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Journal of International Economics 31 (1991) 55–78. North-Holland

Savings, investment and international capital flows

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Received June 1989, revised version received August 1990

The high correlation between national savings and domestic investment rates has been interpreted as evidence that capital is not internationally mobile. This paper surveys the theory and evidence on the relationship between savings and investment. In a sample of 23 OECD countries a positive correlation between savings and investment rates is found in both the short and long runs. However, a wide variety of models generate such co-movements in savings and investment in response to exogenous disturbances, even under conditions of complete financial markets. Thus, the savings–investment correlation provides little evidence on the question of international capital mobility.

1. Introduction

The correlation between savings and investment rates among the industrialized countries and its implications for international capital mobility have been widely debated in the literature. The purpose of this paper is to clarify the empirical relationship between national savings and domestic investment and to assess the implications of this relationship for capital mobility.

The paper provides a survey of the theoretical and empirical literature and presents some basic statistics on savings and investment rates in the OECD countries. A positive correlation between savings and investment rates across countries is found in a sample of 23 OECD countries in both the short and long runs. The correlation is not an artifact of a particular sample of countries or of a particular time period, but is a pervasive characteristic of savings and investment behavior of the OECD countries.

The implications of this correlation for capital mobility, however, are unclear. A wide variety of models produce co-movements in savings and investment in response to exogenous disturbances. Restrictions on labor

*This paper was commissioned by the Brookings Institution under a grant from the Ford Foundation for the study of macroeconomic interactions and policy design for interdependent economies. Financial support from the Rochester Workshop on International Markets funded by a grant from the Alfred P. Sloan Foundation is also gratefully acknowledged. The author thanks Ralph Bryant, Mary Finn, Kenneth Rogoff, and especially Alan Stockman for their helpful comments and advice.

mobility or on trade in goods markets are sufficient to produce the correlation even in the presence of international financial markets. In models with fewer restrictions on factor or goods markets, the positive savings–investment correlation is still a plausible outcome of technology shocks that are positively correlated over time and across countries. The correlation between savings and investment is thus an important empirical regularity, but one that sheds little light on international capital mobility.

2. Evidence on the correlation between savings and investment

The positive correlation between savings and investment rates was first documented in a study by Feldstein and Horioka (1980). Their interpretation of the correlation as proof that financial markets are not well integrated prompted a widespread debate over the validity of their econometric evidence. Subsequent research has verified that the savings–investment correlation is a pervasive phenomenon in the OECD countries that cannot be dismissed as an artifact of a particular choice of countries or sample period.

2.1. The Feldstein–Horioka results

In their 1980 study, Feldstein and Horioka assert that with perfect capital mobility, 'there should be no relation between domestic savings 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' (p. 317).[1] To test for the relationship between savings and investment, the authors run the following regression on a cross-section of 16 industrialized countries:[2]

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

where I = gross domestic investment, S = gross national savings, GDP = gross domestic product, and i is the country index. The ratios of savings and investment to GDP are averaged over the period of 14 years (1960–74). The sample period is also split into the intervals 1960–64, 1965–69 and 1970–74 and the regression is repeated for each of the subsamples. In each of the tests

[1]The appropriate variables are national savings and domestic investment.

[2]The sample studied by Feldstein and Horioka includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Sweden, the United Kingdom and the United States. France, Luxembourg, Norway, Spain and Switzerland were dropped from the samples as the authors assert that these countries significantly changed their methods of national income accounting during the period of study.

the coefficient on savings is found to be in the range 0.85—0.95, insignificantly different from unity. They conclude that 85–95% of national savings is invested in the country of origin and reject the hypothesis of perfect capital mobility.

Feldstein and Horioka examine the possibility that the correlation between savings and investment varies with the degree of openness of the economy, measured as the share of trade in GDP, or with the size of the economy, using the logarithm of GDP as a proxy for size. They conclude that while the relationship between savings and investment may vary among countries, they find 'no evidence that [the relationship] varied in relation to either the size of the economy or the importance of international trade' (p. 323). In order to check the sensitivity of the findings to possible simultaneous equation bias, the authors construct an instrument variable for savings. The instrument is defined as a function of the growth of private income, the number of retirees and dependents as a share of the total population, the benefit–earnings ratio of the social security program, and the labor force participation rate. Incorporation of this estimate of national savings does not significantly change the results. Overall, Feldstein and Horioka find little support for the hypothesis that savings and investment rates are independent. Even more surprising, Feldstein (1983) finds no evidence that the correlation between savings and investment has weakened over time.

The difference between savings and investment, interpreted by Feldstein and Horioka as an indicator of capital mobility, is the current account in the balance of payments. Sachs (1981, 1983) examines fluctuations in the current account balances of LDC and OECD economies since 1960. Sachs approaches the savings–investment relationship from a different perspective: he regresses the balance on the current account on national savings and domestic investment and finds that investment is more closely correlated with changes in the current account than is savings. He concludes that 'variations in investment demand have dominated the medium-run behavior of current accounts and exchange rates in the 1970s' [Sachs (1981, p. 203)]. Although the *causal* links between savings, investment and the balance on the current account are ambiguous, the regressions do establish that there is a significant negative correlation between investment and the balance on current account.[3]

The apparently conflicting implications of the Feldstein–Horioka study

[3]Sachs' conclusion that I/GDP is a better explanatory variable for movements in the current account is based on regressions of $\Delta(CA/\text{GNP})$ on $\Delta(I/\text{GNP})$ and $\Delta(S/\text{GNP})$ in a sample of 15 OECD countries, Brazil, Colombia, Korea, Mexico and Thailand, where the change measures the differences over the intervals 1968–73 and 1974–79. The regression coefficient on the change in the investment rate is -0.61 with a t-statistic of 6.2, while the estimated coefficient on the change in the savings rate is -0.34 with a t-statistic of 1.0 [see Sachs (1981, table 14, p. 250)]. Similar results are reported in Sachs (1983, table 2) for a slightly different sample of countries and where the differences are calculated for slightly different time periods.

and the investment–current account linkage reported by Sachs encouraged a number of other researchers to try to pin down the relationships between national savings, domestic investment and the current account. Penati and Dooley (1984) replicate the Feldstein–Horioka and Sachs regressions, using the same time periods but extending the sample of countries. They confirm the Feldstein–Horioka results but find the regressions reported by Sachs to be heavily dependent on one or two outlying observations and the coefficients to be sensitive to the choice of time period. Based on their own regression analyses in a cross-section of 19 industrialized countries, Penati and Dooley reaffirm that 'the data clearly lead one to reject the hypothesis that changes in net foreign assets have become more sensitive to yield differentials' (p. 9).

Rather than averaging the data over long periods, Caprio and Howard (1984) focus on the medium run, which they define as the period from one business cycle to the next. Observations of savings, investment and the balance on the current account for 23 OECD countries are averaged from trough to trough of the four business cycles in the 1961–81 period (1963–66, 1967–70, 1971–74 and 1975–81). To avoid the problem of endogenous right-hand-side variables, Caprio and Howard analyze the following equation:

$$\frac{\Delta(CA/Y)}{\Delta(S/Y)}=\mu+e, \tag{2}$$

where CA is the current account, S the level of national savings, Y the level of GDP, and e an error term with Δ denoting the difference from trough to trough of the cycle. The coefficient μ for the sample of all countries is estimated at 0.450 with a standard error of 0.115. Caprio and Howard conclude that 'only about half of any change in domestic savings was matched by changes in domestic investment in the medium run . . . [C]ontrary to the conclusions of Feldstein and Horioka and others, there is a large degree of net medium-term capital mobility in the world economy' (p. 15). The authors repeat the regressions using the ratio of changes in the current account as a share of GDP to changes in the investment rate. In contrast to Sachs' results, they report that 'fluctuations in savings were more systematically associated with current account developments than were variations in domestic interest rates' (p. 15). Caprio and Howard are careful to point out that their conclusions differ from the Feldstein and Horioka study due to the use of *changes* in savings and investment over time. When the regressions are repeated with levels of saving and investment, the coefficients are nearly identical to those in the original paper.

Using the Mundell–Fleming model, Turner (1986) estimates excess savings rates (savings less investment) as a function of income, the real interest rate

and the real exchange rate for the seven largest industrialized countries. The current account is then regressed on the 'fitted' excess savings equations for each of the countries. The estimated equations are relatively poor predictors of changes in the current account but it is unclear whether this is because of the lack of a causal link between excess savings and the current account, or because of a misspecification of the underlying model of savings and investment behavior.

2.2. *How robust is the savings–investment correlation?*

To clarify the discussion of the co-movements in savings and investment rates and the current account, this paper presents some basic statistics describing these aggregates and reproduces the savings–investment regressions for a sample of 24 OECD countries. The data used are the annual series in the *Main Aggregates* volume of the *National Accounts of OECD Countries* published by the OECD. Domestic investment and national savings are reported as net rather than gross figures as the inclusion of depreciation does not change the relative magnitudes of savings and investment as shares of GDP. Twelve of the OECD countries report nonzero values for the statistical discrepancy in their balance of payments,

$$S-I+STATDISC=BCA, \tag{3}$$

where BCA equals the balance on current account. In these cases the statistical discrepancy is split equally between net savings and investment so that the identity containing only the three aggregate variables, S, I and BCA, holds exactly across all countries.[4]

The figures in table 1 and fig. 1 confirm the results generally reported in the literature; countries with high savings rates tend to have high investment rates. Throughout the 1960–86 period Japan and Portugal occupied the high-saving–high-investment end of the spectrum. The United States and the United Kingdom tended to be relatively low savers and investors. The balance on current account is a smaller share of GDP than either national savings or domestic investment for all countries except Luxembourg. Contrasting the 1960–74 period with the 1975–86 period, the balance on current account is larger in absolute magnitude for 20 of the 24 countries in the

[4]The countries reporting nonzero values for the statistical discrepancy at the time of this study include Australia, Canada, Finland, France, Italy, Japan, New Zealand, Netherlands, Portugal, Sweden, United Kingdom, and the United States. The set of countries reporting a statistical discrepancy appears to change as the national income accounts are revised. For the countries listed above, the statistical discrepancy was a negligible fraction of GDP, ranging from about 0.001 to 0.04. The share of the discrepancy in the current account, however, was in some cases quite large. For example (taking the most extreme case), the statistical discrepancy reported by Portugal in 1970 was nearly twice as large as its current account.

Table 1

Savings, investment and the current account as a percentage of GDP.

Country	1960–86		
	S/GDP	*I*/GDP	*BCA*/GDP
Canada	10.3	11.5	−1.2
France	14.1	14.2	–
Germany	14.1	13.2	0.8
Italy	15.5	15.1	0.4
Japan	21.0	20.1	0.8
United Kingdom	8.5	8.6	−0.2
United States	7.6	7.7	–
Australia	8.9	11.4	−2.5
Austria	14.9	15.3	−0.4
Belgium	11.5	11.5	–
Denmark	12.2	15.0	−2.8
Finland	12.0	13.6	−1.6
Greece	15.3	18.3	−3.0
Iceland	10.8	13.8	−3.0
Ireland	10.5	15.4	−4.8
Luxembourg	30.0	12.3	17.7
Netherlands	15.7	14.4	1.3
New Zealand	13.7	16.8	−3.1
Norway	13.0	15.2	−2.2
Portugal	19.4	22.1	−2.7
Spain	12.5	13.0	−0.4
Sweden	11.1	11.7	−0.6
Switzerland	18.7	16.8	1.9
Turkey	11.4	13.6	−2.2

Country	1960–74			1975–86		
	S/GDP	*I*/GDP	*BCA*/GDP	*S*/GDP	*I*/GDP	*BCA*/GDP
Canada	10.8	11.9	−1.0	9.7	11.0	−1.3
France	17.2	17.2	–	10.3	10.4	−0.1
Germany	17.4	16.6	0.9	9.9	9.1	0.8
Italy	17.9	17.0	1.0	12.5	12.7	−0.3
Japan	22.9	22.4	0.5	18.6	17.3	1.3
United Kingdom	10.2	10.6	−0.4	6.3	6.1	0.1
United States	9.4	8.9	0.5	5.4	6.1	−0.7
Australia	11.9	13.6	−1.6	5.0	8.7	−3.6
Austria	16.7	16.8	–	12.6	13.5	−0.9
Belgium	13.9	13.0	1.0	8.4	9.6	−1.2
Denmark	16.2	18.2	−2.0	7.2	10.9	−3.7
Finland	14.1	15.7	−1.6	9.4	11.0	−1.6
Greece	16.7	19.6	−2.9	13.4	16.6	−3.2
Iceland	12.3	15.2	−2.8	8.8	12.0	−3.3
Ireland	11.8	14.6	−2.8	8.9	16.3	−7.4
Luxembourg	21.3	12.9	8.5	40.9	11.7	29.2
Netherlands	18.4	17.6	0.8	12.3	10.5	1.9
New Zealand	14.8	16.3	−1.5	12.3	17.4	−5.1
Norway	13.8	16.0	−2.1	11.9	14.2	−2.3
Portugal	20.7	21.0	−0.3	17.7	23.4	−5.7
Spain	14.3	14.4	–	10.2	11.2	−0.9
Sweden	14.6	14.5	0.1	6.8	8.3	−1.5
Switzerland	19.7	19.7	–	17.5	13.3	4.2
Turkey	10.6	11.6	−1.1	12.5	16.1	−3.7

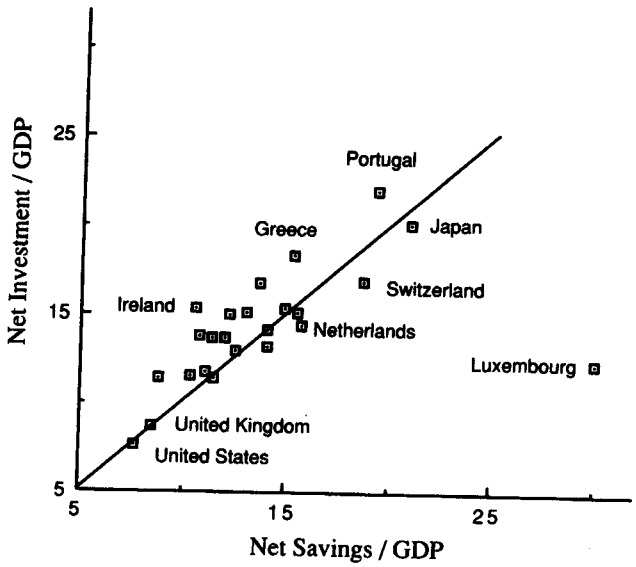


Fig. 1. S/GDP vs. I/GDP for 24 countries: Averages over the period 1960–86.

latter period, implying that the relationship between savings and investment may have weakened over time.

Fig. 1 graphs the share of net investment in GDP against the share of net savings in GDP. An observation on the 45° line indicates that the country's current account is balanced. An observation above the line reflects a deficit in the country's current account; that is, the country's domestic investment exceeds its supply of national savings and the country is a net borrower in the international capital market. Greece and Ireland are examples of countries that have typically had negative current account balances, while Luxembourg appears to have had an excess of national savings over domestic investment.

It is clear by visual inspection of fig. 1 that there is a positive correlation between savings and investment rates and that a regression line through these points would yield a regression coefficient somewhere close to unity when Luxembourg is removed from the sample. Replication of the savings–investment regression for the 16 countries included in the Feldstein–Horioka study, with the cross-section observations measured over the same interval used in their study (1960–74), yields a coefficient on S/GDP of 0.89 with a standard error of 0.10 (see table 2). The estimate of the constant is 2.22, larger than that reported by Feldstein and Horioka. The cross-country correlation between I/GDP and S/GDP appears to be much weaker for the sample of 24 countries over the period 1960–86. This turns out to be an

Table 2

Cross-section regressions of net investment/GDP on net savings/GDP (figures in parentheses are standard errors).

$I/\text{GDP} = \alpha + \beta(S/\text{GDP})$.

Period	Intercept α	Estimate of β	Adj R^2
24-country sample			
1960–86	9.40	0.35	0.23
	(1.81)	(0.12)	
1960–74	4.75	0.71	0.62
	(1.79)	(0.11)	
1975–86	9.96	0.20	0.09
	(1.54)	(0.11)	
16-country sample			
1960–86	3.1	0.84	0.73
	(1.71)	(0.13)	
1960–74[a]	2.22	0.89	0.85
	(1.48)	(0.10)	
1975–86	3.48	0.81	0.58
	(1.85)	(0.18)	
23-country sample (excludes Luxembourg)			
1960–86	3.27	0.84	0.74
	(1.42)	(0.10)	
1960–74	2.66	0.87	0.86
	(1.14)	(0.07)	
1975–86	3.23	0.85	0.59
	(1.70)	(0.15)	

[a]Identical to the sample of countries and time period of the Feldstein–Horioka study.

artifact of the inclusion of Luxembourg in the sample. When Luxembourg is dropped from the sample, the coefficient on S/GDP is once again insignificantly different from unity at the 0.05 level of significance, regardless of the time interval used to calculate the averages.

The cross-country correlation between savings and investment persists even as the period over which the averages are calculated is shortened. Table 3 shows regression results for 5-year and 3-year averages and for single years. The coefficient on savings is insignificantly different from unity at the 0.05 level of significance throughout the sample except for a period in the late 1960s to early 1970s and again in the mid-1980s.[5] These empirical findings suggest that the savings–investment correlation is a short-run as well as long-run phenomenon in cross-section samples and is not merely an artifact of averaging over long intervals.

[5]Feldstein and Bachetta (1989) also find that the regression coefficient on savings is somewhat lower in the 1980s. In breaking the time period of 1960–86 into decades, they find that the savings–investment correlation has fallen from 0.913 with a standard error of 0.081 in the 1960s to 0.864 (with a standard error of 0.122) in the 1970s, to 0.792 (with a standard error of 0.136) in the 1980s.

Table 3

Evidence from cross-section regressions of the short-run correlation between savings and investment (figures in parentheses are standard errors). Sample includes 23 OECD countries – Luxembourg excluded from the sample.

Period	Intercept α	Estimate of β	Adj R^2	Period	Intercept α	Estimate of β	Adj R^2
A. Five-year intervals				C. Point-in-time estimates			
1960–64	1.94	0.92	0.87	1960	3.96	0.78[a]	0.73
	(1.13)	(0.08)[a]			(1.47)	(0.10)	
1965–69	4.66	0.73	0.77	1962	1.75	0.92	0.82
	(1.30)	(0.09)			(1.37)	(0.09)	
1970–74	3.05	0.85	0.80	1964	2.25	0.92	0.82
	(1.50)	(0.09)			(1.44)	(0.09)	
1975–79	3.94	0.83	0.45	1966	4.49	0.76[a]	0.74
	(2.38)	(0.19)			(1.46)	(0.10)	
1980–86	3.58	0.79	0.60	1968	5.92	0.61[a]	0.59
	(1.45)	(0.13)			(1.63)	(0.11)	
B. Three-year intervals				1970	2.32	0.88	0.81
1960–62	2.32	0.89	0.83		(1.52)	(0.09)	
	(1.26)	(0.09)		1972	2.85	0.78[a]	0.85
1963–65	2.35	0.91	0.85		(1.21)	(0.07)	
	(1.23)	(0.08)		1974	7.81	0.68	0.33
1966–68	5.25	0.68[a]	0.69		(3.23)	(0.21)	
	(1.45)	(0.10)		1976	6.48	0.66	0.23
1969–71	3.21	0.81[a]	0.82		(3.05)	(0.24)	
	(1.33)	(0.08)		1978	1.94	0.91	0.60
1972–74	3.09	0.86	0.75		(1.97)	(0.16)	
	(1.74)	(0.10)		1980	4.11	0.85	0.67
1975–77	5.86	0.71	0.26		(1.58)	(0.13)	
	(3.01)	(0.24)		1982	3.50	0.88	0.47
1978–80	2.83	0.90	0.67		(1.94)	(0.19)	
	(1.67)	(0.13)		1984	4.66	0.61[a]	0.42
1981–83	3.22	0.87	0.50		(1.60)	(0.15)	
	(1.85)	(0.18)		1986	4.48	0.60[a]	0.58
1984–86	4.55	0.61[a]	0.55		(1.23)	(0.11)	
	(1.25)	(0.12)					

[a]Indicates that the coefficient is significantly different from unity at the 0.05 level of significance.

The correlation between S/GDP and I/GDP is apparent within national economies over time, as well as across the sample. Figs. 2–4 show the time series and scatter plots of net savings and investment and the balance on current account as shares of GDP for the United States, Germany and Japan. In all three countries there was considerable range in the levels of savings and investment over time but less variation in the difference between the two series. The observations in the scatter plots roughly trace out the 45° line, indicating relatively small changes in the balance on current account despite the large changes in savings and investment over time. Thus, the evidence suggests that savings and investment rates are closely linked not only in a cross-section of countries, but also over time within a particular country.[6]

3. Accounting for the correlation between savings and investment

The evidence clearly suggests that there is an important link between national savings and domestic investment. The implications of this relationship for international capital mobility, however, are not obvious. Several problems with this approach suggest that the high correlation between savings and investment is not inconsistent with integrated financial markets.

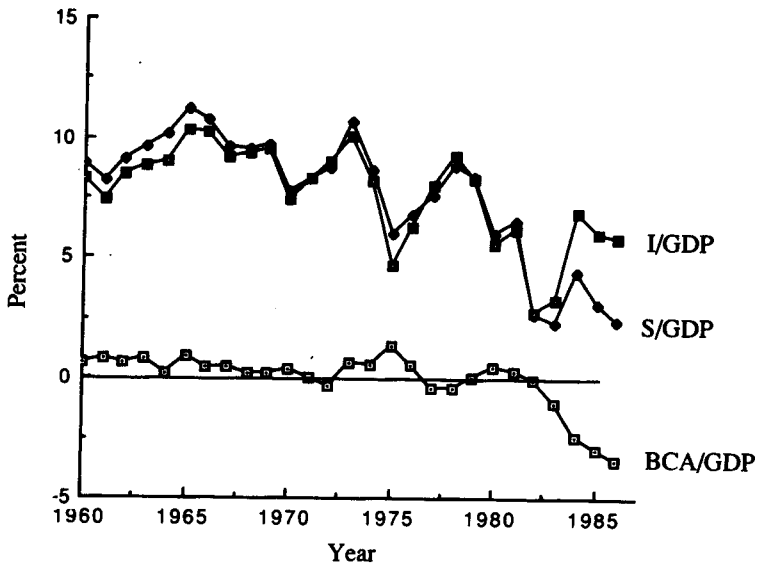
3.1. Sample bias

An important criticism of the Feldstein–Horioka study is that the inclusion of large industrialized countries in the sample may cause an upward bias in the estimated correlation between savings and investment. Harberger (1980) argues that if one compares the investment and savings to income ratios of the residents of a city block, the level of investment on a given block will typically exceed the savings capacity of the block's residents. However, as the level of aggregation rises to the city, state and national levels, the divergence between 'local' investment and 'local' savings will decrease. Similarly, a regression of savings on investment for a large state would probably reveal that most savings remained within state borders – although this hardly proves that financial markets within the United States are not well integrated.[7] Thus, a country with a large share of world output is likely to have a relatively large share of the world's total savings and investment. Small

[6]The strong linkage between savings and investment rates within countries over time is not a characteristic of all OECD countries. Norway, for example, ran a persistent current account deficit during its investment boom in the 1970s.

[7]Some evidence on this point is provided in Atkeson (1989). He examines the regional behavior of consumption and output in the United States and concludes that in the short run of 3 to 7 years, there is a significant divergence between the growth rates of consumption and output reflecting intertemporal trade across regions. The growth rates of output and consumption do tend to converge in the long run.

(a)



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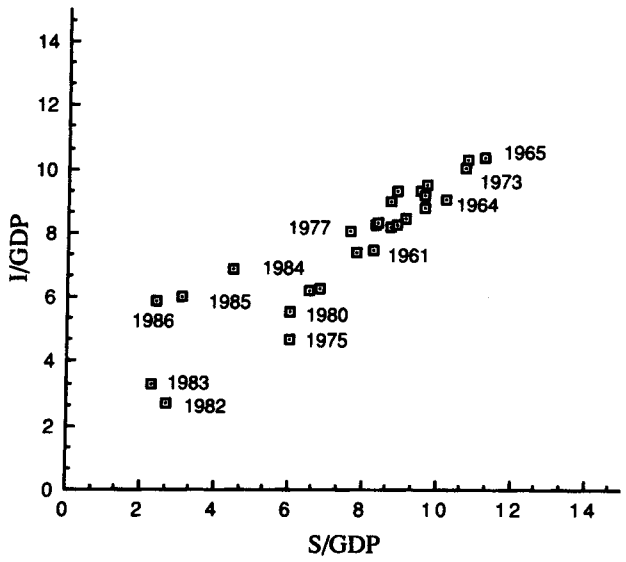
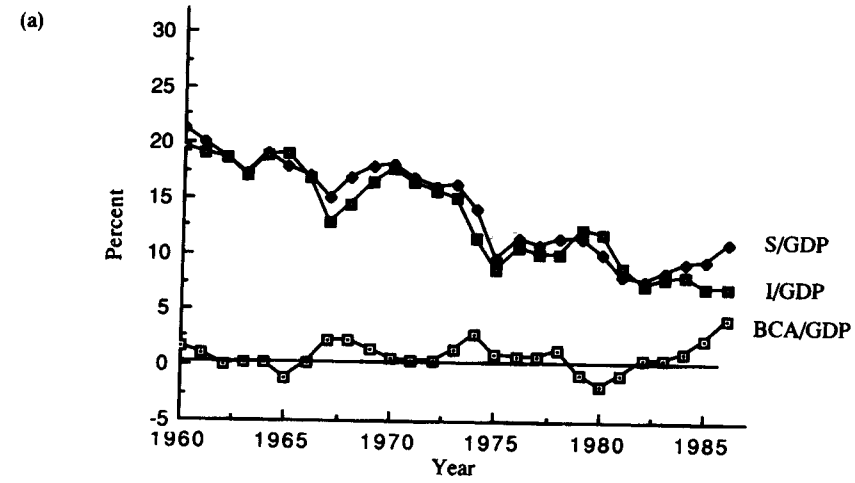


Fig. 2. (a) United States, 1960–86; (b) *S*/GDP vs. *I*/GDP, United States, 1960–86.



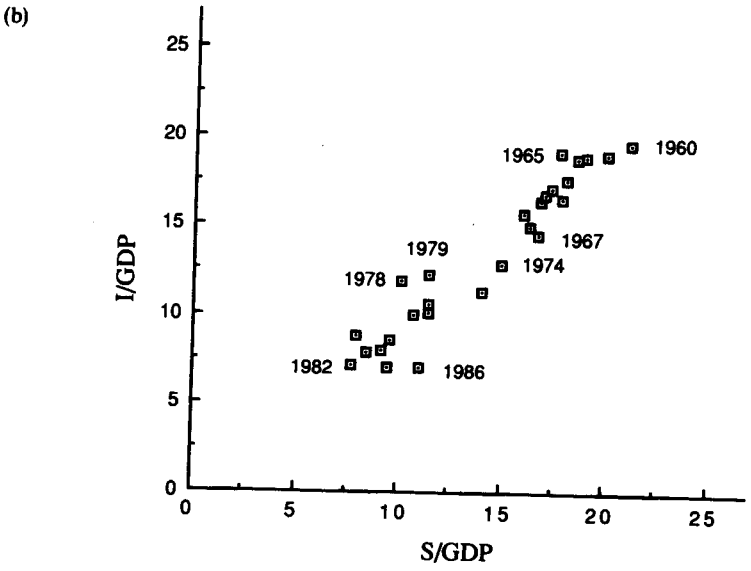
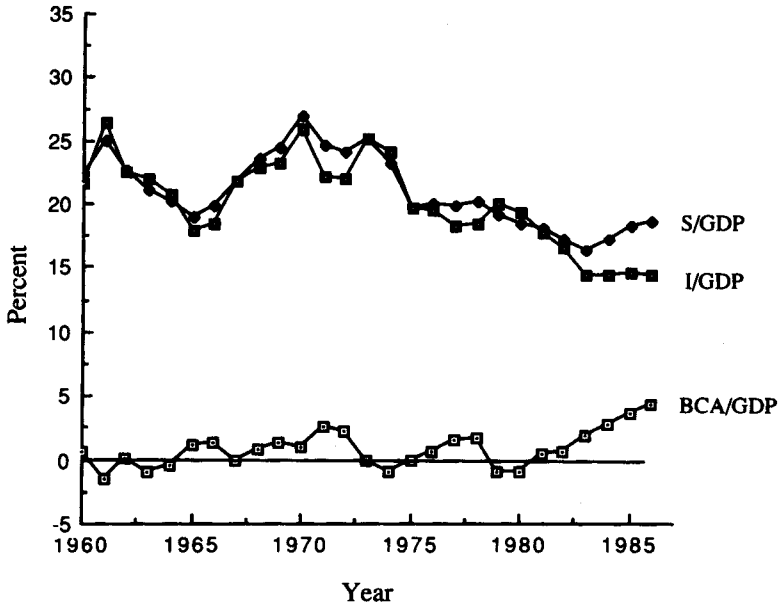


Fig. 3. (a) West Germany, 1960–86; (b) *S*/GDP vs. *I*/GDP, West Germany, 1960–86.

(a)



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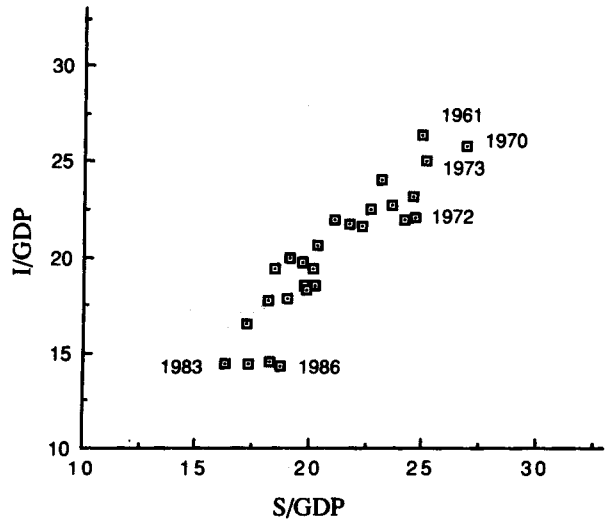

Fig. 4. (a) Japan, 1960–86; (b) *S*/GDP vs. *I*/GDP, Japan, 1960–86.

countries take the world interest rate as given, while changes in the investment and savings behavior of large countries will have an impact on the world interest rate. Feldstein and Horioka admit that even with perfect capital mobility, the correlation coefficient between S/GDP and I/GDP will not approach zero, although they dismiss this bias as negligible.

Harberger conjectures that small and poor countries will experience larger capital flows in and out of their borders than will larger industrialized countries. Sachs (1983) confirms that the absolute magnitude and the variability of the ratio of the current account to GNP is negatively related to size. Furthermore, the inclusion of small countries (in terms of GDP) in the sample tends to weaken the savings–investment correlation [Murphy (1984)]. When the sample is split, the correlation between savings and investment is significantly weaker for developing countries than for industrialized countries [Dooley, Frankel and Mathieson (1987)].[8] In the sample of 24 OECD countries studied in this paper, the standard deviation of the current account relative to GDP is lower (on average) for the largest seven countries, although there appears to be less variability in savings and investment rates for these countries as well (see table 4).

Correction for the bias owing to country size, however, still leaves a significant correlation between savings and investment [Fieleke (1982)]. As discussed above, repeated regressions using the full set of OECD countries averaged over different sample periods indicates that the savings–investment correlation persists and cannot be dismissed merely as an artifact of country-size bias. Within the set of OECD countries, small as well as large countries exhibit a significant correlation between savings and investment rates over time.

Gertler and Rogoff (1989) develop a model based on asymmetric information to help explain the relatively low correlations between savings and investment rates observed in poorer countries. In their framework countries may borrow funds in international capital markets to finance investment in local projects, but, while both borrowers and lenders observe the outcome of the project, only the borrowing country observes the amount actually invested. Since an increase in the level of investment increases the probability that the project will yield a high pay-off (and, hence, a higher debt obligation), countries that rely on international loans to finance local investment have an incentive *not* to use the full amount of the loans for domestic investment. Wealthier countries, with a larger pool of national

[8]Several authors have suggested that the rate of growth in GDP is a possible spurious variable in the savings–investment correlation, arguing that countries with rising incomes are likely to exhibit both higher rates of saving and investment over time. Fry (1986) attributes the savings–investment correlation in a cross-section of Asian countries to differing rates of growth. However, Feldstein and Bachetta (1989) find that the addition of growth rates in output to the savings–investment equation does not significantly alter the regression coefficient on savings in the sample of OECD countries and they reject the hypothesis of growth as the missing variable.

Table 4

Variability of saving, investment and the current account as shares of GDP (standard deviations for the period 1960–86).

	S/GDP	*I*/GDP	*BCA*/GDP
Canada	2.00	2.31	1.12
France	4.05	3.91	0.61
Germany	4.14	4.35	1.27
Italy	3.21	2.91	1.84
Japan	2.84	3.47	1.45
United Kingdom	2.44	2.69	1.42
United States	2.65	2.02	1.17
(Group average)	(3.05)	(3.09)	(1.27)
Australia	4.03	3.03	1.97
Austria	2.57	2.64	1.21
Belgium	2.00	2.31	1.16
Denmark	5.02	4.31	1.36
Finland	2.85	3.66	1.80
Greece	5.14	4.25	1.82
Iceland	3.63	4.23	3.98
Ireland	2.91	3.33	4.12
Luxembourg	12.82	3.83	13.73
Netherlands	3.34	3.97	1.87
New Zealand	2.29	3.12	3.60
Norway	2.60	3.33	4.61
Portugal	5.36	4.00	5.40
Spain	2.91	3.45	2.02
Sweden	4.47	3.80	1.46
Switzerland	1.65	3.78	2.84
Turkey	2.57	3.15	1.99
(Group average)	(3.89)	(3.54)	(3.23)

savings and less need for external financing, will also invest more in domestic projects.

To establish a 'benchmark' for measuring capital mobility, Murphy estimates the relationship between savings and investment for the 143 largest corporations in the United States and finds that even within a highly integrated capital market, firms' savings and investment rates are highly correlated. There also appears to be a firm-size effect on savings and investment behavior: the coefficient on savings is significantly higher for large corporations than for small firms. This evidence is cited as additional support for the existence of bias due to country size, although the direct applicability of results based on firms' behavior to cross-country analysis is questionable. The correlation between savings and investment for firms implies that firms use unexpected profits to finance their own investment projects rather than distribute these profits as dividends to shareholders. For a variety of reasons studied in the theory of corporate finance [see the survey by Litzenberger and Ramaswami (1982)], it may be optimal for managers to

retain unexpected profits for investment instead of utilizing the capital market. These reasons would seem to be quite different from those factors determining savings and investment rates for the country as a whole.

3.2. Capital controls and government policy

Westphal (1983), Summers (1985) and others have suggested that the observed high correlation between savings and investment rates is evidence of a successful balance-of-payments policy on the part of national governments. They argue that governments impose constraints on cross-border capital flows whenever the deficit (or surplus) in the current account exceeds a predetermined level. Capital controls are undoubtedly an important policy instrument in balance-of-payments management, particularly under a system of fixed exchange rates. However, the strength of the correlation between savings and investment rates has not diminished despite widespread consensus that capital markets have become less restricted over time. The regression results shown in table 2 do not support the hypothesis that the savings–investment correlation is linked to the exchange rate regime, although more careful testing of this hypothesis is required to draw any firm conclusions.

Governments can also affect the current account by adjusting the savings and investment rates of the public sector. There is some cross-country evidence that changes in government savings are matched by offsetting changes in private savings and investment such that the balance on current account is relatively constant [Soderstrom (1985)]. One explanation is that government policy responds to shifts in private behavior to maintain a target level in the current account. An alternative interpretation incorporates the Ricardian view of private and government saving: forward-looking agents will internalize the government's budget constraint and adjust their own behavior to offset changes in government policy.

3.3. Restrictions on capital flows or goods markets?

Savings, investment and the balance on the current account are part of an identity linking the domestic economy to the rest of the world through the balance of payments. Ex post, it is necessarily true (abstracting from statistical discrepancies) that the difference between national savings and domestic investment must equal the balance on the current account:

$$\begin{aligned} CA &= Y-(C+I^{P}+G) \\ &= (S^{P}+S^{G})-(I^{P}+I^{G}) \\ &= X-M+\text{net income from abroad}, \end{aligned} \tag{4}$$

where Y equals disposable income plus taxes and the variables with superscripts P and G denote savings and investment of the private sector and government, respectively. These identities stem from the definitions used in national income accounting; they do *not* determine the behavioral relationship linking the national aggregates. On the surface, the correlation between savings and investment implies that the balance on the current account must be fairly stable over time. But the accounting aggregates in the identity reflect all the flows of goods, services and factors of production between the domestic economy and the rest of the world. The strong correlation between savings and investment could be the result of any of a number of forces at work in the national or international economy. Without an explicit model underlying the above identity, it is difficult to draw any conclusions from the regression analyses.

Frankel (1985) argues that markets are segmented due to imperfect integration of the goods market; that is, the goods market, not the capital market, is the binding constraint linking savings and investment rates. If some goods are nontraded, or 'immobile', some of the channels connecting national economies are closed off and the economy behaves more like a 'closed' economy. Cole and Obstfeld (1989) show that under certain conditions (namely, under Cobb–Douglas preferences and complete specialization in production), trade in goods in the absence of trade in financial markets can achieve the same degree of risk-pooling as if there had been exchange of financial assets. In this situation, trade in goods may be sufficient for complete risk-pooling: changes in the terms of trade are sufficient to balance trade in every period making trade in financial claims unnecessary for intertemporal smoothing.

As nontraded goods and immobile factors are introduced into these models, the level of domestic investment becomes increasingly limited by the supply of national savings. Engel and Kletzer (1987) demonstrate this point using a model with a labor-intensive nontraded consumption good. In this model an exogenous increase in the savings rate lowers consumption of the nontraded good. As more labor than capital is released into the economy, the marginal product of capital in the traded good industry rises and investment increases. Thus, a change in the savings rate leads to a roughly contemporaneous change in the investment rate. Murphy (1986) also explores the effects of intersectoral differences in capital–labor ratios and degrees of intertemporal substitution on savings and investment dynamics in a two-period model with nontraded goods.

Tesar (1990) incorporates a nontraded investment good into an infinite-horizon model with uncertainty. In this framework, the correlation between savings and investment depends critically on the elasticity of substitution in consumption between the traded and nontraded goods. A nice feature of the model is that both demand and supply shocks in the nontraded goods sector

lead to co-movements in savings and investment rates. Thus, the model can produce both the observed short- and long-run correlations.

3.4. Alternative hypotheses

Recently, attention in the literature has shifted from attempts to explain the savings–investment correlation as a result of imperfect markets to developing models that produce the correlation in response to exogenous disturbances. Obstfeld (1985) was the first to break ground in this direction. Using a small open-economy framework with an infinitely-lived representative agent, Obstfeld demonstrates that underlying shocks to productivity may generate co-movements in savings and investment. A positive, temporary shock causes the current wage to rise above the permanent wage, increasing the savings rate. If the shock is sufficiently persistent, investment will rise to take advantage of the higher (future) level of productivity. The model is limited by the high degree of consumption smoothing and intertemporal substitution implicit in the infinite-horizon set-up; the shock must be temporary enough to induce an increase in savings, and sufficiently persistent to stimulate an increase in investment.

Backus, Kehoe and Kydland (1989) extend the closed-economy real business cycle model to a two-country setting with exogenous productivity shocks to each country's production technology. In contrast to Obstfeld's model, agents are assumed to trade contingent claims to their labor income, thus breaking the link between wages and the level of national savings. As a result, the savings and investment correlation produced by the model is quite low: changes in savings rates are perfectly correlated across countries while the pattern of investment in the two locations is quite different, reflecting inter-country differentials in the productivity of capital. By adding adjustment costs to the capital accumulation process and by assuming that shocks are transmitted rapidly across national borders, Baxter and Crucini (1989) reduce the volume of international capital flows and thus bring the savings–investment correlation back into line with the correlations observed in the data.

The assumption of overlapping generations makes it possible to study the behavior of finite-lived agents in an analytically tractable framework. In this type of set-up, consumers are usually assumed to work in the first period of their lives and save out of their wages for consumption in the second period. Persson and Svensson (1985) derive the responses of savings and investment to a terms-of-trade shock in a small open-economy model with complete specialization in production. The current account adjusts cyclically to the price change; the change in the terms of trade alters the real rate of return to domestic capital, which leads to a change in the investment rate. The savings rate then responds, with a lag, to the change in the capital stock. The

Table 5
Ratios of savings and investment to GDP and working age population.

	Group averages		
	% of population aged 15–64	*S*/GDP	*I*/GDP
Feldstein–Horioka sample			
Group 1:			
Japan, Sweden, Finland, Italy, Germany	65.7	26.9	28.1
Group 2:			
Greece, Denmark, United Kingdom, Belgium, Austria, Australia	63.7	24.1	24.0
Group 3:			
Netherlands, United States, Canada New Zealand, Ireland	60.5	22.0	23.0
Non-OECD:			
Taiwan, Brazil, Hong Kong, India, Kenya, Singapore, Thailand	54.6	17.0	20.1

Source: World Tables, World Bank, 1984.

magnitude and direction of these swings in the current account depend critically on the degree to which the shock is anticipated and the assumption about the length of time required for investment. Tesar (1988) uses a similar model to study the effects of exogenous disturbances to productivity on savings and investment dynamics. In this framework, both temporary and permanent shocks will produce co-movements in savings and investment as long as some component of the shock is unanticipated. When the shock is fully anticipated, the increase in investment occurs prior to the change in productivity, while the changes in wages, output and savings coincide with the productivity disturbance. A key assumption of these models is that agents can participate in international markets for borrowing and lending, but workers cannot trade in contingent claims markets to insure against fluctuations in their labor incomes.

Obstfeld (1985) employs an overlapping generations model to emphasize the importance of population growth. An increase in the number of workers in the economy increases the level of aggregate savings and stimulates investment to maintain the steady-state capital–labor ratio. To test this hypothesis, table 5 shows the relationship between the share of the population between the ages of 15 and 64 (roughly the working age population) and the savings and investment rates for the OECD countries included in the Feldstein–Horioka sample and seven non-OECD countries. Countries with a higher percentage of the population of working age tend to have higher savings and investment rates. Explanations based on changes in population growth, however, are restricted to the very long-run co-movements between

Table 6
Correlations between savings rates across countries (standard errors).

	France	Germany	Italy	Japan	United Kingdom	United States
Canada	0.577 (0.002)	0.101 (0.616)	0.100 (0.620)	0.273 (0.168)	0.286 (0.148)	0.590 (0.001)
France		0.830 (–)	0.824 (–)	0.795 (–)	0.832 (–)	0.919 (–)
Germany			0.948 (–)	0.748 (–)	0.835 (–)	0.763 (–)
Italy				0.742 (–)	0.820 (–)	0.786 (–)
Japan					0.704 (–)	0.597 (–)
United Kingdom						0.784 (–)

savings and investment and do not shed much light on the observed short-run links between savings and investment.

Finn (1990) incorporates uncertainty in an overlapping generations model of a small open economy and produces time series and investment rates under different assumptions about the degree of autocorrelation in the shocks to technology and the correlation of the shocks across countries. Positively autocorrelated shocks generate patterns of savings and investment that replicate the high correlation between savings and investment observed in the data. The real business cycle literature [see, for example, Prescott (1986)] suggests that for the United States the underlying shocks to technology, or the Solow residuals, are in fact strongly positively auto-correlated. Ghosh (1988) estimates a benchmark series for the current account under the assumption of international capital mobility given the actual disturbances to output, investment and government spending. Ghosh is unable to reject the hypothesis that the historical current account series varied by at least as much as the estimated series.

Another possible explanation for the savings–investment correlation is that the disturbances to productivity are not only correlated over time, but are also positively correlated across countries. If these shocks were in fact aggregate disturbances, individual countries could not rely on international capital markets to smooth their levels of consumption, and savings and investment rates for individual countries as well as for the system as a whole would be positively correlated. Tables 6 and 7 show the correlations between the savings and investment rates of the largest OECD countries. The bar graphs in figs. 5 and 6 indicate the correlation between individual country savings and investment rates for the 17 smallest countries and an aggregate measure of total OECD savings and investment. The sample period is 1960–

Table 7

Correlations between investment rates across countries (standard errors).

	France	Germany	Italy	Japan	United Kingdom	United States
Canada	0.523	0.179	0.160	0.310	0.404	0.512
	(0.005)	(0.372)	(0.427)	(0.116)	(0.037)	(0.006)
France		0.820	0.686	0.830	0.872	0.745
		(–)	(–)	(–)	(–)	(–)
Germany			0.776	0.719	0.763	0.688
			(–)	(–)	(–)	(–)
Italy				0.837	0.539	0.439
				(–)	(–)	(0.022)
Japan					0.696	0.508
					(–)	(0.007)
United Kingdom						0.821
						(–)

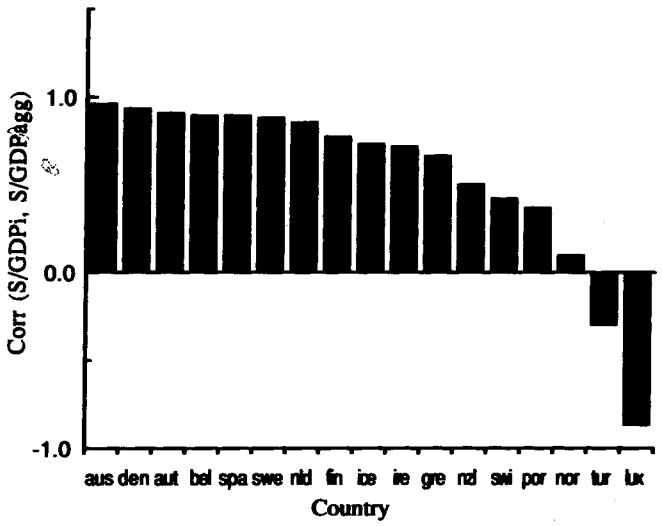

Fig. 5. Correlation with aggregate *S*/GDP.

86. It appears that there is a significant degree of correlation between countries' savings rates and between investment rates, which supports the hypothesis of positively correlated shocks across countries.[9]

[9]Costello (1990) examines the correlation between productivity growth rates (or the change in Solow residuals) in a cross-section of industrialized countries. Her results suggest that the observed correlations in output growth rates are more likely to be a result of trade flows and the transmission of disturbances across countries rather than due to common disturbances to productivity.

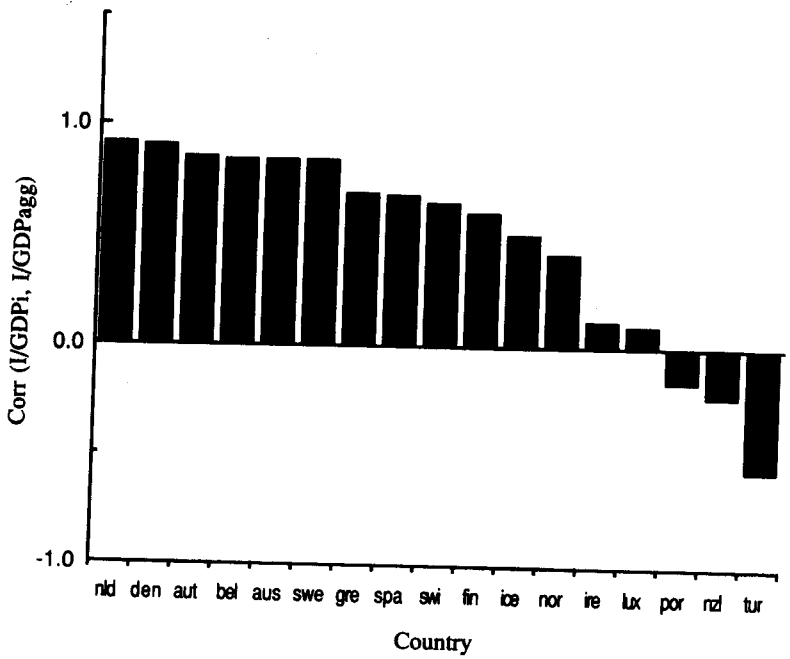

Fig. 6. Correlation with aggregate I/GDP.

4. Conclusion

The statistics presented in this paper suggest that the correlation between savings and investment is both a short-run and very long-run phenomenon and is not restricted to a particular sample of countries. While the correlation poses a challenge for theoretical models, it does not have clear-cut implications for international capital mobility. A variety of models are able to generate such co-movements in savings and investment, even in the presence of international financial markets. Permanent, exogenous shifts in the rate of technological progress or population growth with imperfect labor mobility can explain the long-run co-movements between savings and investment, although this cannot explain the short-run movements. On the other hand, models incorporating temporary demand and productivity shocks produce short-run co-movements but require that the shocks occur with sufficient frequency and persistence to produce long-run correlations within countries over time as well as across countries. Thus, the correlation between national savings and domestic investment rates in the OECD countries remains an important empirical regularity to be explained, although it offers little evidence on the question of international capital mobility.

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