Saving in Mexico: The National and International Evidence

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Abstract: How does Mexico's saving performance compare to the world's? Is Mexico 'different' ? And what drives Mexico's saving behavior since the 1980s? This paper addresses these questions bringing together empirical evidence from Mexico with that from a large cross-country time-series data set on saving aggregates and their determinants. Using dynamic panel data estimation techniques, the paper characterizes the major factors behind world saving performance. In the light of this evidence, Mexico's saving experience is compared to the international benchmark. Further, the paper turns to quarterly time-series evidence on saving in Mexico, and examines the factors behind the observed evolution of private and national saving using a regression framework, with particular attention to the issues of inflation adjustment and Ricardian equivalence. Key variables in Mexico's saving performance have been the terms of trade, public saving, the real interest rate, and the inflation rate. Sustained future growth could be reinforced by a virtuous saving-growth cycle, nurtured by the strong response of private (and national) saving rates to income growth observed in the world sample.

Resumen: ¿Cómo se explica el desempeño del ahorro en México en comparación con el mundo? ¿Acaso México es "diferente"? ¿Qué es lo que conduce el comportamiento del ahorro en México desde los ochenta? Este artículo se ocupa de estas cuestiones, estudiando series de tiempo de México y el mundo sobre las tasas de ahorro y sus determinantes. El artículo explica el desempeño del ahorro en el mundo usando técnicas de estimación de paneles dinámicos; y con esta evidencia se compara el desempeño del

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ahorro en México respecto del resto del mundo. Además se estudian series de tiempo trimestrales sobre ahorro en México para ver los factores que están detrás de la evolución observada en el ahorro privado y nacional, con particular atención a los ajustes por inflación y a la Equivalencia ricardiana. Las variables clave para explicar el ahorro en México son los términos de intercambio, el ahorro público, la tasa de interés real y la tasa de inflación. El crecimiento sostenido en un futuro podría ser reforzado por un círculo virtuoso de ahorro-crecimiento, nutrido por la fuerte respuesta de las tasas de ahorro privado (y nacional) al crecimiento del ingreso en la muestra mundial.

1. Introduction

Over the last three decades the world has witnessed an increasing divergence in saving rates, particularly dramatic within the developing world: saving rates have doubled in East Asia, stagnated in Latin America, and fallen in sub-Saharan Africa. Mexico's saving rate has also experienced a boom-bust cycle: national saving (henceforth GNS) climbed steadily during the 1970s to exceed 25 percent of gross national disposable income (henceforth GNDI) in the early 1980s, and then declined almost without interruption to around 15 percent of GNDI in the mid-1990s, a pattern that is key to the massive current account deficits preceding the external crisis of 1994.

Why do saving rates vary so much across countries and over time? Is Mexico 'different' in terms of saving behavior — *i.e.,* can Mexico's experience be satisfactorily explained by the same factors relevant to other countries' saving? What accounts for the large swings in Mexico's saving over the last two decades just mentioned above? This paper is devoted to address these three questions.

In section 2 we tackle the first two questions by exploiting the largest cross-country time-series macroeconomic data set on saving and related variables assembled to date,[1] adapting and extending previous work by Loayza, Schmidt-Hebbel and Servén (1998). There we discuss the time-series pattern of saving in the world at large and in Mexico over the last three decades. Then we report selective econometric results for dynamic panel GMM-system regressions of private and national saving rates for the full world sample and for the

[1] A detailed description of the basic data set, including descriptive statistics and stylized facts, is provided in López, Loayza, Schmidt-Hebbel and Servén (1998).

set of developing countries. Our reduced-form specification comprises a number of determinants of private (and national) saving in order to establish the stylized facts concerning the effects of key policy and non-policy variables identified in the literature. The applied estimation technique addresses issues of simultaneity and country heterogeneity that plague most earlier panel results. Then we attempt to explain the differences between Mexico's and the world's saving rates by making use of the estimated equations.

Section 3 focuses on the behavior of saving in Mexico using quarterly data from 1980 through mid 1995, expanding on previous work by Burnside (1996, 1998). First, we discuss in some detail the implications of Mexico's high inflation for measured private and public saving, and examine briefly the evolution of adjusted and unadjusted saving as well as key saving determinants. Next, we report simple OLS regressions for private and national saving, using specifications similar to those implemented on the world data. We then use these regression results to re-examine the role of various saving determinants behind Mexico's observed saving performance. Finally, section 4 concludes briefly.

2. Saving in Mexico and in the World

We begin with an overview of saving patterns across the world. The data used here draws from the saving database recently constructed at the World Bank. To our knowledge, such database represents the largest macroeconomics data set on saving and related variables presently available. It comprises 150 countries and spans the years 1965-1994, and thus contains up to 4 500 annual observations. The data have been subject to extensive consistency checks, and hence they represent an important improvement in terms of quality relative to other existing data sets. For some of the key variables in this paper, however, the effective coverage of the data is much more limited, particularly regarding the private (and public) saving measures defined below. In addition from the basic data set we excluded a few countries and or time observations that appeared clearly anomalous.

Private-sector saving and income measures are obtained residually by subtracting the corresponding public-sector measures that correspond to either the general government (for most industrial countries) or the consolidated non-financial sector inclusive of public

enterprises (for most developing countries). In addition, public (private) saving is adjusted for the capital gains (losses) from inflation.[2] National (private) saving rates are defined as ratios to gross national (gross private) disposable income.

2.1. Saving Patterns in Mexico and the World

The contrasting international patterns of saving over the last quarter century are illustrated by Figure 1a, which presents gross national saving rates for various country groups. To avoid the distortion caused by time-varying country samples (as data for several smaller and low-saving countries become available only in the middle of the sample period), the figure only reports information for those countries for which data is available throughout the sample period. In addition, we use medians rather than averages to mitigate the effects of outlying observations on the regional aggregates; see López, Loayza, Schmidt-Hebbel and Servén (1998) for further details.

As Figure 1a shows, during the last 25 years saving rates have risen to record-high levels in China and in a small group of Take-off economies — a set of developing countries that achieved the transition from low to high saving and growth, which includes seven East Asian countries plus Chile and Mauritius. In contrast, median saving rates stagnated in the other (lower-saving) developing countries, and declined steadily in the industrialized world.

In turn, Figure 1b provides a similar picture in terms of geographical regions. The rising pattern of national saving rates in China and East Asia (and, at a more modest level, South Asia as well) contrasts with the trend decline in industrial countries and Sub-Saharan Africa, and the boom-bust cycle in Middle Eastern countries (which include a number of oil-exporting economies) and Latin America.

How has Mexico fared relative to these international trends? Figure 2a presents national saving rates in Mexico and selected world regions. The figure shows large swings in Mexico's national saving: a period of relative stability up to the mid-1970s, during which Mexico's saving levels were broadly similar to those in the rest of the Latin

[2] For alternative public and private saving measures based on central-government saving unadjusted for capital gains and losses due to inflation, as well as empirical results based on them, see Loayza, Schmidt-Hebbel and Servén (1998).

Figure 1a. GROSS NATIONAL SAVING RATES BY COUNTRY GROUPS
Gross national saving as percent of gross national disposable income
(Group medians at current prices, fixed country sample, 1970-1994)

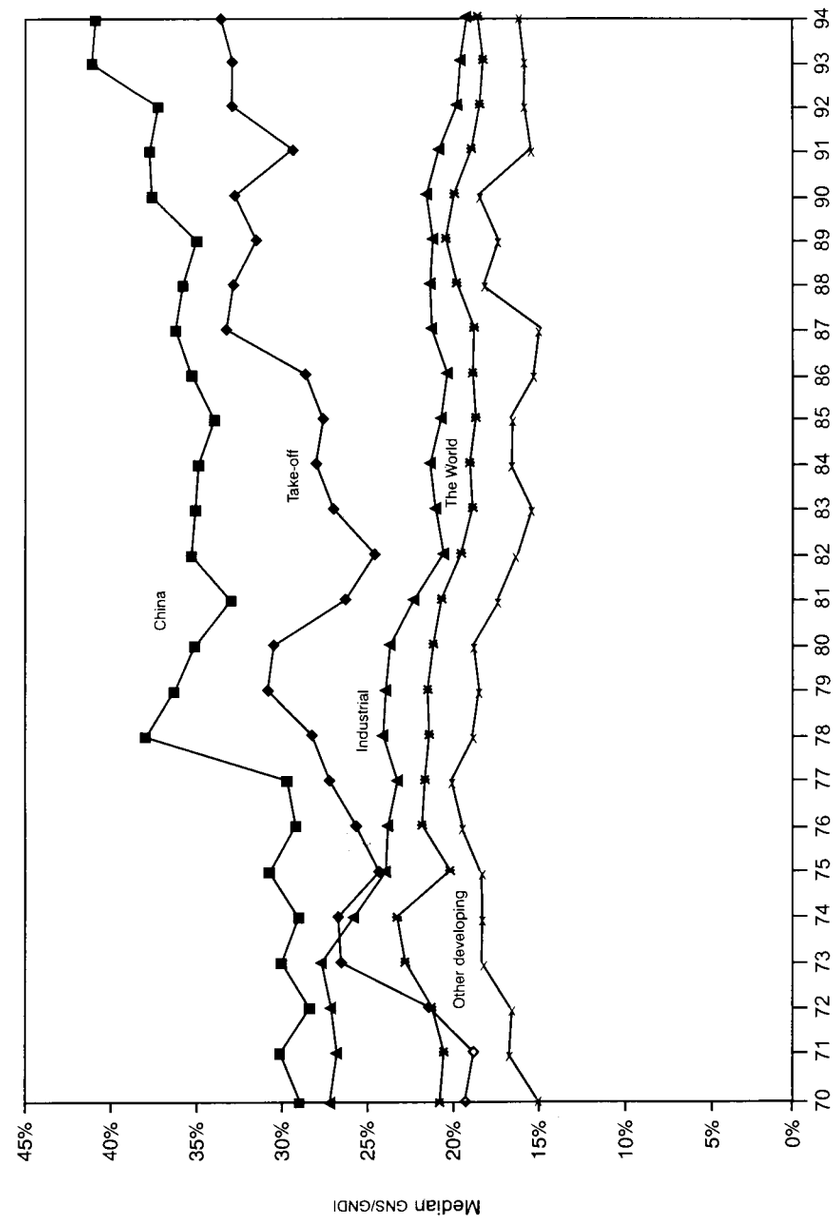
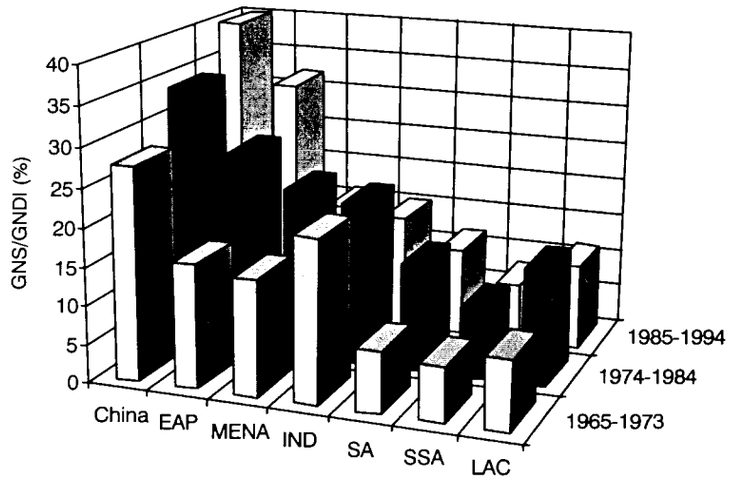


Figure 1b. GROSS NATIONAL SAVING RATES BY WORLD REGIONS
Gross national saving rate net current transfers as percent of gross national disposable income
(Regional medians at current prices, 1965-1994)

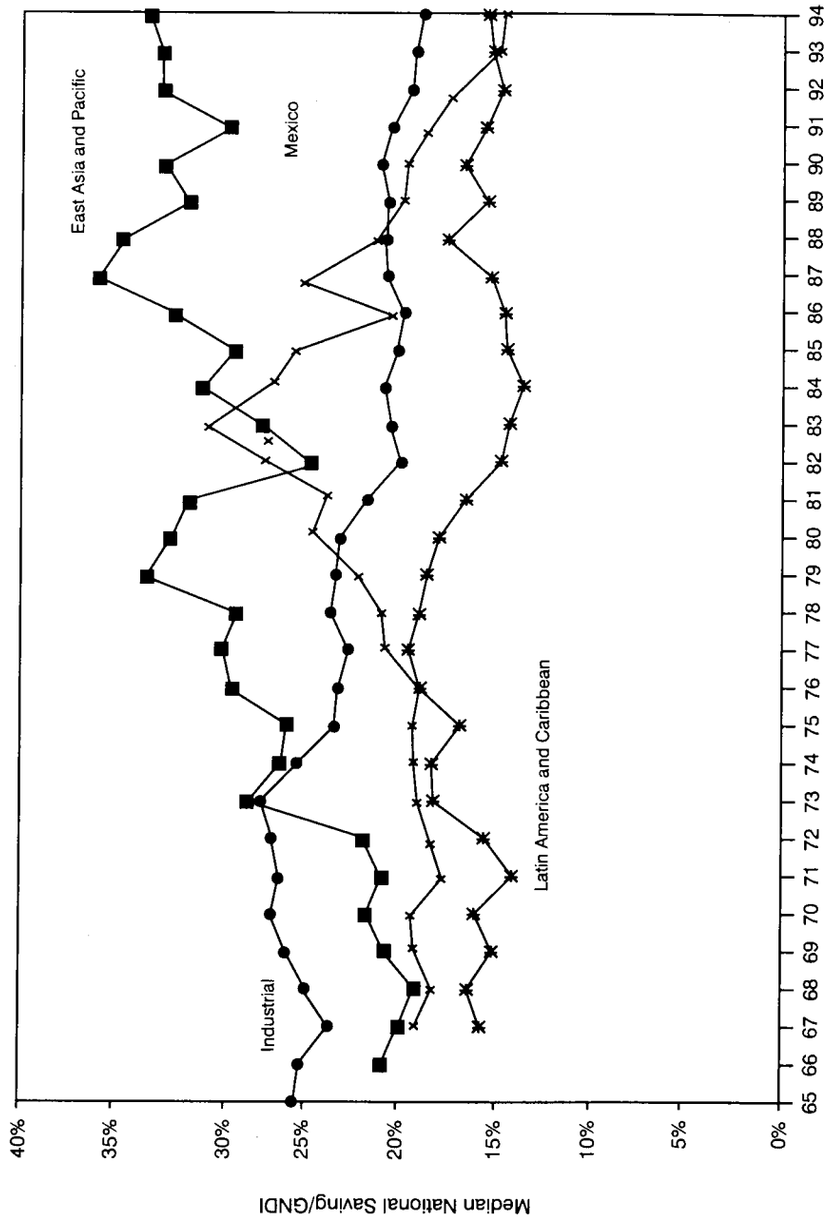


American region; a steady increase considerably above the Latin American (as well as the industrial-country) average until the early 1980s; and a steep decline thereafter, to record lows in 1993-1994, lower even than the median for Latin America. Mexico's boom-bust cycle is qualitatively similar to, but of larger magnitude and later timing than the one observed in the Latin American region as a whole.

What is behind these swings in Mexico's national saving? Figure 2b provides an answer by presenting private saving rates (relative to gross private disposable income GPDI) for Mexico and the same regions as in the preceding figure. The similarity between the time paths of Mexico's private and national saving rates is apparent: private saving hovered around 17-18 percent of GPDI until the late 1970s, rose to record highs in the early 1980s, far above the levels observed in the rest of Latin America, and collapsed after 1987 back to levels not different from those observed in Latin America as a whole.

The boom-bust pattern of Mexico's private saving, however, is overstated by Figure 2b, whose underlying data are not adjusted for the distorting effects of inflation. The latter magnifies the interest

Figure 2a. GROSS NATIONAL SAVING RATES IN MEXICO & WORLD REGIONS
Gross national saving as percent of gross national disposable income
(Group medians at current prices, fixed sample)



payments from the government on its debt held by the private sector; in an inflationary environment, part of these payments really are loan amortization and do not represent real income for the recipient. As we shall see later, if the inflationary component of interest payments is subtracted from private saving (and added to public saving), the boom-bust pattern becomes of smaller magnitude, but remains nevertheless present: private saving rates rise to industrial-country levels in the early 1980s, and then drop to record lows. The private saving fall after 1987, however, is limited to around 6 percentage points of GPDI, rather than the nearly 20-point drop suggested by the unadjusted data. We shall return in Section 3 to the issue of inflation adjustment in the context of the Mexico saving data; to avoid the distortions caused by high inflation, in the worldwide private saving regressions that we present next we use inflation-adjusted saving measures.

2.2. *What Drives Saving Across the World?*

To assess the factors behind these broad saving disparities across countries and over time, we adopt an encompassing approach based on reduced-form linear equations including a broad range of saving determinants. Our regressors include a standard group of income-related variables, namely the (log) level and the rate of growth of real *per capita* 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 1965-1994.

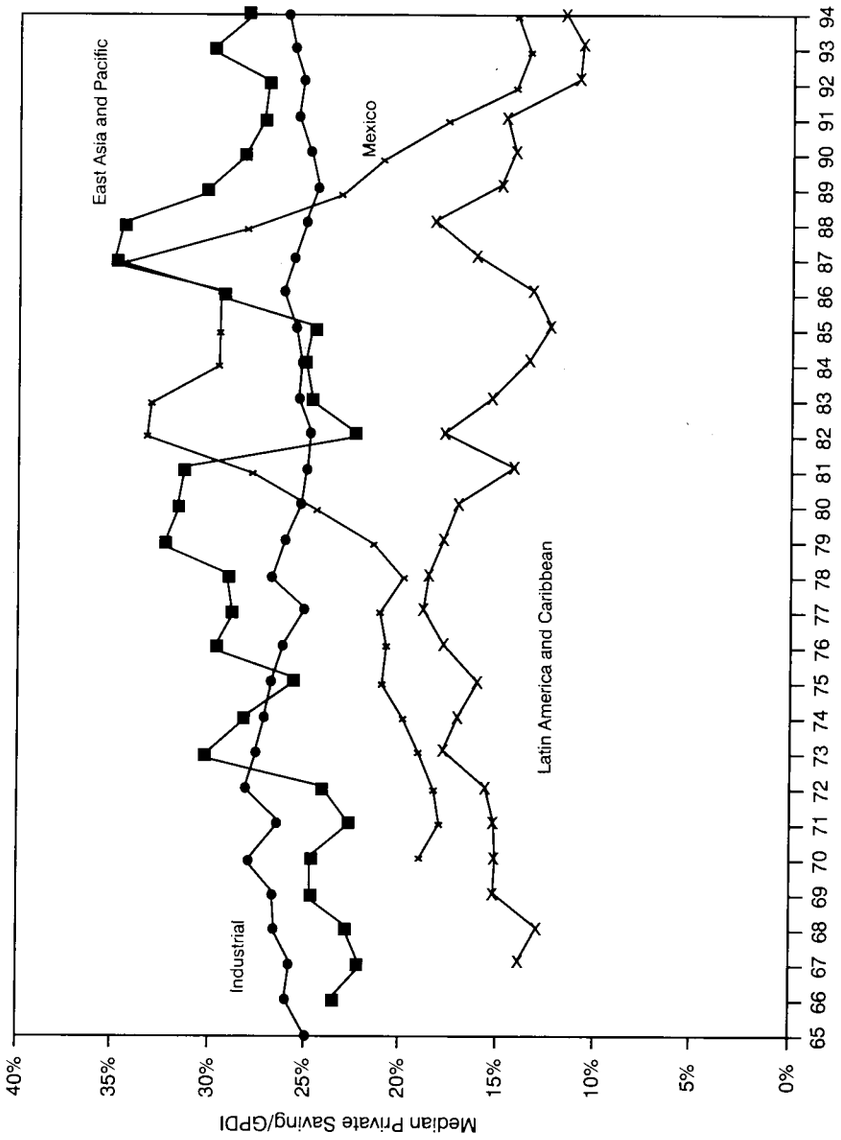
In addition, our basic regressors include both price and quantity financial variables. The latter are the ratio of M2 to GNP, as standard indicator of financial deepening, and the domestic (in national saving equations) or private (in private saving regressions) credit flow relative to income, to capture consumers' access to borrowing.[3] The price variable is the real interest rate, defined as $\ln [(1 + i)/(1 + \pi)]$, where i is the nominal rate of interest and π is the rate of inflation.[4]

As conventional, we attempt to capture Ricardian effects in pri-

[3] 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.

[4] The inflation rate is the average of current and one-period ahead inflation.

Figure 2b. GROSS PRIVATE SAVING RATES IN MEXICO & WORLD REGIONS
Gross private saving (unadjusted, public sector definition) as percent of gross private disposable income
(Group medians at current prices, fixed sample)



vate saving equations by including as regressor the public saving ratio, measured in a way consistent with the definition of private saving under consideration. In turn, demographic factors are reflected by the old and young-age dependency ratios, which are entered separately in the equations,[5] and 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 $(1 + \pi)$ 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).

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 overtime (dynamic) effects of the explanatory variables on saving, and considering it will allow us to discriminate between short-and long-run effects on saving.[6] Second, some of the explanatory variables in the core specification above are likely jointly determined with the saving rate — *e.g.*, the real interest rate, real income, and so on. 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 panel data models, that control for potential endogeneity of the explanatory variables and unobserved country-specific effects.[7]

Data availability varies across countries, and thus we work with an unbalanced panel. To achieve a minimum time-series dimension,

[5] In the results reported below, the null of equality of their estimated coefficients was generally rejected.

[6] While seldom considered in empirical studies, saving inertia would follow directly from *e.g.*, consumption habits. In our sample, the first-order autocorrelation coefficient of the private saving rate is 0.88.

[7] The Generalized Method of Moments (GMM) estimator was proposed by Chamberlain (1984), Holtz-Eakin, Newey and Rosen (1988), and Arellano and Bond (1991). For a concise presentation of the GMM estimator applied to saving regressions see Loayza, Schmidt-Hebbel and Servén (1998). The results we present below were obtained using the system GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998).

as well as to reserve sufficient observations to implement the instrumental-variable estimators just described, we limit our sample coverage to those countries with at least five consecutive annual observations. Further, to avoid the distortions introduced by high inflation in saving measures and related variables, we remove from the sample those observations corresponding to high inflation episodes — specifically, where inflation exceeds 50 percent. Unfortunately, these include part of the 1980s in the case of Mexico. Finally, we also eliminate those observations where the real interest rate exceeds 50 percent in absolute value — an almost certain indication of underlying data problems. After all these adjustments, the data set for the world sample (developing-country sub-sample) comprises 848 (475) observations for 68 (49) countries in the case of private saving, and 1 614 observations for 97 countries in the case of national saving.

With this setup, we performed a number of empirical experiments. Table 1 reports three representative estimation results: for private saving in the world sample, private saving in the developing-country sub-sample (using in both cases inflation-adjusted private saving, with the latter defined consistently with the broadest available definition of the public sector), and national saving in the world sample.[8] The results are fairly robust across country samples (comparing columns 1 and 2) and across private and public-saving ratios (comparing columns 1 and 3). We discuss them by variable categories next.

Persistence. The lagged saving rate has a positive and significant coefficient whose size (ranging from 0.38 to 0.57) reveals a large degree of persistence. The policy implication is that the long-run effects of a change in any policy (or structural) variable that affect saving are approximately twice as large as their respective short-run effects, given by the estimated coefficients reported in the table.

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 is bound to increase. The income level result is consistent with models of subsistence consumption, while the positive income growth effect runs against the permanent

[8] The results are robust to the use of alternative private-sector definitions, estimation techniques, country sub-samples, and addition of explanatory variables, as reported in Loayza, Schmidt-Hebbel and Servén (1998).

Table 1. Private and National Saving in the World:
Empirical Results from Dynamic Panel System-GMM Regressions

	1 *GPS/GPDI*	*2* *GPS/GPDI*	*3* *GNS/GNDI*
	World	LDCs	*World*
Lagged private (national) saving rate	0.569	0.476	0.383
	(8.748)	(17.820)	(6.704)
Real *per capita* GDPI (GNDI)[a]	0.063	0.071	0.100
	(2.836)	(7.473)	(2.669)
Real growth rate of *per capita* GDPI (GNDI)[b]	0.426	0.425	0.436
	(5.472)	(13.282)	(4.695)
Real interest rate[a c]	–0.278	0.002	–0.139
	(5.258)	(0.084)	(–1.313)
M2/GNP	–0.025	0.024	–0.015
	(–0.640)	(1.001)	(–0.331)
Terms of trade[a]	0.087	0.044	0.058
	(5.415)	(4.875)	(5.479)
Urbanization ratio	–0.451	–0.240	–0.496
	(–4.093)	(–5.101)	(–3.508)
Old dependency ratio	–0.752	–1.370	–0.838
	(–3.020)	(–4.321)	(–1.789)
Young dependency ratio	–0.303	–0.279	–0.179
	(–3.783)	(–5.816)	(–2.497)
Government saving/GPDI	–0.280	–0.238	—
	(–5.101)	(–8.333)	
Private credit flow/GPDI	–0.332	–0.508	–0.363
(Domestic credit flow/GNDI)	(–3.952)	(–9.955)	(–4.159)
Inflation rate	0.106	0.177	0.176
	(1.419)	(4.181)	(2.07)
Wald test of joint significance (p-value)	0.000	0.000	0.000
Sargan test (p-value)	0.424	0.292	0.149
Test for 1st-order serial correlation (p-value)	0.001	0.000	0.000
Test for 2nd-order serial correlation (p-value)	0.120	0.690	0.169
Test for 3d-order serial correlation (p-value)	0.253	0.353	0.251
Number of observations (number of countries)	848 (68)	475 (49)	1 614 (97)

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 percent.

income hypothesis, but is consistent with the existence of consumption habits and/or the life-cycle model where income growth accrues mostly across cohorts. According to the estimated coefficients, an increase in income by 1 percentage point raises the long-run private saving rate by approximately 0.15 percentage points, while an increase in the growth rate of income by 1 percentage point raises the private saving rate by similar amounts, ranging from 0.7 to 1.0 percentage points. This strong effect points toward a strong virtuous cycle between saving and growth. Policies that raise income levels or growth rates will also have robust indirect effects on saving, that could feed back to higher income levels or growth effects. Lastly, a 1-percent improvement in the terms of trade leads to an increase in the long-run private saving rate by 0.08 to 0.20.

Financial Variables. The real interest rate has a negative impact on the private saving rate in the world sample, 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 long-run decline of about 0.64 percentage points in the private saving rate. This result should be taken with some caution, however, in view of the strong negative correlation between inflation and the real interest rate, which suggests that our real interest rate measure may reflect more the action of nominal interest rate controls than consumers' intertemporal rate of substitution. In fact, for the LDC sub-sample the effect of the interest rate is zero and, while being negative, its effect is not significantly different from zero for the world gross national saving rate.

In turn, our indicator of financial depth (M2/GNP) has a small and statistically insignificant impact on private and national saving rates. 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 decreased saving (in agreement with evidence given by Japelli and Pagano 1995). When the flow of private (or domestic) credit rises by 1 percent of income, long-run private saving rates decrease by 0.57-0.97 percentage points.

Liberalizing domestic financial intermediation typically involves freeing interest rates, reducing bank reserve requirements, lifting credit allocation requirements on banks, and discontinuing the compulsory placement of government debt at below-market rates. As a result of financial liberalization real interest rates typically increase, the banking sector grows, the size of outstanding monetary and

financial liabilities rises, and private (and domestic) credit flows expand. The results discussed above provide a bleaker view of financial liberalization than suggested by previous studies, in both the price and quantity dimension. Higher interest rates either reduce or do not affect saving — hence liberalized interest rates should definitely not be expected to contribute to higher saving rates. In turn, the quantity channel — activated by the relaxation of borrowing constraints — shows a robust negative effect of liberalization on saving. Finally, the rise in monetary and financial-asset ratios to income caused by financial liberalization is not significantly different from zero. Although on the whole we do not find any positive, direct effect of financial liberalization on saving, there is considerable evidence that financial reform has a positive impact on growth (*e.g.,* Levine, Loayza and Beck, 1998) and, through this channel, a potentially important indirect effect on saving.

Fiscal Policy. A rise in the public saving ratio leads to a statistically significant decline in the private saving rate. Specifically, an increase of the public saving ratio by 1 percentage point reduces the private saving rate by approximately one-quarter of a point in the short run and by 0.45-0.77 of a point in the long run. The former result is at the low end of previous estimates, while the latter is at the upper end (see López, Loayza, Schmidt-Hebbel and Servén, 1998), so that allowing for inertia in saving helps reconcile some conflicting estimates found in the literature.

In any case, our results fall well short of full Ricardian equivalence either in the short or the long run. The implication is that public-sector saving is the most direct tool available to policy makers targeting the level of national saving — but long-term effects are weaker than short-term effects. For instance, a permanent rise in public saving by 4 percent of GNDI will raise national saving by some 3 percent of GNDI within the year, but only by some 0.23 percent to 0.55 percent of GNDI in the long term.

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 argument mentioned earlier — 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 depen-

dency ratios are consistent with standard life-cycle models of consumption. However, the coefficient on the old dependency ratio is significantly larger than that on the young dependency ratio, possibly reflecting the fact that in many countries the labor force effectively includes a non-negligible proportion of the population aged under 16 (the cutoff point for the young dependency ratio).

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, which 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. Conversely, a long-run reduction in the inflation rate by 10 percentage points reduces saving by 2.3 to 3.4 percentage points.

Regarding this result, it is important to keep in mind the same considerations made concerning the impact of financial reform: even if the direct effect of inflation stabilization on private saving is negative, stabilization also affects saving through other indirect channels that may well more than offset any negative direct effects of lower inflation. In this regard, there is systematic evidence that inflation raises growth (see Fischer, 1993, and Andrés and Hernando, 1997, among others) and, as discussed above, the latter has a major positive effect on private saving. Further, the fiscal-adjustment component of macro stabilization also has an unambiguously positive effect on national saving, as noted above.

2.3. Is Mexico Different?

The empirical results just reported summarize the saving behavior of a large group of countries, and one may wonder to what extent they are capable of accounting also for Mexico's saving pattern. To provide an answer, Table 2 reports a quantification of the factors behind the observed discrepancy between Mexico's private saving rates and those of the remaining countries. To facilitate comparability, we use the parameter estimates from the LDC private saving regression in column 2 of Table 1 above.

We perform the decomposition for three different samples. The first one is just the full regression sample for which we have data on Mexico; after reserving observations for lags and instruments, this

Table 2. Comparing Mexico's Private Saving Rate with the LDC Average

	Full sample	*1978-1982*	*1990-1993*	*Change*
	1	*2*	*3*	*3 - 2*
Actual Saving Rate Difference (Mexico — LDC average)	*0.003*	*0.022*	*–0.020*	*–0.042*
Explained by differences in:				
Real *per capita* GPDI[a]	0.123	0.130	0.115	–0.015
Real growth rate of *per capita* GPDI[b]	–0.007	–0.001	–0.015	–0.015
Young dependency ratio	–0.037	–0.064	–0.003	0.062
Old dependency ratio	0.002	–0.010	0.018	0.029
Urbanization ratio	–0.098	–0.099	–0.097	0.002
Inflation rate[a, c]	0.028	0.042	0.011	–0.030
M2/GNP	–0.007	–0.004	–0.009	–0.005
Private credit flow/GPDI	–0.001	0.018	–0.025	–0.044
Government saving/GPDI	0.003	–0.009	0.018	0.026
Real interest rate[a, c]	0.000	0.000	0.000	0.000
Terms of trade[a]	0.018	0.027	0.007	–0.020
Predicted Saving Rate Difference	*0.025*	*0.029*	*0.020*	*–0.009*
Unexplained residual	*–0.022*	*–0.007*	*–0.040*	*–0.033*

[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 percent.

runs from 1978 to 1993, with a gap in the high-inflation period of the mid 1980s. We next redo the exercise separately for the late 1970s-early 1980s, when Mexico's saving rates are near their peak, and the early 1990s, when they reach their trough. We finally compare the results from the latter two subsamples to check whether our empirical model can account for the decline in Mexico's private saving in the 1990s.

Column 1 presents the full-sample results. As the top of the column indicates, Mexico's private saving rate is, on average, 0.3 percentage points above the LDC average (excluding Mexico). The remaining entries along the column show the contribution of the different explanatory variables to this result. The main positive contribution is that of *per capita* income, higher in Mexico than in the LDC average; *ceteris paribus,* this would account for an extra 12 points of private saving rate. Inflation, through the precautionary saving effect, and the terms of trade also tend to raise Mexico's private saving above the levels of the average developing country. In turn, the major negative influences stem from the urbanization and young dependency ratios, both higher than average in Mexico; together, these two factors reduce Mexico's private saving rate by nearly 14 percentage points relative to the LDC average.[9] The bottom of the column shows that all factors considered, if taken together, would raise Mexico's private saving rate 2.5 percentage points above the LDC average, an over-prediction of 2.2 points relative to the level actually observed. Since the estimated equation includes fixed effects, this latter figure roughly reflects the differential action of unmeasured country-specific factors on Mexico's and other LDCs' private saving performances.

Columns 2 and 3 perform a similar decomposition for the subperiods 1978-1982 and 1990-1993, respectively. In the former, Mexico's private saving rates are 2.2 percentage points above the LDC average, while in the latter period the situation is reversed and Mexico's private saving averages 2 points below the rest of LDCs. The estimated equation captures fairly well the first subperiod, for which the predicted difference in saving rates between Mexico and the other LDCs still exceeds its observed counterpart, but only by 0.7 percentage points (bottom of column 2). In the latter subperiod, however, the model

[9] Notice that *per capita* income levels and demographic and urbanization indicators are all very highly correlated, so that their combined effect (which in this case totals –1.0 percentage points) could be viewed as reflecting the overall impact of 'development' on saving.

over-predicts Mexico's saving performance relative to the LDC average by a more substantial margin — 4 percentage points — even though it correctly forecasts a decline.

As the last column in Table 2 shows, between the early 1980s and early 1990s Mexico's private saving ratio declined by over 4 percentage points relative to the LDC average. As implied by the previous paragraph, the estimated model predicts a more modest decline (0.9 percentage points, shown at the bottom of the column), but it is nevertheless instructive to examine the factors behind such deterioration in saving performance, which are listed along the column. The first remarkable fact is that the change in demographic indicators between the first and second subperiods would instead predict a rise in saving performance, reflecting the progress of demographic transition in Mexico relative to other LDCs. These demographic forces would *ceteris paribus* tend to raise Mexico's private saving rate over the LDC average by some 9 percentage points. An additional positive influence is that of public saving, which declined in Mexico relative to the LDC average. Through (partial) Ricardian offsetting, this would in turn add another 2.6 percentage points to the difference between Mexico's private saving rate and the LDC average.

More interesting perhaps are the negative factors. The leading one is the expansion in credit flows to the private sector, which would account for a deterioration of over 4 percentage points in Mexico's private saving performance relative to the other developing countries. This seems to agree well with the widely-held view that enhanced credit availability (or, equivalently, the removal of borrowing constraints) to the private sector triggered a spending boom in Mexico in the early 1990s (see *e.g.,* Montiel, 1998).

Apart from credit availability, several other factors contributed *ceteris paribus* to a decline in Mexico's differential saving performance between the early 1980s and early 1990s: the reduction in inflation, through the precautionary saving effect; the deterioration in the terms of trade; the slowdown in growth and the decline in *per capita* income, in all cases relative to the LDC average, all exerted downward pressure on Mexico's private saving rate, again relative to the LDC average, between the two subperiods considered.

On the whole, these results are reasonably satisfactory for an empirical equation like the present one, estimated on a large cross-country time-series sample. However, while the estimated equation helps single out some potential factors (notably the expansion of

private credit flows) behind the decline in Mexico's private saving performance in the early 1990s, it fails to capture the full extent of the decline. This suggests the need for a more in-depth analysis of the Mexican experience. We turn to this task in the next section.

3. Saving in Mexico

In this section we explore Mexican quarterly time-series data from 1980 through 1995. We do this in three ways. First, we present charts of various measures of private, public and national saving, along with charts of a number of potential explanatory variables for private and national saving. Second, we attempt to explain the behavior of private and national saving using regression analysis. The specifications we use in the analysis are broadly consistent with those we used to analyze the panel data set discussed in section 2. While our regressions do not have a fully structural interpretation, in the third stage of our analysis, we use them to assess the quantitative significance of the various factors affecting aggregate saving in Mexico during this period.[10]

3.1. A Look at the Data

Figure 3 plots deseasonalized quarterly time series for Mexico over the period 1980Q1-1995Q2. Several aspects of these time series are worthy of note. First, the national saving rate, S_N, illustrated in Figure 3a, follows the pattern already found earlier when using annual data in Figure 2a:[11] it was fairly stable at around 23 percent of GNP in the early 1980s, peaked in 1983 at almost over 25 percent of GNP, and then declined slowly and fairly steadily from 1983 through 1994. It stood at about 17 percent of GNP just prior to the peso crisis of December

[10] While our regression specifications include dynamics for the saving rates we do not attempt to determine the pattern of causality among the explanatory variables. In other words, we do not identify mutually exogenous structural shocks that ultimately determine saving behavior. See Burnside (1998) for a vector autoregression-based approach to identifying structural shocks.

[11] Because in this section we use quarterly data, the figures do not match exactly. An appendix giving details of our data is available upon request.

1994. So there is a decline of about 6 percentage points of GNP to be explained over the sample period.

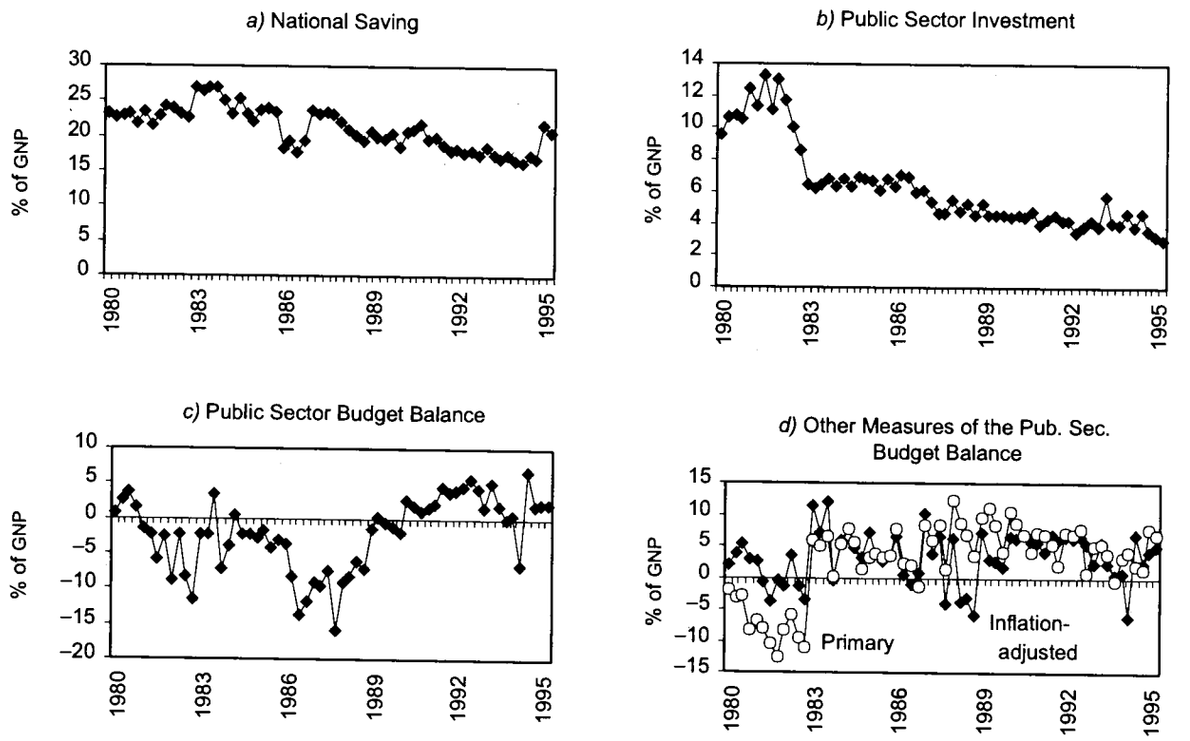
It may be instructive to examine the components of national saving — that is, public and private saving. Public saving can be viewed in turn as the sum of the public sector budget balance and public sector investment, *i.e.*, $S_G = I_G + \Delta_G$, where I_G denotes public sector investment and Δ_G is the public sector balance. From this perspective, one factor in the decline in national saving may have been the decline in public sector investment, illustrated in Figure 3b. It peaked in 1982 at over 12 percent of GNP, and declined rapidly thereafter in the wake of the debt crisis and the decline in world oil prices. By 1994, public sector investment was only about 4 percent of GNP. Of course, the extent to which public sector investment was responsible for the decline in national saving depends on whether the decline in this investment was offset by increased saving by the private sector.

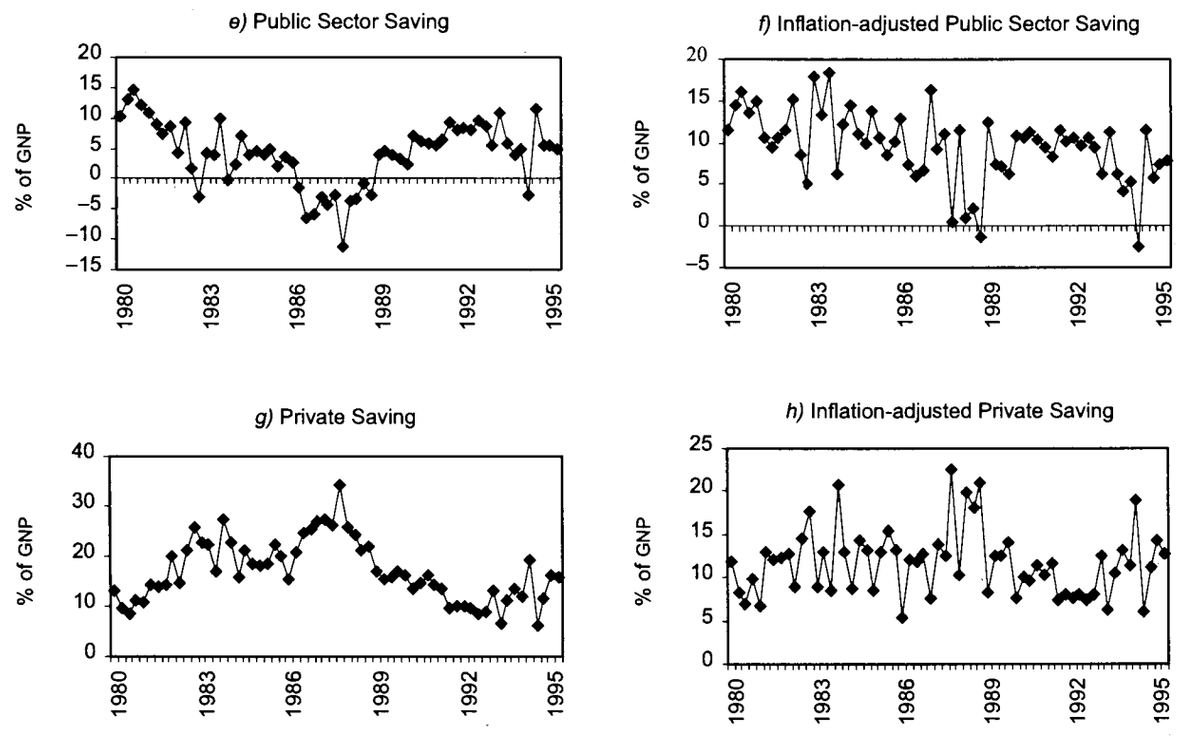
The other component of public sector saving is the public sector budget balance. To measure the budget balance we used data on the financial balance, which includes the federal government, public sector enterprises and public sector financial intermediaries in the definition of the public sector. Detailed data on the finances of state governments are not available for Mexico. Therefore, state governments are implicitly excluded from the definition of the public sector.

The public sector financial balance as a percentage of GNP is illustrated in Figure 3c. There was a steady worsening of budget deficits in the early 1980s as inflation accelerated and nominal interest payments on debt soared. The deficit was almost always greater than 8 percent of GNP, from early 1986 through the first quarter of 1988. After the implementation of the stabilization program in early 1988, the budget deficit was gradually reduced, and the public sector actually moved to a surplus position by 1990.

In Figure 3e we show public saving, defined as the sum of public investment and the public sector financial balance. The overall pattern in public sector saving clearly resembles that of the public sector budget balance. It declined steadily from about 10 percent of GNP in the early 1980s, to almost –10 percent of GNP just prior to the implementation of the stabilization program in 1988. It then rose steadily to remain mostly above 5 percent of GNP in the 1990s. Thus we see an 8-year long decline in public sector saving of about 20 percentage points of GNP followed by a similar rise in public sector saving of about 15 percentage points of GNP.

Figure 3. Saving in Mexico and its Components





Since national saving displays no swings of such magnitudes, it is clear that our measure of private sector saving, S_P, which is obtained residually from the identity, $S_P = S_N - S_G$, will reflect them. This is illustrated in Figure 3g. There is an apparent increase in private sector saving from about 10 percent of GNP in 1980 to about 25 percent of GNP in 1987-1988, followed by a decline to the 10-15 percent of GNP range in the 1990s.

Taken at face value, the fact that private saving and public sector saving seem to move roughly opposite to one another is quite suggestive of Ricardian equivalence, *i.e.* the hypothesis that public sector finance is offset by the saving decisions of the private sector. However, it is important not to take the data at face value. The public sector budget balance figures, which are the basis of our measures of public and private sector saving, are dominated, during the 1980-1988 period, by large nominal interest flows. Figure 4e illustrates the annualized inflation rate during our sample period. A clear negative correlation between the inflation rate and the budget balance is apparent.

This means that we need to think carefully about how we should take interest flows into account in our measures of saving. Suppose a household has a net worth of 1 peso, held in the form of government debt, at time t, and receives interest on that debt at date $t + 1$, in the amount i. Everything else held equal, the household's net worth at date $t + 1$ will be $1 + i$. However, the purchasing power of the household's wealth will be given by $(1 + i)/(1 + \pi)$, where π is the inflation rate between the two time periods. If we were to measure household saving in the same manner as we measured public and private saving above, then in this example it would be i, or in real terms, $i/(1 + \pi)$, where we have normalized the time t price level to 1. But if we were to measure the household's real saving using the change in the purchasing power of its net worth, we would have real saving equal to $(1 + i)/(1 + \pi) - 1 = (i - \pi)/(1 + \pi)$, or nominal saving equal to $i - \pi$. The lesson from this example is that whenever the public sector has a substantial stock of nominal debt outstanding, the first method of measuring saving will tend to overstate effective private saving by the inflation rate times the stock of debt. And there will be an equal and opposite understatement of public sector saving.

Since inflation was rapid, and the Mexican government had substantial nominal debt in the 1980s, this discussion is clearly relevant for our analysis. In our subsequent analysis we will use an

inflation-adjusted measure of the public-sector financial balance, illustrated in Figure 3d, and given by[12]

$$\Delta^*_{Gt} = \Delta_{Gt} + \pi_t B_{t-1},$$

where π_t is the rate of inflation of the GDP deflator, and B_t corresponds to the end-of-period t peso value of the consolidated domestic public debt (economica amplia) published by the Bank of Mexico in the *Informe Anual*. This measure of the public debt considers the public sector to be the federal government, parastatal organizations and enterprises, plus official financial intermediaries, and thus corresponds to the definition of the public sector used to construct the financial balance. We make symmetric adjustments to our measures of public saving, $S^*_{Gt} = S_{Gt} + \pi_t B_{t-1}$, and private saving, $S^*_{Pt} = S_{Nt} - S^*_{Gt}$, illustrated in Figures 3f and 3h, respectively.

There are three possible problems with our inflation adjustments. First, if some domestic currency debt is held by foreigners then the inflation adjustment should be applied to national saving (assuming that the national accounts do not already make the inflation adjustment). Second, adjustments should only be made for debt whose face value is fixed in nominal terms. No adjustment would be required for indexed debt. And finally, similar adjustments should be made for foreign debt whenever there are departures from purchasing power parity. Since we did not have data on foreign holdings of domestic debt, detailed information of debt indexation, nor information regarding holdings of foreign assets by households, we chose not to attempt these further adjustments.

Figures 3d, 3f and 3h show that the inflation adjustments are important. They remove the strong swings in saving that are an artifact of large nominal interest flows. However, the strong negative correlation between public sector and private saving remains. In this case, it seems to arise from the fact that our adjustments for inflation have induced a great deal of high frequency movement in public sector saving. Since similar movements in national saving are not observed, these high frequency movements end up being reflected in our residual measure of private saving. We investigate the possibility that these high frequency movements reflect measurement error below.

[12] The cross-country data behind the regressions in section 2 above is adjusted for inflation following a very similar procedure.

3.2. Empirical Specification

This subsection presents results of regressions that seek to explain the variation in saving rates we saw in the previous section. The specifications we will use in the analysis strongly resemble those we used in Section 2 to describe saving patterns worldwide. One important difference is that we do not use any of the demographic variables because we do not have high frequency measures for them.

There are also some differences regarding econometric procedure. The GMM technique adopted in the previous section was used primarily to deal with the problem of estimating fixed-effects using a dynamic panel data set. Suppose we wish to estimate the relationship

$$y_{it} = \alpha_1 + p\, y_{it-1} + x_{it}' \beta + \varepsilon_{it}, \tag{3.1}$$

where i denotes the country and t denotes the time period, and ε_{it} are assumed to be serially uncorrelated. A standard procedure for handling fixed effects in the context of panel data involves first-differencing equation (3.1) to obtain

$$\Delta y_{it} = \rho\, \Delta y_{it-1} + \Delta x_{it}' \beta + \Delta \varepsilon_{it}. \tag{3.2}$$

The GMM procedure used in the previous section is designed to handle the fact that by first-differencing to eliminate fixed effects, correlation between a regressor, Δy_{it-1}, and the error term, $\Delta \varepsilon_{it}$, is induced. The procedure also allows for possible correlation between x_{it} and ε_{it}, by assuming that ε_{it} is orthogonal to all variables determined in period $t-1$, or earlier. The GMM procedure uses any variable dated $t-2$, or earlier, as an instrument for the right-hand side variables in (3.2).[13]

When we move to studying Mexican data we no longer have to deal with fixed effects so we can work with an equation expressed in levels

$$y_t = \alpha + \rho\, y_{t-1} + x_t' \beta + \varepsilon_t. \tag{3.3}$$

[13] Actually, the system GMM technique used in the previous section is a bit more complicated in that it combines the first-differenced equation (3.2), using lagged levels of the variables as instruments, with the original levels equation (3.1), using lagged *differences* of the variables as instruments. See Blundell and Bond (1998) for further details.

Under the same assumptions as we used in the panel analysis above, the only reason we might need to use a GMM-based procedure is to handle possible correlation between x_t and ε_t. In our regressions we proceed without using an instrumental variables procedure, and simply use OLS. We attempted regressions using lagged explanatory variables as instruments, and in most cases obtained similar but noisier point estimates for most of the variables, but in other cases the instruments appeared to be insufficiently correlated with the explanatory variables to obtain accurate estimates.

3.3. Dependent and Explanatory Variables

In our regressions we attempt to explain movements in the private saving rate, as well as the national saving rate. We define the private saving rate to be given by private saving, S_P, divided by private income, Y_P, where our measure of private income is obtained as the sum of private saving and the national accounts measure of private consumption, C_P. We define the national saving rate as the ratio of national saving, S_N, to GNP.

As above, we include the lagged saving rate as an explanatory variable in order to capture possible lagged responses of saving rates to various shocks.

In our panel regressions we included the level of real *per capita* income along with its growth rate. This is effectively the same as including the level of income as well as its lagged value in the regression. The income variables used in this section are the growth rate of real *per capita* private income, in the regression for private saving, and the growth rate of real *per capita* GNP, in the regression for national saving. We use growth rates rather than income levels, because there appear to be unit roots, if not trends, in the levels of these variables in our sample period (see Table 3). We only include the contemporaneous growth rate of income in the regressions because lags of the growth rate were never significant when they were included. The growth rate of real *per capita* GNP is plotted in Figure 4a.

As in Section 2, we included the ex-post real interest rate as an explanatory variable. This was measured using the nominal interest rate on Mexican treasury bills reported by the International Financial Statistics, and using the inflation rate defined by the annualized quarterly inflation rate of the GDP deflator. This real interest rate

Table 3. Unit Root Tests on Mexican Income Variables

	5% Critical Value	10% Critical Value	Private Income	GNP
Stock-Watson Tests				
Quadratic trend	-27.9	-24.1	-22.8	-9.8
Linear trend	-21.7	-18.2	-15.8	-9.3
No trend	-14.1	-11.2	-12.8	-8.3
Dickey-Fuller Tests				
Linear trend	-3.41	-3.12	-2.30	-1.93
No trend	-2.86	-2.57	-2.01	-1.81

Note: The Dickey-Fuller tests of the null-hypothesis of a unit root in y_t are based on the t-statistic (against 0) for α in the regression $y_t = \beta_0 + \beta_1 t + \alpha y_{t-1} + \varepsilon_t$, with or without the time trend included. The Stock-Watson tests of the null-hypothesis of a unit root in y_t are based on the asymptotic distribution of $T\hat{\alpha}$ from a similarly specified regression: $\tilde{y}_t = \alpha\tilde{y}_{t-1} + \varepsilon_t$, where $\tilde{y}_t$ represents detrended y_t, obtained using varying numbers of trend terms. Tests allowing for higher-ordered serial correlation led to similar results.

measure is plotted in Figure 4b. There are three main episodes of noteworthy fluctuation in real interest rates. The post-debt crisis period and the pre-stabilization period were both periods of financial repression and large negative real interest rates. The immediate post-stabilization period was one of very large positive real interest rates.

As in Section 2, we included measures of both M2 relative to GNP and domestic credit relative to GNP.[14] These variables are illustrated in Figure 4c. They are highly correlated with one another, and so, at least for Mexico it will be difficult to separately identify coefficients on the two variables as measures of financial depth and credit availability respectively.

The terms of trade defined as the ratio of the export price deflator to the import price deflator is included in our regressions. This variable is illustrated in Figure 4d. Not surprisingly, given Mexico's position as a significant oil exporter, its terms of trade are highly correlated with the world price of crude oil defined as the dollar price of a barrel of crude oil relative to the US GDP deflator. The simple correlation between the two time-series is 0.87. For this reason, we can think of the terms of trade as largely reflecting exogenous external shocks to Mexico's national wealth.

In our benchmark regressions we include public sector saving, scaled by either private income or GNP, as an explanatory variable. In the regression for private saving this allows us to determine the extent to which private saving offsets public saving. To the extent that it does, the coefficient on public saving should be close to –1. In the regression for national saving, if private saving offsets public saving, the coefficient on public saving should be close to 0.[15]

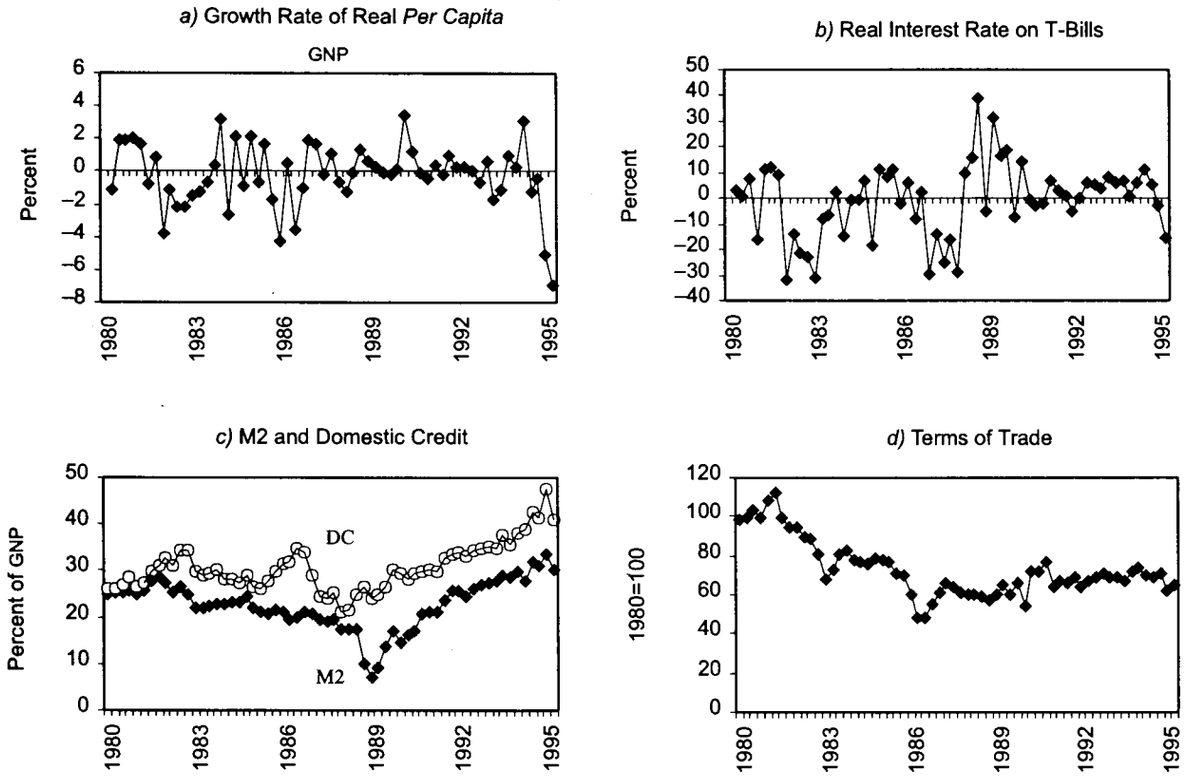
Finally, as in Section 2, we include the inflation rate as a measure of macroeconomic instability. We use the annualized rate of inflation of the GDP deflator as our measure, illustrated in Figure 4e.

Moving beyond our benchmark specifications, we explore the data further to see whether there are systematically different effects on private saving arising from changes in the two components of public

[14] We use private domestic credit in the private savings regression and total domestic credit in the national savings regression.

[15] The definitions of several variables change slightly (because they are scaled differently) when we move from the private saving to the national saving regressions. This, along with inclusion of the lagged saving rates, explains the fact that the coefficients on variables other than saving variables change as we move from one type of regression to the other.

Figure 4. Explanatory Variables for Mexico Saving Regressions



saving: the budget balance and public sector investment. To explore this issue we include these two variables (scaled relative to private income or GNP) in our regressions instead of public saving.

A further departure from our benchmark specifications arises when we include public sector consumption, expressed relative to private income or GNP, in our regressions. We do this for the following reason. Suppose the public sector budget is initially in balance, and the government increases government consumption by 1 peso and finances it in the short-term by borrowing. This shows up as a decline in the budget balance and in public saving. In a Ricardian world, the increased budget deficit will have an offsetting effect on private saving, but the increase in government consumption will also have indirect effects depending on consumers' preferences regarding public sector consumption. In a different experiment, if the deficit increases due to a temporary cut in lump-sum taxation, only the direct effect will come into play. These examples suggest that we should include government consumption as a control variable. It is illustrated in Figure 4f.

3.4. Regression Results

Table 4 presents the regression results for private saving while Table 5 presents the results for national saving. The results are broadly consistent with our findings using the worldwide database.

In Table 4 column 1 we present our benchmark private saving regression which is most comparable to our regressions in section. First, we find little serial correlation in private saving from the pure feedback term. The coefficient of the lagged dependent variable is close to zero and is insignificant. We found larger feedback terms in our worldwide analysis.[16]

Second, we find that income growth has a negligible positive impact on saving rates. While the sign of the point estimate is consistent with our worldwide findings, it is not statistically or economically significant. A 10 percentage-point increase in the growth rate of income would result in an increase in saving of about 0.3 of one percent of income.

[16] The lack of feedback in these data may be a function of high frequency measurement error in the dependent variable as discussed in section 3.1 and below.

Table 4. Regressions for Private Saving in Mexico

	1	*2*	*3*	*4*
Lagged saving rate	0.084	0.086	0.090	0.16
	(0.97)	(1.01)	(1.09)	(2.13)
Private income growth	0.029	0.027	0.022	0.086
	(0.38)	(0.35)	(0.30)	(1.29)
Real interest rate	0.11	0.11	0.13	0.12
	(2.67)	(2.77)	(3.20)	(3.52)
M2/GNP	–0.05			
	(0.44)			
Terms of trade	0.13	0.12	0.16	0.18
	(5.40)	(6.77)	(6.01)	(7.50)
Public saving rate	–0.66	–0.66		
	(9.20)	(9.27)		
Public budget balance			–0.64	–0.58
			(9.20)	(9.06)
Public investment			–0.90	–0.69
			(6.53)	(5.17)
Private domestic credit	0.006	–0.03	–0.04	0.17
	(0.05)	(0.44)	(0.52)	(2.07)
Inflation rate	0.12	0.12	0.13	0.13
	(5.55)	(5.58)	(6.08)	(6.72)
Public consumption				–0.97
				(3.96)
R^2	0.80	0.80	0.81	0.86

Note: The dependent variable is the private saving rate measured as the ratio of private saving to private income. The private income growth rate is expressed as the first difference of the logarithm of real *per capita* income. The real interest rate is expressed as the logarithm of $(1 + i)/(1 + \pi)$. The terms of trade is expressed as its logarithm. Public saving, the public budget balance, public investment, public consumption and private domestic credit are all expressed relative to private income. The inflation rate is expressed as the logarithm of $(1 + \pi)$. The sample is 1980Q2-1995Q2. T-statistics are in parentheses.

Table 5. Regressions for National Saving in Mexico

	1	*2*	*3*	*4*	*5*
Lagged saving rate	0.56	0.56	0.53	0.49	0.48
	(5.01)	(5.00)	(4.62)	(5.13)	(5.15)
GNP growth	0.19	0.19	0.15	0.16	0.19
	(1.63)	(1.65)	(1.23)	(1.65)	(1.94)
Real interest rate	0.050	0.054	0.063	0.052	0.055
	(1.88)	(2.06)	(2.33)	(2.30)	(2.58)
M2/GNP	–0.07				
	(0.97)				
Terms of trade	0.051	0.041	0.064	0.091	0.096
	(2.74)	(2.66)	(2.74)	(4.55)	(4.94)
Public saving rate	0.090	0.091			
	(1.69)	(1.77)			
Public budget balance			0.093	0.013	
			(1.83)	(0.28)	
Public investment			–0.07	–0.029	0.10
			(–0.50)	(0.27)	(0.73)
Domestic credit	0.12	0.06	0.04	0.18	0.22
	(1.43)	(1.07)	(0.75)	(3.29)	(3.67)
Inflation rate	0.058	0.058	0.067	0.067	0.069
	(3.57)	(3.58)	(3.82)	(4.65)	(4.86)
Public consumption				–1.09	–1.10
				(5.02)	(5.54)
Public primary balance					0.077
					(1.43)
R^2	0.80	0.79	0.80	0.87	0.87

Note: The dependent variable is the national saving rate measured as the ratio of national saving to GNP. The GNP growth rate is expressed as the first difference of the logarithm of real *per capita* GNP. The real interest rate is expressed as the logarithm of $(1 + i)/(1 + \pi)$. The terms of trade is expressed as its logarithm. Public saving, the public budget and primary balances, public investment, public consumption and domestic credit are all expressed relative to GNP. The inflation rate is expressed as the logarithm of $(1 + \pi)$. The sample is 1980Q2-1995Q2. T-statistics are in parentheses.

Unlike in our worldwide regressions, in Mexico higher real interest rates are associated with higher saving rates. A 100 basis-point increase in the real interest rate would result in an increase in private saving of about 0.1 of one percent of income. This seems like a small magnitude, until one takes into account the fact that there have been enormous swings in real interest rates in Mexico. For example, in 1988 the real interest rate rose by about 7 000 basis-points from –30 percent to +40 percent.

The level of M2 relative to GNP as a measure of financial development is insignificant in the regression as it was in our cross-country analysis. Similarly, our measure of private domestic credit relative to private income is also insignificant. A possible explanation for this finding is that in our Mexican data, domestic credit is highly correlated with one of our other explanatory variables that has a closer high frequency relationship with private saving.

The terms of trade has a strong positive relationship with private saving, consistent with our findings above. A 10 percent decline in the terms of trade would cause private saving to fall by 1.3 percent of income. In our sample period, oil prices fell steadily and Mexico's terms of trade deteriorated by about 45 percent, implying roughly a 6 percent decline in private saving. Why should private saving fall when the terms of trade worsen? When oil prices fall, if their decline is perceived to be transitory, there will be a decline in income, but the perceived decline in permanent income, and thus, the decline in private consumption will be much smaller. Thus saving rates will fall.

The higher the public saving rate the lower is private saving. The degree of offset is about two-thirds, consistent with Bosworth (1996), although somewhat larger in magnitude than the long-run estimate that we found in our worldwide sample.

Finally, higher inflation appears to be associated with higher saving, consistent with our findings above. An increase in the inflation rate of 10 percentage points causes a rise in saving of just over 1 percent of income. There are two plausible explanations of this behavior. First, periods of high inflation tend to be periods of macroeconomic uncertainty, so households and firms may save more simply for precautionary reasons. Second, higher inflation acts as a tax on consumption purchases financed with cash balances, so households may be postponing consumption and saving in indexed or real assets when inflation is high.

We get similar results when we consider the benchmark national

saving regression in Table 5 column 1. A key difference that arises is that there is more persistence in the national saving rate. The feedback coefficient is 0.56 and is highly significant. Furthermore, real GNP growth has a more robustly positive impact on saving both in terms of its magnitude and in terms of its statistical significance. The real interest rate, terms of trade and inflation effects are all similar to what they are in the private saving regression once we take the feedback coefficient into account. Consistent with the findings from the private saving regression we find that an increase in public sector saving tends to raise the national saving rate by about 0.09 of one percent of GNP in the short run, or about 0.2 of one percent of GNP in the longer run.[17]

In turn, the level of domestic credit relative to GNP appears to have a marginally significant positive impact on saving.

From these regressions we proceed to alternative specifications. Our first step was to remove one of the financial variables from the regression. We chose to eliminate M2/GNP as a regressor and use only domestic credit in the regressions. The resulting estimates are presented in column 2 of Tables 4 and 5. The estimates remain roughly unchanged, and domestic credit remains either insignificant or marginally so.

As we discussed above, it may be important to separate public saving into its two components. The private sector might react quite differently in its decision making to an increase in public saving due to increased public investment, as opposed to an increase driven by, say, higher taxes. So in column 3 of Tables 4 and 5 we present results obtained by separately entering the public sector budget balance and the rate of public investment. In both cases, the coefficients on other variables remain qualitatively unchanged. The offset coefficient on public investment is closer to –1, which suggests public investment is a close substitute to private saving. We tested whether the coefficients on the budget balance and public investment were the same using simple Wald tests. We unambiguously rejected the hypothesis of equality in the private saving regression. However, the hypothesis can only be rejected at the 40 percent level in the national saving regression.

Finally we added public sector consumption to our regressions for the reasons given above. The results are presented in column 4 of Tables 4 and 5. In the private saving regression this caused the offset

[17] This implies an offset coefficient of –0.8.

coefficients on public investment and the budget balance to be of roughly similar magnitude (–0.69 and –0.58 respectively) and made domestic credit a significant — but positively signed — right-hand side variable. It also raised the estimate of persistence in the saving rate. Interestingly, higher public sector consumption appears to cause a decline in private saving of equal magnitude. This finding extends to the national saving regression. What is the explanation? One possibility is that public consumption has no effect on the marginal utility of private consumption. In such case, a temporary, tax-financed increase in public consumption (that is, holding public saving constant) has little effect on private consumption but will cause private income to fall one for one. This would cause a decline in both private and national saving. However, permanent increases in public consumption, something our data appear not to exhibit, would cause private consumption to fall and would have a much smaller impact on saving.

3.5. What Is Important for Explaining Saving in Mexico?

In this subsection we examine our regression results more closely. For this purpose we take our column 4 regressions as benchmark. We consider the fit of these regressions in Figure 5. Our regressions capture a great deal of the variation in saving rates. There is almost no evidence of serial correlation in the residuals. The first order serial correlation coefficient for the error term in the private saving regression is 0.2, while in the national saving regression it is about –0.1.

In Figure 6 we decompose the explained departures of the private saving rate from its mean into its various components. Each graph indicates how much of the deviation is explained by the departure of each variable from its own mean. An important caveat to this sort of analysis is that it does not identify structural causality. For example, thinking of movements in the inflation rate that occur independently of movements in real interest rates may not make sense if the two comove strongly. For this reason we also present the correlation matrix of the explanatory variables in the private saving regression in Table 6. Finally, it is also important to keep in mind that the exercise under consideration here is different from that undertaken in section 2: there the objective was to explain Mexico's *differential* performance *vis-à-vis* the rest of the developing world, while here we are concerned instead with the time pattern of saving in Mexico alone.

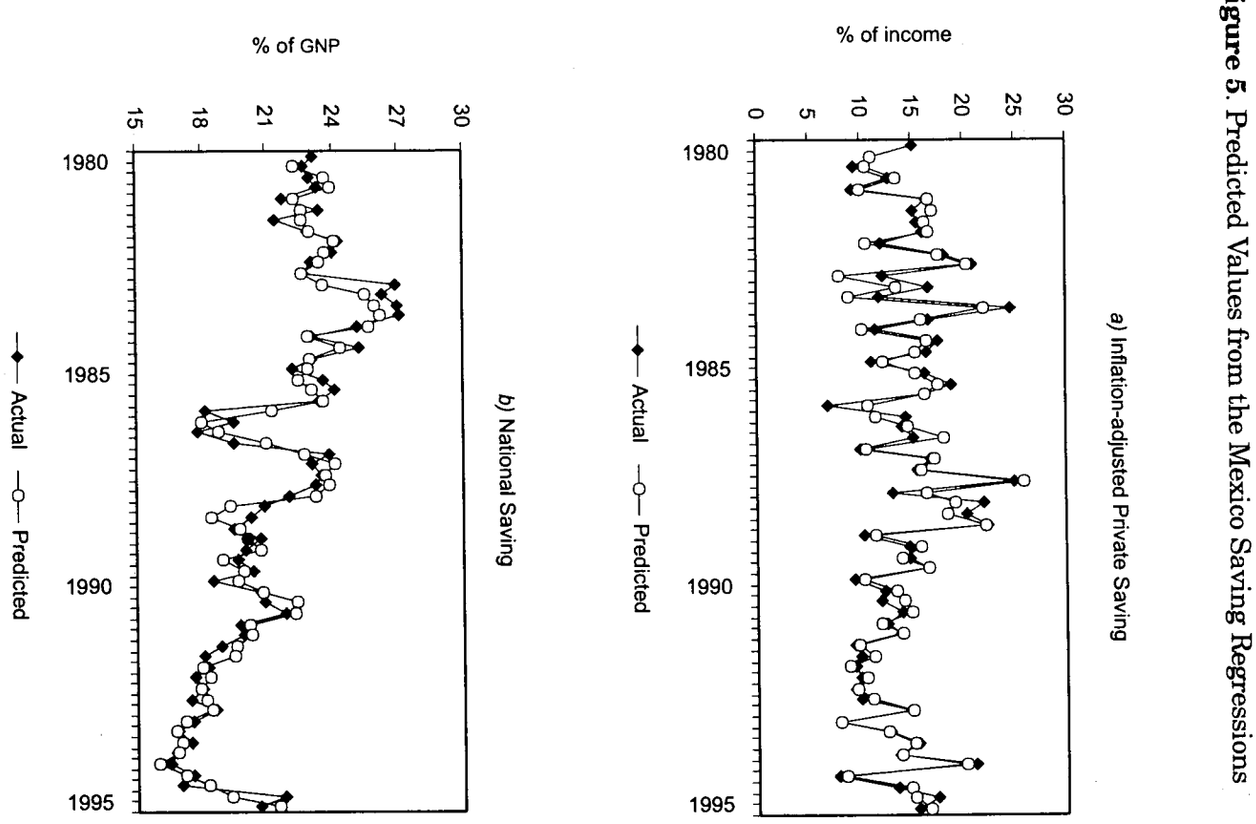
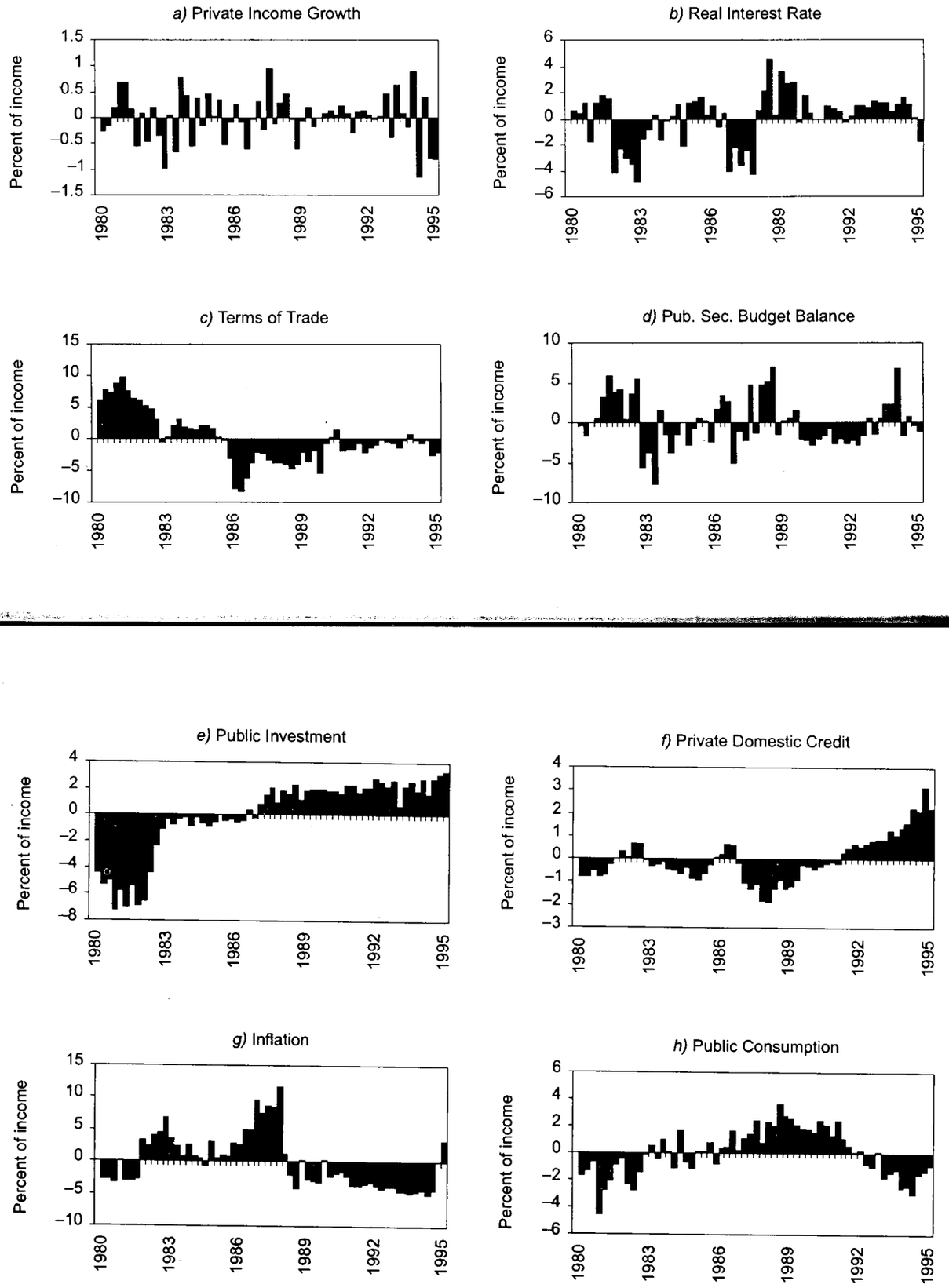


Figure 5. Predicted Values from the Mexico Saving Regressions

Table 6. Correlation Matrix of Explanatory Variables in the Private Saving Regression for Mexico

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1. Income growth	1							
2. Real interest rate	0.089	1						
3. Terms of trade	0.111	–0.091	1					
4. Budget balance	0.359	0.262	0.067	1				
5. Public investment	–0.001	0.257	–0.777	–0.188	1			
6. Public consumption	0.055	0.180	–0.602	–0.056	0.500	1		
7. Credit	–0.260	0.052	–0.069	0.032	0.241	–0.490	1	
8. Inflation	–0.096	–0.799	–0.207	–0.140	–0.152	0.158	–0.324	1

Figure 6. Sources of the Predicted Deviation of Private Saving from its Mean



Subject to these considerations, the important determinants of private saving appear to be:

1. *Real interest rates* (Figure 6b). The fact that these were especially low in the debt crisis and pre-stabilization periods would appear to have lowered private saving rates by about 3 percentage points below its average level. The relatively high real interest rates in the post-stabilization period are associated with significantly higher saving rates. But it is important to keep in mind that the movements in real interest rates we are referring to were enormous. In a relatively stable economic environment, where we would not expect wild fluctuations in real interest rates, they would not have a large impact on private saving.

2. *The terms of trade* (Figure 6c). The decline in oil prices and its terms of trade that Mexico experienced from 1981 through early 1987 would have caused a dramatic decline in private saving of about 15 percentage points according to our estimates. As the terms of trade improved gradually in the late 1980s and early 1990s, the terms of trade effect roughly disappeared.

3. *Public saving: the public sector budget balance* (Figure 6d). Our data include quite sharp high frequency swings in the public sector deficit. Given the large offset coefficients we estimated, private saving moved sharply in several episodes (Figure 6d).

4. *Public saving: public sector investment* (Figure 6e). Interestingly there is a sharp increase in private saving of about 6 percentage points implied by the decline in public investment that occurred in the early 1980s.

5. *Inflation* (Figure 6g). The inflation rate was much higher in Mexico in the 1982-1988 period than before or after. Higher inflation appears to be robustly associated with higher saving. In fact, if there is a decline in private saving in the late 1980s and early 1990s to be accounted for, the decline in inflation rates appears to be the main explanation. The return to macroeconomic stability until 1995 may have caused the private sector to reduce its precautionary balances, and to raise consumption due to a reduction in the inflation tax.

Why do we need to be cautious in conducting this one-variable-at-a-time analysis? To take an example, Table 6 indicates that the inflation rate is not highly correlated with any variable other than the real interest rate. So when we consider the effects of high inflation

on private saving, we need to note that real interest rates typically fall sharply during periods of high inflation, due to financial repression. To find the overall effect of inflation on saving we need to look simultaneously at Figures 6b and 6g. Similarly, public investment is strongly negatively correlated with the terms of trade. If public investment is financed out of discretionary funds obtained through oil revenues, we might want to think of oil shocks as causing the combined outcomes of Figures 6c and 6e.

In Figure 7 and Table 7 we perform a similar analysis using our regression for national saving. Here the main determinants of saving appear to be:

1. *Real Interest Rates and Inflation* (Figures 7b and 7g).
2. *The Terms of Trade* (Figure 7c).
3. *Domestic Credit and Public Sector Consumption* (Figures 7f and 7h). Variation in these variables appears to have had a moderate impact on saving rates.

3.6. Measurement Error and Budget Deficits

The results in Tables 5 and 6 consistently suggest that private saving behavior offsets, at least to a large degree, the budgetary policies of the public sector in the 1980s and early 1990s in Mexico. However, as we have noted above, there is a strong possibility that this result is driven by measurement error.

For example, suppose our measure of national saving is correct, but that the *measured* budget balance, Δ_t^m, is subject to a white-noise classical measurement error. This will imply that $\Delta_t^m = \Delta_t^* + \varepsilon_t$, where Δ_t^* is the true budget balance and ε_t is a white noise error term uncorrelated with Δ_t^* and with national saving. Since national saving is assumed to be measured correctly, in a simple regression of national saving on the budget balance the coefficient estimate would be given by

$$\beta = \frac{Cov(S_{Nt}, \Delta_t^m)}{Var\,(\Delta_t^m)} = \frac{Cov\,(S_{Nt}, \Delta_t^* + \varepsilon_t)}{Var\,(\Delta_t^* + \varepsilon_t)} = \frac{Cov\,(S_{Nt}, \Delta_t^*)}{Var\,(\Delta_t^*) + \sigma_\varepsilon^2}$$

$$= \frac{Cov\,(S_{Nt}, \Delta_t^*)}{Var\,(\Delta_t^*)} \frac{Var\,(\Delta_t^*)}{Var\,(\Delta_t^*) + \sigma_\varepsilon^2}$$

$$= \beta^* \frac{Var\,(\Delta_t^*)}{Var\,(\Delta_t^*) + \sigma_\varepsilon^2},$$

where β^* is the true coefficient. The noisier the budget balance data are, the further the coefficient estimate will be biased towards zero. A similar argument explains how the offset coefficient in the private saving regression may be biased toward –1.

Are our data corrupted with measurement error? It is effectively impossible for us to determine whether they are, without an independent measure of private saving or the government's inflation-adjusted budget balance. Our estimates of the offset coefficients are not that different from those presented by Bosworth (1996), who worked with annual data over a different sample period. Since our inflation adjustments are the most likely source of measurement error and his were based on official Mexican data, we are inclined to have some faith in our estimates.

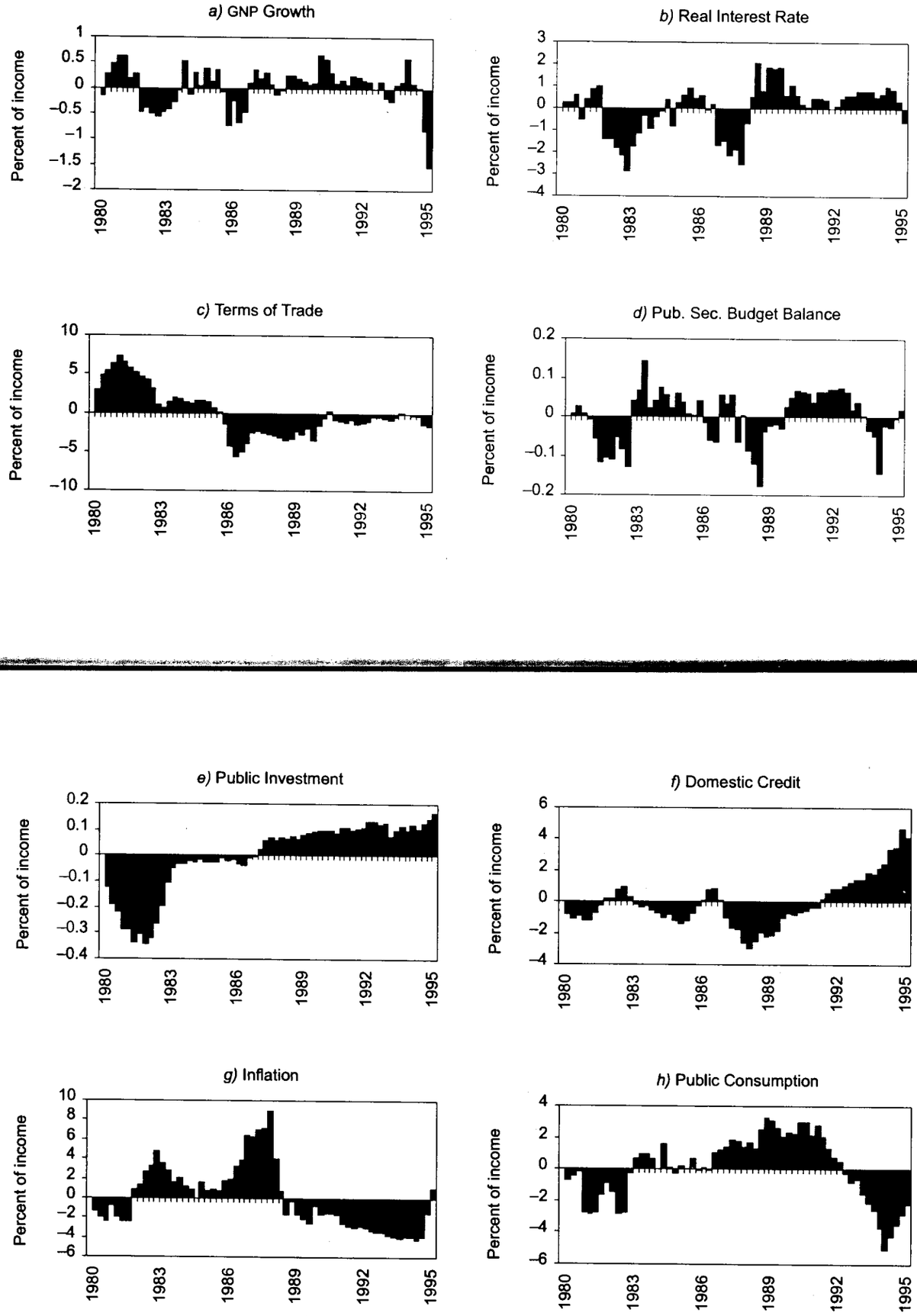
Finally, again because our inflation adjustments are the most likely source of measurement error, we performed an additional regression which is presented in Table 5, column 5. In this regression we simply eliminate interest payments from our measure of the budget balance by using the primary balance. We again obtain an estimate which implies substantial offset of public saving behavior by the private sector.

As a final word of caution, it should be pointed out that the regressions cannot truly be given a structural interpretation. They describe a simple relationship among the variables, and they do not identify the responses of private or national saving to exogenous shocks to the Mexican economy. Most of the right-hand side variables in the equations could easily be thought of as simultaneously determined by a large number of common structural shocks. Burnside (1998) uses a structural VAR approach to attempt to identify some of these structural shocks.

Table 7. Correlation Matrix of Explanatory Variables in the National Saving Regression for Mexico

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1. GNP growth	1							
2. Real interest rate	0.275	1						
3. Terms of trade	0.159	–0.146	1					
4. Budget balance	0.076	–0.140	–0.101	1				
5. Public investment	0.024	0.311	–0.787	0.337	1			
6. Public consumption	0.226	0.049	–0.484	0.349	0.314	1		
7. Credit	–0.453	0.072	–0.016	0.029	0.244	–0.665	1	
8. Inflation	–0.246	–0.785	–0.202	0.022	–0.199	0.288	–0.397	1

Figure 7. Sources of the Predicted Deviation of National Saving from its Mean



4. Conclusions

We started this paper by making use of the largest cross-country time-series macroeconomic data set on saving and related variables assembled to date to discuss the time-series pattern of saving in the world at large and in Mexico over the last three decades. A simple comparison shows that boom-bust saving cycles were more pronounced in Mexico than in other Latin American countries during the last three decades. Selective econometric results for dynamic panel GMM-system regressions of private and national saving rates for the full world sample and for the set of developing countries were reported. The results helped identify the stylized facts concerning the effects of key policy and non-policy variables in explaining saving across the world.

Then we attempted to explain the differences between Mexico's and the world saving rates by making use of the estimated equations. While the estimated equation helps single out some potential factors behind the decline in Mexico's private saving performance in the early 1990s, it fails to capture the full extent of the decline, suggesting the need for a more in-depth analysis of the Mexican experience. We turned to this task in three stages.

First, we noted the importance of adjusting for inflation the Mexican saving data. While this correction to saving data needs to be made quite generally (and has been implemented in our worldwide database), in the case of Mexico it is particularly important due to the high-inflation environment of the 1980s, that distorts considerably the unadjusted public and private saving figures and causes them to display strong swings that are largely artificial.

We next reported simple OLS regressions for private and national saving using specifications analogous to those estimated on the world sample. The results — which should be interpreted as reflecting association rather than strict causation among the different variables — are in general fairly similar to those obtained with the cross-country data. We find a significant positive association of private saving with the terms of trade and inflation, and a negative association with public saving. In contrast with our panel regressions, however, we also find a significant positive effect of the real interest rate, although of small magnitude, while the effects of credit availability and income growth are insignificant in the Mexican data. Finally, regressions with national saving as the dependent variable yield very similar results. On

the whole, our estimated equations do a good job at accounting for the observed variation in saving ratios.

Using these estimates, we concluded by examining again the contribution of different factors to the observed time pattern of private saving in Mexico. From this analysis, we identified as key variables the terms of trade, public saving, the real interest rate, and the inflation rate.

Income growth had a small and insignificant effect on Mexico's private saving rate during 1980-1995 — a result that might be attributed to low and noisy growth in Mexico during this particular sample period. But from the strong contribution of *per capita* income level and growth rates to saving rates in the world, documented in this paper, one may be optimistic about Mexico's future saving rates. If the country is able to sustain a high growth path in the future, this path could be reinforced by a virtuous saving-growth cycle, nurtured by the strong response of private (and national) saving rates to real income growth observed in the world sample.

References

Andrés, J. and Hernando (1997), "Does Inflation Harm Economic Growth?", NBER Working Paper No. 6 062, June.

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

Arellano, Manuel and O. Bover (1995), "Another Look at the Instrumental Variable Estimation of Error-Component Models", *Journal of Econometrics* 68, pp. 29-51.

Banco de México (various), *Informe Anual,* D.F., Mexico, Banco de México.

Blundell, R. and Steve Bond (1998), "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models", *University College London Discussion Paper* 97-07.

Bosworth, Barry (1996), "The Decline in Mexican Saving: A Cost of Reform?", manuscript, The Brookings Institution.

Burnside, Craig (1996), "Public Saving, Stabilization and Private Saving in Mexico", manuscript, The World Bank.

——— (1998), "Private Saving in Mexico, 1980-1995", manuscript, The World Bank.

Chamberlain, G. (1984), "Panel Data", in Z. Griliches and M. D. Intrilligator (eds.), *Handbook of Econometrics*. Amsterdam, Elsevier.

Deaton, Angus (1977), "Involuntary Saving through Unanticipated Inflation", *American Economic Review* 67 (5), pp. 899-910.

Fischer, Stanley (1993), "The Role of Macroeconomic Factors in Growth", *Journal of Monetary Economics* 32 (3), pp. 485-512.

Holtz-Eakin, D., Whinston Newey, and H. Rosen (1988), "Estimating Vector Autoregressions with Panel Data", *Econometrica* 56 (6), pp. 1371-1395.

Japelli, Tullio and Marco Pagano (1995), "Saving, Growth and Liquidity Constraints", *Quarterly Journal of Economics* 109, pp. 83-109.

Levine, Ross, Norman Loayza and T. Beck (1998), "Financial Liberalization and Growth: Causes and Consequences", manuscript, The World Bank, September.

Loayza, Norman, Klaus Schmidt-Hebbel, and Luis Servén (1998), "What Drives Saving Across the World?", manuscript, The World Bank, September.

López, Humberto, Norman Loayza, Klaus Schmidt-Hebbel and Luis Servén (1998), "Saving in the World: Stylized Facts", manuscript, The World Bank, September.

Public Policies and Private Saving in Mexico

Martin Feldstein*

Abstract: This paper presents a variety of ideas about ways in which the government of Mexico can stimulate a higher rate of saving. These ideas are building blocks rather than an overall plan. Mexico has recently replaced its traditional pay-as-you-go social security system with a system of mandatory individual pension accounts that is likely to increase national saving and capital accumulation. The present paper focuses on other tax, regulatory and government financial policy changes that could increase the reward, the security and the liquidity of savings in ways that would raise the national saving rate. The design of the individual pension accounts (the AFORE program) is discussed in the Appendix to this paper.

Resumen: Este artículo presenta una serie de ideas sobre cómo el gobierno mexicano podría estimular mayores tasas de ahorro. Éstas son ideas separadas y no un plan estructurado en conjunto. México ha reemplazado recientemente su sistema de pensiones de reparto por un sistema obligatorio de cuentas individuales, que al parecer debe aumentar el ahorro nacional y la acumulación de capital. El presente artículo se enfoca sobre otros impuestos y cambios en la política regulatoria y financiera gubernamental que podrían aumentar el premio, la seguridad y la liquidez de los ahorros, de modo que aumente la tasa nacional de ahorro. El diseño del

* Professor of Economics, Harvard University, and President of the National Bureau of Economic Research. I am grateful to Dr. Kathleen Feldstein and Dr. Carlos Sales for their assistance in this project, to the Mexican Bankers Association for sponsoring a 1995 study on which this paper is based, and to officials of the IMF and World Bank, the Mexican government, the Bank of Mexico, and Mexican commercial banks for very helpful discussions. The views expressed here are my own and should not be attributed to anyone else or to any organization.

An earlier version of this paper, "Public Policies to Increase the Private Saving Rate in Mexico", was distributed in 1995 before the introduction of the current Mexican system of mandatory individual pension savings accounts. Although many of the issues discussed in that paper about individual pension savings accounts have now been resolved by legislation, a slightly revised version of that section of the original paper is presented in an appendix to the present paper. Even those issues that now seem settled may be revisited by Mexican policy makers in the future. In addition, the analysis in the appendix is relevant not only to Mexico but to other countries, particularly emerging market countries, that are considering the adoption of such a system of individual accounts.