham, 1987). By exploiting both dimensions, and using data for 61 industrial and developing countries, the robustness of more limited studies can be examined.

II. Outstanding Empirical Issues

In order to place the estimates presented below in context, a selective survey of unresolved issues follows. In addition, data for private saving and some of its potential determinants are plotted, both in time-series form in Charts 1 and 2 (for aggregates of industrial and developing countries, respectively) and across countries in Chart 3 (using data averaged over 1982-93). Though not a substitute for multiple regression, these charts suggest simple correlations and give an idea of the degree of variation in the data, both across countries and over time.

1/ Aghevli and others (1990) and Deaton (1992) provide literature surveys.

2/ Notably Schmidt-Hebbel and others (1992), who use panel data for developing countries.

1. Does private sector saving offset government dissaving?

The empirical literature on the private saving offset to government deficits (or dissaving) has generally concluded that a full offset (Ricardian equivalence) is rejected by the data, with some dissenters. Bernheim (1987) summarizes existing evidence for industrial countries as indicating that a unit government deficit increase would be associated with a decrease in consumption of 0.5 to 0.6, and he presents new empirical results tending to confirm this range. Similar results have been obtained for developing countries. Corbo and Schmidt-Hebbel (1991), in a typical estimate, find a roughly 50 percent offset on private saving of changes in government saving, while Haque and Montiel (1989) overwhelmingly reject Ricardian equivalence for their sample of developing countries, 1/ and also conclude that the reason for non-equivalence is the presence of liquidity constraints affecting at least some households. 2/ By contrast, a survey by Seater (1993), which criticizes much of the empirical work as being inadequate, concludes that the evidence supports the hypothesis. Nevertheless, he recognizes that different government behavior than in the past could imply Ricardian non-equivalence in the future. Chart 1 suggests that there are periods when a sharp deterioration of the fiscal position (measured as the surplus of reserves over expenditure) was associated with a rise in private saving in industrial countries.

An increase in the government deficit due to lower taxes or higher government spending can be expected to have different effects on private saving, and hence these variables are allowed to have separate coefficients in the estimates presented below. Increased government spending may lower the resources available to the private sector and hence have a negative effect on private saving, whether or not it affects the deficit. The composition of government spending may also be important. Public investment, to the extent that it is viewed as productive, would not be expected to require further taxes, and hence should not generate a private saving response. Its coefficient in a saving equation should be smaller than the coefficient of government consumption. In contrast, investment that does not generate revenues for the government (and hence is considered equivalent to government consumption) would involve future taxes and hence might induce a larger private saving offset.

2. Does income growth raise saving?

Modigliani (1966) argued that a higher growth rate (whether due to population or productivity growth), would, with unchanged saving rates by age group, raise aggregate saving because it would increase the aggregate

1/ Their sample includes 16 developing countries for which data were available.

2/ Evidence that households in industrial countries face liquidity constraints has also been found by Hayashi (1985), Flavin (1981), and Campbell and Mankiw (1989).

Chart 1. Industrial Countries: Private Saving Rates and Potential Determinants, 1971-93.

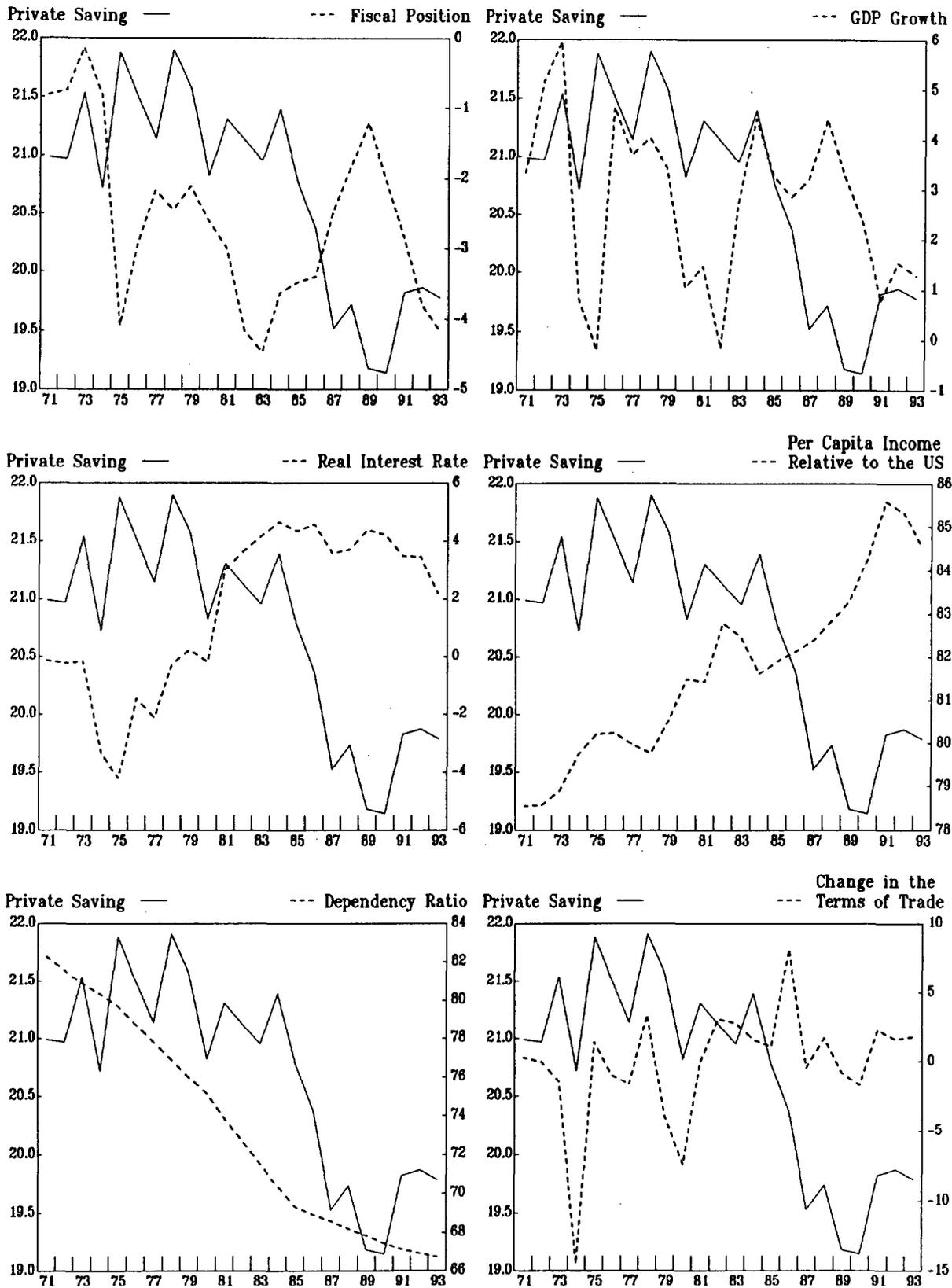


Chart 2. Developing Countries: Private Saving Rates and Potential Determinants, 1982-93.

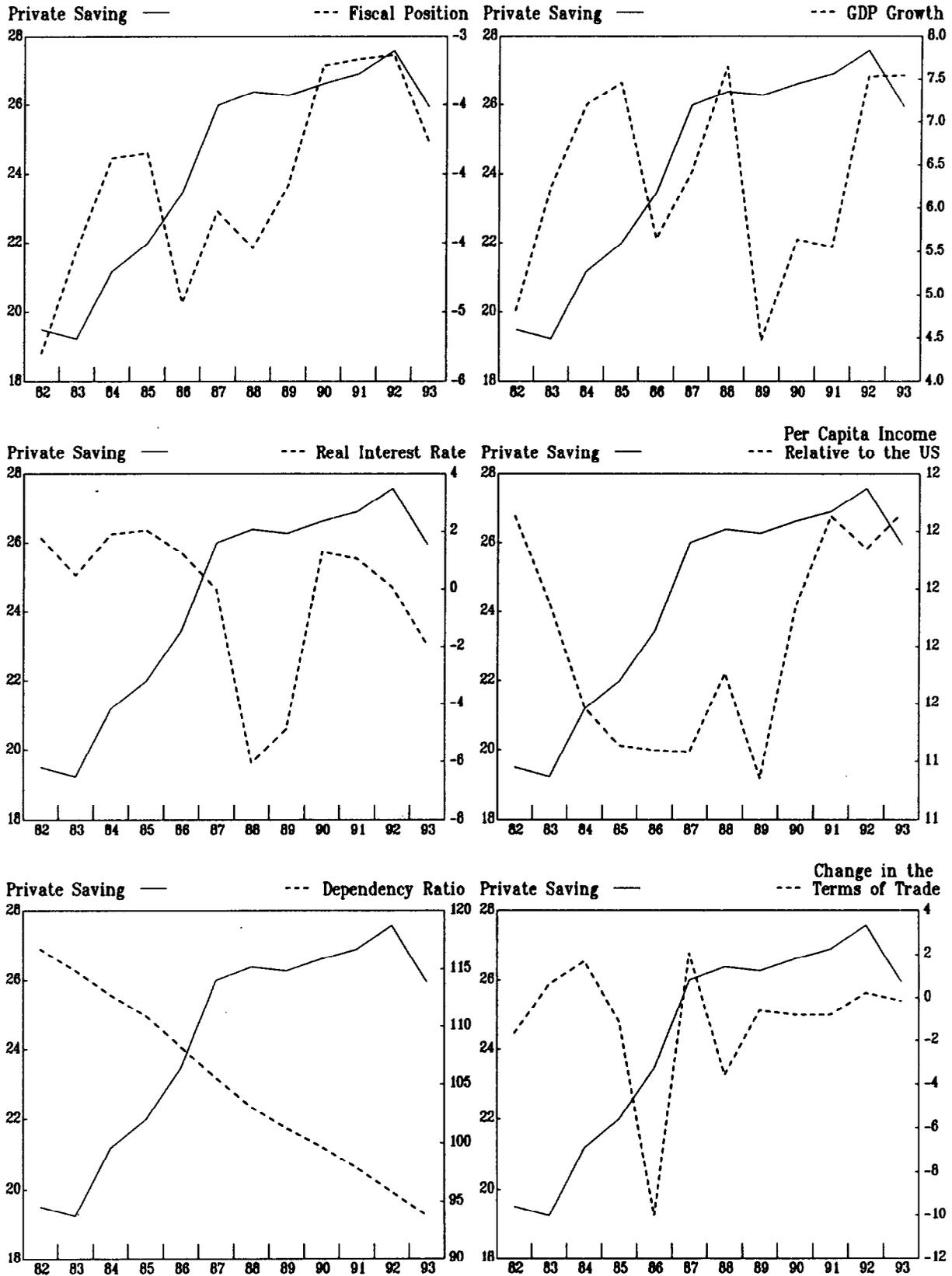
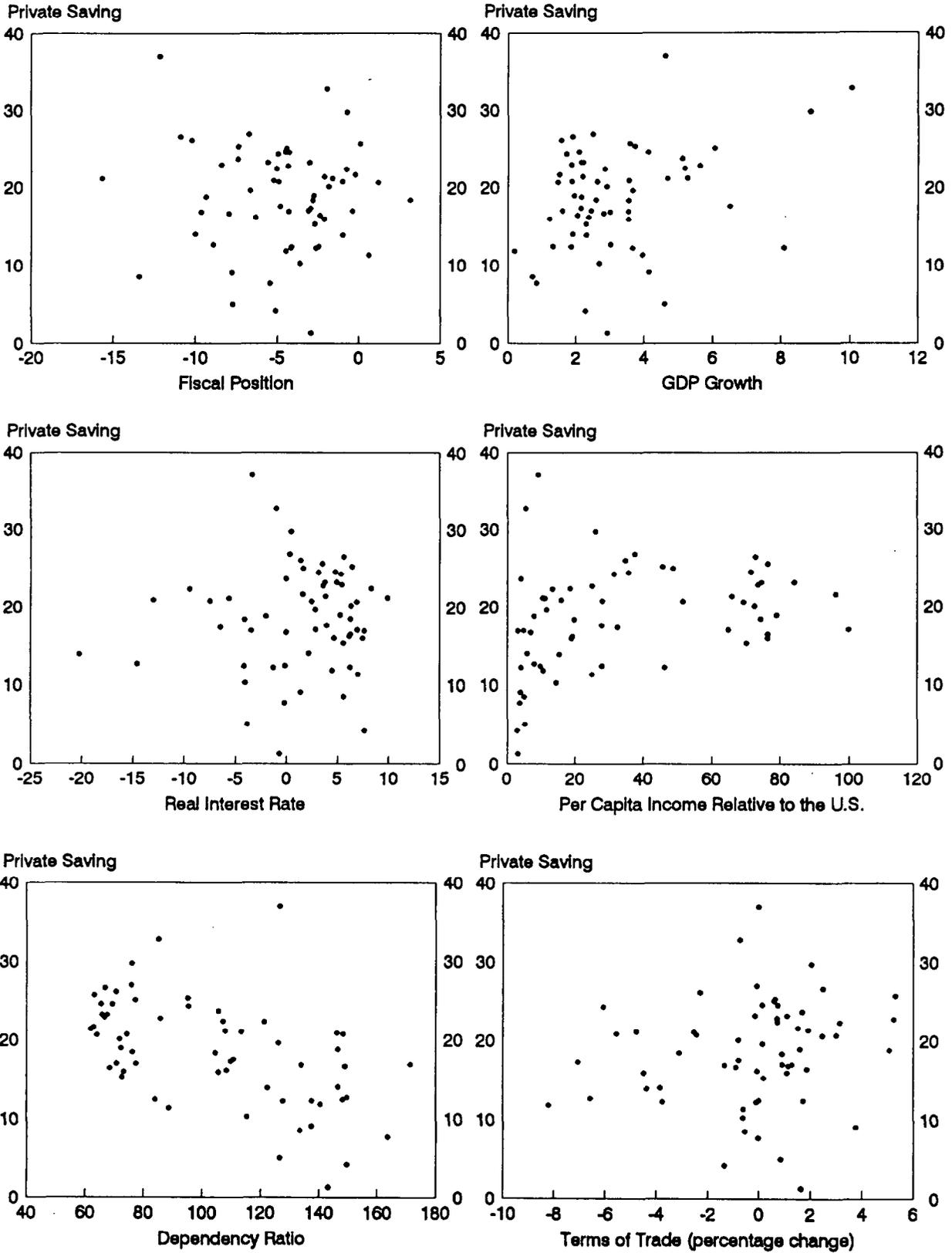


Chart 3. Private Saving Rates and Potential Determinants
Across 61 Industrial and Developing Countries
(Averages, 1982-93)



income of those working relative to those not earning labor income (i.e., retired persons, living off their accumulated assets). This view is based on the life-cycle hypothesis (LCH) model (Modigliani and Brumberg, 1954; Modigliani and Ando, 1957), which relates saving behavior to successive stages of schooling, increasing earnings, and retirement. It is in fact the case that saving seems to be positively correlated with income growth (Modigliani, 1970), as high growth countries such as Japan or Korea have also had high saving rates, as suggested by Chart 3.

However, Tobin (1967) pointed out that unchanged individual saving rates are only consistent in this context with myopic expectations of future income. If workers correctly expect that their income will grow in the future, they should, according to the life-cycle model, want to consume more today. It is thus possible that individual saving rates for those in work will fall by a sufficient amount to offset the aggregate effects of higher growth, a hypothesis confirmed by back-of-the-envelope calculations given the length of working lives relative to retirement. Thus the empirical positive correlation of saving with income growth is not on the face of it consistent with the LCH, unless the higher income growth is expected to be at least partly transitory. Carroll and Weil (1994) confirm that lagged values of increases in income growth seem to explain higher saving rates; they argue that the usual consumption models with either uncertainty or liquidity constraints are not sufficient to explain this result, and advance instead the hypothesis of habit persistence. If growth leads to higher saving, for whatever reason, then there could be important implications for countries like Japan whose growth has slowed. However, another explanation for the correlation may be that a high growth rate is a proxy for a high rate of return on capital, which may be inadequately reflected in domestic interest rates (especially if financial markets are not liberalized).

3. Do higher interest rates lead to higher saving?

The effect of interest rates on consumption is ambiguous theoretically, being subject to potentially offsetting negative substitution and positive income effects, the latter reflecting the fact that the private sector is a net creditor in financial assets. It is true that human wealth (that is, discounted future labor income) is much larger than financial wealth for a typical individual, and human wealth varies inversely with the rate of interest--suggesting that the negative substitution effect should dominate. However, consumers may not plan their lifetime consumption but respond primarily to current income. The empirical importance of the income effect on private saving is enhanced by pension plans' saving behavior: for defined benefit plans, higher interest rates increase the income available to pay pensions, allowing lower contributions (Bernheim and Shoven, 1988). Empirical research has reported mixed results, paralleling the theoretical ambiguity. For instance, using saving data for industrial countries, Bosworth (1993) finds a positive interest rate coefficient in time series estimation for individual countries, but a negative coefficient in panel (cross-country) estimation. For developing countries, Giovannini (1985) concludes that in most cases the real interest elasticity is zero, while

Schmidt-Hebbel and others (1992) also find no clear effects on saving. Ogaki, Ostry, and Reinhart (1994) find positive interest rate effects that vary with income but are still small. Chart 1 suggests, if anything, a negative relationship, while Chart 3 shows little cross-country correlation, in part no doubt because it is difficult with different financial systems to calculate comparable measures of real rates.

Given that financial liberalization may have changed interest rate effects, it is not too surprising that results are not robust. The effect of liberalization on saving behavior can operate through at least two channels. First, financial development may provide outlets for financial saving, thereby raising saving rates (McKinnon, 1973; Shaw, 1973), a channel that has been emphasized in the development literature. However, though financial liberalization generally affects the form saving takes and also the efficiency of investment, it need not raise the level of saving (De Gregorio and Guidotti, 1994). The second aspect involves liberalization of consumer access to bank credit, as occurred in a number of industrial countries in the 1980s. Regulatory changes have allowed banks to lend more freely to individuals, for instance for house purchase or for consumption, and this may lead, at least initially, to a significant decline in saving. There is empirical evidence in support of this effect in countries which have liberalized access to consumer credit (Japelli and Pagano, 1989; Bayoumi, 1993; Lehmussaari, 1990; Ostry and Levy, 1994). Financial liberalization may involve one or another of these aspects, each of which will tend to increase the sensitivity of saving to interest rates. 1/

4. Does saving vary with a country's income level?

A possible explanation of the wide range of saving rates in developing countries may be differences in per capita income. At subsistence levels the potential for significant saving is small. A rise in per capita income may therefore lead to higher saving rates. The size of this effect is likely to decline as per capita income rises and may even become negative for rich countries where investment opportunities and growth are relatively lower. It seems to be a stylized fact that the process of development involves initially low saving rates, a period of high growth accompanied by high saving rates, and lower saving rates in more mature economies. A plot of saving rates against per capita income in Chart 3 seems to give some support for such a hump-shaped pattern, though clearly there are outliers (see also Ogaki, Ostry, and Reinhart, 1994).

1/ Financial liberalization in a given country may also expand the international diversification possibilities of other countries, making their saving more responsive to foreign interest rates.

5. Is the age structure a significant influence on saving?

An implication of the LCH is that the age structure of the population is important. If a high proportion of the population is of working age--especially if at peak earning years--then the economy's private saving rate should be high, as workers provide for their retirement. Conversely, when this cohort reaches retirement age and dissaves (or, at least, consumes a greater fraction of its income), then the aggregate saving rate should decline. There is an extensive literature attempting to link demographic variables to saving behavior. Studies using cross-country data (either as cross sections or panels) have been more successful than time-series studies for individual countries in finding significant demographic effects, probably because the variation over time of demographic variables is relatively small. In particular, Leff (1969), Modigliani (1970), Modigliani and Sterling (1983), Graham (1987), and Masson and Tryon (1990) have found that higher proportions of the young and elderly to those of working age--dependency ratios--are associated with lower saving rates. These estimates, and the projections of population aging in coming decades, would produce quite large falls in private saving in many industrial countries, and especially in Japan. Chart 3 confirms that there is a negative cross-country correlation between private saving and the dependency ratio (calculated as those aged 0-19 and 65 and over, divided by those aged 20-64), but Charts 1 and 2 show how slow-moving the movements in dependency ratios are (and the absence of a consistent correlation with movements in saving).

Koskela and Viren (1989), moreover, question the robustness of the cross-country demographic effects identified by Graham (1987), and there remains a conflict between macroeconomic results (including across countries) and studies using micro data for consumers by age cohort. Kennickell (1990) and Carroll and Summers (1991), for instance, argue that age-consumption profiles do not differ enough to explain why aggregate consumption should be very much affected by demographic factors. The discrepancy may however be explained by interactions between generations that are picked up by the macro data but ignored by the micro data studies: bequests may lower the saving of the young, and hence aggregate saving, even if the elderly do not themselves dissave (Weil, 1994). Therefore, the thought experiment of changing the age structure of the population while keeping age-specific saving profiles unchanged may not be legitimate. Nevertheless, it must be acknowledged that studies using macro data have also found diverse results.

6. Is there a terms of trade effect on saving?

Another aspect of saving behavior that has appeared in the literature is the possible relationship between the terms of trade and saving (the Harberger-Laursen-Metzler, or HLM, effect): an improvement in the terms of trade is supposed to lead to an increase in saving and an improvement of the trade balance. The modern literature integrates this effect into intertemporal models, and stresses the distinction between transitory and

permanent changes in the terms of trade. A transitory improvement, since it causes only a transitory change in income, should lead to higher saving rather than higher consumption, confirming the direction of HLM effect (Obstfeld, 1982; Svensson and Razin, 1983). Permanent shocks to the terms of trade would have ambiguous effects which should be small in magnitude. The empirical literature has tended to confirm a positive correlation between transitory terms of trade shocks and saving (e.g. Ostry and Reinhart, 1992), and Chart 1 shows some association between the two variables in time series data, though the relationship is not evident for developing countries (Chart 2).

7. Other potential determinants

A number of other variables have been suggested as explanatory factors. These include inflation, wealth, and foreign saving. Inflation may affect saving for several reasons: higher inflation will tend to lead to higher nominal interest rates and hence higher measured household income and saving. However, higher inflation may also lower saving through increased uncertainty. Financial wealth should negatively affect saving in a life cycle model, as it increases the resources available for consumption. Foreign saving becomes a potential exogenous determinant of national saving when foreign borrowing is rationed, as often is the case for developing countries. There is some empirical evidence supporting such a negative relationship between national and foreign saving (Fry, 1978, 1980; Giovannini, 1985), and between household and foreign saving (Schmidt-Hebbel and others, 1992).

III. Empirical Results

1. The data

To examine the issues discussed above, saving rates for industrial and developing countries were regressed on a number of potential explanatory variables which could be collected on a reasonably comparable basis across all countries. For the industrial countries, a panel data set comprising 21 countries over the period 1971 to 1993 was collected. ^{1/} In addition to the ratio of private saving to GDP the data set consisted of the general government budget surplus, government current expenditure, government

^{1/} The 23 industrial countries, as defined by the International Monetary Fund, excluding Iceland and Luxembourg. See Appendix for data sources. Measurement issues have been discussed by Blades and Sturm (1982), Lipsey and Kravis (1987), and Elmeskov, Shafer, and Tease (1991).

investment, and beginning-of-period private sector wealth 1/ (all measured as ratios of nominal GDP); growth rates of real output, consumer prices, and the terms of trade; the real short-term interest rate; GDP per capita relative to that in the United States (measured using purchasing power parities); and the dependency ratio (the ratio of those under 20 and 65 and over to those aged 20-64). 2/

The same variables were collected for a sample of 40 developing countries over the period 1982-93. Several variables in the developing country data had to be constructed due to limitations with the data. National saving was calculated as domestic investment plus the current account surplus, 3/ and then private saving was calculated as national saving minus the central government fiscal surplus and minus central government expenditure on capital goods. Hence, saving by lower levels of government is included in private saving. In addition, private wealth was derived as the cumulative sum of nominal private savings. As most developing countries face constraints on their external borrowing, foreign saving is also likely to be a determinant of domestic saving. The current account surplus (equal to minus foreign saving) was, therefore, included in the developing country data. 4/ Sources for both industrial and developing countries' data are given in the Appendix.

The advantage of panel data is that it provides variation both across countries and over time. Table 1 provides information on some of the characteristics of the underlying data. It divides the total variance of each of the series into that part which can be ascribed to changes over time within countries (the time-series variation) and that which can be ascribed to long-term differences across countries (the cross-sectional

1/ The private wealth variable includes the stock of government debt. To the extent that individuals are Ricardian, however, this debt should not be included in private wealth. Results when the stock of government debt was included in the specification as a separate variable were very similar to the main case, and are not reported.

2/ Separating the overall dependency ratio into dependency ratios for the young and the old gave coefficients which were not significantly different from each other.

3/ This means that foreign transfers are included as part of national saving.

4/ As the current account includes net private and official transfers, it excludes foreign aid from foreign saving. Data on foreign aid were not available on a balance of payments basis. Thus, the estimations reported below do not test for the effect of foreign aid on national saving.

Table 1. Decomposition of Overall Variance
into Cross-Sectional and Time-Series Variances

(In percent of total)

Variable	Industrial Countries 1/		Developing Countries 2/	
	Across Countries	Over Time	Across Countries	Over Time
Private saving/GDP	65.6	34.4	77.2	22.8
Government budget surplus/GDP	60.5	39.5	53.6	46.4
Government current expenditure/GDP	67.3	32.7	90.5	9.5
Government investment/GDP	62.1	37.9	72.5	27.5
GDP growth rate	8.2	91.8	20.7	79.3
Real interest rate	13.2	86.8	36.7	63.3
Wealth/GDP	66.7	33.3	82.1	17.9
Inflation rate	24.5	75.5	67.5	32.5
Percent change in terms of trade	1.1	98.9	4.4	95.6
Per capita GDP relative to U.S.	94.7	5.3	97.0	3.0
Dependency ratio	62.3	37.7	95.7	4.3
Current account/GDP	35.7	64.3

Source: See Appendix.

1/ 1971-93.

2/ 1982-93.

variation). 1/ Private saving, the dependent variable, contains significant amounts of variation in both dimensions across both data sets, with cross-sectional differences explaining 60-80 percent of the total variance and changes over time the remainder. The importance of the cross-sectional differences presumably reflects the persistence of differences in saving behavior across countries. For example, countries such as China, Italy, Japan, and Korea had relatively high private saving ratios throughout the sample period, while Kenya, the United Kingdom, the United States, and Uruguay had relatively low ratios.

Cross-sectional differences are also more important than changes over time for the fiscal variables, the dependency ratio, the wealth ratio, and per capita GDP relative to the United States. By contrast, most of the variation in real short-term interest rates, output growth, the change in the terms of trade, and the current account is across time, presumably reflecting the greater importance of cyclical variation in these cases. Inflation in industrial countries also shows more variation over time but in developing countries the reverse is true. Most variables have significant variation across both countries and time, indicating that useful information can be extracted in both dimensions, the main exceptions being relative per capita GDP and the change in the terms of trade. 2/ In what follows, the results from different approaches which give more or less weight to one or another aspect of the data are reported, together with a discussion of the similarities and differences found in the empirical results using alternative methods.

Time series regressions are first reported for industrial countries and developing countries separately in order to look at potential differences in behavior across these different types of economies. Next, a combined regression, using both data sets simultaneously, is reported. Finally, cross-sectional regressions are reported. The regressions focus on four principal explanatory factors as determinants of private saving: fiscal variables; demographics; GDP per capita and GDP growth; and interest rates, inflation and changes in the terms of trade.

1/ See Kessler, Perelman, and Pestieau (1993) for a more detailed description of this approach. Briefly, the variation over time is calculated by summing the individual variances across countries assuming that each country has a different mean. The cross-sectional variation is calculated as the variance across these country means multiplied by the number of time periods. The two measures sum to the total variation.

2/ Ideally, one would exploit both dimensions simultaneously, using a single specification across all countries. As the statistical assumptions required to make such an approach valid do not generally hold, the results from each dimension were explored separately.

2. Panel estimation

Industrial countries. A specification was run in which the constant terms were allowed to vary by country, but the coefficients on the independent variables were made equal across all countries in order to focus on the time-series information. These regressions are probably best seen as a way of using data across a large number of different economies to estimate the response of saving in a typical country with more precision than is possible using individual country data. Unfortunately, the constraint that all of the coefficients are equal across countries is rejected by the data. However, it was considered that the benefits from a greater number of observations outweighed the potential biases in the estimates for individual countries. Moreover, the large number of variables and countries involved in the analysis made it impractical to report results of the individual country regressions.

Table 2 reports the results from a general specification including all the variables and a more restricted one with some variables eliminated from the model. The variables in the general specification are generally correctly signed and significant. Increases in the general government budget surplus (the fiscal position), government current and capital expenditure, per capita output relative to the United States, and the dependency ratio all lower private saving, while increases in the real interest rate, inflation (included as a proxy for measurement biases in national accounts measures of saving caused by the nominal component in interest payments) 1/ and the terms of trade raise it. Finally, the coefficient on the growth in real GDP was small and insignificant, while that on wealth was significant but incorrectly signed.

The results from excluding the growth in real output and the wealth ratio are shown in the restricted regression. The implied effects from the remaining variables appear reasonable. 2/ Around half of the change in the fiscal position caused by tax changes is estimated to be offset by changes in private saving, while if caused by changes in government expenditure, the offset on private saving is much less (about 10 percent, the difference between the two coefficients). A 5 percentage point increase in the real interest rate raises the private saving ratio by 1 percent of GDP, a result which would also come from a 20 percent rise in the terms of trade or a comparable fall in per capita income relative to the United States. Finally, a 7 percentage point increase in the dependency ratio lowers private saving by 1 percentage point of GDP, an effect which is

1/ Similar results were found using an alternative proxy for the inflation bias, namely the product of the inflation rate and the general government debt ratio, the logic being that this is a measure of the increase in private saving required to keep the real value of claims on the government unchanged.

2/ Regressions including time dummies for each year produced broadly similar results.

Table 2. Private Saving/GDP Ratio: Panel Estimates, 1971-93
for 21 Industrial Countries with Separate Country Constant Terms

(Absolute t-ratios in parentheses)

Explanatory Variable	General Model	Restricted Model	Instrumental Variables
General government budget surplus/GDP	-0.51 (8.5)	-0.52 (8.8)	-0.53 (4.8)
General government current expenditure/GDP	-0.42 (10.5)		
General government investment/GDP	-0.52 (4.9)	-0.40 (10.3)	-0.42 (7.2)
GDP growth rate	-0.04 (0.8)	--	--
Real interest rate	0.22 (4.5)	0.17 (3.5)	0.24 (2.8)
Wealth/GDP	0.016 (3.9)	--	--
Inflation rate	0.18 (4.6)	0.13 (3.5)	0.17 (3.1)
Percent change in terms of trade	0.05 (3.0)	0.05 (3.2)	0.05 (3.2)
Per capita GDP relative to U.S.	-0.07 (2.1)	-0.04 (1.3)	-0.05 (1.3)
Dependency ratio	-0.13 (4.5)	-0.15 (5.4)	-0.14 (4.4)
<u>Fit statistics</u>			
Adjusted R ²	0.23	0.25	0.25
S.E.R.	2.36	2.40	2.41
Number of observations	483	483	483

within the (wide) range of existing estimates, but is somewhat lower than the typical value found in cross-country studies.

One potential problem with these results is that saving may be determined simultaneously with some of the other variables, in particular the real interest rate and fiscal variables, causing the estimated coefficients to be biased downward. Accordingly, the restricted regression was re-estimated using instrumental variables to test for biases in the coefficients on the fiscal deficit, government current expenditure, and the real interest rate. 1/ The coefficient on the real interest rate rises by over a third of its original value, from 0.17 to 0.24, indicating that original coefficient may indeed have been biased downwards. The size and significance of the other estimated coefficients, by contrast, are similar to those found in the regression without instruments.

The R-squared statistics indicate that these regressions explain about a quarter of the variation in the private saving ratio in industrial countries over time. 2/ To summarize, the results indicate that the relevant economic variables are generally correctly signed and have significant effects on the level of private saving in industrial countries, but that a reasonably large amount of the variance of saving over time remains unexplained, at least when the coefficients on the explanatory variables are assumed equal across countries.

Developing countries. Similar regressions were run for developing countries, although some differences should be noted. First, the current account surplus (equal to minus foreign saving) was included as an extra explanatory variable in the regressions. Second, broad money as a ratio to GDP was included in the initial estimation as a proxy for financial development; however, this variable was not significant, and hence was omitted from the regressions reported below. Third, relatively reliable data on private saving and the interest rate were available for a sufficiently large set of countries only for the 1982-93 period, thus a shorter period of estimation than that for industrial countries was used. Finally, in all regressions a quadratic function of per capita income was included to test the hypothesis that the saving ratio may increase at the initial stages of development but decrease at later stages. This would require the coefficients of per capita income and per capita income squared to be positive and negative, respectively.

1/ The instrumental variables chosen were the dummy variables for each country, first lags of the fiscal surplus, ratio of government current spending to GDP, and real interest rate, and contemporaneous values of the change in the terms of trade, inflation, per capita GDP relative to the United States, and the dependency ratio. Contemporaneous values were used for these latter variables as they were regarded as exogenous to the simultaneity issues being investigated.

2/ When the impact of differing country intercepts is included, over 70 percent of the total variation in saving is explained.

Separate estimations were carried out for the entire set of countries, as well as for countries classified into high-income, middle-income, and low-income groups based on 1990 per capita GDP (see Appendix for a list of countries in each group). All panel estimations allowed for the presence of fixed country effects, i.e. separate country intercepts. The inclusion of time dummies did not significantly influence the estimated coefficients, and these are excluded in the results reported below.

Table 3 reports the regression results after dropping the insignificant variables. 1/ The estimation results vary quite a lot across different country groups with the fit being the best for the high-income group. The estimated coefficient of the dependency ratio is significant and with the right sign except for the middle-income group. The results for the group of all developing countries indicates that a one percentage point rise in this variable leads to fall of 0.18 percentage points in the private saving rate. 2/ Foreign saving has a significant influence on domestic saving in all groups, 3/ and the coefficient of the current account surplus indicates that an increase in foreign saving equal to 1 percent of GDP reduces the national saving rate (increases the consumption/GDP ratio) on average by about half a percentage point. Growth also appears to be an important determinant of private saving, although it turns out to be insignificant in the case of middle- and low-income groups.

The results support the hypothesis of a quadratic relationship between the national saving rate and per capita income. The estimated coefficients suggest that the turn-around is mild and occurs at around 50 percent of U.S. per capita income. However, since very few countries in the sample have reached that per capita income level, this estimate is likely to lack precision. Note also that the estimation results for the middle and low income countries give quite different estimates for the turn-around point.

The coefficient of the fiscal position/GDP indicates a 0.63 percent offset of government dissaving by increased private saving for all

1/ Four variables were insignificant in all of the regressions and are therefore excluded from Table 3, namely government current expenditure, the change in the terms of trade, private wealth, and the real interest rate.

2/ As was done for the industrial countries, youth and elderly dependency ratios were first included separately, and then they were combined into a single variable since the coefficient on the elderly dependency ratio was not well determined (perhaps reflecting the very small proportion of the population in this age group).

3/ Note, however, that this may be partly the result of data problems, since national saving is calculated as the sum of domestic investment and the current account deficit. Therefore, the estimated coefficient of the current account surplus will be biased if the latter variable is itself influenced by national saving or if it contains measurement errors which also enter national saving as calculated here, which is quite likely.

Table 3. Private Saving/GDP Ratio: Preferred Panel Estimates,
1982-93, for 40 Developing Countries with Separate Country Constant Terms

(Absolute t-ratios in parentheses)

Explanatory Variable	All Countries	High Income Countries	Middle Income Countries	Low Income Countries
Central government budget surplus/GDP	-0.659 (11.43)	-0.940 (11.19)	-0.349 (3.90)	-0.673 (6.99)
Central government capital expenditure/GDP	-0.298 (3.91)	-0.408 (4.80)	--	-0.397 (3.11)
GDP growth rate	0.156 (3.97)	0.197 (3.75)	--	--
Per capita GDP relative to U.S.	0.870 (3.98)	1.086 (4.19)	3.881 (4.28)	5.504 (2.54)
Per capita GDP relative to U.S. squared	-0.009 (2.82)	-0.011 (3.31)	-0.117 (3.93)	-0.520 (2.64)
Dependency ratio	-0.181 (6.04)	-0.241 (6.29)	--	-0.159 (2.79)
Inflation	--	-0.056 (3.15)	--	--
Current account surplus/GDP	0.469 (11.39)	0.697 (11.96)	0.268 (3.86)	0.572 (6.49)
Adjusted R ²	0.302	0.627	0.136	0.423
S.E.R.	3.37	2.52	4.10	2.69
Number of observations	480	168	156	156

developing countries. The Ricardian equivalence hypothesis of a full offset is rejected for all but the high-income countries. It has to be noted that the fiscal balance used here only includes the central government, implying that private saving includes the non-central government fiscal balance. If central and non-central government saving ratios are negatively correlated, the estimated coefficient of the fiscal position will be biased upwards. When the fiscal deficit is reduced by cuts in central government investment, rather than increases in taxes, there is a smaller offset on private saving (except in the case of the middle-income countries). However, government current expenditure does not have such a differentiated effect.

The real interest rate was not significant at the 5 percent level for any of the groups. This result, which is in line with most earlier studies, may reflect the importance of liquidity constraints and subsistence considerations in many developing countries, but the poor quality of the data may also be a significant factor. The terms of trade did not appear to affect the saving rate either, probably reflecting the small degree of variation in this variable during the 1982-1993 period which excludes the two major oil price increases. Finally, inflation has a significant (but negative) effect on the saving rate only for the high-income countries, while wealth/GDP ratio was insignificant in all cases.

The combined panel. The industrial country and developing country data sets were combined to produce an unbalanced panel involving a total of 61 countries: 21 industrial countries with 23 years of data (1971-93); and 40 developing countries with 12 years of data (1982-93). The private saving ratio was then regressed upon those series available in both panels. ^{1/} The data were treated identically across all countries except for the current account, which was eliminated from the estimation for industrial countries.

Table 4 reports the results from a general specification and from a more restricted version in which a number of insignificant or incorrectly signed explanatory variables have been eliminated. All of the coefficients in the restricted model are correctly signed and significant. The fiscal offset is estimated to be 0.64. Rises in the ratio of government expenditure to GDP that do not affect the fiscal position (i.e. involve higher taxes) are found to lower the corresponding private saving ratio by around a third. Both output growth and per capita income relative to the U.S. are found to have significant impacts on saving, with the quadratic term implying that rises in relative per capita income boost saving when the ratio is below about 60 percent of the value in the United States, and reduce it above this point. The real interest rate has a significant, but

^{1/} The government balance, government current and investment expenditures, and wealth (all as ratios to GDP), the growth in real output, the real short-term interest rate, inflation, the change in the terms of trade, GDP per capita relative to the U.S. and its square, the current account as a ratio to GDP, and the dependency ratio.

Table 4. Private Saving/GDP Ratio:
Results from the Combined Industrial and Developing Country Panel 1/

(Absolute t-ratios in parentheses)

Explanatory Variable	General Model	Restricted Model
Government budget surplus/GDP	-0.62 (13.7)	-0.64 (14.8)
Government current expenditure/GDP	-0.32 (11.1)	-0.32 (11.5)
Government investment/GDP	-0.26 (4.2)	
GDP growth rate	0.10 (3.4)	0.11 (3.9)
Real interest rate	0.03 (1.2)	0.03 (2.0)
Wealth/GDP	0.01 (2.7)	--
Inflation rate	-0.01 (0.3)	--
Percent change in the terms of trade	0.01 (1.3)	--
Per capita GDP relative to U.S.	0.55 (5.0)	0.51 (5.0)
Square of per capita GDP relative to U.S.	-0.005 (5.3)	-0.004 (5.1)
Current account/GDP ²	0.44 (12.5)	0.44 (12.7)
Dependency ratio	-0.15 (7.2)	-0.16 (8.0)
<u>Fit statistics</u>		
Adjusted R ²	0.31	0.30
S.E.R.	2.96	2.97
Number of observations	963	963

1/ Estimated using 1971-93 data for 21 industrial countries and 1982-93 data for 40 developing countries.

2/ Developing countries only.

relatively small, impact on saving, while at -0.16 the coefficient on the dependency ratio is very similar to that found in the earlier regressions. The equation explains 30 percent of the variance of saving in the combined panel. ^{1/}

Uniting the combined panel results with the earlier ones for industrial and developing countries permits a certain number of conclusions to be drawn. First, the fiscal position induces an offset in private saving, but only a partial one, estimated to be about three-fifths. Moreover, given the typical negative coefficient on government spending, fiscal consolidation that takes the form of spending reduction rather than tax increases induces less of a private saving offset. Second, higher output growth is generally associated with higher saving rates. Third, the real interest rate generally seems to have a positive effect on private saving. Fourth, the dependency ratio is generally significant and with the expected negative sign. Finally, per capita income has an effect on saving that depends on its level: it is initially positive, but at higher levels it turns negative. These conclusions seem relatively insensitive to changes in specification, time period, and the countries in the sample.

Other potential determinants fare less well. Wealth effects seem either to be insignificant or perverse. Inflation, which because of omission of real capital losses on nominal assets was expected to increase measured saving, is generally insignificant. There does seem to be strong evidence that the current account matters for developing countries' private saving, although, given the identity linking the two variables, the evidence should be treated with caution. Moreover, the current account variable was not considered a legitimate regressor for industrial countries, since they do not typically face exogenous financing constraints. As for the terms of trade, there is generally a positive coefficient on this variable, but it is only significant when a sufficiently long data period is used.

3. Cross-sectional results

The same variables used in the time-series work were included in a cross-sectional regression in which private saving ratios averaged over time were regressed on average values of the explanatory variables. Thus, the industrial country regressions involved 21 observations, one for each country, while the developing country and combined panel results involved 40 and 61 observations, respectively. The industrial country regressions were carried out using data averaged over the full 1971-93 period, while the other regressions used 1982-93 averages. The variables that turned out to be significant in regressions which included all the potential determinants (not reported for the sake of brevity) were the government balance, real output growth, the dependency ratio, relative per capita GDP, and (in the

^{1/} As noted above, this understates the explanatory power because it ignores the contribution of separate country intercepts.

case of the developing country and combined panel estimates) the square of relative GDP.

The first column of Table 5 reports the results for industrial countries from a restricted regression using these variables. A comparison of the results in Tables 2 and 5 indicates that the estimated coefficients tend to be greater in the cross-sectional regression than in the time-series results. The most dramatic difference is in the case of real growth, which has a coefficient of over 2 in the cross-sectional regression. If, as seems reasonable, the time-series regressions measure the sensitivity of saving to changes over the economic cycle, while the cross-sectional regressions measure the impact of long-term differences in behavior, this indicates that saving may be more sensitive to long-term differences in output growth than to shorter-term movements in these variables. Somewhat larger coefficients are also estimated for the fiscal balance, relative per capita GDP, and the dependency ratio, although in these cases the differences are less striking.

To investigate whether the estimated coefficients were robust to alternative time periods, the restricted version of the cross-sectional regressions was re-estimated over three subsamples: the 1970s, the 1980s, and 1990-93. These results (not reported) show that the underlying pattern found over the full sample period also holds over all three subsamples. At the same time, there did appear to be some diminution in the coefficients on the fiscal position and the growth in output over time. This might reflect rising international capital mobility. As access to international capital markets has expanded over time, the linkages between national saving, investment and growth, and between government and private saving may have been reduced. The corollary may be an increase in the sensitivity of domestic saving to international influences, as domestic and world financial markets have become more integrated.

The second column of Table 5 shows the results from running the same specification on the developing countries, except that the square of per capita relative GDP is included in the specification. As in the case of the industrial country regressions, the coefficient on growth is considerably higher in these cross-sectional regressions than in the panel estimates reported earlier. On the other hand, the coefficient on the fiscal position is very similar to that found using panel estimation while the coefficient on the dependency ratio is actually lower in the cross-sectional regression than in the panel estimation, in contrast to both our own and others' results using industrial country data. Both the level and square of per capita relative GDP are significant. The coefficients are generally similar to those found in the panel estimation although the peak value for saving implied by these point estimates occurs at around one quarter of U.S. per capita GDP, which is lower than that found using the time-series estimates.

The results from the combined industrial and developing country data are shown in the last column. As in the other cross-sectional regressions, the coefficient on growth is much higher than in the equivalent panel regression; however, those on the fiscal balance and dependency ratio are

Table 5. Cross-Sectional Estimates

(Absolute t-ratios in parentheses)

Explanatory Variable	Industrial Countries (Averages 1971-93)	Developing Countries (Averages 1982-93)	All Countries (Averages 1982-93)
Government budget surplus/GDP	-0.71 (4.6)	-0.61 (2.0)	-0.53 (2.6)
GDP growth rate	2.77 (3.9)	1.73 (3.1)	1.25 (3.2)
Per capita GDP relative to U.S.	-0.06 (1.7)	0.72 (2.1)	0.16 (1.3)
Square of per capita GDP relative to U.S.	--	-0.014 (2.1)	-0.0015 (1.3)
Dependency ratio	-0.28 (3.8)	-0.05 (1.0)	-0.10 (2.5)
<u>Fit statistics</u>			
Adjusted R ²	0.74	0.37	0.41
S.E.R.	2.06	5.95	5.18
Number of observations	21	40	61

very similar. The coefficients on the relative level of GDP and its squared value are somewhat smaller than in the equivalent panel regression, and are not very well determined. At around 60 percent of U.S. GDP, the implied peak level of saving is very similar to that found earlier.

Comparing the overall results from the cross-sectional regressions with those found using panel estimation provides a number of interesting insights. The first is that the two approaches provide reasonably similar estimated coefficients (for those variables which are included in both regressions), except in the case of output growth. This contrasts with results using only industrial countries data, where several authors have pointed to the very different coefficients, in particular for demographic variables, produced by the two estimation techniques. 1/ Second, the results confirm the quadratic relationship between saving and per capita income. Finally, the strong relationship between saving and growth in the cross-sectional results may well imply reverse causation of some sort, with high saving being associated with faster growth over time. Changes in the rate of growth in output over the cycle, by contrast, appear from the panel estimates to have a much smaller impact on the saving rate.

IV. Concluding Remarks

Several conclusions emerge clearly from the regressions, despite some heterogeneity in the results. First, there seems to be a substantial offset of changes in the government fiscal position from private saving, averaging 60 percent, but depending on whether those changes are due to government spending or tax changes. While this offset is large, it is considerably below unity, implying that changes in the government's fiscal position can have a significant impact on national saving, especially if they result from spending reductions. Thus, prospects for world saving depend importantly on decisions with respect to fiscal policies.

Another conclusion that can be drawn from both country groups' estimates is that demographic effects are an important determinant of private saving rates. The size of the effect of the dependency ratio on private saving is somewhat lower than in most previous studies that found a significant saving impact from demographic variables. Nevertheless, it suggests that the projected aging of the population in most industrial countries will generate significant downward pressure on private saving rates over the next three decades. However, developing countries show an opposite trend in the overall dependency ratio, despite an increase in those

1/ See, for example, Bosworth (1993).

over 65, due to a decline in the proportion of those under 20. ^{1/} Hence the net effect on world saving is ambiguous.

The results identify a number of channels through which growth influences saving. There is a direct positive association between GDP growth and private saving which emerges from most of the specifications, although it is unclear whether there is a causal effect in either direction or a joint response to a third factor. There is also a suggestive result concerning the level of per capita income (relative to the United States) and saving. For developing countries, there is a generally significant positive effect of the level, but negative effect of the squared level, of this variable, implying that beyond a certain point higher income has a negative effect on the private saving rate. The industrial country panel estimates, which suggest a negative level effect (the squared term was not significant), are consistent with this, as are the results of the combined panel and the cross sections. Given the distribution of per capita incomes, a continuation of growth trends would have positive and negative effects through this channel, but the positive effects on world saving dominate. Finally, a composition effect of changes in the relative sizes of the countries concerned can also affect the aggregate rate of saving. If countries with high saving rates continued to grow faster, their increasing share of world output could induce an upward trend to world saving of several percentage points. However, such a favorable outcome is very sensitive to assumptions concerning one country, China, given its importance in the world economy, and its very high rates of growth and saving.

The real interest rate has a positive, and significant, coefficient for industrial countries and for the combined panel, but the results are not very robust. There are measurement problems related to the choice of the appropriate interest rate and measure of inflation--and this may in particular affect the results for developing countries, which did not show a significant coefficient. It is also the case that financial reforms may have changed the relationship during our sample period.

Changes in the terms of trade were also found to have a significantly positive effect on saving for industrial countries (for which a larger sample was available). Clearly, the deterioration in many countries' terms of trade due to the oil price shocks of 1973 and 1979 had large effects in reducing their saving rates, and conversely the improvement in oil-exporters' terms of trade increased their saving, at least for a time. However, the effect is transitory, and since terms of trade changes balance out at the world level, there is no presumption that this variable will durably affect world saving. An additional external factor that negatively affects private saving in developing countries is the level of foreign

^{1/} See Masson, Bayoumi, and Samiei (1995). Projections in World Bank (1994) show a large increase in the proportion of elderly in the population, but this is more than offset by a decline in the proportion of the young.

saving. As in the case of the government fiscal position, however, the offset is only partial. Thus, greater availability of foreign saving should help contribute to higher investment in these countries.

Data Sources

1. Industrial Country Data

The 21 industrial countries for which data were available are the following: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States. Most of the data come from the WEO Database, supplemented in some cases by OECD sources. Specifically OECD values were used for the private saving rate in Portugal and for some general government fiscal surplus and investment series. The dependency ratio data came from the United Nations World Population Prospects (1992 Revision). In some cases the central government fiscal surplus was used to infer historical general government values. General government current expenditures were calculated as total general government expenditures less general government investment. The real interest rate was calculated as the short-term rate minus current inflation. Private wealth was calculated as the sum of the beginning-of-period capital stock (from the OECD Analytic Data Base where available, otherwise cumulated investment), government debt, and net foreign assets (NFA). Some of the historical values for NFA were calculated by cumulating current account values backwards from the earliest available NFA figures.

2. Developing Country Data

The data source for developing countries is the WEO Database, except for the interest rate for which data from International Financial Statistics was used for some countries to supplement the WEO Database (specifically, China, Paraguay, and Uruguay). The regressions include 40 countries, ranked by per capita income as follows:

High income: Cyprus, Oman, Malta, Korea, Venezuela, Malaysia, Gabon, Mauritius, Uruguay, Chile, Algeria, Costa Rica, Turkey, Colombia.

Middle income: Panama, Jamaica, Ecuador, Islamic Republic of Iran, Paraguay, Morocco, Egypt, Indonesia, Lesotho, El Salvador, Cameroon, Nigeria, Zimbabwe.

Low income: Honduras, China, Benin, Nepal, Kenya, Central African Republic, India, Bangladesh, The Gambia, Rwanda, Burundi, Mali, Burkina Faso.

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