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DOMESTIC SAVING AND INTERNATIONAL CAPITAL FLOWS*

How internationally mobile is the world's supply of capital? Does capital flow among industrial countries to equalise the yield to investors? Alternatively, does the saving that originates in a country remain to be invested there? Or does the truth lie somewhere between these two extremes? The answers to these questions are not only important for understanding the international capital market but are also critical for analysing a wide range of issues including the nation's optimal rate of saving and the incidence of tax changes.

I. INTERNATIONAL CAPITAL MOBILITY: SIGNIFICANCE AND LIMITATIONS

Before turning to our empirical analysis, it is useful to consider in more detail the implication of international capital mobility for these major questions of policy and analysis. Consider first the problem of determining an optimal savings policy. In a closed economy, the national return on additional saving is the domestic marginal product of capital. The question of whether the government should pursue policies to increase the saving rate is therefore equivalent to deciding whether this domestic marginal product of capital offers a high enough reward to justify postponing consumption.[1] Although the net yield that individual investors receive is lowered by taxes on capital income, the nation as a whole receives both the after-tax yield and the tax revenue; it is this pretax marginal product of capital that should influence national saving policy in a closed economy.

In contrast, if capital is perfectly mobile between countries, most of any incremental saving will leave the home country (if it is already a capital exporter) or will replace other foreign source capital that would otherwise be invested in the home country (if it is already a capital importer). In this case, the yield to the home country on the additional saving is only the net-of-tax return received by the investor and not the pretax marginal product of capital. If the additional saving is invested abroad, the foreign governments collect the additional tax revenue. If the additional saving reduces capital imports into the home country, the tax revenue of the domestic government remains unchanged and national income rises only by the after-tax return to

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[1] This argument is discussed in Feldstein (1977*a*); Feldstein and Summers (1977) estimate that the domestic marginal product of corporate capital is between 10% and 12%.

investors. Since after-tax real yields are only about 50 % of the pretax yield, the optimal savings policy is likely to depend critically on whether the 'closed economy' or the 'perfect world capital market' is a better approximation to reality.[1] For the United States, a pre-tax yield of 10–12 % may be a convincing reason for more saving while a post-tax yield of 5–6 % may be much less compelling.

The extent of capital mobility is also crucial for the analysis of tax incidence. In the modern literature on public finance, the theoretical and empirical studies of tax incidence have assumed a closed economy.[2] It is easy to see, however, that the results obtained in such an analysis would be radically altered by replacing this assumption with a model of perfect capital mobility. For example, in the familiar model of a closed economy with a fixed capital stock, a tax on the income of all capital used in production is borne completely by the owners of capital. But if capital is free to leave the country, a very large part of the burden could be shifted to domestic labour and to foreign capital owners.[3] Similarly, a corporate income tax would tend to be borne less by capital and more by domestic labour to the extent that capital is freely mobile across national boundaries. Moreover, labour's ability to shift a tax on labour income to domestic owners of capital by a reduction in labour supply would be less if capital were free to escape abroad. Statistical evidence in favour of the complete world capital mobility assumption would thus require a major revision of our theories of tax incidence.

The view that capital flows among countries to equate net-of-tax rates of return seems at first to be the most reasonable. It is clear from the yields on short-term securities in the Eurocurrency market and the forward prices of those currencies that liquid financial capital moves very rapidly to arbitrage such short-term international yield differentials.[4] Unfortunately, similar measures of expected real net-of-tax yields on long-term portfolio capital or direct investments cannot be observed.[5] It nevertheless may seem plausible that long-term capital movements would also equalise net-of-tax yields since the failure to do so would leave unexploited opportunities for profit. There are however reasons to be sceptical about the extent of such long-term arbitrage. First, the assumption that investment will flow to the highest yielding opportunity is only one extreme form of the portfolio theory of investment. More

[1] The issue is more complex if there are no capital flows but trade flows respond to changes in domestic factor proportions.

[2] This is true of both static and dynamic analyses. See, among others, Harberger (1962), Shoven and Whalley (1972), Feldstein (1974*a*) and Miezkowski (1969).

[3] See the discussion of this in McLure (1976) and Feldstein (in process).

[4] Even for short-term assets, this full arbitrage relation appears to be limited to Eurocurrency assets. Frenkel and Levich (1977) show that there are substantial departures from covered interest rate parity for national assets such as Treasury bills.

[5] Harberger (1977) has estimated rates of return on the total capital stock for a number of countries, including underdeveloped as well as industrial countries. There is only moderate variation among these estimated rates; the range among developed countries is between 4·4 % and 8·5 %. Unfortunately, these estimated returns include the return on the housing capital stock which is largely imputation rather than market evidence; since housing accounts for roughly half of fixed capital, the overall return will be quite sensitive to the return that local national income accountants impute on housing. Harberger provides no evidence on the relative importance of capital flows, trade flows and domestic savings responses in any movement toward an equalising of rates of return.

generally, since the risks of investing in different countries and currencies are not perfectly correlated, individual and corporate investors will tend to choose a portfolio in which expected yields are not equal. For most investors, the uncertainties and risks associated with foreign investment are perceived as so great that investment is restricted to the domestic economy. These risk aversion considerations become increasingly important for longer-term and less liquid investments, implying that short-term liquid asset arbitrage is consistent with much less mobile long-term capital.[1] If the aggregate portfolio demand functions are not very sensitive to yield differentials, major changes in national saving rates or in tax rates can occur without inducing substantial international capital flows.[2]

Second, even if all investors were well informed and eager to seek the highest yield without regard to risk, the full mobility of capital would be impeded by official restrictions on the export of capital. Moreover, the fear of future capital export controls by potential host countries or adverse changes in their taxation of foreign investment may deter investors from putting capital there.

Third, important institutional rigidities also tend to keep a large segment of domestic saving at home. The most obvious of these in the United States is the saving institutions that are required by law to be invested in mortgages on local real estate. American insurance companies and some other financial institutions have large liabilities that are denominated in dollars and therefore seek to limit their risk by investing in dollar assets. Pension funds and other fiduciaries that are legally governed by the 'prudent man' rule may be unwilling to invest abroad.[3]

Finally, there is indirect evidence in the pattern of investment flows that capital does not move to maximise each investor's net-of-tax return. Because of international differences in tax rules and the interaction of foreign and domestic taxation, net return maximisation implies a very different pattern of investment flows from what it would imply if there were no taxes. Without taxes, the gross returns would be equal in all countries and each individual investor would be indifferent about where he placed his funds. But with existing tax rules, investors should specialise their investment in a particular country that is often different from the investor's home country.[4] The absence

[1] Even if long-term capital is not internationally mobile, the yields on long-term assets could be equalised indirectly if short-term assets are arbitraged internationally and assets of all maturities are arbitraged domestically. But even within domestic markets, such arbitraging is far from perfect because of portfolio considerations. An inflow of short-term capital is thus likely to widen the differential between short and long domestic interest rates and to limit itself by depressing the forward discount on the domestic currency.

[2] Eliminating international yield differentials would not, of course, require all investors to be willing to invest wherever the expected yield is highest. Yields could be arbitraged if sufficient capital were invested on a yield maximising basis. But the existence of some risk neutral investors is obviously not sufficient for arbitrage; they could specialise their investment while yield differentials persist.

[3] If these restrictions prevented households from taking advantage of very much higher yields abroad, thrift institutions and other restricted intermediaries would lose deposits in favour of higher yielding alternatives. Moreover, these restricted funds are irrelevant if there are enough mobile funds 'at the margin'; see preceding footnote.

[4] For example, a U.S. individual who wishes to invest in bonds and believes that purchasing power parity will prevail in the long-run and that Germany will have a lower rate of inflation should invest in German bonds but not in U.S. bonds because the return that comes in the form of the appreciation

of such specialisation is an indication that portfolio considerations or restrictions on capital movement prevent capital from flowing to maximise each investor's net return.

Much of the direct investment in foreign markets appears to be associated with implementing marketing strategies, exploiting production knowledge, or overcoming trade restrictions rather than with an undifferentiated pursuit of profit opportunities.[1] This is probably the major reason why individual countries are both importers and exporters of capital.[2] It implies that substantial flows of direct investment may exist even if they are not responsive to changes in domestic taxation or relative capital supplies.

In the end, the issue must be settled empirically. The current paper provides direct evidence on the relationship between domestic savings and international capital flows. The statistical estimates indicate that nearly all of incremental saving remains in the country of origin. These results are quite incompatible with the assumption of complete arbitrage in a perfect world capital market. Large flows of liquid capital may arbitrage short-term interest rates while direct investment flows may exploit profitable sales opportunities, but additions to the domestic supply of capital do not appear to move abroad in search of the maximum return. The next section of this paper discusses the method of statistical measurement that we have used to analyse this question and describes the data. The basic results and a number of extensions are presented in sections III and IV. The fifth section disaggregates both saving and investment into household, corporate and government sectors. The effects of changes in saving rates are discussed in section VI. The implications of the results are considered in a brief concluding section.

II. SPECIFICATION AND DATA

This paper uses data on the major industrial countries to measure the extent to which a higher domestic saving rate in a country is associated with a higher rate of domestic investment. With perfect world capital mobility, there should be no relation between domestic saving and domestic investment: saving in each country responds to the worldwide opportunities for investment while investment in that country is financed by the worldwide pool of capital. Conversely, if incremental saving tends to be invested in the country of origin, differences among countries in investment rates should correspond closely to differences in saving rates.

There is in fact substantial variation in domestic saving rates among the OECD countries that are the focus of the study. For the period 1960–74 as a whole, the ratio of gross domestic saving to gross domestic product averaged

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of the dollar value of the principal of the bond will be taxed as capital gains rather than ordinary income; equal pre-tax yields imply different post-tax yields. If market forces make pre-tax yields unequal, some U.S. investors would maximise total net yield by specialising in German bonds while others would maximise total net yield by specialising in U.S. bonds.

[1] See Caves (1971) for a discussion of these reasons for foreign investment.

[2] Hartman (1978) provides striking evidence that the United States both exports capital to and receives comparable amounts of investment from a number of major countries.

0·250 for the 21 OECD countries for which data are available.[1] This saving rate varied from a high of 0·372 in Japan to a low of 0·184 in the United Kingdom. The standard deviation was 0·045.

The pattern of high and low savings rate countries has remained quite stable over this period. To measure this stability, we divided the sample into three five-year periods and calculated the correlation of saving rates between pairs of sample periods. Between 1960–4 and 1965–9, the saving rate correlation is 0·974. For 1965–9 and 1970–4, the correlation is 0·931. Finally between 1960–4 and 1970–4, the correlation is 0·895.

The corresponding ratios of gross domestic investment to gross domestic product also show substantial variation among countries and a stable pattern over time. Among the 21 OECD countries the 15-year average gross investment ratio had a mean of 0·254 and a standard deviation of 0·041. The correlations among the investment ratios in the three 5-year periods are: 0·937 between 1960–4 and 1965–9, 0·884 between 1965–9 and 1970–4, and 0·864 between 1960–4 and 1970–4.

The mean savings and investment ratios from the full 15-year period are presented in the first two columns of Table 1.

To assess the relation between savings rates and investment rates we estimated equations of the form:

$$\left(\frac{I}{Y}\right)_i = \alpha + \beta\left(\frac{S}{Y}\right)_i, \tag{1}$$

where $(I/Y)_i$ is the ratio of gross domestic investment to gross domestic product in country i and $(S/Y)_i$ is the corresponding ratio of gross domestic saving to gross domestic product. Results are presented in the next section using average ratios for the entire period as well as for subperiods. Other specifications with additional variables are also discussed. The problem of simultaneity is considered explicitly in section IV where estimates based on a model with an endogenous saving rate are presented. Before turning to these more general specifications, it is useful to discuss the interpretation of this basic equation.

With perfect world capital mobility, an increase in the saving rate in country i would cause an increase in investment in all countries; the distribution of the incremental capital among countries would vary positively with each country's initial capital stock and inversely with the elasticity of the country's marginal product of capital schedule. In the extreme case in which country i is infinitesimally small relative to the world economy, the value of β implied by perfect world capital mobility would be zero. But even for a relatively large country, the value of β would only be of the order of magnitude of its share of total world capital. The true value of β would thus vary among the OECD countries but would average less than 0·10.

[1] The four OECD countries for which data for the full 15-year period are not available are Iceland, Portugal, Turkey and Yugoslavia. The year 1974 was the most recent one for which data were available when this study began. The data used in the study are published in OECD (1976).

Table 1

Mean Gross Domestic Saving and Investment Ratios for O.E.C.D. Countries, 1960–74

Country	$\frac{S}{GDP}$	$\frac{I}{GDP}$	$\frac{\lvert S-I\rvert}{GDP}$	$\frac{\lvert S-I\rvert}{S}$
Australia	0·250	0·270	0·0201	0·0835
Austria	0·285	0·282	0·0025	0·0087
Belgium	0·235	0·224	0·0114	0·0450
Canada	0·219	0·231	0·0113	0·0540
Denmark	0·202	0·224	0·0213	0·0965
Finland	0·288	0·305	0·0159	0·0566
France	0·254	0·260	0·0069	0·0273
Germany	0·271	0·264	0·0067	0·0246
Greece	0·219	0·248	0·0293	0·1381
Ireland	0·190	0·218	0·0287	0·1385
Italy	0·235	0·224	0·0109	0·0429
Japan	0·372	0·368	0·0012	0·0036
Luxembourg	0·313	0·277	0·0356	0·1043
Netherlands	0·273	0·266	0·0118	0·0405
New Zealand	0·232	0·249	0·0246	0·1033
Norway	0·278	0·299	0·0209	0·0751
Spain	0·235	0·241	0·0058	0·0259
Sweden	0·241	0·242	0·0004	0·0016
Switzerland	0·297	0·297	0·0007	0·0055
U.K.	0·184	0·192	0·0085	0·0485
U.S.	0·186	0·186	0·0001	0·0010
Mean	0·250	0·254	0·0131	0·0536
S.D.	0·045	0·041	0·0103	0·0423

The saving ratios are defined as the ratios of gross domestic saving to gross domestic product; the investment ratios are also defined in terms of gross domestic investment and gross domestic product.

In contrast, estimates of β close to one would indicate that most of the incremental saving in each country has remained there. Note that a finding that β is close to one might reflect the fact that domestic saving and domestic investment are both stimulated by a high rate of return but that this interpretation is inconsistent with the hypothesis of perfect world capital mobility; with perfect capital mobility, the domestic saving rate does not depend on the domestic investment opportunities. Note also that the assumption of perfect capital mobility is inconsistent with the traditional Keynesian interpretation that exogenous changes in the level of investment cause income to vary until the resulting savings level equals investment; whatever the validity of this argument for a closed economy, it is inappropriate if domestic saving is added to the worldwide pool of capital. It is of course possible that a high observed value of β could reflect other common causes of the variation in both saving and investment. The findings of a high value of β would however be strong evidence against the hypothesis of perfect world capital mobility and would place on the defenders of that hypothesis the burden of identifying such common causal factors.

Although equation (1) measures the extent of world-wide capital mobility by analysing domestic saving and investment, the equation can also be interpreted in terms of foreign investment flows. Since the excess of gross domestic

investment over gross domestic saving is equal to the net inflow of foreign investment,[1] a regression of the ratio of net foreign investment inflow to GDP on the domestic savings ratio would have a coefficient of $\beta - 1$. Testing the hypothesis that β equals one is therefore equivalent to testing the hypothesis that the international capital flows do not depend on domestic savings rates.

It is important to stress that the identity of *national* saving and investment does not imply equality of *domestic* saving and investment. Because of international capital flows, domestic saving and investment can differ for very long periods of time. For example, during much of the nineteenth century, British domestic saving exceeded domestic investment while Britain invested abroad. The third column of Table 1 shows the average difference between domestic saving and domestic investment as a fraction of GDP in each country over the 15-year sample period. The average absolute value of these differences was 1·3 % of GDP and their standard deviation was 1·0 % of GDP. The fourth column of Table 1 presents the 15-year averages of the differences between saving and investment expressed as a percentage of saving. The absolute differences averaged 5·4 % of gross saving with a standard deviation of 4·2 %.

Our analysis focuses on gross saving and investment rather than savings and investment net of depreciation for two basic reasons. First, it is the gross flow of savings that is, in principle, free to move from country to country in response to yield differentials. Secondly, the accounting definitions of depreciation are very imperfect, especially when there is significant inflation; errors of measurement in the depreciation estimates would cause a spurious correlation between net saving and investment. Net investment is nevertheless of interest because it is equivalent to the growth of the capital stock. Although the results presented in the following sections generally deal with gross saving and investment, all of the coefficients have also been estimated for net flows as well. The parameter estimates are quite similar. The coefficients based on net flows are generally slightly higher, reflecting the common measurement error noted above.

From the basic sample of 21 OECD countries for which data are available for all years between 1960 and 1974, five have been deleted because they switched their method of national income accounting during the period.[2] When some of the regressions were estimated using the entire 21 country sample, the coefficients were very similar to the sample of 16 countries that had an unchanged accounting method. The analysis of the disaggregated components of saving and investment by sectors in section V requires a further reduction in the sample because of the limited data provided by some countries.

[1] Except for the official statistical discrepancy. It also follows from the national income identities that the net inflow of foreign investment is equal to the current account deficit.

[2] The countries that switched were France, Luxembourg, Norway, Spain and Switzerland.

III. BASIC RESULTS

The basic estimates of equation (1) are presented in Table 2. The estimate of β for the entire 15-year sample is 0·89 (S.E. = 0·07) when gross saving and investment are used and 0·94 (S.E. = 0·09) when net saving and investment are used. Neither coefficient is significantly different from one while both are obviously incompatible with the hypothesis that the true value of β is zero. The coefficients for each of the five-year subperiods are similar to the overall coefficient. In short, the evidence strongly contradicts the hypothesis of perfect world capital mobility and indicates that most of any incremental saving tends to remain in the country in which the saving is done. The substantial international capital flows that exist thus do not appear to respond to international differences in saving rates.

Table 2

The Relation between Domestic Saving Ratios and Domestic Investment Ratios

	Gross saving and investment			Net saving and investment		
Sample period	Constant	S/Y	R^2	Constant	S/Y	R^2
1960–74	0·035	0·887	0·91	0·017	0·938	0·87
	(0·018)	(0·074)		(0·014)	(0·091)	
1960–64	0·029	0·909	0·94	0·017	0·936	0·91
	(0·015)	(0·060)		(0·011)	(0·072)	
1965–69	0·039	0·872	0·83	0·022	0·908	0·75
	(0·025)	(0·101)		(0·020)	(0·133)	
1970–74	0·039	0·871	0·85	0·018	0·932	0·83
	(0·024)	(0·092)		(0·018)	(0·107)	

Parameter estimates refer to equation (1) in the text. All equations are based on observations for 16 countries, with the variables averaged for the sample period indicated. Standard errors are shown in parentheses.

The savings-rate coefficients based on the net flows are higher than the corresponding coefficients based on gross flows. As we indicated in the previous section, errors in measuring depreciation are likely to cause a spurious correlation that causes an upward bias in the net flow coefficients. A consistent estimate can nevertheless be obtained with instrumental variable estimation by using as an instrument a variable that is correlated with net saving but uncorrelated with the measurement error in depreciation. The obvious candidate for this variable is the gross saving rate since it involves no estimate of depreciation but is likely to be highly correlated with true net saving. The instrumental variable estimates of β are all lower than the ordinary least squares estimates of Table 2 but the difference is never as large as 0·1. For the overall 15-year period, the coefficient falls from 0·938 (S.E. = 0·091) to 0·867 (S.E. = 0·102). Thus using instrumental variable estimation does not alter the conclusion that domestic investment absorbs nearly all of the international differences in saving rates.

The linear approximation of equation (1) is clearly a simplification. It is of course possible that the link between domestic saving and domestic investment becomes weaker as the saving rate increases. To assess this, we estimated a quadratic generalisation of equation (1). The coefficient of the squared value of S/Y is always statistically insignificant and positive. For the entire 15-year period the coefficient of this variable is 0·432 with a standard error of 1·146. There is clearly no indication of nonlinearity.

As we noted above, the high coefficient in the relation between domestic investment and domestic saving may reflect the impact of some third variable. According to the life-cycle theory of saving, the most important exogenous determinant of the aggregate saving rate is the rate of population growth.[1] A higher rate of population growth might also increase the rate of investment. However, adding the mean annual growth rate of population as an additional variable in equation (1) had almost no effect on the estimated value of β; the coefficient of the growth variable was itself very small and statistically quite insignificant. There may of course be other variables that independently influence both saving and investment; although we do not pursue this question here, further analysis would clearly be desirable.

We have also examined the possibility that the link between domestic investment and domestic saving varies with the degree of openness of the economy. It seems plausible that small economies that engage in substantial international trade will have a much weaker link between domestic saving and domestic investment than large and nearly autarchic economies. We therefore estimated an extension of equation (1) in which the value of β is permitted to vary with a measure of the openness of the economy:

$$\left(\frac{I}{Y}\right)_i = \alpha + (\beta_0 + \beta_1 X_i)\left(\frac{S}{Y}\right)_i, \tag{2}$$

where X_i represents a measure of the openness or closedness of the economy. Our first measure of openness is the share of trade in GDP as measured by the sum of exports and imports per dollar of GDP. The estimates of β_1 are negative as expected but very small and not significantly different from zero. For the 15-year period as a whole, $\beta_1 = -0{\cdot}033$ with a standard error of 0·071. The results for the individual subperiods are similar. As an alternative measure we used the size of the economy based on the reasoning that a large economy is more likely to be self-contained and therefore to invest a higher share of its savings domestically. We used the logarithm of GDP to measure size so that the variance of the variable would not be dominated by the few largest observations. With X_i defined in this way, β_1 was expected to be positive. All of the estimates of β_1 were, however, negative; although they differed from zero in a statistically significant way, the coefficient estimates are very small. For the 15-year period, $\beta_0 = 0{\cdot}999$ with a standard error of 0·075. In short,

[1] The rate of total income growth should also have an important impact on saving and possibly investment but this cannot be regarded as exogenous in the current context. Adding this variable to the basic equation has relatively little effect on the coefficient of the saving rate (it falls from 0·887 to 0·785 with a standard error of 0·098) while the coefficient of the income growth variable itself is not significantly different from zero (0·42 with a standard error of 0·29).

while the link between domestic saving and investment may vary among countries, we found no evidence that it varied in relation to either the size of the economy or the importance of international trade.

As we noted in the previous section, a coefficient of $\beta = 1$ implies that a regression of the ratio of net foreign investment inflow to GDP on the domestic saving ratio would have coefficient of zero. This in turn implies that the difference between exports and imports is also not a function of the saving ratio. To analyse this further, we estimate a separate equation relating the export ratio (i.e. the ratio of exports to GDP) to the saving ratio and a similar equation for the import ratio. The parameter estimates for the 15-year period and for each of the subperiods indicate that sustained intercountry differences in saving rates do not affect either exports or imports. More specifically, with the gross saving rates the coefficients in the export and import equations were small negative values and always less than one-fourth of their standard error. With the net saving rates, the coefficients were positive but always less than 0·25 while the standard errors always exceeded 0·7.

This completes the description of our analysis of the aggregate cross-country estimates. They provide evidence that is clearly incompatible with the hypothesis of a perfectly mobile world capital stock that flows among countries to equalise yields. Although there may be perfect arbitrage of short-term yields and substantial flows of long-term direct and portfolio investment, there appear to be sufficient rigidities and locational preferences to keep most of any incremental saving invested in the country of origin.

IV. A SIMULTANEOUS EQUATION FRAMEWORK

Until now we have ignored the potential endogeneity of the saving ratio. This would clearly be inappropriate in a short-run Keynesian framework. A random shock to investment or any other component of demand would also affect the saving ratio; the estimate of β could not be interpreted as a measure of the effect on investment of exogenous changes in saving behaviour. However, we view the investment-saving function of equation (1) as a long-run relation in which intercountry differences in saving rates reflect basic structural differences among countries. In this context, the estimate of β can represent the effect on investment of sustained changes in saving rates.

This section presents a more explicit model of the structural features that are responsible for intercountry differences in saving rates. The exogenous variables that determine national saving rates are sufficient to provide econometric identification of equation (1). Despite the small size of the sample, we have re-estimated equation (1) within the framework of this model by two stage least squares. The parameter estimates are very similar to the ordinary least square values presented in Table 2.[1]

[1] A different form of endogeneity that may be important in less developed countries (LDC's) is discussed by Bhagwati (1978). Additional foreign capital (government aid or private capital) flowing into a less-developed country may induce planners to release more domestic resources for current consumption. This hypothesis implies a negative correlation between the domestic saving rate and the net capital inflow, i.e. a bias in favour of a low estimated value of β. Although this mechanism is

The model of intercountry differences in saving rates that is used here is an extension of the traditional life-cycle model (Feldstein, 1977*b*, 1979). Modigliani (1970) showed that the traditional life-cycle model implies that a country's saving rate will be higher where the rate of growth of private income is faster and where the working age population is large relative to the numbers of retirees and younger dependants. A weakness of this model is that it treats the retirement period as fixed when the fraction of men over age 65 who are working has been falling over time and varies among countries. The extended life-cycle model with endogenous retirement is developed explicitly in Feldstein (1974*b*, 1977*b*) and will not be repeated here. That model also introduces the ratio of social security benefits to pre-retirement income as a key determinant of both the country's saving ratio and the labour force participation rate of older men.[1]

More specifically, the equation describing intercountry differences in saving rates is

$$\left(\frac{SP}{Y}\right)_i = \gamma_0 + \gamma_1 G_i + \gamma_2 AGE_i + \gamma_3 DEP_i + \gamma_4 (B/E)_i + \gamma_5 LPAGED_i, \qquad (3)$$

where SP/Y is the private saving rate, G is the growth rate of total private income, AGE is the ratio of the number of retirees over the age of 65 to the population aged 20–65, DEP is the ratio of the number of younger dependants to the working age population, B/E is the benefit–earnings replacement ratio or the social-security programme, and $LPAGED$ is the labour force participation rate of older men. Earlier research (Feldstein, 1977*b*, 1979) established the specification of the equation describing the labour force participation rate:

$$LPAGED_i = \delta_0 + \delta_1 \left(\frac{B}{E}\right)_i + \delta_2 \left(\frac{100}{y_i^*}\right) + \delta_3 \left(\frac{y_i^*}{100}\right) + \delta_4 RET_i, \qquad (4)$$

where y^* is the average per capita income of the country measured in 1970 U.S. dollars and RET indicates the presence of a retirement test as a condition for receiving benefits. The overall domestic saving ratio is related to private saving according to

$$\left(\frac{S}{Y}\right)_i = \left(\frac{SP}{Y}\right)_i + \left(\frac{SG}{Y}\right)_i, \qquad (5)$$

where SG is government saving. Finally, there is the investment–saving relationship discussed and estimated in earlier sections and repeated here for convenience:

$$\left(\frac{I}{Y}\right)_i = \alpha + \beta \left(\frac{S}{Y}\right)_i. \qquad (6)$$

These four equations can be regarded either as a 'complete' model of inter-country differences in saving, investment and retirement or as a component of a larger model that also determines the level of income (y^*) and

probably not applicable to the developed countries in our sample, it is reassuring that the estimation bias is against our conclusion.

[1] This model is estimated for different data sets in Feldstein (1977*a*, 1979).

its rate of growth (G). For the present analysis, it is sufficient to note that the parameters of equation (6) are identified by the exclusion of the social security variable (B/E) and the demographic variables (AGE and DEP).[1]

We have estimated equation (6) by two stage least squares for the 12 countries for which data on the social security B/E variable are available.[2] The estimates use the gross saving rate and the full sample period. For these 12 countries, the ordinary least-squares estimate of β is 0·920 (with a standard error of 0·083).[3] When G, AGE, DEP and RET are regarded as the excluded exogenous variables, the two stage least squares estimate of β is 0·874 with a standard error of 0·118. If G is omitted from the set of exogenous variables, the estimate of β is 0·795 with a standard error of 0·142. In short, the two stage least squares estimates are quite similar to the OLS estimates, are inconsistent with perfect capital mobility but not inconsistent with a value of at or near one.

V. COMPONENTS OF SAVING AND INVESTMENT

For nine of the countries the OECD disaggregates total saving into three components: household saving, corporate saving and government saving.[4] This disaggregation is important because it makes it possible to see whether domestic investment is equally responsive to all types of saving. To the extent that this is so, it is less likely that the high value of β represents some unobserved factor that increases both saving and investment. The sensitivity of total investment to the different types of saving is also relevant for assessing policies that are designed to increase investment by stimulating forms of saving. The data for these countries also permit separating public and private investment and, within private investment, distinguishing household and corporate investment.

In place of equation (1) we have therefore estimated

$$\left(\frac{I}{Y}\right)_i = \alpha + \beta_H \left(\frac{SH}{Y}\right)_i + \beta_C \left(\frac{SC}{Y}\right)_i + \beta_G \left(\frac{SG}{Y}\right)_i, \tag{7}$$

where SH is household saving, SC is corporate saving[5] and SG is government saving. This equation is also estimated with total investment replaced by private investment or corporate investment.

The results are presented in Table 3; the corresponding estimates based on aggregate saving for these countries are presented for comparison. The general picture that emerges from these estimates is that there is not a major difference among the three types of saving in their contribution to total

[1] If the government saving rate is regarded as exogenous, the structure of the model provides further identifying restrictions.

[2] The data for the variables in equations (3) and (4) are described in Feldstein (1979). These data are generally averages for the years 1969 through 1975.

[3] For the full sample of 16 countries, Table 2 shows that this coefficient is 0·887 with a standard error of 0·074.

[4] The countries in this sample are Australia, Belgium, Canada, Finland, Germany, Japan, Netherlands, Sweden and the United Kingdom.

[5] 'Household saving' includes saving by households and private non-profit institutions serving households; corporate saving includes saving by corporate and quasi-corporate enterprises (including public).

investment or total private investment. However, at the more disaggregate level of corporate investment, there may be intranational barriers or portfolio preferences that make corporate investment more responsive to corporate saving than to other sources of funds.

Table 3

Relations between the Components of Saving and Investment

	Disaggregated saving					Aggregate saving		
Investment	Constant	$\frac{SH}{Y}$	$\frac{SC}{Y}$	$\frac{SG}{Y}$	$\bar{R}^2$	Constant	$\frac{S}{Y}$	$\bar{R}^2$
Total, gross	0·031 (0·015)	1·172 (0·121)	0·548 (0·153)	1·120 (0·112)	0·975	0·015 (0·020)	0·957 (0·078)	0·951
Total, net	0·004 (0·012)	0·826 (0·141)	1·195 (0·571)	1·103 (0·175)	0·926	0·011 (0·015)	0·952 (0·093)	0·929
Private, gross	−0·003 (0·016)	1·172 (0·127)	0·577 (0·161)	0·878 (0·118)	0·969	−0·016 (0·019)	0·907 (0·071)	0·954
Private, net	−0·013 (0·020)	0·739 (0·143)	1·041 (0·581)	0·869 (0·178)	0·900	−0·008 (0·014)	0·833 (0·084)	0·924
Corporate, gross	−0·049 (0·027)	0·231 (0·213)	1·849 (0·275)	0·071 (0·197)	0·911	−0·009 (0·053)	0·726 (0·200)	0·603
Corporate, net	0·006 (0·022)	0·662 (0·167)	1·019 (0·656)	0·232 (0·206)	0·773	0·010 (0·021)	0·574 (0·126)	0·710

All equations correspond to data for nine countries for the period 1961–74. Gross investment equations use gross saving measures; net investment equations use net saving measures. Standard errors are shown in parentheses.

Consider first the response of total gross investment. The coefficient of the aggregate rate is 0·957; the coefficients of household and government saving are slightly higher than this (1·17 and 1·12) while the coefficient of corporate saving is substantially lower (0·55). However, with the small sample of only nine countries, these differences are not statistically significant. The *F*-statistic for the hypothesis that the three coefficients are equal is only 4·5 and therefore less than the 5 % critical value of 5·8. The coefficients for total net investment are even closer to each other and clearly do not differ in a statistically significant way. The results for private saving are quite similar to the results for total saving: although there is some variation among the coefficients, the differences are not statistically significant.

Gross corporate investment appears to be most sensitive to gross corporate saving and substantially less sensitive to household and government saving. With the net concepts of investment and saving, the pattern is the same but the differences among the coefficients are smaller and not statistically significant. The apparently greater sensitivity of corporate investment to corporate saving may reflect institutional rigidities or portfolio preferences within national economies. Alternatively, the large coefficient may indicate that corporations choose to save more in countries where corporate investment is greater. In either case, the evidence is inconsistent with the hypothesis of perfect world capital mobility.

VI. THE RESPONSE TO CHANGES IN SAVING RATES

The evidence based on the cross-section of countries reflects the long-term adjustment of domestic investment rates to the relatively stable differences in savings rates among countries. Domestic investment may be much less responsive to short-run variations in saving and a larger share of such temporary changes in saving may be reflected in international capital flows. Because of the national income identities, this is equivalent to stating that a larger share of the short-run fluctuations in the saving rate is reflected in changes in imports and exports that alter the current account balance of payments.

The response of investment to short-run changes in saving rates is more difficult (if not impossible) to estimate accurately because of the endogeneity problem discussed in section IV. In particular, estimates of β based on annual time series data are much more likely to be subject to the type of simultaneity bias than estimates based on intercountry differences in saving rates.[1]

It is, however, possible to study the response to more sustained changes in saving rates by comparing cross sections of data for different multi-year periods. If the changes in saving between these periods represent responses to basic structural forces (and not changes induced by cyclical fluctuations in demand), the resulting value of β will be a valid estimate of the response of investment to changes in saving.

This approach is pursued in equation (8) which relates changes in investment to changes in saving:

$$\left(\frac{I}{Y}\right)_{70,i} - \left(\frac{I}{Y}\right)_{60,i} = \underset{(0\cdot004)}{0\cdot002} + \underset{(0\cdot158)}{0\cdot724}\left[\left(\frac{S}{Y}\right)_{70,i} - \left(\frac{S}{Y}\right)_{60,i}\right]$$

$$R^2 = 0\cdot52, \tag{8}$$

where $(I/Y)_{70,i}$ is the average ratio of investment to income in country i during the period 1970 to 1974, $(I/Y)_{60,i}$ is the corresponding average for the period 1960 to 1969, and the savings ratios are defined in similar ways. Although the coefficient of 0·724 is somewhat lower than the estimated long-run value discussed in section III, the difference is not very substantial. This evidence implies that domestic investment rates adjust within a few years to changes in saving rates. More research on the transition between the short-run response and the long-run response would clearly add to our understanding of international capital mobility.

VII. CONCLUSION

This paper has compared two views of the relation between domestic saving and world capital mobility. With perfect world capital mobility there is little or no relation between the domestic investment in a country and the amount

[1] Annual time-series estimates of β for each of the 21 countries were presented in the earlier NBER Working Paper no. 310 version of this study. They averaged 0·64 but showed great variation among countries. We now believe that simultaneous equations bias makes these time-series estimates too unreliable to warrant serious attention.

of savings generated in that country. In contrast, if portfolio preferences and institutional rigidities impede the flow of long-term capital among countries, increases in domestic saving will be reflected primarily in additional domestic investment. The statistical evidence presented here on the relation between domestic investment and saving implies that the truth lies closer to the second view than to the first. International differences in domestic savings rates among major industrial countries have corresponded to almost equal differences in domestic investment rates.

It is important to emphasise that this conclusion is compatible with the obvious international mobility of short-term liquid capital. While a small part of the total world capital stock is held in liquid form and is available to eliminate short-term interest rate differentials, most capital is apparently not available for such arbitrage-type activity among long-term investments. Similarly, our finding of the very close link between domestic saving and investment does not conflict with the existence of substantial international flows of long-term portfolio and direct investments. Much of the direct investment is made in foreign countries to enhance trade positions or to take advantage of special knowledge; such investment will not be sensitive to differences in savings rates or relative capital intensities. While some direct and portfolio investments are made in pursuit of higher yields *per se*, the extent of such investment is apparently limited by institutional barriers and portfolio preferences.

As the introductory section of this paper indicated, the evidence against world capital mobility and in favour of a close relation between domestic investment and saving is important in a number of ways. First and most directly, it sheds light on the true nature of the world capital market and the character of existing long-term capital movements. Second, it confirms that it is appropriate, at least as an approximation, to study income distribution in general and tax incidence in particular with models that ignore international capital mobility. Finally, the evidence implies that the national return on domestic saving is approximately equal to the pretax domestic marginal product of capital since such saving does increase the domestic capital stock rather than either flowing abroad or replacing foreign investment at home.

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