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Saving-Investment Correlations: Immobile Capital, Government Policy or Endogenous Behavior?

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Abstract

This paper analyzes reasons for the high post-war correlations of saving and investment, both across countries and over time. It is concluded that the main reason for the observed high correlations over the recent period is probably government policy.

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Summary

This paper analyzes reasons for the high post-war correlations of total saving and total investment, both across countries and over time. Three hypotheses are examined: the correlations may represent a genuine structural lack of international capital mobility; they may reflect the reaction of private agents to disturbances in a world of perfect capital mobility; or they may be caused by governments targeting the current account.

Two tests are used. First, post-war data for saving and investment are disaggregated into government and private sector series, and the correlations of these series are determined. Cross-sectional regressions indicate that private sector saving and investment are less correlated than total saving and investment, which is inconsistent with the hypothesis that the correlations stem from private sector behavior. The second test consists of a comparison of the post-war experience with data for the Gold Standard period, which was characterized by high capital mobility and little government intervention. The Gold Standard regressions show little correlation, which is inconsistent with the hypothesis of structural low capital mobility. The paper concludes that the main reason for the observed high correlations over the recent period is government policy and that the degree of mobility of private sector capital has been high and has tended to increase over time.

I. Introduction

The level of capital mobility among countries is clearly an important question in international economics. For analysts, the assumption of a high or low level of capital mobility has profound implications for their modeling strategy; for policy makers, the degree of capital mobility may significantly affect the impact of different policy instruments. There are two principal methods of measuring the level of international capital mobility: one involves comparing the movement of rates of return on capital across countries, while the other looks at actual international capital flows. This paper will focus on the latter approach, and in particular on what the correlation of saving and investment rates across countries may imply for the level of capital mobility. The focus on flows of capital rather than rates of return reflects an interest in whether real (as opposed to financial) capital has been mobile among economies; by contrast, studies of the behavior of relative rates of return have tended to concentrate on the behavior of financial capital.

Interest in looking at the correlation of saving and investment across countries as a test of the degree of capital mobility stems principally from a paper by Feldstein and Horioka (1980). They argued that in a world characterized by high capital mobility there is no a priori reason to expect saving and investment to be correlated across countries. Because savers in different countries face the same interest rate, the relative level of saving in one country compared to another will reflect structural factors in the two economies; similarly, investors also face the same interest rate, so investment decisions simply depend upon relative investment opportunities. Assuming that structural factors affecting saving and investment are not correlated, saving and investment rates will also be uncorrelated. If, on the other hand, capital mobility is restricted then domestic investors will face a wedge between the cost of domestic and foreign saving with the implication that domestic saving and investment rates are likely to be correlated. In the extreme case of zero capital mobility, saving and investment would be perfectly correlated.

Feldstein and Horioka found that saving and investment rates were highly correlated, both in terms of levels and in terms of changes over the medium term. When the ratio of saving to output was regressed on the investment-output ratio, the estimated coefficients were generally significantly different from zero, but not from one, and showed no signs of declining over time. This led the authors to conclude that capital mobility was relatively low across countries, and was not increasing over time. Subsequent work (including the results in this paper) have broadly confirmed the empirical findings of Feldstein and Horioka. 1/ In

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1/ For example Feldstein (1983), Penati and Dooley (1984), Murphy (1984), Caprio and Howard (1985), Dooley, Frankel and Mathieson (1987), Summers (1988) and Feldstein and Bacchetta (1989).

addition, several studies have also found that domestic saving and investment are highly correlated in a time-series sense. 1/

While the existence of these high correlations has been confirmed, the Feldstein-Horioka conclusion that this is due to a low level of international capital mobility has been challenged by a number of authors, partly because tests of capital mobility based on rates of return data suggest that capital mobility has been rising over time (Obstfeld (1986)). Alternative explanations for the correlations fall into two camps. Some authors have constructed theoretical models in which there is perfect capital mobility, but where investment and saving are correlated due to the nature of the disturbances affecting the economy. These authors argue that the propensities to save and invest are correlated among countries due to factors such as productivity shocks or lack of integration of goods markets. 2/ Second, several authors have pointed out that government policy may target the current account through various policy measures designed to offset certain aspects of private behavior that are judged to be undesirable. 3/

This paper sets out to test the empirical validity of these hypotheses for the high observed correlation of saving and investments which can be summarized as follows: (i) it may reflect genuine lack of capital mobility, caused by structural factors such as information constraints, inapplicability of domestic law, risk aversion, or differences in legal codes, which can be considered independent of the policy regime; (ii) it may be the result of endogenous behavior by private agents, such that even when capital mobility is high saving and investment are still highly correlated; or (iii) it may be due to government policy, such as capital controls and fiscal policy.

The results support the view that the observed cross-section correlations are caused by government policy, and that cross-sectional regressions of private sector saving and investment may provide a useful test of capital mobility. On the other hand, the observed time-series correlations appear to be a product of disturbances to the economy and government policy; no consistent time-series correlations can be found when these factors are excluded.

II. The Empirical Tests

Three tests of the different hypotheses identified above are used. The first differentiates hypothesis (i) from (ii) or (iii), by seeking to determine whether the high correlations may reflect endogenous private sector behavior as opposed to government policy or low capital mobility.

1/ For example Frankel, (1985 and 1989), and Obstfeld (1986 and 1987).
2/ Tesar (1988) gives a good summary of these arguments.
3/ Recent examples are Summers (1988) and Roubini (1988).

It involves dividing post-war data on total saving and investment into public and private components. To the extent that the high correlations in total saving and investment data are caused by endogenous private sector behavior, private sector data should be at least as highly correlated as data for the total economy. On the other hand, if government policy or low capital mobility explain the correlations in total saving and investment, then private sector saving and investment will have a lower correlation than total saving and investment, since part of the behavior causing the correlations (namely government policy) is excluded from the regressions. An assessment of the importance of endogenous private sector behavior can thus be obtained by comparing the coefficients from regressing private sector saving on private investment with those for the same regression using economy-wide saving and investment data.

The second test uses data from the classical gold standard period (1880-1913) to differentiate between the hypotheses. The gold standard represented a regime in which there were few capital controls and little government intervention. If the post-war correlations reflect endogenous behavior or genuine structurally low capital mobility, then the gold standard and the post-war periods should have similar levels of correlation between total saving and investment. On the other hand, if the post-war correlations reflect government policy then the gold standard results should reflect the lower level of government intervention in that period. A comparison of regressions using post-war and gold standard saving and investment data would thus allow an assessment of the importance of government policy in the observed post-war correlations.

The third test looks at the importance of endogenous private sector behavior on the basis of time-series correlations of total domestic saving and investment. It compares the regression coefficients of equations using total saving and total investment with results based on total saving and total fixed investment. Since inventory investment may be viewed as largely reflecting the effects of unexpected disturbances, a decline in the observed correlations when inventory changes are excluded might suggest that endogenous behavior is important in explaining the time-series correlations.

1.   Cross-section results

The cross-section tests were carried out on the basis of annual observations for the period 1965-86, covering ten industrial countries, namely the U.S., Japan, West Germany, U.K., France, Canada, Norway, Finland, Belgium and Greece. These were the only countries for which the necessary data on government saving and investment was available on the OECD Annual National Account data tape. While it is a relatively small list, it includes six of the seven major industrial countries plus a selection of smaller economies. All the saving and investment variables were converted into ratios by dividing by nominal GNP. Throughout his paper, government saving and investment refer to general government data, while private sector refers

to total data less general government. Hence the private sector includes public enterprises. 1/

Before starting to analyze the data some caveats should be noted. Although the data are based on OECD's Standardized National Accounts definitions, differences in accounting practices between countries are difficult to iron out. While some of the more glaring problems have been solved (such as the U.S. counting all government expenditure as consumption), the data may still contain anomalies. 2/ In addition, as discussed in Obstfeld (1986), national accounting definitions of saving and investment may not correspond to the concepts actually desired, due to factors such as the exclusion of durable goods purchases, lack of adjustments for inflation and failure to take proper account of valuation effects due to changes in asset prices and exchange rates.

The cross-section data are plotted in Figures 1-3. Figure 1(a) shows the average level over 1965-1986 of total investment against saving, both as a percentage of GNP, while Figure 1(b) shows the private sector fixed investment ratio against the private sector saving ratio for the same period. Figures 2(a) to (d) show scatter plots for total investment and saving ratios averaged over successive five year periods, starting with 1966-1970, and ending with 1981-1985; figures 3(a) to (d) show the same information for private sector fixed investment and saving.

These plots illustrate the relationships that are found subsequently by formal regression techniques. Figure 1(a) shows a strong correlation between total saving and investment over the 1965-1986 time period. From figure 1(b), however, it is clear that when private sector saving and fixed investment are used the relationship is much weaker; indeed if Japan is excluded there is almost no relationship at all. Figure 2 shows that the strong positive relationship between total saving and total investment is also true for successive five year periods. By contrast, when the data for private sector saving and investment are plotted for the same time periods in Figure 3, there is a clear positive relationship for the 1966/70 and 1971/75 periods, but very little correlation in the two subsequent five-year periods.

These visual impressions are confirmed by formal statistical techniques. Table 1 presents ordinary least squares estimates using

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1/ The savings and investment data were examined on both a gross and net basis. Only the results for the gross data are reported, since the net data gave similar results. An earlier version of this paper included an analysis of data for developing countries. The results from this data set were similar to those found using industrial countries data, and are not reported for the sake of brevity.

2/ Balassa and Noland (1988) discuss some of the problems of comparing U.S. and Japanese saving and investment rates. What is striking is the size of the differences between the adjusted estimates produced by different researchers.

Figure 1. Scatter Plots—Average Values 1965-1986

(a) Total saving and total investment

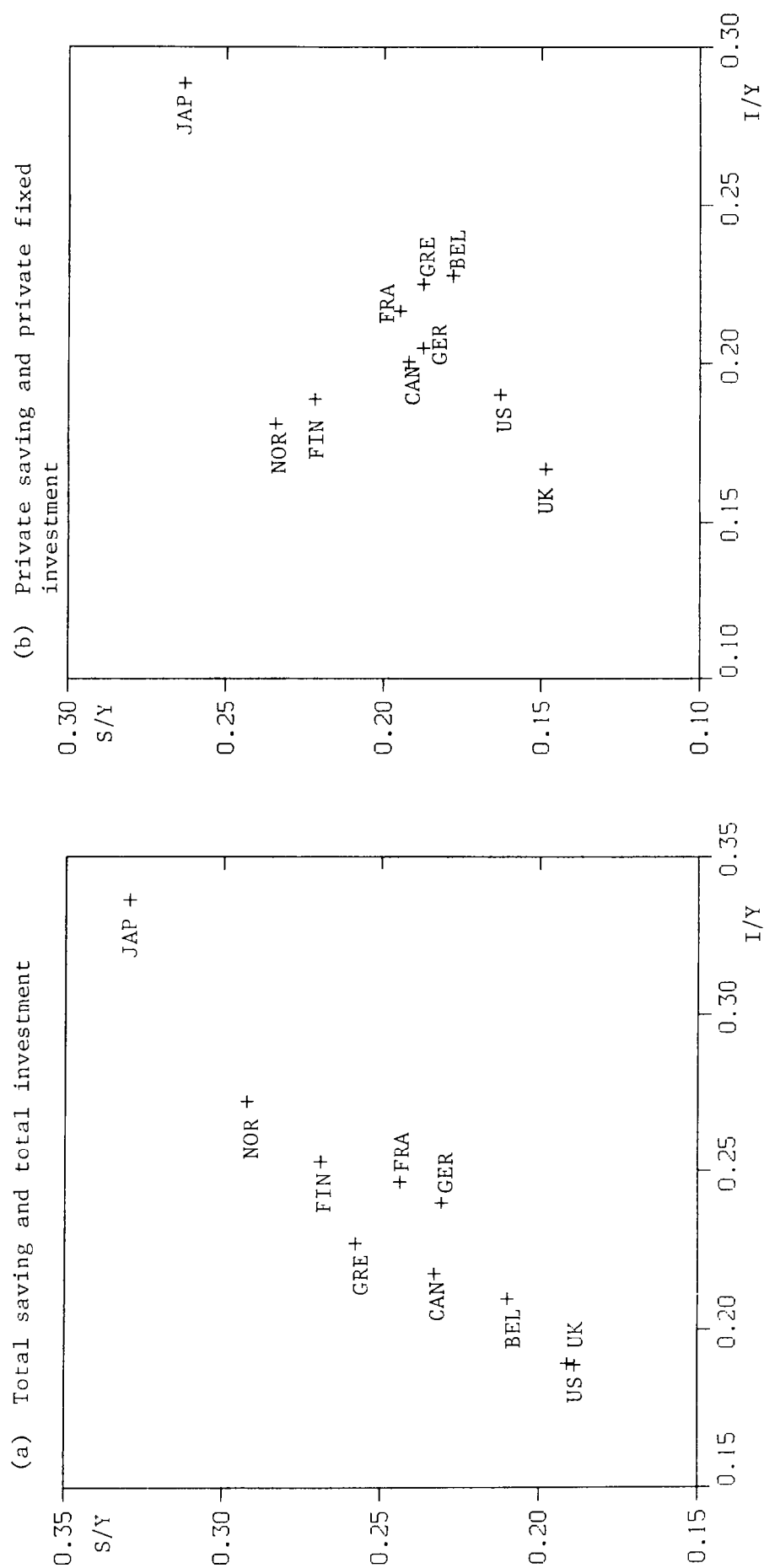(b) Private saving and private fixed investment

Figure 2.   Scatter Plots--Average Values Over Time:
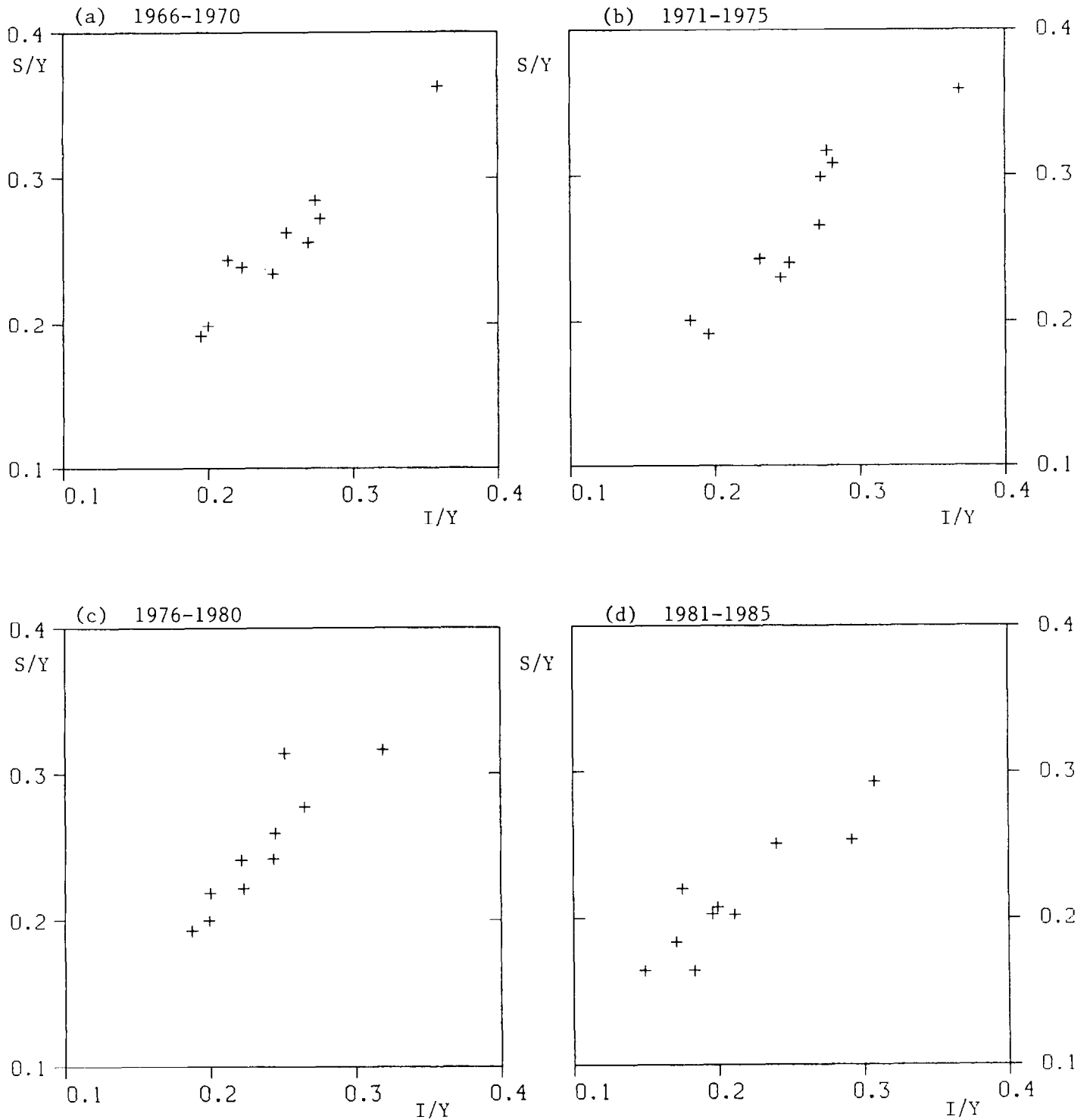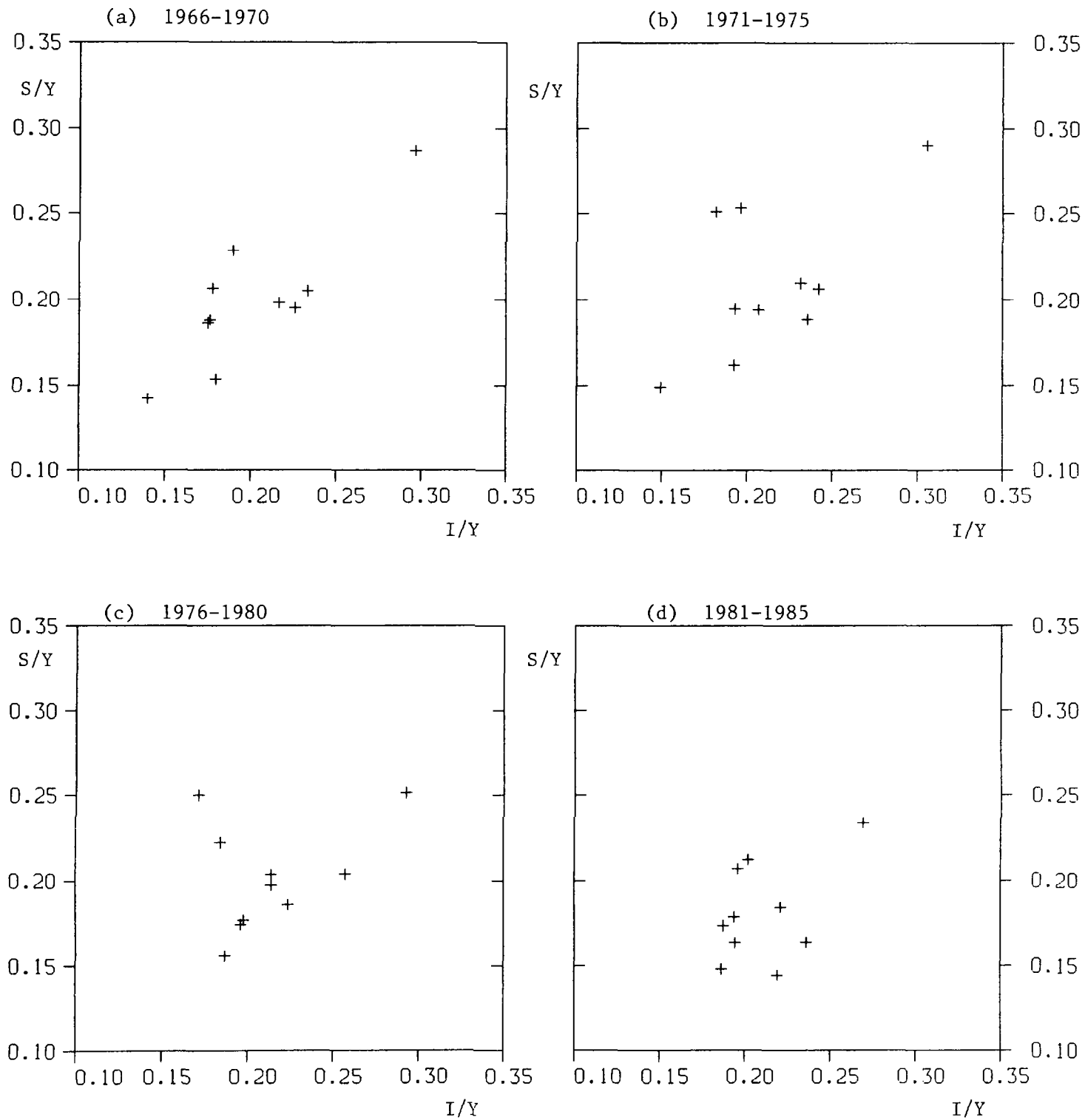Total Saving and Total Investment

Figure 3. Scatter Plots--Average Values Over Time: Private Saving
and Private Fixed Investment

cross-sectional data for the ten countries. In each case, the regression equation was of the form:

$$(I/Y)_i = \alpha + \beta(S/Y)_i + \epsilon_i, \qquad (1)$$

where the subscript refers to different countries. For each country the dependent variable was the average investment-output ratio over the sample period, and the independent variable was the average saving ratio. The sample period is given in the first column of the table. The first row shows the estimates of β on the basis of average data for the entire 1965-1986 period. The next four rows show the results using average observations for successive five year periods starting with 1966-1970. The last row indicates the results of regressing the change in the average ratios between the two halves of the overall sample period.

Table 1. Cross-Section Results for Ten Industrial Countries

Regression: $(I/Y)_i = \alpha + \beta(S/Y)_i$

Time Period	Total Investment β_{TI}	Private Fixed Investment β_{PI}	Probability Value H_0: $\beta_{TI} = \beta_{PI}$
1965/86	.97 (.11)	.58 (.29)	.094
1966/70	.96 (.10)	.76 (.18)	.162
1971/75	.98 (.13)	.61 (.29)	.121
1976/80	1.01 (.18)	.27 (.29)	.022
1981/85	.72 (.12)	.42 (.35)	.188
65/75-76/86	.65 (.16)	.42 (.18)	.183

Notes: The table shows estimates of β. Standard errors are shown in parentheses.

The results of regressing total saving on total investment (first column), confirm the standard Feldstein-Horioka conclusion. Using the full sample period, the estimate of β is .97, and is significantly different from zero and insignificantly different from unity. The estimates of β are large for all sub-periods, and show no marked pattern over time, and the change in the average investment and saving ratios over the time period are also highly correlated. Results using total fixed investment as the dependent variable instead of total investment (not shown) have a very similar pattern, indicating that the exclusion of inventory investment from the dependent variable has little effect on the cross-sectional results.

The second column of Table 1 reports the results of regressing private saving on private fixed investment. These results show a markedly different pattern from those for total saving and total investment. Over the entire sample period the value of β falls to .58, while the standard error rises to .29. Even more striking is the fact that the coefficient falls markedly over time, both in size and significance. When data for the late 1960's are used, β is estimated to be .76, significantly different from zero but not from one. However, this estimate falls over time, and is only .42, for the first half of 1980, with a standard error of .35. 1/ The fall in the coefficient is consistent with the commonly held impression that the level of capital mobility has risen over time, reflecting the progressive liberalization of domestic financial markets and the dismantling of international capital controls. This aspect of the data will be discussed further below.

Comparing the results in columns 1 and 2 of Table 1, the coefficients using private sector saving and investment data are consistently lower that the corresponding coefficients for total saving and investment. A formal test of this hypothesis can be obtained by stacking the two data sets and using dummy variables to allow the coefficients to differ between the total and private sector data. Single tailed probability values of the t-statistic on the change in the coefficient β between the two data sets are presented in the last column of Table 1. The hypothesis the two coefficients are equal fails at the ten percent significance level for the full data period. The test fails at much lower levels of significance for the 1976-80 sub-period, although not for the 1981-85 data. When averages for the period 1976-85, which is generally considered to have had high capital mobility, are used the probability value is .028. As explained above, these results are inconsistent with the hypothesis that the high post-war correlations reflect endogenous private sector behavior. It can therefore be inferred that the correlations are caused either by genuine, structurally low capital mobility or by government policy. The next two sub-sections explore the degree to which the results and conclusions are robust to two considerations: statistical misspecification and Ricardian effects on saving.

Statistical misspecification

This section uses instrumental variable estimation and robust regression techniques to investigate two potential problems related to the estimation of equation (1), namely the potential endogeneity of the saving ratio and the validity of the distributional assumptions that need to be fulfilled in ordinary least squares estimation.

1/ This fall is not significant at conventional levels of significance. However, it was found to be significant in alternative regressions (not reported) using the actual annual observations for each five year period rather than their mean.

As a general rule, if the saving and investment ratio react to the same endogenous shocks, OLS coefficient estimates will be upwardly biased. The standard method to control for this type of effect is to rerun the regressions using instrumental variables that are correlated with saving, but not investment. The instruments which were chosen were the percentage of the total population aged between 15 and 64, total employment as a percentage of the population aged between 15 and 64, social security transfers as a percentage of GDP and current disbursements of government as a percentage of GDP, averaged over the period 1967-84. According to the permanent income hypothesis all of these variables effect saving, while they are not obviously relevant for investment. The results of rerunning the regressions with these instruments using two-stage least squares are shown in Table 2. They are generally similar to those in Table 1, particularly for the private sector regressions.

Table 2. Two-Stage Least Squares and Bootstrap Regression Results

Regression: $(I/Y)_i = \alpha + \beta(S/Y)_i$

Time Period	Two-Stage Least Squares		Bootstrap Regressions	
	Total Investment	Private Investment	Total Investment	Private Investment
1965/86	.85 (.15)	.55 (.31)	1.01 (.12)	.39 (.48)
1966/70	.91 (.12)	.72 (.20)	.93 (.12)	.69 (.24)
1971/75	.82 (.18)	.56 (.30)	1.05 (.22)	.48 (.41)
1976/80	.71 (.25)	.34 (.31)	1.08 (.22)	.14 (.43)
1981/85	.75 (.17)	.45 (.39)	.72 (.12)	.26 (.52)
65/75-76/86	.68 (.18)	.49 (.21)	.69 (.19)	.43 (.17)

Notes: The table shows estimates of β. Standard errors are shown in parentheses.

Given the small data sample, it is important to investigate the validity of the distributional assumptions implicit in OLS. Robust regressions were carried out using the "bootstrap" technique, described in Efron (1982). The basis of this technique is that the empirical distribution of the data (made up, in this case, of the observed dependent and independent variables) are resampled a large number of times with replacement. For each resample the desired regression is then rerun. The mean of the resulting coefficient estimates is an unbiased, robust estimate of the parameter in question, with empirical confidence intervals determined by the distribution of the estimated coefficients.

The last two columns of Table 2 show the results of running the bootstrap technique on the regressions for total saving and investment

and private saving and investment, using 500 data samples. The coefficient estimates for the total saving and investment data are similar to those using OLS. For the private sector data the bootstrap coefficient estimates are lower than the OLS results. Moreover, the distribution of the bootstrap coefficient estimates is somewhat skewed, which may explain the upward bias of the OLS estimates.

Overall, the previous conclusions, namely that endogenous private sector behavior does not seem to account for the high post-war correlations of total saving and investment, and that there has been a marked fall in the correlation of private saving and investment over the period 1965-1986, are basically unchanged by the use of instrumental variable or robust regression techniques.

Ricardian equivalence

Up to this point, the analysis has implicitly assumed that the behavior of the private sector is not affected by the behavior of the public sector. This is a strong assumption, and it is difficult to think of any well specified model in which there would be absolutely no relationship between government fiscal policy and private sector behavior.

The Ricardian equivalence proposition states that changes in the financing of fiscal policy has no effect upon total saving of the nation. This result occurs when the private sector reacts to the change in future tax liabilities implied by such government's behavior by altering their saving decisions. While the requirements for full Ricardian equivalence, in which the private sector entirely offsets the change in government saving, are quite stringent, some degree of substitution between private and public saving appears to be likely. It is also possible that there is a connection between government and private sector investment, although the sign is not clear.

In terms of the data that has been used for this paper, the Ricardian proposition can be tested by examining the relationship between government saving and private sector saving, 1/ while the endogeneity of investment decisions can be studied by considering the effect of government fixed investment on private fixed investment. The first column of Table 3 presents ordinary least squares estimates of β from the following time-series model

$$\Delta(PS/Y)_t = \alpha + \beta \ \Delta(GS/Y)_t + \epsilon_t \tag{2}$$

where PS is private sector saving, GS is government saving and Δ is the first difference operator. 2/ Column 2 presents the results from the same model with investment substituted for saving.

1/ This formulation ignores the effect of changes in government consumption on private sector behavior.
2/ First differences are used in order to make the data stationary.

The results in Table 3 using saving data indicate evidence of partial
Ricardian effects. All but one of the coefficients have the expected

Table 3. Ricardian Equivalence: Coefficient Estimates

Regression: $\Delta(PS/Y)_t = \alpha + \beta\Delta(GS/Y)_t$

Country	Saving	Investment
U.S.	-.26 (.11)	-2.80 (1.35)
Japan	.06 (.32)	-0.50 (.87)
West Germany	-.25 (.12)	1.46 (.76)
U.K.	-.32 (.28)	0.39 (.26)
France	-.56 (.17)	-0.35 (.77)
Canada	-.23 (.14)	0.73 (1.06)
Norway	-.21 (.23)	0.80 (.79)
Belgium	-.21 (.23)	-0.81 (1.12)
Finland	-.85 (.31)	0.20 (1.49)
Greece	-.42 (.30)	0.57 (.99)

Notes: The table shows estimates of β. Standard errors are shown in
parentheses.

negative sign, and four are significantly different from zero. What is
also striking is the consistency of the estimates: five of the ten
coefficients lie in the range -.21 to -.26. These estimates were used to
construct a "Ricardian adjusted" saving series. The adjusted series
assume that the coefficient β is -.25 for all counties, implying that 25
percent of all government saving represents substitution for private
saving. 1/ Accordingly, an alternative private saving series was
calculated by adding 25 percent of government saving onto the original
private sector saving data.

The results using investment data in equation (2) are also reported
in Table 3. The coefficients are large, unstable and generally
insignificant. Given the lack of any common pattern among countries, no
attempt was made to adjust private investment for the effects of
government investment.

1/ This figure was chosen as the approximate mean of the estimates in
Table 5. It is also within the range of -.2 to -.5 quoted by Bernheim
(1987) in a survey of the results from consumption function studies of
Ricardian equivalence. A second "Ricardian adjusted" saving series was
constructed assuming that the coefficients in Table 5 were the true
coefficients, except that the Japanese coefficient was set to 0. The
results using these data were unsatisfactory, however, and are not reported.

The cross-sectional regression results using the "Ricardian adjusted" saving series described above are shown in Table 4. The coefficients are lower and considerably more significant in all sub-periods, notably the early 1980's. Adjusting the saving data for Ricardian equivalence effects strengthens the central conclusions that when private saving is regressed on private fixed investment, the correlation coefficient is smaller than that obtained on the basis of total saving and investment data. The adjusted saving series also confirm that the correlation coefficient falls over time.

Table 4. Ricardian Equivalence:
Cross-Section Results

Time Period	Private Investment
1965/86	.31 (.07)
1966/70	.36 (.08)
1971/75	.36 (.10)
1976/80	.27 (.07)
1981/85	.24 (.06)

Notes: The table shows estimates of β. Standard errors are shown in parentheses.

2. Comparison with the gold standard period

The balance of the evidence appears to indicate that for the post-war period the observed correlations between investment and saving are caused by either government policy or structurally low capital mobility. By comparing with data from the classical gold standard (1880-1913), a period characterized by few international capital controls and little government intervention, these hypotheses can be differentiated. If government policy explains the post-war correlations, the gold standard data should show little correlation. By contrast, if the explanation is structurally low capital mobility then the gold standard data should show a similar degree of correlation to that observed in the post-war period.

For this purpose, annual data on nominal output, capital formation and the current account over the period 1880-1913 were collected for seven countries, Germany, Italy, the United Kingdom, Australia, Denmark, Norway and Sweden. In addition, some data that are useful only for

cross-section work was collected on Canada. 1/ National saving rates, which are not available in the historical data sources, were then calculated indirectly by adding the current account to the figures on capital formation. 2/

Figure 4 shows a scatter plot of these data over the full time period, 1880-1913. There appears to be little correlation between saving and investment rates, an impression that is confirmed by the regression results reported in Table 5. For the entire period, β is estimated (using OLS) at .29, with a standard error of 0.46; when decade averages are regressed, the estimates of β are unstable and insignificant, as are the coefficients on regressions using changes in investment and saving between decades. The robust estimates produced by the bootstrap technique described above yield the same basic results. There appears to be no evidence of a significant correlation between saving and investment in the gold standard period. 3/ The evidence would thus seem to imply that the observed post-war correlations reflect government policy. 4/

These results indicate that there were substantial movements of capital internationally during the gold standard period, involving large and persistent current account imbalances. Indeed, as shown in Table 6, during the gold standard period (1880-1913), six out of the eight economies for which data are available recorded an _average_ current

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1/ The European data comes from Mitchell (1980), the Canadian and Australian from Mitchell (1983). Limited U.S. data on decade averages were also collected. However both the saving and the investment rates appeared so much higher and more correlated than for any of the other countries that these data were excluded from the analysis. Including these data the results using level of saving and investment are affected, but not those using changes.

2/ The investment data exclude stocks for the U.K., Denmark, Sweden, Australia and Canada, while include stocks in the case of Germany, Norway and Italy. The German data refer to net investment and net national product, the rest to gross investment and gross national product (or gross domestic product).

3/ The formal test of the equality of the β for the full post-war period with the β from the Gold Standard period yields a single-tailed probability value of .056.

4/ Bayoumi and Rose (1989) find no positive correlation between regional saving and investment using post-war data for the British Isles, in stark contrast to the international post-war data; since governments do not target "regional" current accounts, these results would also appear to point to a significant role for government policy.

Table 5. Cross-Section Results: Gold Standard Data.
Regression: $(I/Y)_i = \alpha + \beta(S/Y)_i$

Time Period	OLS	Bootstrap
1880-1913	.29 (.46)	.31 (.53)
1880-1890	.48 (.50)	.40 (.42)
1891-1901	.69 (.48)	.64 (.77)
1902-1913	-.10 (.43)	.09 (.56)
Differences Over Time		
1880/1890-1890/1901	.13 (.66)	.32 (.87)
1890/1901-1902/1913	-.18 (.40)	-.09 (.70)

Notes: The table shows estimates of β. Standard errors are indicated in parentheses. The bootstrap regressions used 500 replications.

Table 6. Current Account Imbalances: Gold Standard versus Post-War

Gold Standard (1880-1913)		Post-War (1965-1986)	
Country	Average current account balance as a percentage of GNP/GDP	Country	Average current account balance as a percentage of GNP/GDP
U.K.	4.5	U.K.	0.0
Germany	1.8	Germany	0.9
Italy	0.6	U.S.	-0.0
Sweden	-2.7	Japan	0.7
Norway	-2.5	France	0.2
Denmark	-2.6	Belgium	0.0
Australia	-3.7	Norway	-2.1
Canada 1/	-7.7	Canada	-1.5
		Finland	-1.6
		Greece	-3.1

1/ Average of data for 1900 and 1910.

Figure 4. Gold Standard Data--Total Saving and Total Investment:
Average 1880-1913

account surplus or deficit of over two and a half percent of output. This contrasts with the shorter post-war period (1965-1986), when only one of the ten economies included in this study had an average imbalance of over 2.5 percent of output, and only one of the six largest countries had an average imbalance of over one percent of output. Since the gold standard represents a period of free capital mobility with little government intervention, this comparison gives some idea of the potential implications of the recent liberalization and growing integration of financial markets. 1/ The results underline that in a world of free capital mobility large imbalances are not, per se, unusual. 2/

3.   The time-series correlations

    To this point, the paper has focused on the correlation of saving and investment across countries. This section explores the time-series correlations between saving and investment which have been documented by various studies.

    Figures 5 (a) to (j) in the Annex, graphs the time-series data for the same group of 10 industrial countries used above. 3/ The top panel shows total investment, total fixed investment and total saving, while the bottom panel shows private sector saving and fixed investment plus government saving and fixed investment. The most striking feature of these plots is the stability of government investment compared to government saving. In addition, comparisons of the path of total saving and fixed investment to private saving and fixed investment appear to indicate a stronger correlation for the former than the latter.

    Calculated standard deviations confirm the stability of government investment; the standard deviation for government investment is below half of that for government saving for every country except Norway, and is below half of the standard deviation for private investment for eight of the ten countries. The differences that exist between the economy-wide and private sector data are clearly dominated by government saving behavior. Government saving is also slightly more volatile than private saving (the standard

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1/ These glows do not appear to have been secured by the use of imperialistic force such as gunboat diplomacy. Defaults could and did occur throughout the Gold Standard period (Fishlow (1985)).

2/ The Gold Standard period represents a fixed exchange rate regime. The large fluctuations in nominal exchange rates experienced over the recent floating exchange rate period might explain the high post-1971 saving investment correlations via increased exchange rate uncertainty or large deviations from purchasing power parity. However, the large gross flows of international financial assets in the recent period argue against such an explanation.

3/ The data for the United States, West Germany, United Kingdom, France, Canada, Belgium, Finland and Greece cover the period 1960-1986, those for Japan and Norway the period 1965-1986.

deviation for government saving is higher than that for private saving in six of the ten economies analyzed.)

Table 7 presents results using ordinary least squares for annual data over the period 1966-1986 using the following equation:-

$$\Delta(I/Y)_t = \alpha + \beta \ \Delta(S/Y)_t + \epsilon_t, \tag{3}$$

where Δ is the first difference operator. 1/ The equations appear generally well behaved given the simplicity of the specification; only six of the forty regressions have a Durbin-Watson statistic below the lower 5 percent significance interval.

The results for total investment (column 1) confirm the findings of earlier studies that these variables are closely correlated. The coefficient β is significantly different from zero in all but one of the regressions, while it is significantly different from unity in only two cases. When fixed investment is used as the dependent variable (column 2), there is a marked fall in the size and significance of the regression coefficient. 2/ The difference between total investment and total fixed

Table 7.   Time-Series Results for Selected Industrial Countries
Regression: $\Delta(I/Y)_t = \alpha + \beta \ \Delta(S/Y)_t$
Period 1961-1986

Country	Total Investment	Total Fixed Investment	Private Fixed Investment	Government Fixed Investment
United States	1.00 (.10)	.49 (.07)	-.13 (.20)	-.03 (.02)
Japan 1/	.84 (.15)	.55 (.11)	.46 (.18)	-.05 (.08)
Germany	.87 (.17)	.32 (.16)	-.14 (.21)	.02 (.05)
United Kingdom	.33 (.18)	-.02 (.10)	.03 (.07)	.05 (.07)
France	.80 (.26)	.19 (.13)	-.16 (.10)	.02 (.04)
Canada	.83 (.16)	.25 (.13)	-.06 (.21)	-.03 (.03)
Norway 1/	-.21 (.31)	-.55 (.27)	-.01 (.36)	-.08 (.07)
Belgium	.63 (.12)	.41 (.09)	.18 (.16)	.02 (.05)
Finland	.98 (.30)	.10 (.19)	.07 (.16)	-.05 (.05)
Greece	.73 (.13)	.40 (.12)	.26 (.13)	-.03 (.05)

Notes: The table reports estimates of β.   Standard errors are shown in parentheses.

1/   Data period 1966-1986.

1/   First differences were used in order to make the data stationary.
2/   Similar results (not reported) were found using OECD quarterly National Accounts data.

investment is inventory investment, which can be broadly interpreted as representing unexpected shocks to the economy. These results suggest that aggregate demand and supply shocks explain much of the time-series correlation between total saving and investment. This may be illustrated by considering a demand shock such as a fall in permanent income, resulting in a fall in consumption and a rise in saving. To the extent that the fall in consumption is unanticipated it will also result in a rise in inventory investment as producers realize that the demand for their products is smaller than anticipated. A similar result is obtained in the case of a productivity shock. Since consumers smooth their consumption over time, the upward movement in income will raise saving, while higher production causes inventories to rise, again inducing a positive correlation between total saving and total investment. Hence, the difference between the regression results in columns 1 and 2 may give some idea as to the importance of endogenous private sector behavior in the observed correlations. 1/

Columns 3 and 4 of the Table show the results of dividing saving and fixed investment into private and government components. The private sector results indicate no stable correlation over the different countries; only five of the ten estimates of β are positive, and only two are significant at conventional levels. Overall, it appears that private saving and fixed investment behave independently from each other. Interestingly, there also seems to be no time-series correlation between government saving and investment. None of the estimated coefficients are larger than 0.1, six out of ten are negative and none are significantly different from zero. Despite the lack of correlation of either private or government saving and investment over time, the results in column 2 indicate that their sums are correlated, which implies that government policy played a role in producing these correlations.

Overall, the time-series results indicate that the correlation between total saving and investment identified in the literature seems to reflect a combination of endogenous inventory investment behavior and government behavior.

In order to investigate whether the results for the entire period mask some interesting differences in behavior over time, Table 8 presents estimates of equation (2) over two sub-periods, 1960-1973 and 1974-1986. F-tests of the stability of the parameters indicate no significant change over time except in the case of the French data, notwithstanding considerable changes in the degree of capital controls in many countries. Hence the time-series results do not appear to correspond to changes in capital mobility over time.

1/ While this distinction between total investment and total fixed investment matters for the time series regressions, is relatively unimportant for the cross-section results.

Table 8. Time-Series Results for Sub-Periods

Country	1960-1973		1974-1986	
---------	Total fixed investment	Private fixed investment	Total fixed investment	Private fixed investment
United States	.38 (.09)	-.15 (.18)	.55 (.10)	-.18 (.38)
Japan 1/	.50 (.19)	.57 (.30)	.39 (.16)	.04 (.18)
Germany	.40 (.32)	-.02 (.30)	.27 (.17)	-.28 (.34)
United Kingdom	.08 (.15)	.05 (.10)	-.10 (.12)	.02 (.11)
France	.02 (.17)	.03 (.08)	.03 (.19)	-.26 (.11)
Canada	.46 (.22)	.35 (.34)	.14 (.20)	-.28 (.28)
Norway 1/	.93 (.67)	.35 (.51)	-.72 (.30)	-.21 (.50)
Belgium	.51 (.10)	.43 (.26)	.30 (.15)	.06 (.21)
Finland	.18 (.27)	.03 (.29)	-.02 (.29)	.09 (.20)
Greece	.04 (.28)	-.11 (.26)	.42 (.16)	.27 (.17)

Notes: The table reports estimates of β. Standard errors are shown in parenthesis.

1/ First period runs from 1966-1973.

III. Conclusions

This paper has analyzed the reasons for the observed high correlations between total saving and investment, both among countries and over time. Three possible explanations have been explored; that the correlations are the result of structurally low international capital mobility; that they are caused by the reaction of private agents to disturbances in an economy with perfect capital mobility; and that the correlations are a product of governments seeking to maintain a balanced current account.

Post-war data on total saving and investment were divided into private sector and government series. Regressions using data for the private sector consistently showed a lower correlation than the economy-wide data, using different data periods and alternative regression techniques, rejecting the hypothesis that the correlations are caused by endogenous private sector behavior. In comparison, regressions using data from the gold standard period showed a low correlation between saving and investment, suggesting no evidence of structurally low capital mobility. These results point to government policy being a major reason for the post-war cross-sectional correlations. While some of this effect may have been caused by factors such as automatic stabilizers, the size of the correlations point to explicit targetting of the current account.

Post-war private sector data also indicate a steady decline in the correlation between saving and investment between the late 1960s and the early 1980s, a period in which capital mobility is generally thought to have risen. As such, the private sector saving-investment regressions may provide a useful measure of the degree of capital mobility in the international economy; government policy apparently mask this trend when the economy-wide saving and investment data are considered.

The high post-war time-series correlations were found to reflect the inclusion of inventory investment in the data together with government policy. Once these factors are excluded, the resulting regressions show no significant correlation for any time period. In particular, they do not appear to indicate changes in capital mobility over time.

The conclusion that current account imbalances in the post-war period were small due to government behavior has important implications for current international economic issues. Targeting the current account may make sense to the extent that capital outflows are judged to be undesirable because they may be less easy to tax, are open to expropriation of one sort or another and may have negative terms of trade effects; capital inflows may also be unwelcome due to their effects on the traded goods sector. However from the point of view of world welfare, free movement of capital is probably a desirable objective since it allows investors to diversify their portfolios and because it helps to enhance the efficiency of resource allocation among countries.

Figure 5. Ratios of Saving and Investment to GNP

(b) Japan

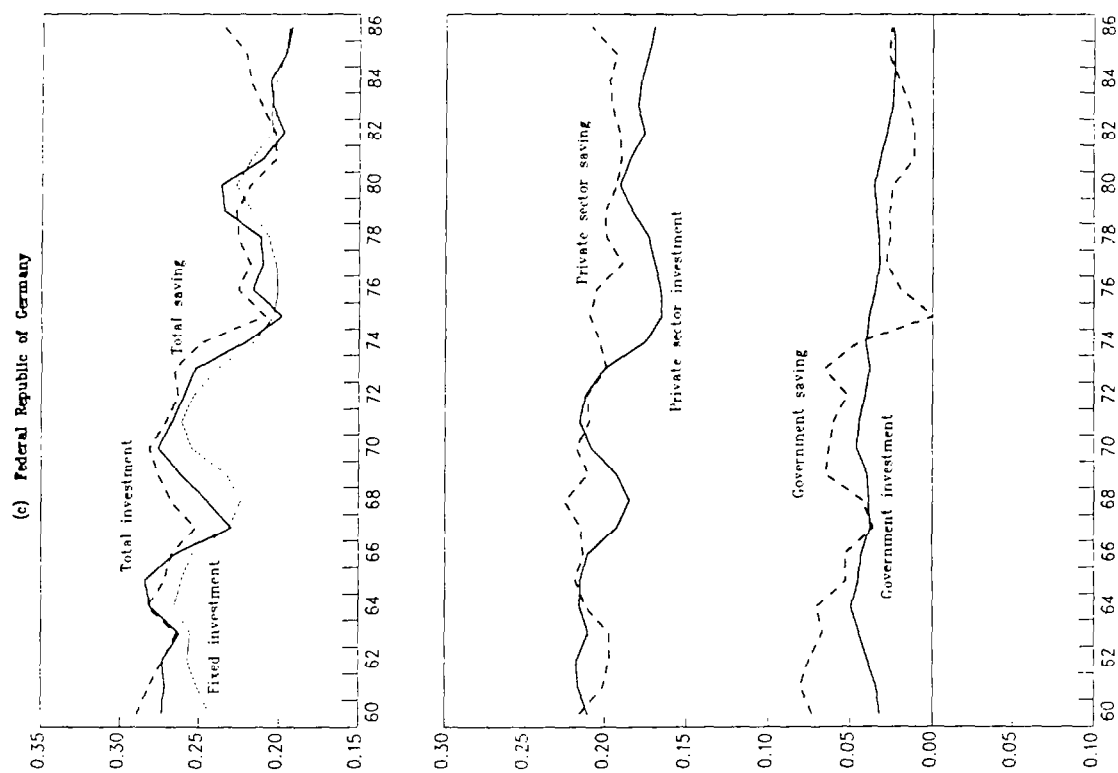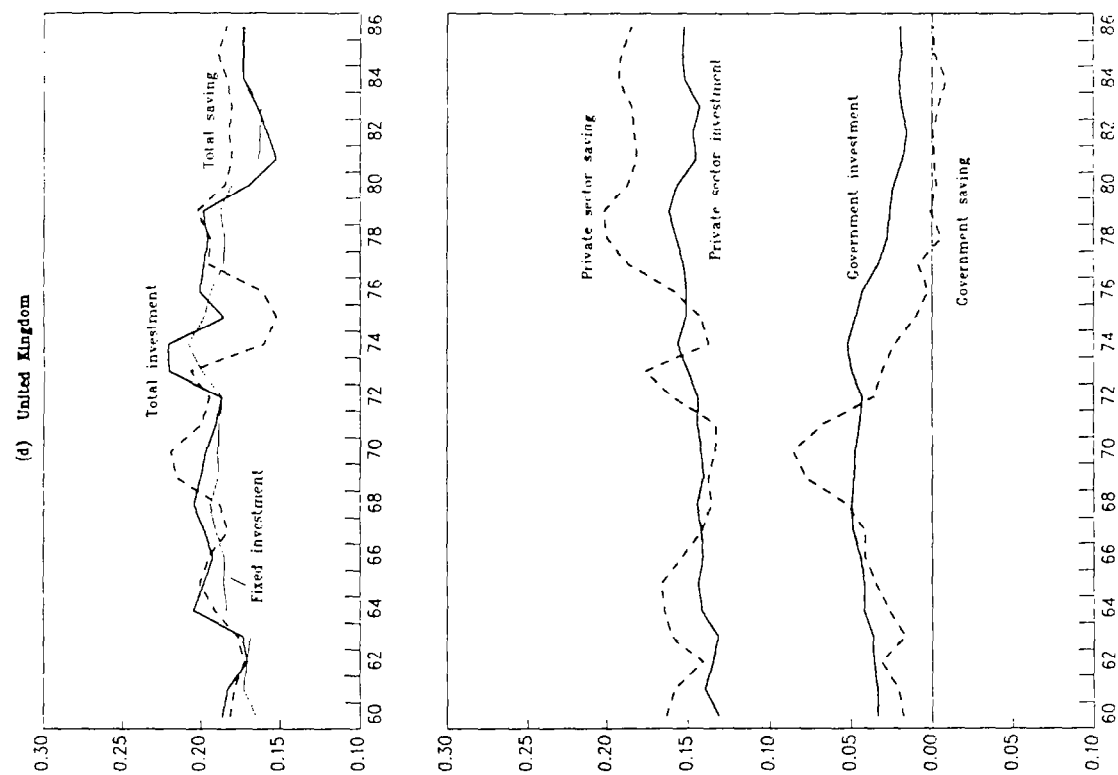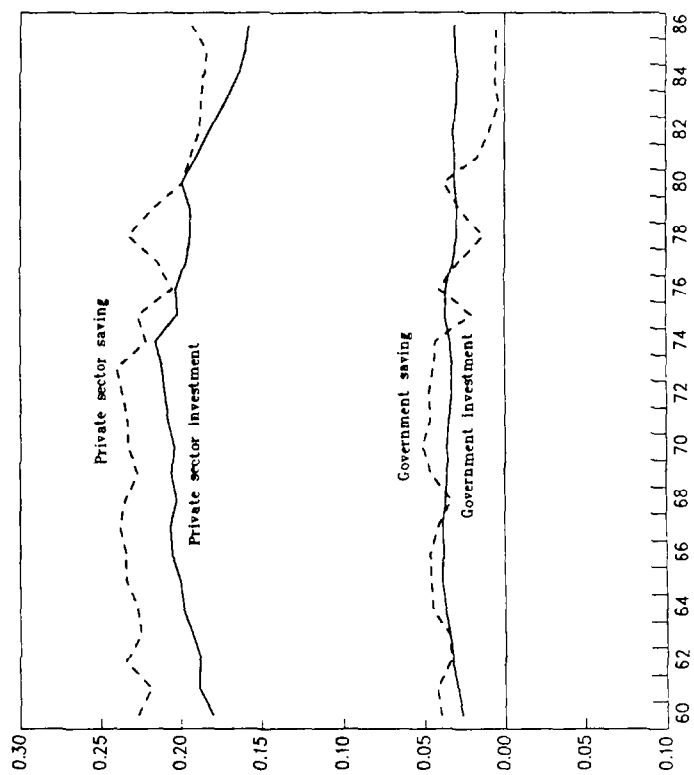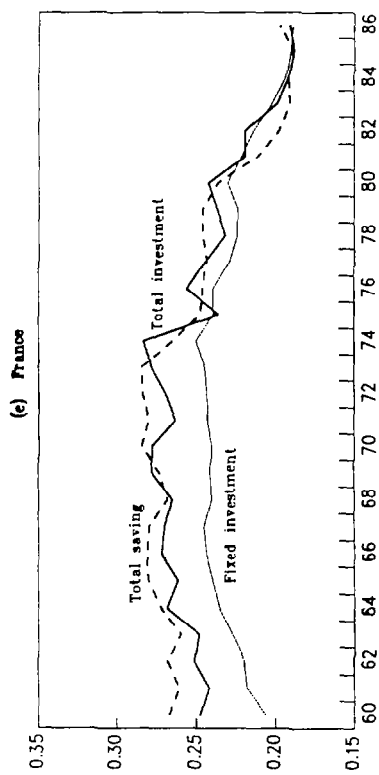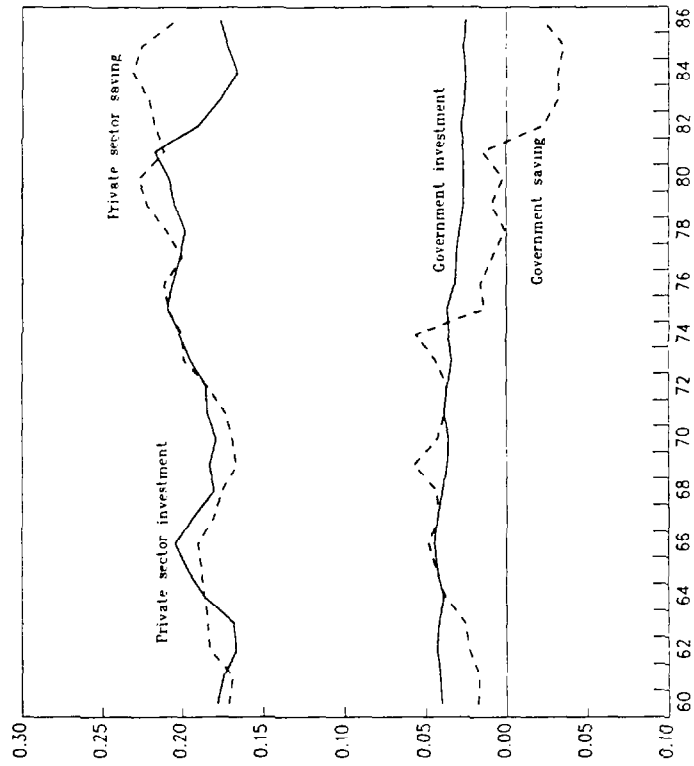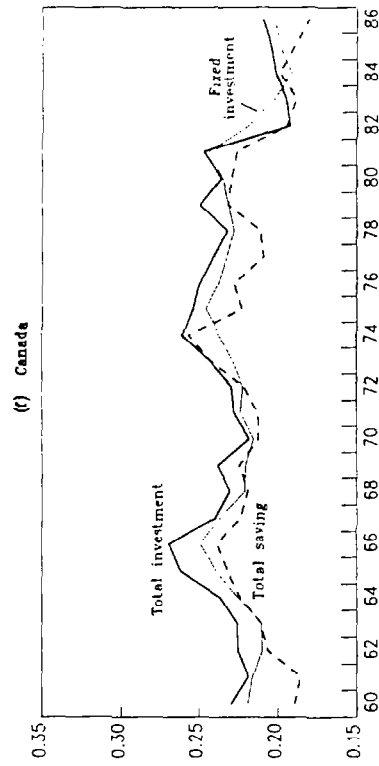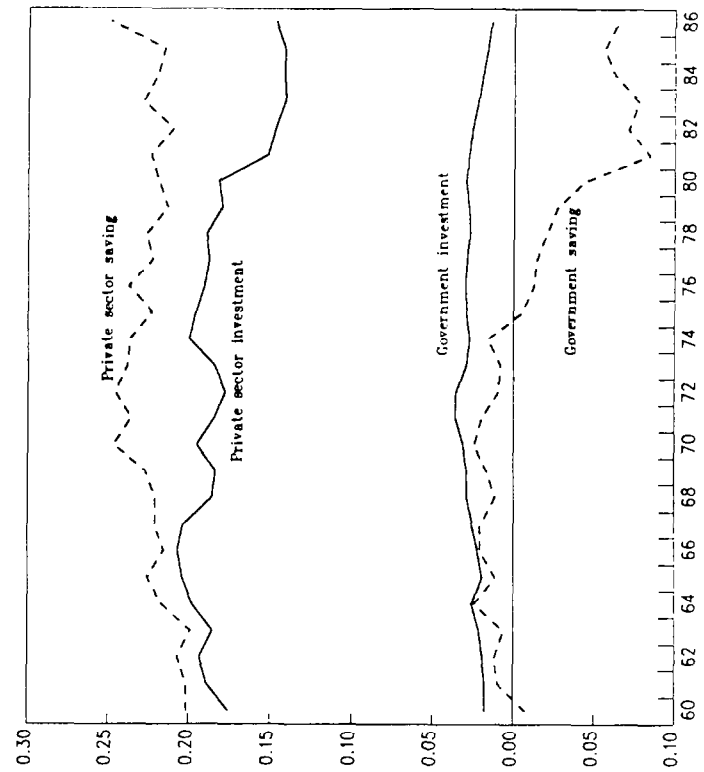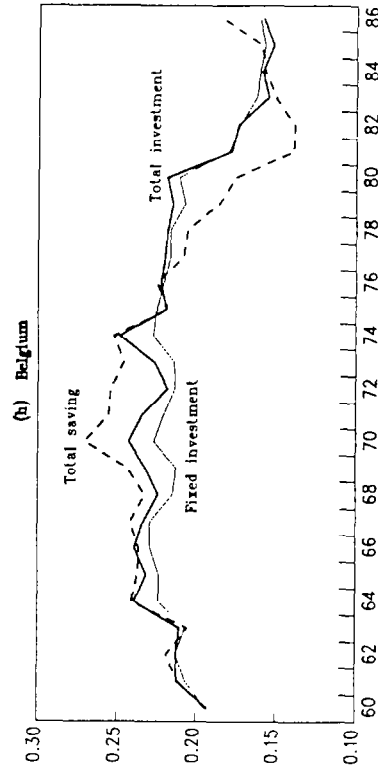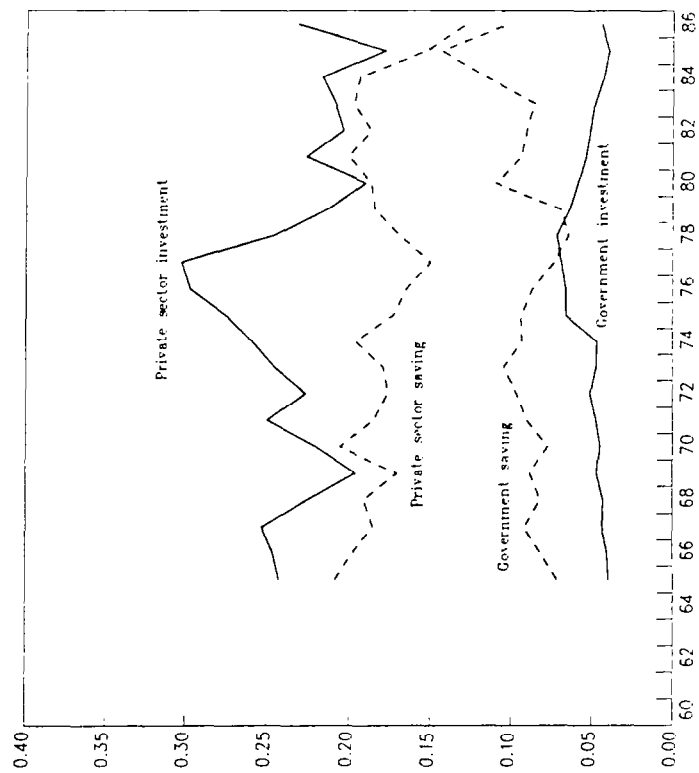

Figure 5. Ratios of Saving and Investment to GNP

(a) United States

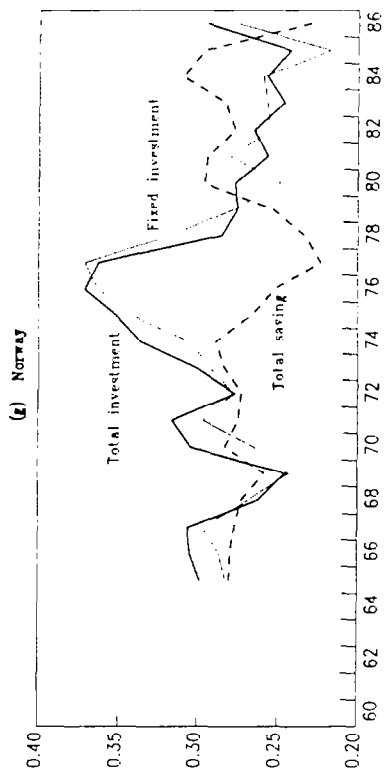Figure 5. Ratios of Saving and Investment to GNP

(d) United Kingdom

Figure 5. Ratios of Saving and Investment to GNP

(c) Federal Republic of Germany

Figure 5. Ratios of Saving and Investment to GNP

(f) Canada

Figure 5. Ratios of Saving and Investment to GNP

(e) France
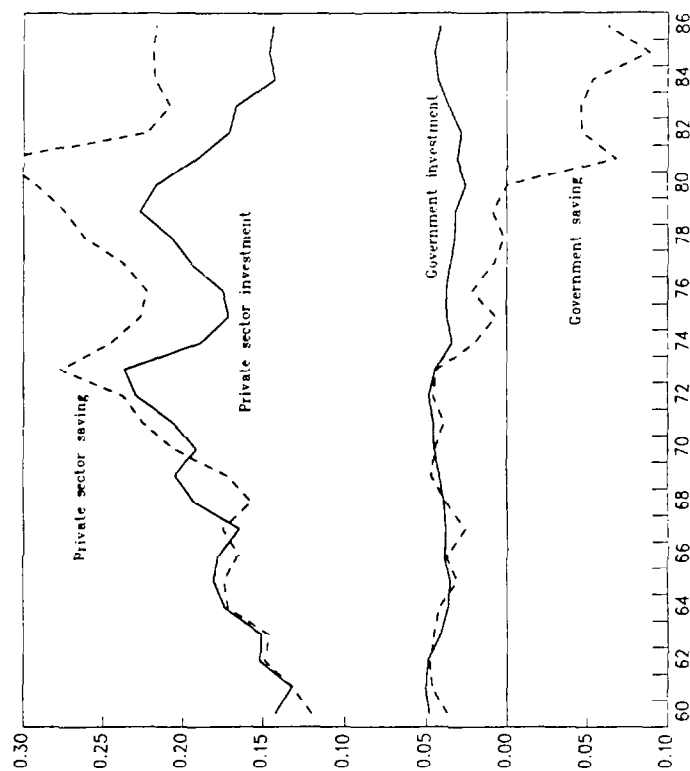
Figure 5. Ratios of Saving and Investment to GNP

(h) Belgium

Figure 5. Ratios of Saving and Investment to GNP

(g) Norway

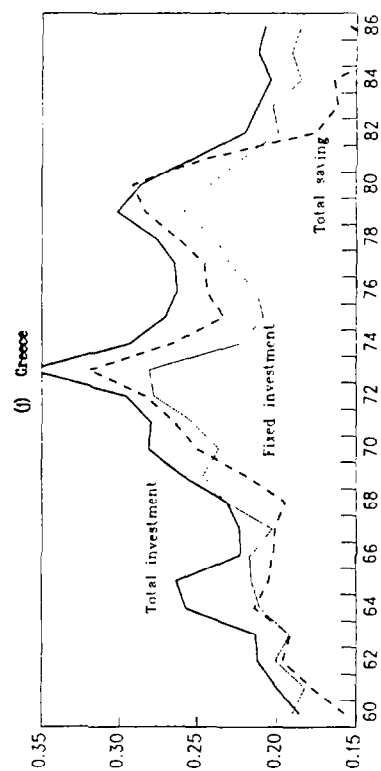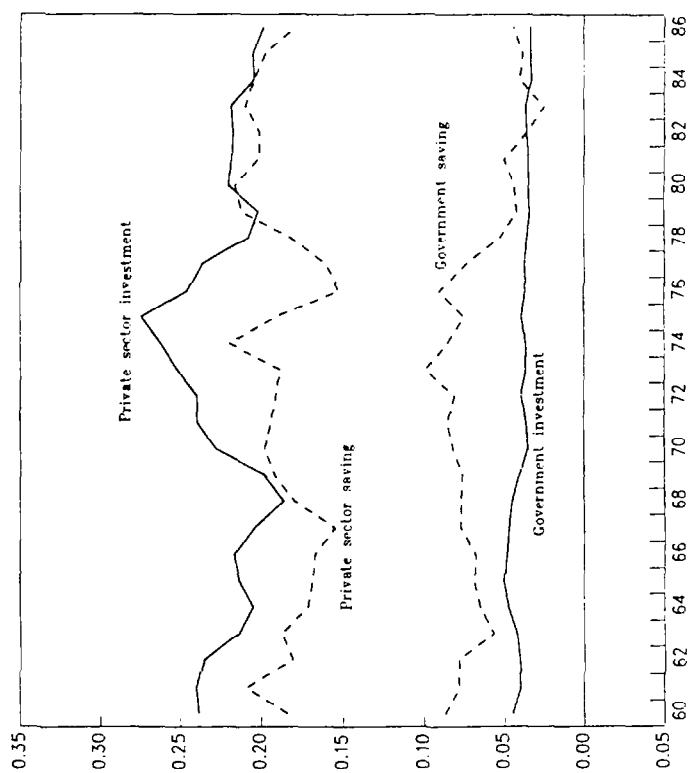Figure 5. Ratios of Saving and Investment to GNP
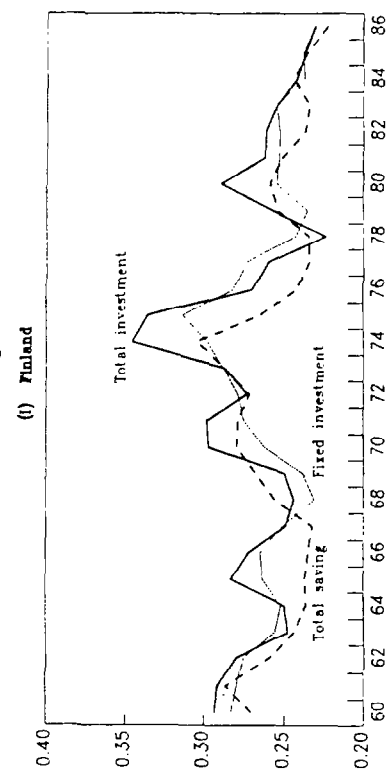
(j) Greece

Figure 5. Ratios of Saving and Investment to GNP

(i) Finland

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