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NATIONAL SAVING AND INTERNATIONAL INVESTMENT

Martin Feldstein

Phillipe Bacchetta

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ABSTRACT

This paper extends earlier work by Feldstein and Horioka on the relation between domestic saving rates and international capital flows or, equivalently, between domestic saving rates and domestic investment. The basic conclusion of the present analysis is that an increase in domestic saving has a substantial effect on the level of domestic investment although a smaller effect than would have been observed in the 1960s and 1970s. The savings retention coefficient for the 1980-86 period is 0.79, down from 0.91 in the 1960s and 0.86 in the 1970s.

The more closely integrated economies of the EEC also appear to have more outward capital mobility (i.e., a lower saving retention coefficient) than other OECD countries.

There is no support for the view that the estimated saving-investment relation reflects a spurious impact of an omitted economic growth variable.

Although budget deficits are inversely related to the difference between private investment and private saving, we reject the view that this reflects an endogenous response of fiscal policy in favor to the alternative interpretation that the negative relation is evidence of crowding out of private investment by budget deficits. This interpretation is supported by the evidence that domestic investment responds equally to private saving and to budget deficits.

The implication of the analysis thus supports the original Feldstein-Horioka conclusion that increase in domestic saving does raise a nation's capital stock and therefore the productivity of its workforce. Similarly, a tax on capital income is not likely to be shifted fully to labor and land by the outflow of enough capital to maintain the real rate of return unchanged.

Martin Feldstein
NBER
1050 Massachusetts Avenue
Cambridge, MA 02138

Phillipe Bacchetta
Brandeis University
Department of Economics
Waltham, MA 02254

1. INTRODUCTION

Do tax policies that stimulate a nation's private saving rate increase its domestic capital stock or do the extra savings flow abroad? Does an increase in the corporate tax rate cause an outflow of capital that shifts the burden of that tax increase to labor and land?

These were the two key questions that motivated the 1980 Feldstein-Horioka (FH) study of the relation between domestic saving rates and domestic investment. FH reasoned that if domestic saving were added to a world saving pool and domestic investment competed for funds in that same world saving pool, there would be no correlation between a nation's saving rate and its rate of investment. The statistical evidence showed that, on the contrary, the long-term saving and investment rates of the individual industrialized countries in the OECD are highly correlated. The data were consistent with the view that a sustained one percentage point increase in the saving rate induced nearly a one percentage point increase in the investment rate.

Much has happened in the international capital markets during the decade since the Feldstein-Horioka study was done. The 1980s saw an unprecedented increase in the international flow of capital to the United States. Capital market barriers in Japan and Europe have been lowered or eliminated. This

experience raises the question of whether the empirical regularity observed for the 1960s and 1970s continued through the 1980s. Even those studies that followed Feldstein-Horioka[1] were limited to data for the 1970s or the early 1980s. One purpose of the present study is to examine the experience for the period 1980 through 1986 and to compare the results with the analysis for earlier years.

1.1 International Capital Mobility and Risk Aversion

The initial FH paper created confusion about the interpretation of the results by discussing them as evidence about international capital mobility. Economists who believe that the evidence on interest arbitrage implies that there is perfect capital mobility were therefore inclined to reject the FH findings. Fortunately, Jeffrey Frankel (1986) clarified the issue by reminding everyone that perfect capital mobility does not imply the international equalization of <u>real</u> interest rates.[2]

More specifically, as Frankel pointed out, the interest arbitrage condition of integrated capital markets refers to nominal interest rates only. Perfect capital mobility implies equal ex ante real interest rates only for time periods for which the expected change in the exchange rate equals the difference in the expected inflation rates. As Frankel stresses, since ex ante purchasing power parity may not hold even for periods as long as a decade, the existence of perfect capital markets (in the sense that the

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[1] These include Feldstein (1983), Caprio and Howard (1984), Murphy (1984), Penati and Dooley (1984), Sachs (1981), and Summers (1988). See Dooley et al. (1987) for a summary of these results.

[2] For a more complete discussion of these issues, see the essay by Frankel in the current volume.

interest differential between two countries is equal to the expected change in the nominal exchange rate) does not imply a continuing equality of expected real interest rates. An increase in saving in one country that gives rise to an equal increase in its investment need not violate the nominal interest arbitrage condition even though it causes a decline in the real interest rate.

Purchasing power parity does not appear to hold even in the long run that is relevant for the tax policy questions that motivated this research. But even if it did, in that very long run the difference between the nominal interest rates in each pair of countries may no longer equal the expected change in the exchange rate because of investor risk aversion. An investor looking ahead for ten years or more must be concerned about risks of changes in tax rules on foreign source income or even in political institutions that can affect the value of his international investments. Opportunities to hedge the interest rate or exchange rate risk on long-term positions are far more limited than for short-term positions, or at least have been until quite recently. For such long horizons, investor risk aversion may induce portfolio investors to prefer investments in their own currency. As a result, expected real interest rates may also differ internationally in the long run.

In a riskless world, long-term nominal interest rate arbitrage could be achieved even though international investors only took net positions in the short-term market if domestic investors arbitraged short-term and long-term domestic interest rates. Once risk is introduced, however, arbitrage by hedged international short-term investors and the equilibrium of risk-averse domestic investors who hold both long-term and short-term securities is not enough to provide international equality of long-term rates.

As an example, a mean-variance investor will allocate his wealth among assets in proportions that vary positively with yield and inversely with risk. An investor who has a high degree of risk aversion or who attributes a large subjective variance to long-term investments in foreign assets may want to invest a large share of his portfolio in domestic assets (depending on asset yield covariances) even when a substantial expected yield difference exists in favor of the foreign assets. Since the mean-variance investor's optimal proportional allocation of the assets is independent of the total value, an increase in saving that raises the total pool of funds will be invested primarily in the domestic economy.

In short, there is no presumption that real long-term yields would be equalized even if all investors were completely free to invest wherever in the world they want. Moreover, broad classes of financial institutions (and, in some countries, nonfinancial corporations as well) are in fact not permitted by regulatory authorities to take net positions in foreign currencies. Many nonfinancial corporations also choose to avoid net foreign exchange exposure as a matter of policy rather than to evaluate the opportunities available at each point in time. The absence of these substantial pools of funds from the potential pool of arbitrage funds would not be important if other investors were risk neutral. However, if the remaining investors are risk averse, the limited size of the mobile pool of unhedged funds increases the potential importance of risk aversion and therefore the scope for expected real rates of return to remain unequal.

1.2 Government Policies and the Current Account

Although the lack of ex ante purchasing power parity and the risk-aversion of international investors are sufficient to permit domestic saving rates to influence substantially the rate of domestic investment, the observed link between saving and investment may also reflect explicit government policy decisions.

It is easy to understand why governments would want to restrict the size of trade imbalances in general and of changes in trade imbalances in particular. Since an increase in the merchandise trade deficit means a loss of exports and the substitution of imports for domestic production, the affected domestic industries are likely to seek government actions to shrink the trade deficit. A decrease in the merchandise trade deficit caused by a spontaneous increase in the demand for the country's exports may be welcome if there is excess capacity in the economy but would be resisted by the government as a source of inflation if there is not excess capacity. Since a rise in exports in a fully employed economy also means a fall in the production of other goods and services, the industries producing for the domestic market are likely to seek policies to reverse the rise in exports.

These arguments refer to changes in the trade balance rather than to its level. Why should a government resist a long-run current account deficit or surplus? One answer is that an economy that starts in trade balance will not want to shift to a long-run imbalance because of its reluctance to accept the dislocations involved in changing the pattern of production from trade balance to trade imbalance. But there are also reasons why a government would resist a long-term trade and current account imbalance in addition to the problems of transition.

Because of capital income taxes, a persistent capital outflow diverts domestic savings to investment abroad that has a lower return to the originating nation. Each government therefore has an incentive to seek a capital inflow and to resist the outflow of its own capital.

A country with a trade surplus and a capital outflow also has the opportunity to trade a reduction in the trade surplus for a higher level of real income (through an improvement in the terms of trade) and a temporarily lower level of inflation (through the favorable "supply shock" of an increase in the level of the currency).

There are a variety of policies that governments can use to shift the economy toward trade and current account balance. In the short run, monetary policy can be used to influence the exchange rate and the level of economic activity. Summers (1988) has suggested that governments may tailor the size of the budget deficit to offset differences between private saving and investment. Other possibilities include the use of targeted tax policies designed to increase or decrease the level of investment or private saving: the investment tax credit, the schedule of depreciation allowances, the availability of special tax preferred savings accounts, a difference in the tax rates on capital and labor income, etc.

I.3 Implication for the Effects of Fiscal Policies

The reason that saving and investment are closely correlated is important for answering the questions that motivated the original study.

Consider the Summers hypothesis that the close correlation between investment and savings reflects the response of government deficit policy to shifts in private investment and saving. If a tax change that encourages

private saving is offset by an increase in the government budget deficit, there is no rise in capital formation. If however the close correlation between saving and investment reflects either the reluctance of private risk averse investors to move capital abroad (so that private investment rises automatically) or a government tax policy to stimulate private investment until it absorbs all of the increase in domestic saving (rather than permit a capital outflow or a contraction of national income), the tax induced rise in saving does get converted into greater domestic capital formation.

The reason for the observed saving-investment correlation is also important for assessing whether a tax on investment income causes a capital outflow that permits the incidence of the tax to be shifted to labor. If the observed saving-investment correlation reflects the unwillingness of risk-averse domestic investors to shift capital abroad, the increase in the capital tax causes a fall in the net of tax rate of return and thus no shifting of the tax burden. In contrast, if the savings-investment equality occurs because of a government decision to increase the budget deficit to absorb the capital that would otherwise go abroad, leaving just enough domestic saving to finance a level of investment at which the after-tax return is equal to the after-tax return abroad, the tax is fully shifted.

In support of the "endogenous deficit policy" hypothesis, Summers presents a regression for a cross-section of industrialized countries of the average deficit-GNP ratio for the period 1973 through 1980 on the average private savings-investment gap (the difference between net private savings and net private investment) for those same years. He finds a coefficient of 0.72 and concludes that it implies that 72 percent of the net savings gap may be offset by an explicit budget deficit policy.

There is however a quite different interpretation of the Summers deficit regression. If the long-run level of the budget deficit is thought of as exogenous (reflecting political considerations in the county rather than an attempt to offset the savings-investment gap), then the regression may only reflect the impact of the budget deficit on the level of investment. This would be the traditional crowding out of private investment by government deficits. Summers presents no evidence or reason to think that his regression should be interpreted as a policy response function rather than as a description of the crowding out of private investment by government deficits. We return to this in section 5 below.

1.4 Statistical Estimates

First however we will turn to the evidence on the link between savings and investment in the most recently available data. We also take this opportunity to consider whether the correlation between savings and investment is equally strong for different subsets of countries within the OECD, including separate analyses for the EEC and non-EEC countries.

Previous comments on the FH regressions raised the issue of the possible endogeneity of national savings rates. This was actually discussed in the original FH paper and estimates using instrumental variables provided as a check on the possible bias from this source. The instrumental variables were demographic and social security variables. The resulting coefficient confirmed the ordinary least squares results. Since this issue has been explored rather thoroughly in the earlier paper, we will not present such instrumental variable estimates in the current analysis.

We will however examine two other issues in some detail. The first is the suggestion by Obstfeld that the observed correlation may reflect the common influence of economic growth on both saving and investment. We replicate the Obstfeld analysis in section 3 and show that although it can in theory explain the observed savings-investment correlation, the actual data are not consistent with the Obstfeld hypothesis.

The second is an analysis of the dynamic adjustment process by which savings and investment adjust to changes in the savings-investment gap. We show in section 6 that the process can be described as an adjustment of investment to close the gap and not an adjustment of savings. We also present some evidence that suggests that the desired gap is not zero in all countries but that countries adjust investment to close the difference between the actual savings-investment gap and a preferred gap.

2. IS CAPITAL MARKET INTEGRATION INCREASING?

The reduction in government barriers to international capital flows, the creation of extensive new hedging markets, and the growing sophistication of financial institutions around the world have increased the likelihood of net capital flows. The sharp fall in the U.S. national saving rate in the 1980s (due to both the increased budget deficit and the decline in private saving) also provided a major incentive for the shift of capital to the United States.

The evidence in this section indicates that there has in fact been a substantial decline in the correlation between the rates of gross domestic saving and gross domestic investment. However, the effect of additional domestic saving on domestic investment remains quite substantial. Even in the

1980s, each dollar of additional saving is associated with an increase in investment of more than 50 cents.

The analysis is based on the regression equation

$$(1.1) \qquad I_t/Y_t = a_0 + a_1 S_t/Y_t$$

where I_t is gross investment (as defined by the OECD and including inventory investment), Y_t is gross domestic product, and S_t is gross saving. The estimates use data for 23 OECD countries (excluding Luxembourg). The unit of observation is a single country and the data for that country has been averaged over a group of years. The coefficient a_1 that indicates the proportion of the incremental savings that is invested domestically will be referred to as the "savings retention coefficient."

Consider first the estimates for gross investment presented in column 1 of table 1. In the decade of the 1960s, each extra dollar of domestic saving increased domestic investment 91.4 cents with a standard error of 6.3 cents. For the next decade this had declined to 80.5 cents with a standard error of 12.1 cents. The decline of 10.9 cents is, however, less than the 13.6 cent standard error of the difference. The seven available years of the 1980s shows a further decline to 60.7 cents with a standard error of 12.6 cents. Although the 19.8 cents decline from the 1970s is only slightly larger than the associated standard error of 17.5 cents, the pattern of continuing decline from the 1960s implies a more significant relation. From the 1960s to the 1980s the decline of 30.7 cents is more than twice the standard error associated with this difference.

Another way of comparing the earlier and later parts of the 27 year sample period is to contrast the earlier fixed exchange rate years (1960–73) with the later floating rate years (1974–86). During the earlier 14 years the savings retention coefficient was 0.911 (standard error 0.066), barely different from the result for the decade of the 1960s. The coefficient for the later 13 years was however 0.669, much more similar to the coefficient for the 1980s. The difference of 0.242 is approximately 1.5 times its standard error.

The final row of column 1 shows that, for the 27 year period as a whole, the savings retention coefficient was 0.791 with a standard error of 0.094. A potentially interesting line of analysis that we have not pursued would be to test whether the investment–savings relation has changed at a constant rate during this period or has had significant step changes after the beginning of the floating rate period or in the decade of the 1980s.

The net saving and investment relations (shown in column 2 of Table 1) do not indicate a fall over time similar to the corresponding gross saving–investment coefficients. The key savings retention coefficient only declines from 0.913 in the 1960s to 0.864 in the 1970s and 0.792 in 1980–86; none of the differences, including the difference between the 1960s and the 1980s, is a as large as its standard error.

This difference between the gross and net saving–investment relations masks a more complex difference between the changes over time in the European Economic Community (EEC) countries and among the non–EEC industrial countries of the OECD. The differences in experience among different groups of countries is the subject of the next section of this paper.

3. CAPITAL FLOWS AND THE EEC

Although capital might in principle flow with equal ease among all countries or at least all industrial countries, the availability of market information, the existence of institutional relationships, and the perception of risk might make capital flows greater among some pairs of countries than among others. More specifically, in the current context, each extra dollar of saving in one country may be divided between the home capital market (which gets the largest share) and other individual national capital markets in a way which depends on a variety of institutional and other country-specific factors.

We have explored this possibility by looking separately at the investment-saving equation for nine of the European Economic Community (excluding the new entrants, Spain and Portugal, as well as Luxembourg) and the investment-saving equation for the remaining 14 OECD countries. It should be emphasized that the EEC savings retention coefficient does not reflect the extent of the capital flow among the EEC countries but rather the extent to which individual EEC countries retain their national saving within the saving country.

Consider first the behavior of the investment-savings relation in the nine EEC countries shown in columns 3 and 4 of Table 1. The gross savings retention coefficients, shown in column 3, are lower among the EEC countries than for the entire OECD group and decline much more rapidly between the 1970s and the 1980s. The decline from 0.742 in the 1960s to 0.652 in the 1970s was not large but this was followed by a sharp decline to only 0.356 in the 1980-86 period. By comparison, the coefficients of the 14 non-EEC members of the OECD were 0.962 in the 1960s, 0.810 in the 1970s and 0.578 in the 1980s.

We should caution, however, that the standard errors of the coefficients for the EEC countries are quite large since each is based on only nine observations. Thus the sharp decline from 0.652 in the 1970s to 0.356 in the 1980s is only two-thirds as large as its standard error of 0.456. We cannot reject the hypothesis that there was no change. Even the fall from 0.742 in the 1960s to 0.356 in the 1980s is only slightly greater than its standard error of 0.359; the hypothesis of no change cannot be formally rejected with this small sample. The test however is of low power because of the small sample size and we would emphasize the large decline rather than its statistical "insignificance."

When we shift from gross to net saving and investment, the pattern of the savings retention coefficients differs even more sharply between the EEC and non-EEC countries. As already noted, among the OECD as a whole, the net saving-investment relation shows virtually no change between the early and later periods (see column 2). In contrast, column 4 shows that the net saving-investment coefficients declined sharply within the EEC between the 1970s and 1980s. This contrast is seen most clearly when the EEC coefficients of column 4 are compared with the non-EEC coefficients of column 6.

Although the small sample of EEC countries makes it difficult to draw any firm conclusions, these data appear to indicate that there have been greater capital flows out of the individual EEC countries (i.e., a smaller share of incremental saving is retained within the saving country) than among the non-EEC countries and that the extent of this capital mobility increased in the 1980s.

We have also examined the saving-investment behavior in the wider group of all 17 European OECD countries (columns 7 and 8 of Table 1) and in the non-

EEC European OECD countries (columns 9 and 10). The results shows that the non-EEC European countries behaved more like the EEC countries than like the non-European members of the OECD.

These results are not only interesting in themselves as an indication of the increasing integration of the European capital markets but also suggest that the reason why the savings retention coefficients are generally much greater than zero reflects the extent of informational and institutional links among the capital markets. The coefficient is lower for the EEC countries despite formal barriers on capital exports in some countries because of the strength of institutional links. Even when capital is completely mobile in principle, actual capital flows are retarded by ignorance and risk aversion.

4. THE "MISSING" GROWTH VARIABLE

The surprising strength of the savings retention coefficient in the original FH study led subsequent researchers to postulate that the strength of the coefficient may reflect the impact of some missing variables that influence investment and are correlated with savings. Obstfeld (1986) has developed the idea that the missing variable may be the growth rate of GDP or a combination of the GDP growth rate and of labor's share of national income.

Life cycle theory implies that these two variables determine the long-term behavior of a country's saving rate. Obstfeld posits a model in which the rate of output growth is also an important determinant of the country's rate of investment; although demand-determined variations in output growth may have an important influence on the timing of investment, in the current context of comparing long-term differences in national investment rates we would be more inclined to regard output growth as the result of previous

capital investment than to look upon output growth as an exogenous determination of investment. Obstfeld (1986) used data on GDP growth and on the ratio of employee compensation to national income in individual OECD countries to simulate the saving-GDP ratios and investment-GDP ratios for those countries that would result in a simple theoretical model. He then used these simulated investment and saving ratios to estimate statistically the basic investment-savings ratio.

The Obstfeld model assumes complete world capital mobility; that is, the only link between savings and investment in each country is that they depend on common variables. Nevertheless, a regression of the simulated investment-GDP ratio on the simulated saving-GDP ratio produces coefficients that are approximately equal to one, with the precise coefficient depending on the group of countries selected.

Although we regard this as an ingenious demonstration of how the observed investment-savings relation might in principle be just a spurious reflection of the missing growth and income distribution variables, we do not find it convincing. The real test of whether the savings variable is just a proxy for the growth and distribution variables is whether the inclusion of growth and distribution causes a significant change in the savings retention coefficient in a regression using the actual saving and investment variables instead of the simulated ones.

To test this in a way that makes it strictly comparable to Obstfeld's analysis, we began by following his procedure to create synthetic saving and investment variables. We used observations for the same countries and years as Obstfeld. Despite the usual OECD data revisions, we found that we were able to reproduce his results quite closely. For example, with a sample of 17

countries for the period 1970 through 1979, Obstfeld found a savings retention coefficient of 0.86 (with a standard error of 0.81) and we found a coefficient of 1.01 with a standard error of 0.78. Adding the product of the growth and income distribution variables to the Obstfeld synthetic equation caused the savings absorption coefficient to become −0.75 with a standard error of 0.10 while the other variable "explained" the variation in the synthetic investment series.

However, when we replaced the synthetic variables with the actual saving and investment variables, the estimated savings retention coefficient was little affected by adding the growth and distribution variables to the equation. More specifically, with the same Obstfeld sample of countries and years, but using the actual saving and investment data rather than the synthetic ones, the estimated coefficient of the savings variable was 0.88 (with a standard error of 0.12) in the basic regression. When the growth and distribution variables were added to the equation, the coefficient of the saving variable because 0.87 (with standard error of 0.13).

Similar results were obtained with other combinations of growth rates and income. In no case did the inclusion of the growth and distribution variables substitute for the effect of the savings variable as a determinant of domestic saving.

The implication of this is clear. Although the estimated savings retention coefficient could in theory reflect only the indirect effect of omitted growth and distribution variables, the evidence indicates that this is not so.

5. BUDGET DEFICITS

As we wrote in section 1, Summers (1988) has noted that there is an alternative possible explanation for the observed relation between investment and savings rates. Summers suggests that if governments do not like capital outflows or inflows, they might adjust their budget deficits to offset the gap between investment and private saving.

As evidence for this possibility, Summers presents a regression of the ratio of the budget deficit to GDP on the difference between the private savings ratio (i.e., the ratio of domestic savings plus the budget deficit to GDP) and the investment-GDP ratio:

$$(5.1) \qquad DEF/Y = b_0 + b_1 \, (PS - I)/Y$$

where DEF is the general government budget deficit (i.e., the OECD measure of general government saving with the sign changed), PS is private saving (i.e., saving as previously defined plus the budget deficit) and I and Y are investment and gross domestic product as previously defined.

For a sample of 14 countries for the period 1973 through 1980 Summers obtained a coefficient of 0.72.[3] Taken at face value, this would imply that each dollar of the private saving-investment gap induces governments to increase their budget deficit by 72 cents. Since the precise sample used by Summers is not known, we reestimated his equation 5.1 with data for 13 OECD

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[3] The text of Summers' paper does not specify the sample of countries or years for which his regression was estimated but elsewhere in his paper he indicates that an equation using the deficit variable as an instrumental variable is limited to this sample of countries and years because of data limitations.

countries for which data are available for the period 1973 through 1980. The estimated coefficient of 0.68 with a standard error of 0.15 is quite close to the original estimate by Summers.

There are, however, serious problems of interpretation of equation 5.1. Although such a model of deficit adjustment may have merit as a description of short-term stabilization policy, we find it very implausible as an explanation of why long-term differences in budget deficit ratios persist among countries. A more likely explanation of the correlation between budget deficits and net saving ratios is that budget deficit ratios are "exogenous" (reflecting political and historical characteristics) and that high deficit ratios crowd out private investment in the traditional way. Similarly, countries with budget surpluses may "crowd in" more private investment.

To assess the plausibility of this alternative specification, we reorder the variables of equation 5.1 and estimate the equation:

$$(5.2) \qquad I/Y = c_0 + c_1 \, DEF/Y + c_2 \, PS/Y.$$

This is a natural generalization of the basic equation (1.1) that divides domestic saving into two components: private saving (PS) and government saving (-DEF). The original basic model implies that the coefficients c_1 and c_2 are equal in absolute value but opposite in sign with private saving having a positive effect and the budget deficit a negative effect.

The results, presented in Table 2, are generally consistent with this generalization of the original basic model. For example, with the largest possible sample (13 countries for 1970 through 1985) the coefficient of net private savings is 0.699 with a standard error of 0.112 while the coefficient

of the budget deficit is −0.865 with a standard error of 0.150. Taken at face value, these coefficients imply that each dollar of gross private saving adds 70 cents to gross investment while each dollar of the budget deficit crowds out 0.87 cents of investment.

The higher absolute coefficient on government deficits than on private saving is what would be expected if governments are likely to invest less when they face a budget deficit and to invest more when tax receipts are large relative to current spending. To see this, note that total investment includes government sector investment (I_g) as well as private sector investment (I_p), while the government deficit is defined as the difference between government current outlays and taxes. Assume that private investment depends on the total pool of national savings net of government borrowing for both current and investment outlays:

$$(5.3) \qquad I_p/Y = \alpha + \beta\ (T - G - I_g + PS)/Y + \epsilon$$

where T is total tax revenue of the government. Note that this implies that government investment does not directly reduce (or increase) private investment but does so only through the domestic availability of funds.

Adding government investment to both sides of the equation and regrouping terms yields:

$$(5.4) \qquad I_p/Y + I_g/Y = \alpha + \beta\ (T - G)/Y + \beta PS/Y + (1-\beta)\ I_g/Y + \epsilon.$$

A regression in the form of equation 5.2 is thus equivalent to estimating the "true" equation 5.4 with the last term omitted. The relation between the

estimated coefficients c_1 and c_2 of equation 5.2 and the parameter β of equation 5.4 depends on the relation between government investment and the other two variables. If government investment does not depend on the level of private saving but does respond positively to government current budget surpluses, the estimated coefficient of the government surplus variable (T-G)/Y will equal the true coefficient (β) plus the product of ($1-\beta$) and the regression of I_g/Y and (T-G)/Y. This implies that the coefficient of the government surplus variable ($-c_1$ of equation 5.2) will exceed the coefficient of the private saving variable (c_2 of equation 5.2). The bias is, however, relatively small. If the "true" coefficient β is 0.75 and the long-run propensity of the government to spend current surpluses on government investment is as large as 0.4, the estimated value of $-c_1$ will be 0.85 instead of 0.75.

In practice, the difference between the estimates of $-c_1$ and c_2 is not statistically significant with a sample of only 13 observations. Estimating the constrained equation for this sample produces a coefficient of 0.76 on domestic saving with a standard error of 0.09. Comparing the sums of squared residuals for the constrained and unconstrained specifications implies an F statistic of 0.81 with 1 and 10 degrees of freedom. Since the critical value for 5 percent significance is 4.96, we cannot reject the simple original specification.

Note that the estimate of c_2 is an unbiased estimate of the true parameter β regardless of the size of β and of the government's propensity to do public investment as a function of the government's current surplus as long as the government investment is not influenced by the private saving rate.

The problem of distinguishing between the "deficit reaction function approach" of equation 5.1 and the "components of domestic saving" approach of equation 5.2 cannot be definitively resolved by these estimates since the statistical problem is one of identification and, more fundamentally, of providing the theoretically correct specification. It is helpful in this to look at the underlying raw data in the context of what we know about the particular economies.

Table 3 presents data on the deficit, net private saving and net investment for the decade of the 1970s and the period 1980-84. Such data are only available for 13 countries.

It is noteworthy that in the 1970s the "deficits" were negative in all of the countries except the United States and Belgium. The other countries had surpluses ranging from one percent of GDP to seven percent of GDP. By the 1980s, most of these countries were experiencing actual deficits. It would be very interesting but beyond our capability to examine the historic reasons for these shifts country by country.

Consider however the case of the United States which went from a deficit of one percent of GNP in the 1970s to 3 percent in the first half of the 1980s. For the 1970s, the U.S. deficit was the largest of all 13 countries; indeed, none of the others had a deficit. It is hard to argue, however, that this represented a fiscal policy decision aimed at supporting aggregate demand since inflation was a serious problem during most of this decade and there was a general feeling that national saving was too low. While it might in theory be argued that the shift to a larger deficit in the 1980s was a way of dealing with the large recession in 1980-82, the actual historic record shows that the recession was the unintended consequence of a political inability to obtain

sufficient domestic spending cuts to pay for the combination of tax cuts, defense spending increases, and higher interest payments on the national debt.

One caveat should be indicated about this analysis. Government deficits reflect payments of interest on the national debt because such interest payments are part of current government outlay. Since inflation differences among the countries influence the interest rates on the government debt, the deficits reflect to differing degrees the inflation erosion of the government debt and are in this sense not "true" deficits. This is likely to be more important in the international context than over time in individual countries.

To examine the sensitivity of our conclusions to the failure to adjust for inflation, we have repeated the analysis using inflation-adjusted government deficits and private savings using data constructed by Mullen and Price (1984) (as given by Roubini and Sachs (1989). The inflation-adjusted results are very similar to the unadjusted estimates. Using data for the largest available sample (13 countries for the period 1971 through 1986), the disaggregated savings coefficients are almost exactly equal in absolute value:

$$(5.5) \qquad I/Y = \underset{}{0.019} - \underset{(0.012)}{0.89}\ DEF^*/Y + \underset{(0.10)}{0.88}PS^*/Y \qquad \underset{(0.14)}{}$$

where DEF^* and PS^* are both inflation adjusted. The evidence clearly supports the view that either source of variation in national saving has the same effect on domestic investment.

6. DYNAMIC ADJUSTMENT

As Feldstein (1983) and Feldstein-Horioka (1980) emphasized, the close relationship between domestic saving and domestic investment is a long-term characteristic and does not hold from year to year. With time series data, the savings retention coefficients are much lower than in cross-section analyses.

It is possible however to examine the dynamic adjustment process by which the close association between domestic investment and domestic saving is maintained. The evidence presented in this section supports the view that it is domestic investment that responds to changes in domestic saving. The evidence is not consistent with a view that domestic saving (either private alone or the combination of private and public) responds to shifts in investment.

Consider therefore the simple adjustment process by which the change in the investment ratio from year to year $(I_t/Y_t - I_{t-1}/Y_{t-1})$ varies inversely with the previous year's investment-savings gap $(I_{t-1}-S_{t-1})/Y_{t-1}$:

$$(6.1) \qquad I_t/Y_t - I_{t-1}/Y_{t-1} = d_0 + d_1 (I_{t-1} - S_{t-1})/Y_{t-1}.$$

If an increase in the gap between investment and saving causes investment to decline, d_1 is negative. Such a decline could be caused by a rise in interest rates induced by the "shortage" of savings in year t-1. The evidence presented below shows that d_1 is in fact negative, supporting the view that investment responds to shifts in saving.

A similar regression shows that the saving rate does not respond to the gap between investment and savings. For this purpose, we estimate the equation

$$(6.2) \qquad S_t/Y_t - S_{t-1}/Y_{t-1} = e_0 + e_1 (I_{t-1} - S_{t-1})/Y_{t-1}.$$

Although a shortage of saving could raise saving by increasing the interest rate or inducing an increase in the government surplus, the evidence suggest that this does not occur. Of course, this is quite consistent with much previous evidence that investment is more sensitive to interest rates than saving.

The results are presented in Table 4. Equation 1 presents the results corresponding to equation 6.1 for the 23 OECD countries (i.e., all OECD countries except Luxembourg) for the period 1961 through 1986. The coefficient of -0.227 (with a standard error of 0.026) implies that an investment-savings gap of one percentage point of GDP causes the investment-GDP ratio to fall by approximately a quarter of a percentage point in the following year. After three years the adjustment of investment alone would reduce the gap to less than one half a percent of GDP; after six years, 80 percent of the gap would be eliminated.

The corresponding saving equation is presented as equation 2 of Table 4. The coefficient of -0.036 is small both absolutely and relative to its standard error of 0.024 and of the wrong sign. The data thus imply no response of the saving rate to the savings-investment gap.

Disaggregating the adjustment coefficient into separate coefficients for lagged investment and lagged saving supports this interpretation of the

evidence. In the unconstrained investment equation (equation 3 of Table 4) the coefficients of the lagged investment ratio is -0.275 with a standard error of 0.028 while the coefficient of the lagged saving variable is 0.198 with a standard error of 0.027. The coefficients are close enough in magnitude to be equal for practical purposes. But if the point estimates are taken literally, the evidence implies that a rise in the savings ratio induces a slightly smaller rise in subsequent investment that a fall in the investment ratio. This is just what might be expected if the stochastic disturbance contains a serially correlated determinant of investment.

Dividing the sample into the fixed rate first half (1961-73) and the floating rate second half (1974-86) shows that the results are similar in both subperiods, with some indication of a slower response in the second half than in the earlier period. These results are shown in equations 5 through 8 of Table 4. This confirms the results presented in section 2.

The constant terms in equations 6.1 and 6.2 imply that the investment and saving ratios would adjust monotonically over time even if there were no investment-savings gap. Since there is no justification for such a trend, we have also estimated the equations of Table 4 with the constraint that there is no constant term. The results are very similar to the coefficients of Table 4 and are not presented to save space.

We have also repeated this dynamic analysis for the nine EEC countries alone. The basic results, presented in Table 5, are very similar to the result for the entire OECD. Investment adjusts to the lagged investment-savings gap while saving does not adjust. The coefficients for the EEC also imply a small savings retention, confirming the results in section 3. The other principal difference between the two sets of results is that the

unconstrained coefficients suggest that the effect of an increase in saving is smaller than the effect of an increase in investment. This may reflect only the bias referred to above that results if the disturbance is serially correlated.

It would be worthwhile to examine the adjustment process more extensively, considering more general adjustment dynamics and using estimation methods that are consistent in the presence of serial correlation, although that may provide little reassurance with such small samples.

6.1 Persistent Current Account Imbalances

The specification of equation 6.1 implies that each country will adjust its investment to eliminate eventually the entire investment-savings gap. A more general specification would recognize that countries may instead have a "normal" nonzero level of current account surplus or deficit to which they adjust.

We consider therefore the following generalization of equation 6.1:

$$(6.3) \qquad I_t/Y_t - I_{t-1}/Y_{t-1} = f_0 + f_1 \{(I_{t-1}-S_{t-1})/Y_{t-1}-GAP\}$$

where GAP is the desired or normal investment-saving gap. Equation 6.3 is only distinguishable from equation 6.1 when the GAP is permitted to vary among countries.

Equation 6.3 has therefore been estimated with individual constant terms for each of the 23 OECD countries using data for 1961 through 1986. Separate estimates for the subperiods 1961-73 and 1974-86 have also been calculated. The results are presented in Table 6.

Equation 1 of Table 6 corresponds to equation 6.3 for the entire period 1961 through 1986. Equations 2 and 3 correspond to the two subperiods.

The individual constant terms correspond to substantial positive "normal" or "target" investment-saving gaps in several countries including Australia, New Zealand, Portugal, Greece, Turkey, Denmark, and Ireland. There were fewer countries with negative target investment-saving balances, but these included Germany, France, Switzerland, the Netherlands and, since 1974, Japan. It is clear that these "normal" or "target" investment-saving balances do correspond generally to the economic situations of the countries with the lower income countries more likely to seek capital inflows while the high saving and older industrial countries correspond to a target excess of saving over investment.

7. CONCLUSION

The basic conclusion of the present analysis is that an increase in domestic saving has a substantial effect on the level of domestic investment although a smaller effect than would have been observed in the 1960s and 1970s. The more closely integrated economies of the EEC also appear to have more outward capital mobility (i.e., a lower saving retention coefficient) than other OECD countries.

There is no support for the view that the estimated saving-investment relation reflects a spurious impact of an omitted economic growth variable. Although budget deficits are inversely related to the difference between private investment and private saving, we reject the view that this reflects an endogenous response of fiscal policy in favor of the alternative interpretation that the negative relation is evidence of the crowding out of private investment by budget deficits. This interpretation is supported by

the evidence that domestic investment responds equally to private saving and budget deficits.

The dynamic adjustment analysis supports the view that domestic investment adjusts rather quickly when there is an unwanted investment-savings gap while domestic saving shows little tendency to adjust.

The implication of the analysis thus supports the original Feldstein-Horioka conclusions that increases in domestic saving do raise a nation's capital stock and thereby the productivity of its workforce. Similarly, a tax on capital income is not likely to be shifted to labor and land by the outflow of enough domestic capital to maintain the real rate of return unchanged.

References

Caprio, Gerard and David Howard. 1984. Domestic saving, current account, and international capital mobility. International Finance Discussion Papers No. 244. Federal Reserve Board.

Dooley, Michael, Jeffrey Frankel, and Donald Mathieson. 1987. International capital mobility: What do saving-investment correlations tell us? International Monetary Fund Staff Papers 34: 503-530.

Feldstein, Martin. 1983. Domestic saving and international capital movements in the long run and the short run. European Economic Review 21: 129-51.

Feldstein, Martin and Charles Horioka. 1980. Domestic saving and international capital flows. Economic Journal 90: 314-29.

Frankel, Jeffrey. 1985. The implications of mean-variance analysis for four questions in international macroeconomics. Journal of International Money and Finance.

Frankel, Jeffrey. 1986. International capital mobility and crowding out in the U.S. economy: Imperfect integration of financial markets or of goods markets? In R. Hafer, ed., How Open Is The U.S. Economy? Federal Reserve Bank of St. Louis. Lexington: Lexington Books.

Muller, Patrice and Robert Price. 1984. Structural budget deficits and fiscal stance. OECD Working Paper No. 15.

Murphy, Robert. 1984. Capital mobility and the relationship between saving and investment in OECD countries. Journal of International Money and Finance 3: 327-342.

Obstfeld, Maurice. 1986. Capital mobility in the world economy: Theory and measurement. Carnegie-Rochester Conference Series on Public Policy. Amsterdam: North-Holland.

Penati, Alessandro and Michael Dooley. 1984. Current account imbalances and capital formation in industrial countries, 1949-1981. International Monetary Fund Staff Papers 31: 1-24.

Roubini, Nouriel and Jeffrey Sachs. 1989. Government spending and budget deficits in industrial economies. NBER Working Paper No. 2919.

Sachs, Jeffrey. 1981. Aspects of the current account behavior of OECD economies. In E. Claassen and P. Salin, eds., Recent Issues in the Theory of Flexible Exchange Rates.

Summers, Lawrence. 1988. Tax policy and international competitiveness. In Jacob Frenkel, ed., International Aspects of Fiscal Policies. NBER Conference Report. Chicago University Press.

Table 1

The Changing Impact of Domestic Savings on Domestic Investment

Period	23 OECD Countries		9 EEC Countries		14 Non-EEC OECD Countries		17 OECD European Countries		8 Non-EEC OECD European Countries	
	Gross (1)	Net (2)	Gross (3)	Net (4)	Gross (5)	Net (6)	Gross (7)	Net (8)	Gross (9)	Net (10)
1960-69	0.914 (0.063)	0.913 (0.081)	0.742 (0.109)	0.884 (0.173)	0.962 (0.072)	0.940 (0.091)	0.835 (0.082)	0.877 (0.111)	0.870 (0.166)	0.848 (0.146)
1970-79	0.805 (0.121)	0.864 (0.122)	0.652 (0.302)	0.956 (0.282)	0.810 (0.141)	0.831 (0.140)	0.770 (0.204)	0.810 (0.173)	0.636 (0.399)	0.671 (0.239)
1980-86	0.607 (0.126)	0.792 (0.136)	0.356 (0.342)	0.509 (0.461)	0.578 (0.134)	0.807 (0.145)	0.581 (0.156)	0.792 (0.180)	0.555 (0.203)	0.863 (0.224)
1960-73	0.911 (0.066)	0.894 (0.077)	0.725 (0.152)	0.961 (0.211)	0.951 (0.071)	0.878 (0.076)	0.832 (0.105)	0.837 (0.114)	0.906 (0.232)	0.718 (0.105)
1974-86	0.669 (0.145)	0.878 (0.154)	0.462 (0.383)	0.804 (0.431)	0.628 (0.161)	0.868 (0.172)	0.641 (0.202)	0.874 (0.221)	0.521 (0.303)	0.868 (0.308)
1960-86	0.791 (0.094)	0.865 (0.111)	0.524 (0.243)	0.830 (0.318)	0.816 (0.098)	0.867 (0.111)	0.717 (0.140)	0.847 (0.158)	0.668 (0.218)	0.833 (0.185)

Table 2

Investment and the Components of Domestic Saving

Period	Countries (#)	Deficit	Private Saving
1970–85	13	-0.865 (0.150)	0.699 (0.112)
1965–84	9	-0.948 (0.153)	0.747 (0.124)

Table 3

Budget Deficits, Private Savings, and Investments

	1970–79			1980–84		
	Deficit	Saving	Investment	Deficit	Saving	Investmen
Germany	−0.03	0.10	0.13	−0.01	0.08	0.09
Austria	−0.05	0.11	0.17	−0.02	0.09	0.12
Switzerland	−0.04	0.14	0.16	−0.03	0.14	0.14
Netherlands	−0.03	0.13	0.15	0.01	0.12	0.09
Sweden	−0.07	0.05	0.12	0.01	0.06	0.07
Finland	−0.07	0.06	0.15	−0.03	0.07	0.11
Belgium	0.00	0.14	0.13	0.07	0.13	0.08
Spain	−0.03	0.12	0.16	0.01	0.09	0.10
U.K.	−0.01	0.07	0.10	0.02	0.08	0.04
Australia	−0.05	0.11	0.17	0.01	0.04	0.09
Canada	−0.01	0.10	0.13	0.03	0.12	0.10
U.S.	0.01	0.09	0.08	0.03	0.08	0.05
Japan	−0.04	0.18	0.22	−0.03	0.14	0.17

All figures are expressed as ratios to gross domestic product.
Investment and private saving are net variables.

Table 4

Dynamic Adjustment of Investment and Saving in 23 OECD Countries

Equation	Dependent Variable	Coefficient Constrained	Period	Coefficient of Lagged: Investment	Saving
1.	Investment	yes	1961–86	−0.227 (0.026)	0.227 (0.026)
2.	Saving	yes	1961–86	−0.036 (0.026)	0.036 (0.026)
3.	Investment	no	1961–86	−0.275 (0.028)	0.198 (0.027)
4.	Saving	no	1961–86	−0.014 (0.025)	−0.068 (0.024)
5.	Investment	no	1961–73	−0.344 (0.048)	0.262 (0.045)
6.	Saving	no	1961–73	0.034 (0.039)	−0.083 (0.037)
7.	Investment	no	1974–86	−0.240 (0.037)	0.140 (0.036)
8.	Saving	no	1974–86	−0.025 (0.036)	−0.132 (0.033)

Table 5

Dynamic Adjustment of Investment and Saving in 9 EEC Countries

Equation	Dependent Variable	Coefficient Constant?	Period	Coefficient of Lagged: Investment	Saving
1.	Investment	yes	1961–86	-0.159 (0.042)	0.159 (0.042)
2.	Saving	yes	1961–86	-0.015 (0.037)	0.015 (0.037)
3.	Investment	no	1961–86	-0.225 (0.045)	0.123 (0.042)
4.	Saving	no	1961–86	-0.059 (0.040)	-0.055 (0.037)
5.	Investment	no	1961–73	-0.222 (0.087)	0.083 (0.078)
6.	Saving	no	1961–73	0.064 (0.065)	-0.160 (0.058)
7.	Investment	no	1974–86	-0.216 (0.055)	0.071 (0.055)
8.	Saving	no	1974–86	-0.090 (0.051)	-0.115 (0.050)

The 9 EEC countries exclude Spain, Portugal, and Luxemburg.

Table 6

Normal Investment-Savings Gaps in OECD Countries

Equation No:	(1)	(2)	(3)
Time Period:	1961-86	1961-73	1974-86
Lagged Investment Coefficient:	-0.335 (0.030)	-0.422 (0.049)	-0.349 (0.044)
Lagged Savings Coefficient:	0.335 (0.030)	0.422 (0.049)	0.349 (0.044)
Normal Gap: (in percent)			
U.S.	-0.21	-0.31	-0.14
U.K.	-0.03	0.55	-0.75
Japan	-0.54	1.64	-2.84
Germany	-1.64	-1.07	-2.07
France	-0.28	-0.26	-1.55
Italy	0.12	0.14	0.20
Canada	1.37	2.11	0.63
Australia	2.33	1.52	3.24
New Zealand	4.21	3.35	4.91
Switzerland	-2.09	0.50	-4.73
Spain	0.30	0.69	-0.37
Portugal	2.74	0.76	4.50
Belgium	-0.33	-0.33	-0.37
Netherlands	-1.94	-0.83	-2.90
Greece	3.16	5.95	-0.32
Turkey	3.22	2.25	3.90
Sweden	-0.21	-0.69	0.49
Denmark	2.15	1.97	2.38
Finland	0.89	1.23	0.63
Norway	1.97	1.99	1.92
Iceland	1.85	2.41	1.29
Austria	-0.03	0.45	-0.55
Ireland	5.28	4.13	6.02