IMF WORKING PAPER

WP/95/39   INTERNATIONAL MONETARY FUND

Southeast Asia and Pacific Department

Saving Trends in Southeast Asia:
A Cross-Country Analysis

Prepared by Hamid Faruqee and Aasim M. Husain *

Authorized for distribution by Kenneth B. Bercuson

April 1995

Abstract

This paper investigates the long-run pattern of private saving in Indonesia, Malaysia, Singapore, and Thailand. These countries have not only maintained saving levels that are currently among the highest in the world but have also experienced a sustained increase in their rate of private saving over the past twenty years. Using a cointegration approach, this paper empirically examines the economic determinants underlying the saving trends in this group and the extent to which these countries share a common experience with respect to the factors accounting for their strong saving performance. The findings suggest that demographic shifts have been an important factor underlying regional saving trends with a similar long-run impact in each country, except for Indonesia where the effects of demographics have been even more pronounced.

<div align="center">

Contents   <u>Page</u>

</div>

Summary

This paper reviews long-run developments in private saving behavior in Indonesia, Malaysia, Singapore, and Thailand since 1970. Over this period, rates of private sector saving in these economies have risen steadily and are presently among the highest in the world. Using cointegration analysis, the paper empirically examines the economic determinants underlying the long-run pattern of saving in these countries and the degree to which these economies share common developments in the factors accounting for their strong saving performance.

Based on country estimates and cross-country analysis, the principal finding of this study is that shifts in the demographic structure of the population appear to be the main factor explaining the sustained rise in the rate of saving in all four countries over the sample period. Fundamental demographic shifts increasing the relative size of the working age population appear to have boosted the rate of saving in these countries. Moreover, the magnitude of these long-run effects appears to be quite comparable across countries with the exception of Indonesia, where the impact has been even more pronounced.

The paper finds that the long-run implications of provident funds and compulsory saving policies are less clear. Compulsory provident fund saving appears to have had little or no consequence for the trend rate of saving in Malaysia, but there is some evidence of a long-run impact in Singapore. These differences may well be tied to each country's differing experience with compulsory saving schemes. Finally, financial deepening appears to be marginally significant for the long-run determination of saving only in the case of Singapore, the country achieving the highest level of financial development over this period.

I. Introduction

The remarkable economic performance posted by the dynamic economies in Southeast Asia has attracted increasing attention in recent years. The development experience of these countries, which were among the fastest growing economies in the world over the past two decades, is widely believed to provide valuable lessons for other developing countries. 1/ A hallmark of that experience of sustained rapid growth has been the high and increasing rate of private saving among these countries. Indeed, the high rates of investment associated with rapid economic growth are often attributed to the high rates of domestic saving. Hence, a basic understanding of the "virtuous cycles" behind these economic success stories fundamentally rests upon an understanding of the factors driving such high saving behavior.

This paper reviews trend developments in private saving behavior in Indonesia, Malaysia, Singapore, and Thailand since 1970. Like many of their high-performing neighbors, each of these economies has experienced rapid growth in per capita income over this period. At the same time, rates of private sector saving in these economies have risen steadily and are presently among the highest in the world. While the impact of saving on growth is certainly an important issue, the focus here is to examine the economic determinants underlying the long-run pattern of saving in these countries and the degree to which these economies share common developments in the factors accounting for their strong saving performance.

Using cointegration analysis, this paper empirically investigates the long-run behavior of private sector saving for this group of countries. After verifying the trend properties of saving and its potential determinants, the long-run impact of these variables on the trend rate of saving is estimated. In addition, an error correction model is estimated to investigate the short-run dynamics of saving. The empirical analysis is conducted for each country individually and for a panel consisting of time-series data for all the countries to allow for the detection of common relationships across countries between saving and its fundamental determinants.

The principal finding of this study is that shifts in the demographic structure of the population appear to be the main factor explaining the sustained rise in the rate of saving in all four countries over the sample period. Moreover, the long-run impact of demographic changes on saving is nearly identical in three of the countries in the sample, and even stronger in the fourth.

These results are consistent with other studies of the impact of demographics on saving. Masson, Kremers, and Horne (1994), for example, find that demographics affect the long-run level of net foreign assets for the major industrial countries, reflecting the effects of this factor on net national saving. 2/ The saving performance of developing countries, surveyed in Chandavarkar

---

1/ See World Bank (1993) for a cross-country study of the high-performing economies of East Asia.

2/ Specifically, they examine the long-run impact of the dependency ratio and the public debt ratio (relative to the remaining G7 countries) on the net foreign asset position of the United States, Germany, and Japan. For a broad study on saving trends in OECD countries see Dean et al. (1990) and the references cited therein.

(1993), is empirically analyzed by Lahiri (1989). Estimating saving behavior in eight Asian economies, Lahiri finds that the principal determinants of saving are growth and demographics. 3/

While presenting evidence in support of Lahiri's findings regarding the effect of demographic changes, we find that growth does not appear to affect long-run changes in the trend rate of saving. Rather, differences in growth rates across countries possibly account for cross-country differences in the level of saving. Also, our panel estimations, which allow us to test for common relationships between saving and its determinants across countries, suggest that the impact of demographics on developments in long-run saving was very similar in three of the four countries in our sample.

The remainder of the paper is organized as follows: Section II discusses various factors influencing the long-run rate of saving. Developments in saving and these factors in each country over the period 1970-92 are summarized in Section III. Section IV contains a discussion of data issues and the empirical methodology. The estimation results are presented in Section V. Section VI offers some concluding remarks.

II. Long-Run Determinants of Private Saving

Models of saving and consumption behavior point to various factors that may influence the long-run rate of saving. For example, in the basic life-cycle model in which agents work and save during the first period of their lives, then retire and dissave in the second period, the overall rate of saving in the economy depends, inter alia, on the proportion of workers to retirees. Hence, among two otherwise identical economies, the one with the higher working age population ratio would be expected to have a higher steady-state average propensity to save. 2/ Moreover, shifts in the demographic structure of the population in a given economy would likely have long-run consequences for the aggregate rate of saving.

Under the overlapping generations framework, the growth rate of income can also be shown to be a determinant of the saving rate in the steady state. While leaving unchanged the average propensity to save of the individual, an increase in steady-state growth raises the aggregate saving rate by making the young savers in the present period more affluent than the young savers of the previous period, who now constitute the older dissavers. Moreover, to the extent that higher growth is associated with higher real interest rates, long-run saving may be higher as well.

The level of financial development and deepening may also influence an economy's saving performance, particularly in developing countries. By increasing the availability of saving instruments, financial deepening could potentially raise the rate of saving. In addition, financial deepening brought about through a liberalization of financial markets could raise real rates of return

---

1/ Lahiri's estimations of saving behavior are conducted country by country, rather than with a pooled dataset for all the countries in his sample.

2/ Several cross-sectional studies have found that higher dependency ratios are associated with lower saving rates. See for example Graham (1987), Masson and Tyron (1990).

on financial assets, thereby boosting the saving rate. The latter effect, however, has drawn at best limited support in the empirical literature. 3/

Compulsory saving schemes, such as social security, could also affect the overall rate of private sector saving. The magnitude of this impact, however, may vary considerably across countries. For example, an increase in the mandatory contribution rate would raise the saving of liquidity-constrained individuals at the margin. Hence, as long as compulsory saving earns a rate of interest comparable to that of voluntary saving, and voluntary and compulsory saving are seen as broadly substitutable, the impact of changes in compulsory saving on overall private saving would depend on the proportion of liquidity-constrained individuals in the population. Empirical cross-country studies attempting to estimate this effect have generally concluded that increases in mandatory saving rates tend to raise overall saving. Indeed, Kopits and Gotur (1980) and Datta and Shome (1981) report that changes in compulsory saving are fully reflected in changes in total saving.

Other variables, such as wealth, interest rates, and government debt, also feature prominently in intertemporal models of consumption and saving. For a variety of reasons, the inclusion of such variables in empirical estimation of saving behavior in developing countries is problematic. Interest rates in many developing economies tend to be either administered or controlled, and formal financial markets are small relative to the economy. Consequently, observed interest rates need not reflect the true return on saving. As regards wealth, time series data on financial and human wealth are simply not available for these countries. 2/ However, financial wealth may be reasonably proxied by broad measures of real money balances in the economy. Finally, while information on government debt is available for most countries, data on the value of government assets are generally not. Since private agents' saving decisions are affected by net government indebtedness, a proper measure of individuals' future tax liability cannot be obtained.

III. Historical Background

Before turning to the empirical methods and results regarding private saving in Indonesia, Malaysia, Singapore, and Thailand, a brief description of the developments in the potential long-run determinants of saving behavior during the period 1970-92 is in order.

Rates of private saving rose significantly in each of the four countries in the sample over the past two decades (Table 1). In Indonesia and Singapore, saving rates more than doubled during 1970-92, while in Thailand the increase was about 50 percent. Indeed, rates of saving in all four countries appear to have been trending upward throughout the period, although significant deviations from the trend occurred in Malaysia (Chart 1).

1/ Empirical studies, however, generally find that real interest rate effects on saving are quite small. For example, Ogaki, Ostry, and Reinhart (1995) find that the interest sensitivity of saving rises with income, but from a very low level.

2/ To the extent that the wealth as a ratio to income—e.g., capital-output ratio—is roughly constant over time, wealth may only affect the level of saving.

Table 1. Selected Economic Indicators, 1970-92

	1970-74	1975-79	1980-84	1985-89	1990-92	1970-92
Per capita private disposable Income growth (in percent)						
Indonesia	2.8	2.1	3.1	1.9	2.0	2.4
Malaysia	4.1	3.7	3.8	3.0	4.8	3.8
Singapore	6.1	6.3	6.5	4.8	4.6	5.8
Thailand	2.0	1.8	0.6	3.1	3.1	2.1
Private saving (in percent of private disposable income)						
Indonesia	13.3	18.1	23.3	27.9	30.8	22.0
Malaysia	28.5	33.4	33.2	37.5	33.4	33.2
Singapore	21.8	28.7	40.3	39.8	43.4	34.0
Thailand	23.4	24.4	26.1	31.3	33.8	27.3

CHART 1

PRIVATE SAVING, 1970-92
(In percent of private disposable income)

Accompanying the upward trend in saving rates was a sizable shift in the demographic structure of the population in each country. In Singapore, the working age population ratio, defined as the ratio of working age individuals to the total population, rose from 58 percent in 1970 to about 70 percent in the early 1980s but remained at that level over the next decade (Chart 2). In Indonesia, Malaysia, and Thailand, the working age population ratio increased steadily throughout the period, though the rise was not as pronounced as in Singapore.

Growth rates of per capita private disposable income varied considerably across the four countries and over different time periods (Table 1). Income growth in Indonesia, where the petroleum sector constitutes a significant share of the economy, rose to an average of about 3 percent annually during the oil price shocks of the early 1970s and 1980s but averaged about 2 percent annually for much of the remainder of the sample period. In Malaysia, per capita income growth, while varying considerably, averaged close to 4 percent annually during the 1970s and early 1980s. The volatility of income resulted, in part, from movements in the prices of commodities, which accounted for a substantial share of production in the 1970s. Since the 1985-86 recession, during which time incomes shrank in Malaysia, growth picked up to an annual average of almost 5 percent in per capita terms. Growth in Singapore, after averaging over 6 percent during the 1970s and early 1980s, declined during the 1985-86 recession but subsequently recovered to almost 5 percent annually in recent years. In Thailand, per capita growth declined during the 1970s and early 1980s, partly on account of the oil shocks, but recovered to an average of over 3 percent annually in recent years.

Financial deepening, as measured by the ratio of money and quasi-money to disposable income, progressed steadily in each country over the past two decades, although the comparative degree of deepening among the four countries remained broadly unchanged (Chart 3). By this measure, the most financially developed economy throughout the period was Singapore, where the financial deepening ratio rose from about 80 percent in the 1970s to almost 130 percent in recent years. By contrast, the ratio for Indonesia was only 10 percent in 1970 but rose to almost 60 percent by 1992, remaining the least developed on this front. In both Malaysia and Thailand, the financial deepening ratio rose from about 35 percent in 1970 to almost 100 percent in 1992.

Economy-wide compulsory saving schemes exist in Malaysia and Singapore in accordance with their publicly-managed, fully funded social security systems. Saving under these schemes, measured as contributions plus interest on accumulated balances less withdrawals for purposes other than housing, rose rapidly over the past two decades. Even relative to disposable income, compulsory saving rates exhibited a strong upward trend throughout the period. Saving under the compulsory scheme in Malaysia, known as the Employees Provident Fund (EPF), accounted for 3 percent of disposable income in the early 1970s (Chart 4). As the coverage of the EPF expanded and the required contribution rates were raised, the ratio of EPF saving to disposable income rose steadily. In 1992, required contribution rates stood at 20 percent of wage income--9 percent by employees and 11 percent by employers--compared with 10 percent in 1970. In Singapore, required contribution rates to the Central Provident Fund (CPF) were increased gradually from 16 percent of wage income in 1970 to 50 percent in 1984. Following a reduction to 35 percent in 1986, required contribution rates were again gradually raised to 40 percent of labor income by 1992. Coverage of the CPF has also increased gradually, from about one half of the labor force in

CHART 2

WORKING AGE POPULATION, 1970-92
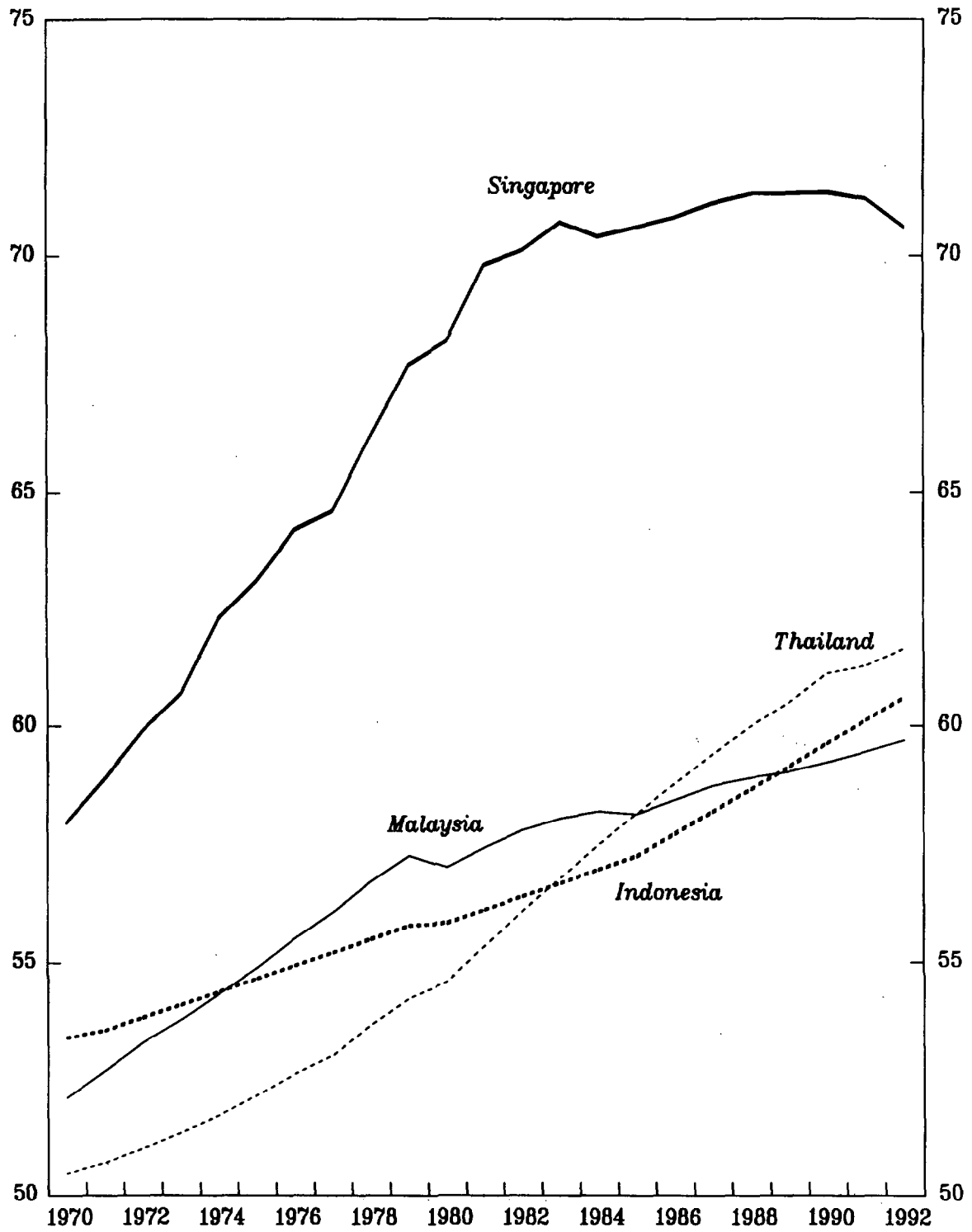## (In percent of total population)

CHART 3

MONEY PLUS QUASI-MONEY, 1970-92
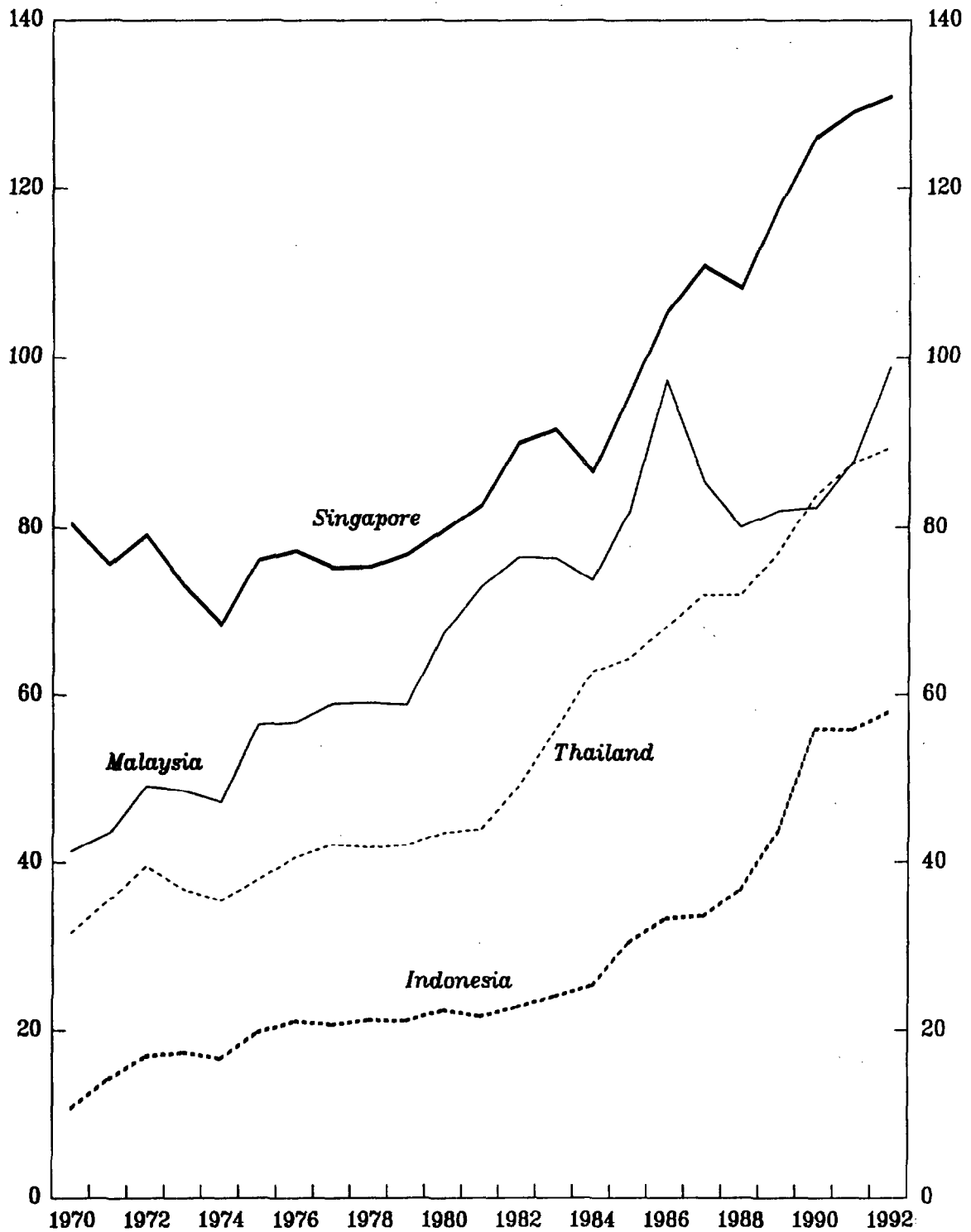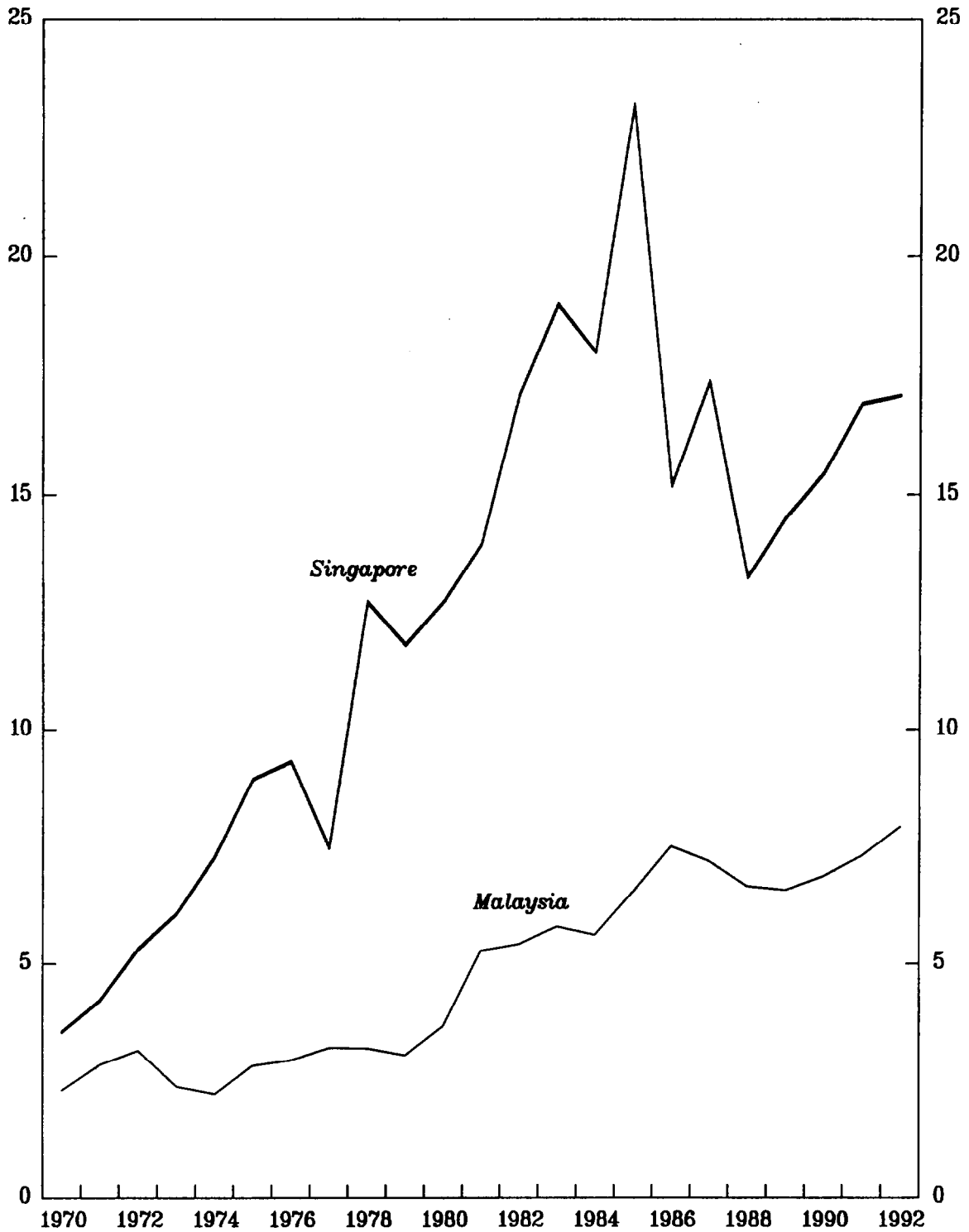(In percent of private disposable income)

CHART 4

PROVIDENT FUND SAVING, 1970-92
(In percent of private disposable income)

the mid-1970s to over three fourths in the early 1990s. As a result, the CPF saving rate trended upward, rising from less than 5 percent in the early 1970s to over 15 percent in recent years. 1/

IV. Data and Estimation

This section discusses issues related to the availability of data and the econometric methods employed in estimating saving behavior.

1.   Data issues

As multinational corporations constitute a significant share of the corporate sector in each country in the sample, and as these corporations are principally foreign-owned, the appropriate measure of domestic private saving for the purpose of this study would be household saving plus the component of corporate saving due to firms owned by domestic residents. However, of the four countries, only Thailand publishes data on saving disaggregated between the household and corporate sectors. Even these data, though, do not distinguish between saving by foreign- and domestic-owned corporations. Consequently, total private saving is used as the dependent variable. 2/

Another data-related complication has to do with the comparison of saving rates across countries. National income statistics are not directly comparable across countries due to differences in accounting practices, and cross-country comparisons must be interpreted with caution. As Hayashi (1989) points out, a significant portion of the difference between the saving rates of the United States and Japan is removed once common accounting practices are applied to the national accounts of both countries.

In view of these issues, a common procedure is applied in the construction of saving and income data series for each of the four countries. Private disposable income is calculated as national income less tax revenue 3/ of the consolidated central government, and total private sector saving is then measured as the residual after deducting private consumption from disposable income. 4/ While this measure of saving does not remove the contribution to domestic saving by foreign-owned corporations, the econometric techniques discussed below allow for an assessment of

---

1/ For details of the EPF and CPF, see Asher (1993).

2/ Leaving aside the issue of foreign firm ownership, this measure of saving may be appropriate under the presumption that households see through the "corporate veil" and account for corporate saving in their own saving decisions.

3/ Which excludes provident fund contributions in the case of Singapore and Malaysia.

4/ Data on consumption, income, money, and quasi-money are obtained from International Financial Statistics. Data on tax revenue for the period 1972-92 are obtained from Government Financial Statistics, and figures for the early part of the sample are calculated based on the average tax revenue to GNP ratios during 1972-74. Demographic data are taken from the Demographic Yearbook and country national accounts publications. Figures for missing observations are calculated using period average growth rates of working age population and total population. Data for provident fund saving are based on figures contained in the annual reports of the CPF and the EPF.

whether this factor is particularly important for the trend behavior of private sector saving. To the extent that part of the (stochastic) trend in saving is left unexplained by domestic variables, long-run movements in saving by foreign corporations may have played an important role in determining total private sector saving. It turns out, however, that trend movements in private sector saving rates can generally be explained by domestic variables.

As for the cross-country comparability of saving rates, all income and consumption data are taken from a common source, thereby minimizing the possibility of serious discrepancies in accounting practices in different countries. Moreover, the empirical analysis to follow focuses on trend movements in the saving rate, rather than the level of saving across countries. Hence, difference across countries in the classification of data are likely not to have a significant impact on the results discussed below.

2.   Econometric methodology

Determining the relevant set of economic variables that underlie the long-run trend developments in saving behavior remains essentially an empirical issue, and devising an econometric framework based on the preceding theoretical discussion becomes the focus here. The central considerations involve the identification and estimation of the long-run relationship between saving and its fundamental determinants.

In this regard, cointegration analysis provides a natural conceptual framework for examining long-term co-movements between a set of time-series variables. By way of definition, a set of N difference-stationary variables is said to be cointegrated if there exists at least one linear combination--i.e., cointegrating vector--of these variables that is stationary, defining their long-run equilibrium relationship(s). 1/ Intuitively, cointegrated variables may drift apart temporarily but must converge systematically over time. Hence, a model that imposes a deterministic long-run relationship between a set of integrated economic variables, while allowing those variables to deviate over the short term, will exhibit cointegration.

In terms of estimation strategy, we proceed by first determining the order of integration of each time series using standard Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests for stationarity. Once the order of integration is determined, Engle-Granger cointegration tests are applied to long-run saving equations country by country. The data for all the countries are then pooled and two sets of estimates are obtained for the entire panel. The first is the cointegrating relationship obtained using ordinary least squares (OLS) estimation (Engle-Granger estimates), while the second set is based on a nonlinear least squares (NLS) technique (Phillips-Loretan estimates). Finally, error correction equations capturing the short-run dynamics of saving rates for the panel are estimated, using both OLS and NLS methods.

1/ Moreover, the number of independent cointegrating vectors r must be such that $0 < r < N$. If there were exactly N such linearly independent combinations, then the set of variables must all be stationary (I(0)). If no combinations exist ($r = 0$), the series are independent difference-stationary (I(1)) variables.

V. Estimation Results

The results obtained from the various sets of estimations are described in this section. In general, the upward drift in saving rates evident in Chart 1 is statistically verified, motivating the empirical investigation of its long-run determinants both country by country and for the entire panel.

1.   Tests of order of integration

Test statistics are calculated to indicate the order of integration in each of the univariate time series--saving (S/Y), demographics (DEM), growth ($GROWTH$), financial deepening (M/Y), and provident fund saving (PFS). 1/ The results of the unit root tests, based on a unit-root null versus a stationary alternative, are reported in Table 2.

The most important result evident in Table 2 is the finding that saving rates appear to be difference stationary (i.e., I(1) or integrated of order one) for every country in the sample over the period 1970-92. Specifically, the ADF tests fail to reject a unit root in levels but not first differences of the times series data for saving. 2/

The results suggest that saving rates exhibit a stochastic trend or nonstationary drift, rather than mean-reversion to a given long-run level, over the sample period. The cointegration analysis that follows attempts to explain these long-run trend developments in saving behavior by identifying long-run determinants, or I(1) explanatory variables, which share a common variable trend, or cointegrate, with saving. Based on the corresponding cointegration estimates, fluctuations in saving rates can then be decomposed into trend (permanent) and cyclical (transitory) components, depending on the time series behavior its fundamental determinants.

Stationarity tests of the explanatory variables suggest that, with the exception of the growth rate of disposable income, the variables appear to be I(1) indicating that they are possible candidates helping explain the (stochastic) trend in private saving. Growth, however, appears to be mean stationary so that (transitory) changes in the growth rate are likely to have only a short-run impact on the rate of saving within each country. Meanwhile, country-differences in the long-run level of growth should be reflected in the constant term in the cointegrating equation, representing level rather than trend implications for saving behavior across countries.

1/ Saving and provident fund saving are defined as ratios to private disposable income. The demographic variable is the working age population ratio, financial deepening is the ratio of money plus quasi-money to private disposable income, and growth is the percentage change in real per capita private disposable income.

2/ It should be noted, however, that the sample period for each country is small and the ADF test is low-powered, too often accepting a false null hypothesis (unit root)--i.e., prone to making type II errors.

Table 2. Tests of Order of Integration, 1/ 1970-92

	ADF(k) Test Statistic			
Variable	Malaysia	Singapore	Thailand	Indonesia
S/Y	-1.83 (k=4)	-1.63 (k=1)	-0.55	-0.90 (k=1)
$\Delta S/Y$	-4.09[b] (k=3)	-4.05[b]	-5.64[b]	-7.11[b]
DEM	-1.57	-2.25	-1.44 (k=3)	-1.36
ΔDEM	-4.12[b]	-4.96[b]	-2.48 (k=1)	-2.77
M/Y	-0.46 (k=2)	2.05 (k=2)	1.42	2.61 (k=2)
$\Delta M/Y$	-4.65[b] (k=1)	-4.30[b]	-2.97[a]	-3.36[a]
PFS	-0.25	-1.64 (k=1)	...	...
ΔPFS	-3.67[b]	-7.78[b]	...	...
$GROW$	-5.25[b]	-4.41[b] (k=1)	-3.75[b]	-3.88[b]
$\Delta GROW$	-4.98[b] (k=3)	-5.31[b] (k=1)	-4.78[b] (k=3)	-6.90[b]

[a] Indicates significance at 5 percent level.
[b] Indicates significance at 1 percent level.
* Based on Mackinnon (1991) critical values.

1/ The null hypothesis is a unit root versus a stationary alternative. The ADF(k) test statistic for a variable x_t is given by the t-statistic on the estimated coefficient π_1 in the following auxiliary regression:

$$\Delta x_t = \pi_0 + \pi_1 x_{t-1} + \sum_{j=1}^{k} \Upsilon_j \Delta x_{t-j} \, ,$$

where k is determined by the highest order lag for which the corresponding Υ_j is significant. In Table 2 k=0 (DF test), unless specified otherwise. For DEM, a time trend was also included in the auxiliary regression (i.e., unit root versus trend-stationary alternative). See Campbell and Perron (1991) for a recent discussion.

2.   <u>Country estimates</u>

The long-run structural equation for saving may be expressed as:

$$\frac{S}{Y} - \beta'X = U, \quad U \sim I(0), \qquad\qquad (1)$$

where X represents the vector of fundamental determinants, β is the vector of long-run coefficients of cointegration, and U is the stationary residual. 1/ Engle-Granger tests for cointegration—consisting of ADF tests for stationarity of the OLS residuals from the cointegrating regression based on equation (1)—as well as parameter estimates of the elements of β characterizing the long-run relationship with saving are reported in Table 3.

Based on the estimated vectors of cointegration reported in Table 3, estimates for the trend component of saving can be computed for each country. 2/ The underlying stochastic trend depicting the long-run equilibrium path for the saving rate—conditional on the path of the relevant fundamentals—is depicted in Charts 5 through 8. Estimates of the cyclical fluctuations in saving, obtained as the difference between the actual and trend values, are also shown in the charts. This (stationary) residual component can be interpreted as transitory deviations from the long-run path, resulting from short-term cyclical factors discussed below in the error correction model.

a.   <u>Malaysia</u>

Demographics appear to explain the long-run rate of private saving in Malaysia. In particular, Table 3 shows that the variables S/Y and DEM cointegrate by themselves, with a significant ADF test statistic at the 5 percent level. The trend increase in the working age population ratio appears to have raised the saving rate approximately one-for-one over the sample period.

Corresponding cointegration estimates obtained by sequentially replacing DEM with PFS or M/Y (not reported) show that long-run movements in either provident fund saving or financial deepening may also explain the trend in private saving, although the explanatory power of either variable is lower than with demographics. Including either of these variables jointly with demographics in the cointegrating regression reverses the long-run coefficient on PFS or M/Y. This

---

1/ The corresponding normalized cointegrating vector is given by $(1,-\beta)$, representing the stationary linear combination of the I(1) variables, S/Y and X.

2/ In general, since the long-run coefficients of cointegration are based on the co-movements between the series over the entire sample period, substituting observed values of the fundamentals directly into the estimated long-run relationship neglects the effects of stationary short-run noise in the explanatory variables. To compensate, filtered estimates of the fundamentals are subsequently used where appropriate. Specifically, the permanent (trend) component is smoothed using a three-year centered moving average, including one lead and one lag, in the case of Singapore largely due to the transitory noise in the PFS variable.

Table 3. Long-Run Determinants of Savings
Country Estimates, 1970-92
(Dependent Variable: S/Y) 1/

Variable	Malaysia	Singapore	Thailand	Indonesia
DEM	1.34 (4.33)	1.38 (3.32)	0.48 (1.40)	3.03 (12.41)
M/Y	...	0.05 (1.73)	0.12 (1.68)	...
PFS	...	0.29 (1.51)	...	...
	$R^2 = 0.47$ DW = 1.54 ADF = 3.78[a]	$R^2 = 0.96$ DW = 1.42 ADF = 4.63[b]	$R^2 = 0.89$ DW =1.54 ADF = -3.58	$R^2 = 0.88$ DW = 1.73 ADF = -4.19[b]

[a] Indicates significance of 5 percent level.
[b] Indicates significance of 1 percent level;
t-ratios in parentheses. 2/

1/ A constant (not shown) was also included in each cointegrating regression.

2/ Note that the Engle-Granger estimates reported in the table have non-normal distributions. Hence, standard inference based on the reported t-ratios must be done with care. Using a three-stage least squares method suggested by Engle and Yoo (1991), corrected parameter estimates and normal standard errors can be obtained. See Cuthbertson, Hall, and Taylor (1992) for a review. For our estimates, the corrections have only a minor impact on the point estimates and generally raise the t-statistics shown in Table 3. For example, for Singapore, where the initial t-ratios for PFS and M/Y appear close to their critical value, revised estimates suggest that at least one, if not both, of these variables enter the cointegrating vector, depending on the exact error correction model used in the previous (second) stage to obtain the corrected (third stage) estimates.

CHART 5

INDONESIA
PRIVATE SAVING, 1970-92
(In percent of private disposable income)
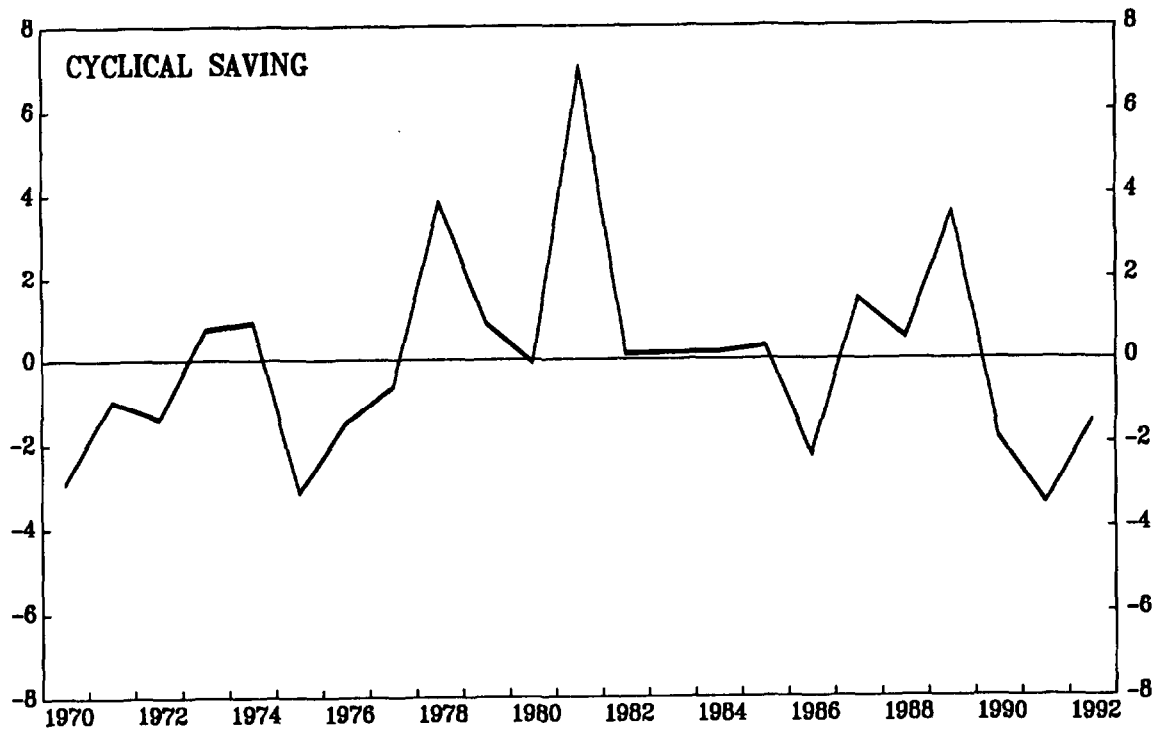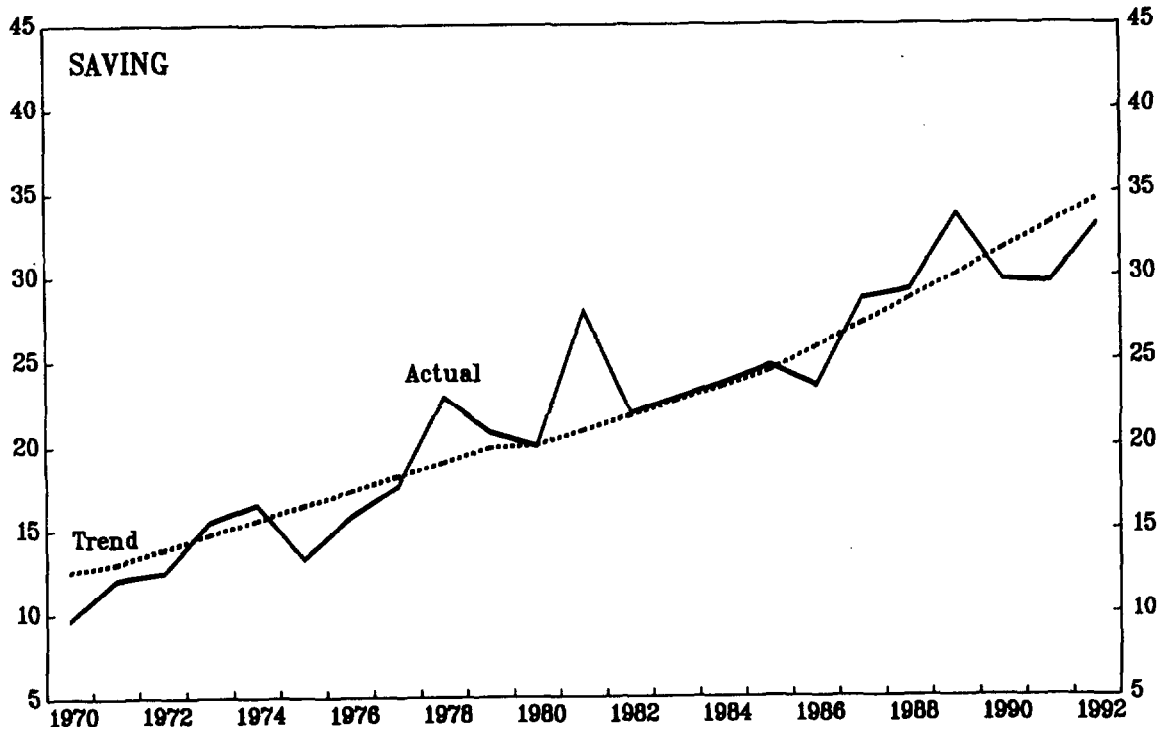
SAVING

Actual

Trend

CYCLICAL SAVING

CHART 6

MALAYSIA
PRIVATE SAVING, 1970-92
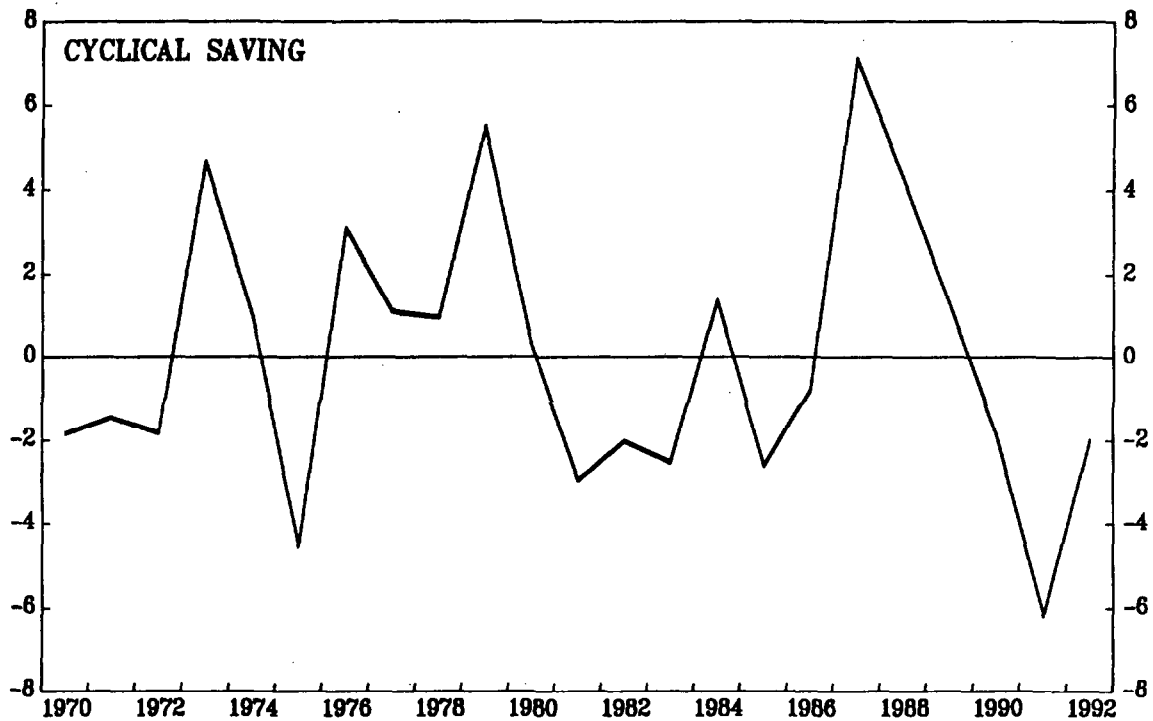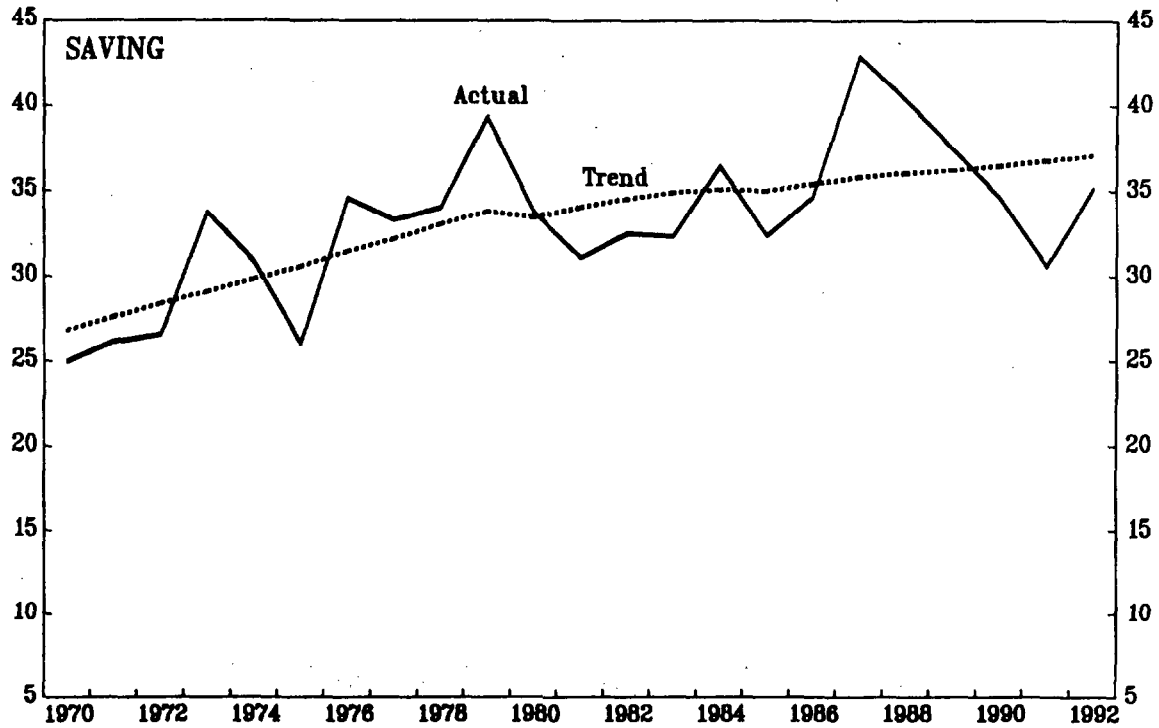(In percent of private disposable income)

CHART 7

SINGAPORE
PRIVATE SAVING, 1970-92
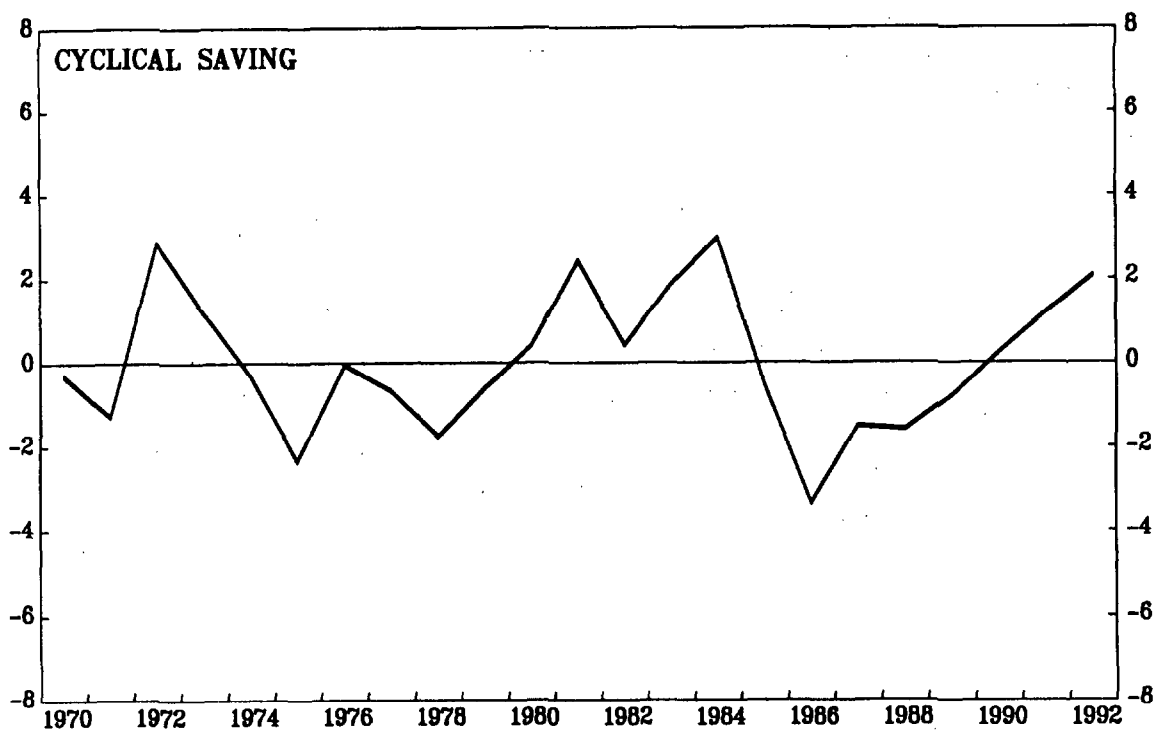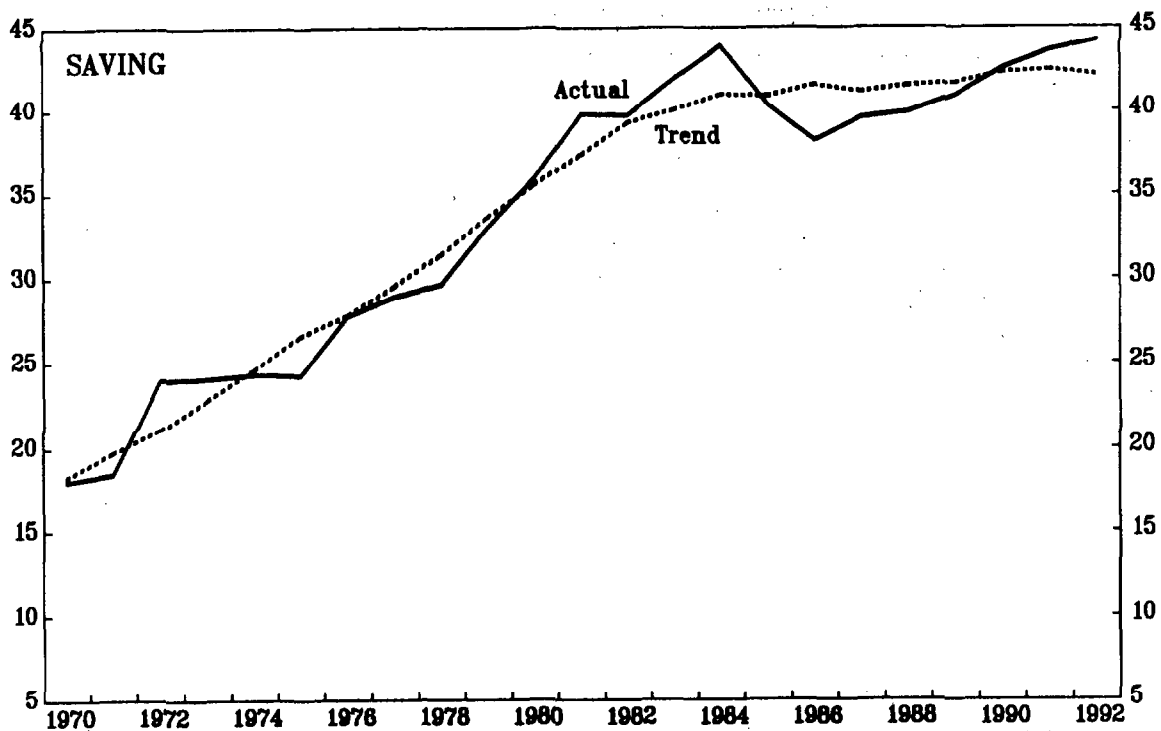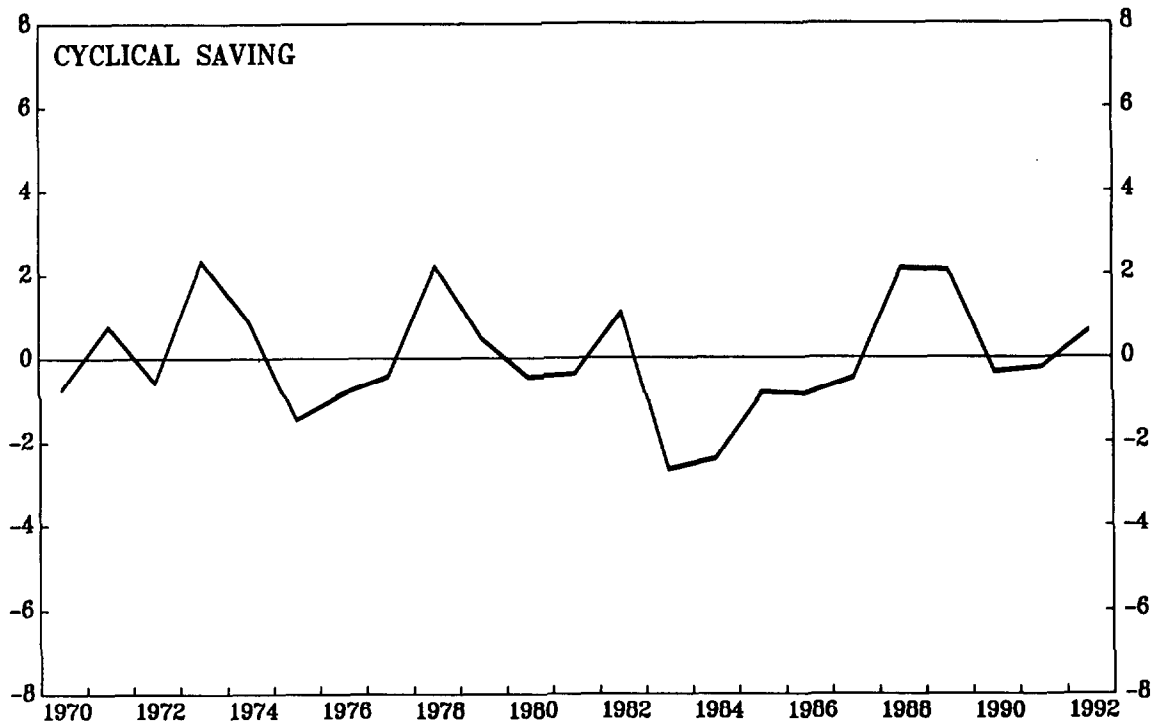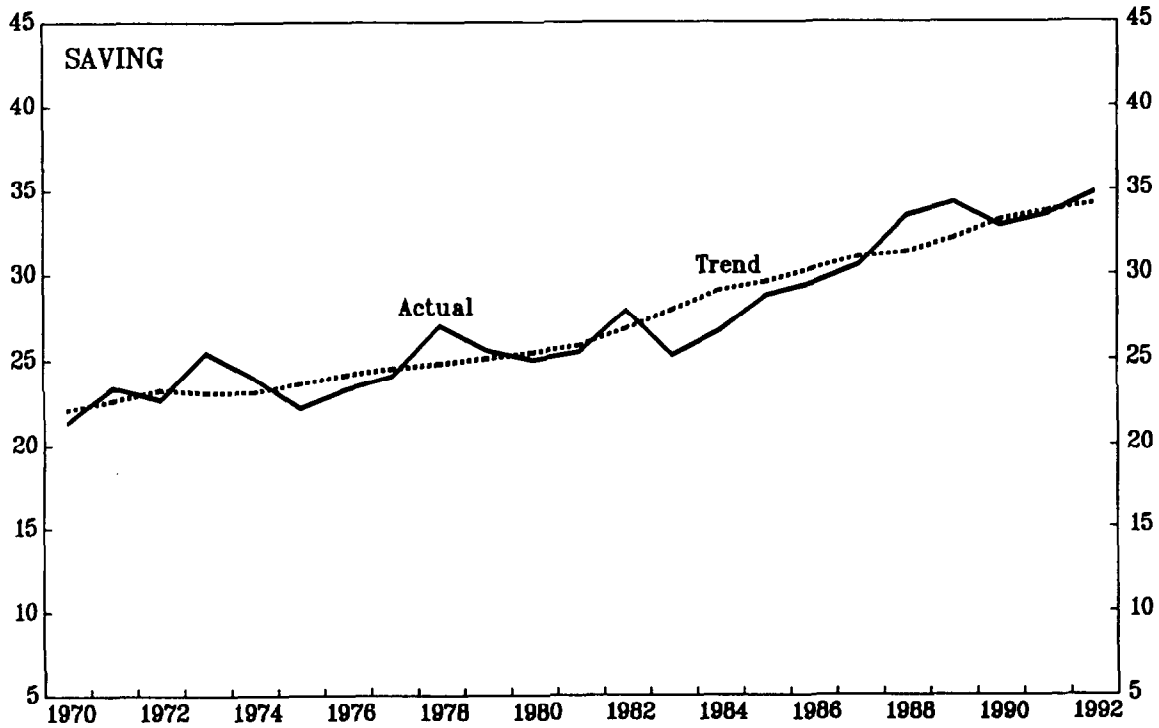(In percent of private disposable income)

SAVING

Actual

Trend

CYCLICAL SAVING

CHART 8

THAILAND
PRIVATE SAVING, 1970-92
(In percent of private disposable income)

SAVING

Actual

Trend

CYCLICAL SAVING

finding strongly suggests, as do further cointegration tests on subsets of the variables, that these "explanatory" variables themselves share a positive common trend with demographics and, therefore, add no extra information in explaining the stochastic trend in saving. 1/ Moreover, demographics is the only fundamental variable which always remains significant in various cointegrating regressions and retains the correct sign in each variation, suggesting that it is the dominant factor underlying saving trends in Malaysia.

The long-run estimates for Malaysia reported in Table 3 explain only about one half of the variation in the saving rate over the sample period. In comparison to the estimates obtained for the other countries, these estimates suggest that the cyclical component of saving in Malaysia was more volatile than in the other countries over the sample period.

b.   Singapore

Cointegration tests for Singapore indicate that demographics alone cannot explain the long-run movements in private sector saving. Indeed, Engle-Granger estimates indicate that financial deepening and possibly provident fund saving, in addition to demographics, jointly explain the long-run movements in the saving rate. 2/

In contrast with Malaysia, compulsory contribution rates to the CPF in Singapore rose substantially through the sample period, before a sharp downward revision in 1986 (See Chart 4). Hence, long-run trends in the flow of mandatory saving to Singapore's provident fund may not merely reflect changes in the age structure or coverage of the population. To the extent that returns to mandatory and voluntary saving differ or to the extent that a portion of the population is liquidity constrained, especially given the high contribution rates to the CPF relative to the EPF in Malaysia, changes in provident fund saving rates could have affected the trend rate of aggregate private saving in Singapore. Indeed, the coefficient estimate representing the long-run impact of changes in long-run provident fund saving indicates that, on average, increases in compulsory saving boosted aggregate saving in the long-run, but almost three-fourths of the rise in compulsory saving was offset by a reduction in voluntary saving. 3/

As for demographics, it is interesting to note that the point estimate for the long-run coefficient on *DEM* for Singapore is virtually identical to the corresponding estimate for Malaysia. This finding, along with the small sample size for each country, provides motivation for the pooled estimation reported in the next subsection.

1/ In general, with N difference-stationary time series, there can exist up to $N-1$ possible cointegrating vectors. See Cuthbertson, Hall, and Taylor (1992) for a discussion.

2/ Initially, *PFS* and *DEM*, without the inclusion of a time trend, proved insufficient for cointegration with saving. Subsequently, the time trend was replaced with the financial deepening variable and virtually the same parameter estimates and R^2, DW, and ADF statistics were obtained (reported in Table 3). At that stage, further tests suggest that cointegration obtains even after dropping *PFS* from the regression.

3/ The findings are consistent with the results of the study conducted by the Monetary Authority of Singapore (1991). See also Chandavarkar (1993). In contrast, Husain (1994) finds that CPF saving had a statistically insignificant impact on total private saving in Singapore.

c.   Thailand

Cointegration tests for Thailand, as for Singapore, indicate that demographics alone does not entirely account for the variable trend movements of the saving rate, although the ADF test statistic (not reported) is nearly significant at the 10 percent level. However, including financial deepening, together with demographics, in the cointegrating regression results in a finding of cointegration with saving at the 10 percent significance level.

The point estimates from the corresponding cointegrating regression indicate that the impact of long-run changes in the demographic variable on the trend rate of saving was about half as large as in Malaysia and Singapore. At the same time, the impact of financial deepening was about twice as high as in Singapore. However, the version of the cointegrating equation in which the demographic variable alone was used (not shown) yielded a coefficient estimate of unity for *DEM*, a value quite close to those obtained for Malaysia and Singapore. Since the demographic and financial deepening variables appear to have had similar trends for Thailand, these findings seem to suggest that the long-run relationship between demographics and saving was the same across the three countries, and that the financial deepening variable may only be picking up part of the impact of demographics in the cointegrating regression for Thailand.

Note that the ADF test statistic for cointegration in the case of Thailand is lower than for the other countries. This appears to be due mainly to an increase at the end of the sample period in the saving rate that was not accompanied by similar contemporaneous movements in any of the explanatory variables. Closer examination of the data for Thailand indicates that the rise was entirely due to a pickup in the rate of corporate saving. Hence, the trend behavior of the saving rate could partly be due to trend movements in saving by foreign-owned corporations, and not captured by developments in the domestic variables. However, this discrepancy appears only to exist at the very end of the sample.

d.   Indonesia

The estimates for Indonesia, also reported in Table 3, indicate that long-run developments in the demographic structure of the population appear to account for trend movements in saving behavior. Indeed, the ADF statistic for cointegration is significant at the 1 percent level. The coefficient estimate for the impact of demographics, however, is considerably higher than those obtained for the other countries in the sample, owing to the fact that the general upward trend in saving rates clearly outpaced the rise in the working age population ratio. 1/

3.   Panel estimates

Long-run relationships between the explanatory variables and the saving rate that are common across countries may be estimated by pooling the data from all the countries in the sample and testing country-specific restrictions on the coefficients of cointegration. The findings, based on two different estimation techniques, indicate that trend movements in the demographic structure of

1/ The inclusion of the financial deepening variable results in a coefficient estimate with a negative sign, due to the strong co-movement in the trends of demographics and financial deepening.

the population in each country except Indonesia affected the saving rate in a common fashion. In Indonesia, the effects of demographic shifts were considerably stronger than in the other countries.

a.   Engle-Granger estimates

Panel estimation of the cointegrating vector using OLS, reported in Table 4, yielded a good fit. As in each of the country estimates, the demographic variable in the panel is an important determinant of long-run saving behavior. Constraining the demographic coefficient to be the same for Malaysia, Singapore, and Thailand results in a highly significant coefficient estimate near unity, about the same as what obtains for the individual country estimates. Country dummies allowing for demographic effects in each of these countries to be different from the others were found to be insignificant. For Indonesia, however, the estimated coefficient on demographics is not only significantly larger than for the other countries, but also somewhat higher than in the country estimation.

Demographics alone, however, does not appear to fully explain long-run movements in the saving rate across the panel. 1/ The sequential inclusion of financial deepening and provident fund saving variables, with coefficients constrained to be the same across countries, did not generally yield significant coefficient estimates. Allowing the impact of these variables to vary across countries, though, results in significant coefficients only for Singapore, as may have been expected given the country estimates. Hence, in the version of the cointegrating regression reported in Table 4, financial deepening and provident fund saving were included only for Singapore. 2/ The resulting estimates of the coefficients are very close to the country estimates for Singapore, although the impact of compulsory saving is somewhat greater and appears to be statistically significant.

Cross-country differences in the average level of the saving over the sample period were measured by including country-specific constants in the cointegrating regression reported in Table 4. While the estimated values of the constant are not contained in the table, it is worth mentioning that the fixed country effects are found to be statistically significant for each country. This suggests that the underlying rate of saving differs among the four countries even after holding constant the effects of the other variables. Indeed, differences in the long-run rate of growth in each country, which impact on the country-specific constants in the cointegrating equation, could explain part of this variation in saving rates across countries.

_____

1/ The Dickey-Fuller test statistic, while quite high for the entire panel in this case, is not readily comparable to available critical values. Hence, country-by-country ADF test statistics were also calculated using corresponding subsets of the pooled residuals from the panel regression. These tests indicate that the residuals for Singapore and Thailand exhibit nonstationarity (evidence against cointegration) when only demographics is included.

2/ In terms of the panel estimation, coefficients for these variables for Indonesia, Malaysia, and Thailand were constrained to be zero as warranted. For example, in the case of Malaysia, constraining the coefficient on DEM to equal that of Singapore and Thailand and near the point estimate obtained from the country estimates confirms that the long-run impact of EPF savings on total savings is zero.

Table 4. Long-Run Determinants of Savings
Panel Estimates (OLS), 1970-92
(Dependent Variable: S/Y) 1/

Variable	Malaysia	Singapore	Thailand	Indonesia
DEM	1.15 (10.52)	1.15 (10.52)	1.15 (10.52)	3.03 (12.66)
M/Y	...	0.06 (1.87)	...	...
PFS	...	0.44 (3.08)	...	...
	R^2= 0.91	DW = 1.58	DF = -7.75 2/	

1/ Country-specific constants (not shown) were included in the pooled regression to allow for fixed country effects.

2/ The DF statistic for a unit root in the residuals based on panel estimation is significant at the 1 percent level based on the critical values tabulated in Mackinnon (1991) [ADF (k=3) is also significant]. These critical values are, however, sensitive to the presence of nuisance parameters such as constants and trends. See Campbell and Perron (1991). The test statistic reported in Table 4 was obtained from a pooled regression that contains country dummies for the constant term (fixed effects), which may affect the critical value. Exact critical values are not available. The ADF statistic was also computed on country-by-country subsets of the pooled residual series. The ADF test on country residuals was found to be significant at the 5 percent level for Malaysia and Indonesia, but insignificant for Singapore and Thailand (p values near 10 percent).

b.   Nonlinear least squares estimates

A check for the robustness of the estimated cointegrating relationship may be obtained by NLS estimation of an error correction model of the form:

$$\Delta \left(\frac{S}{Y}\right) = -\alpha \left[\left(\frac{S}{Y}\right)_{-1} - \beta' X_{-1} \right] + \gamma' Z,$$

(2)

where Δ denotes a first difference, X is the vector of I(1) explanatory variables, and Z is a vector of I(0) variables that affect the short-run dynamics of saving. 1/ Also in equation (2), the parameter α provides a measure of the speed of adjustment (error correction) in the saving rate to its long-run level, β is the vector of long-run coefficients of cointegration, and γ is the vector of short-run coefficients. As before, the variable S/Y is the saving rate. Note that every component in equation (2) is stationary by construction or otherwise, allowing for standard regression analysis. Specifically, the first difference in the rate of saving is I(0) for each of the countries in the panel as shown by Table 2. Moreover, as long as the saving rate and the X variables cointegrate, the error correction term in the square brackets is also I(0).

The NLS panel estimates for the long-run cointegrating relationship may be obtained by estimating equation (2) over the panel while imposing a common α coefficient across all countries. The resulting estimates of the vector β are reported in Table 5 and are very similar to those obtained in the OLS panel estimation.

The highly significant relationship between demographics and the saving rate is stable across specifications, and the estimated long-run coefficient under both specifications is very close to those obtained in the country estimations. The results regarding financial deepening and provident fund saving are not as strong, however. Financial deepening appears to matter only in the case of Singapore, and even then its impact is not significant under the NLS specification. Provident fund saving also seems to matter only for Singapore. The estimated long-run impact of compulsory savings under the panel specifications (restricted coefficient on demographics) is significant and somewhat stronger than in the country estimates (unrestricted coefficient on demographics) for Singapore.

1/ Included in the last component in equation (2) is present and past innovations in X reflecting transitory fluctuations in the long-run determinants of saving, which may affect short-run changes in saving.

Table 5. Long-Run Determinants of Savings
Panel Estimates (NLS) 1970-92
(Dependent Variable: S/Y) 1/

Variable	Malaysia	Singapore	Thailand	Indonesia
DEM	1.20 (10.89)	1.20 (10.89)	1.20 (10.89)	3.28 (13.11)
M/Y	...	0.05 (1.50)	...	...
PFS	...	0.44 (2.92)	...	...

t-ratios given in parentheses. 2/

1/ Country-specific constants (not shown) were included in the pooled regression to allow for fixed country effects.

2/ The estimators shown in Table 5 based on NLS estimation have normal distributions, allowing for standard inference based on the reported *t*-ratios.

4.   Error correction model

The empirical analysis up to this point has focused exclusively on the long-run determination of saving. The short-term dynamics in saving, as noted above, may be incorporated into the analysis through an error correction specification of the form seen in equation (2). 1/ An error correction model has the advantage that it incorporates both the long-run economic relationships and the short-term dynamic adjustment.

The error correction model may be estimated using either OLS or NLS techniques. Under the OLS method, first-stage Engle-Granger estimates of the long-run relationship are substituted for error correction mechanism (ECM) β in equation (2). The remaining parameters, α and γ, are then estimated using OLS at the second stage. In the NLS version, all the parameters are estimated jointly as previously mentioned. Under both techniques, insignificant short-run variables are sequentially omitted from the estimated version. The estimates of the final parsimonious error correction representation using both techniques are reported in Table 6. 2/

The estimates of the error correction model under both specifications indicate that the short-run dynamics of saving are determined by changes in growth and financial deepening. In addition, changes in provident fund saving rates in both Malaysia and Singapore appear to matter in the short run, and the lagged change in demographics matters in the OLS version of the model. Lagged changes in saving do not appear to have a significant effect. 3/ The coefficient of error correction, α, which provides a measure of the speed of adjustment in saving, indicates that full adjustment to equilibrium following a transitory shock takes 3 1/2 years under the OLS specification and about 3 years under the NLS version. 4/

Changes in the rate of growth, as expected, raise the rate of saving in the short-run. This finding, as well as its point estimate, is robust across specifications. An increase in the rate of growth (relative to its long-run level) suggests that the level of disposable income is high relative to its long-run path. According to the permanent income hypothesis, this transitory income should

---

1/ In fact, the Granger representation theorem shows that for any set of I(1) variables that cointegrate, there exists a valid error correction representation of the data. See Engle and Granger (1987).

2/ Including contemporaneous innovations in the explanatory variables in the error correction representation gives the model more structural interpretation with regard to short-run dynamics. However, this specification also raises the risk of simultaneity bias. Fortunately, based on the Lagrange Multiplier (LM) tests for serial correlation reported in Table 6, simultaneity does not appear to be a serious problem.

3/ To the extent that consumption displays some habit persistence or is subject to adjustment costs, consumption rates and, hence, saving rates may display some inertia and depend on past innovations. This effect appears weak, based on the error correction estimates.

4/ The error correction mechanism (ECM) term in Table 6 captures the effect of equilibrium errors on the short-run adjustment of saving to its long-run value while the short-term factors capture the effects of disequilibrium disturbances. The speed of adjustment to the long-run trend rate of saving can be calculated as follows: the number of periods T required for all but x percent of a shock to remain is $(1-\alpha)^T = x$.

Table 6. Error Correction and Model for Savings
Panel Estimates, 1970-92
(Dependent Variable: $\Delta S/Y$)

Engle-Granger Two-Stage (OLS) Estimates

$\Delta S/Y = -0.72ECM_{-1} + 0.16\Delta S/Y_{-1} + 0.43\Delta PFS*DS - 2.29\Delta PFS*DM + 1.71\Delta PFS_{-1}*DM$
    (-6.58)   (1.65)   (2.74)   (-2.55)   (2.00)

$+ 1.21\Delta DEM_{-1} - 0.09\Delta M/Y + 0.15\Delta GROWTH$
    (2.89)   (-1.75)   (2.67)

$R^2 = 0.61$ $LM [x^2(1)] = 0.90$
$DW = 2.11$ $LM [x^2(4)] = 3.20$

Phillips-Loretan (NLS) Estimates

$\Delta S/Y = -0.81ECM_{-1} + 0.12\Delta S/Y_{-1} + 0.47\Delta PFS*DS - 2.31\Delta PFS*DM - 0.16\Delta M/Y$

$+ 0.15\Delta GROWTH$

$R^2 = 0.65$ $LM [x^2(1)] = 0.03$
$DW = 2.01$ $LM [x^2(4)] = 6.83$

Standard t-ratios given in parentheses.
$LM [x^2(n)]$ is the Lagrange Multiplier test against n-th order serial correlation in the errors.

1/ The error correction mechanism (ECM) term is given by $S/Y - \beta'X$ (see Tables 4 and 5) plus a constant which includes fixed country effects. The variables DS and DM in Table 6 represent country dummies for Singapore and Malaysia respectively.

find its way predominantly into saving rather than consumption, thereby raising the saving rate. Financial deepening, possibly reflecting an increase in financial wealth, depresses saving in the short run. This result is also robust across both versions of the error correction model. As regards the short-run impact of changes in provident fund saving, there appears to be a positive effect on overall saving in Singapore but a negative impact in Malaysia. The latter, though somewhat puzzling, may be related to the timing of changes in contribution rates to the EPF. These rates were raised from 10 percent to 13 percent in 1975, and to 20 percent in 1980, coinciding both times with cyclical dips in the overall saving rate.

VI. Conclusions

The remarkable record of sustained high growth among the countries in Southeast Asia over the past twenty years is in no small part due to their high saving performance. For Indonesia, Malaysia, Singapore, and Thailand, the last two decades were also a period of sustained increase in private saving rates. While the level rate of saving showed some variation across nations, these economies appear to share a common experience in the factors underlying the trend in their respective rates of saving and the direction of those long-run developments.

Based on country estimates and cross-country analysis, fundamental demographic shifts increasing the relative size of the working age population appear to have over time driven up the rate of saving in these countries. Moreover, the magnitude of these long-run effects appear to be quite comparable across countries with the exception of Indonesia, where impact has been even more pronounced. The long-run implications of provident funds are perhaps less clear, with little evidence of compulsory saving having had any consequence for the trend rate of saving in Malaysia but some evidence of a long-run impact in Singapore. These differences may well be tied to each country's differing experience in the management of their compulsory saving scheme. Financial deepening also appears marginally significant only in the case of Singapore, the country achieving the highest level of finacial development over this period.

References

Asher, Mukul G., Social Security in Malaysia and Singapore: Practices, Issues and Reform Discussions (Malaysia: Institute of Strategic and International Studies, 1993).

Campbell, John, and Pierre Perron, "Pitfalls and Opportunities: What Macroeconomists Should Know About Unit Roots," National Bureau of Economic Research, Macroeconomics Annual (1991).

Chandavarkar, Anand, "Saving Behavior in the Asian-Pacific Region," Asian-Pacific Economic Literature, Vol 7 (1993), pp. 9-27.

Cuthbertson, Keith, Stephen G. Hall and Mark P. Taylor, Applied Econometric Techniques (Ann Arbor: University of Michigan Press, 1992).

Datta, Gautam, and Parthasarathi Shome, "Social Security and Household Saving: Asian Experience," The Developing Economies, Vol. 19 (1981), pp. 143-160.

Dean, Andrew, Martine Durand, John Fallon, and Peter Hoeller, "Saving Trends and Behavior in OECD Countries," OECD Economic Studies, Vol. 14 (1990), pp. 7-58.

Dickey, David A. and Wayne A. Fuller, "Likelihood Ratio Statistics for Autoregressive Times Series with a Unit Root," Econometrica, Vol. 49 (1981), pp. 1057-1072.

Engle, Robert F., and Clive W.J. Granger, "Cointegration and Error Correction: Representation, Estimation and Testing," Econometrica, Vol. 55 (1987), pp. 251-276.

Engle, Robert F., and B. Sam Yoo, "Forecasting and Testing in Co-Integrated Systems," in R. Engle and C. Granger (eds.), Long-Run Economic Relationships: Readings in Cointegration (Oxford: Oxford University Press, 1991).

Feldstein, Martin, and Charles Horioka, "Domestic Saving and International Capital Flows," EconomicJournal, Vol. 90 (1980), pp. 314-329.

Hayashi, Fumio, "Is Japan's Saving Rate High?," Federal Reserve Bank of Minneapolis Quarterly Review, Vol. 13 (1989), pp. 3-9.

Husain, Aasim M., "Determinants of Private Consumption and Saving," Annex in IMF's "Singapore: Recent Economic Developments," SM/94/49 (1994).

International Monetary Fund, International Financial Statistics Yearbook.

_____, Government Finance Statistics Yearbook.

Kopits, George, and Padma Gottur, "The Influence of Social Security on Household Savings: A Cross-Country Investigation," IMF Staff Papers, Vol. 27 (1980), pp. 160-190.

Lahiri, Ashok K., "Dynamics of Asian Saving: The Role of Growth and Age Structure," IMF Staff Papers,Vol. 36 (1989), pp. 228-261.

Mackinnon, James, "Critical Values for Cointegration Tests," in R. Engle and C. Granger (eds.), Long-Run Economic Relationships: Readings in Cointegration (Oxford: Oxford University Press, 1991).

Malaysia, Annual Report of the Employees Provident Fund, various issues.

Masson, Paul, and R. Tyron, "Macroeconomic Effecgs of Projected Population Agin in Industrial Countries," IMF Staff Papers, Vol. 37 (1990), pp. 453-485.

Masson, Paul, Jeroen Kremers, and Jocelyn Horne, "Net Foreign Assets and International Adjustment: The United States, Japan, and Germany," Journal of International Money and Finance, vol.(1994).

Monetary Authority of Singapore, "Saving-Investment Balances in Singapore: Determinants and Medium-Term Outlook," Singapore: Economics Department (1991).

Ogaki, Masao, Jonathan D. Ostry, and Carmen M. Reinhart, "Saving Behavior in Low- and Middle-Income Developing Countries: A Comparison," IMF Working Paper WP/95/3, (January 1995).

Phillips, Peter C.B. and Sam Ouliaris, "Asymptotic Properties of Residual Based Tests for Cointegration," Econometrica, Vol. 58 (1990), pp. 165-193.

Phillips, Peter C.B. and M. Loretan, "Estimating Long-run Economic Equilibria," Review of Economic Studies, Vol. 57 (1991), pp. 99-125.

Singapore, Annual Report of the Central Provident Fund, various issues.

United Nations, Demographic Yearbook, various issues.

World Bank, The East Asian Miracle: Economic Growth and Public Policy, (Washington, D.C., 1993).