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The Feldstein–Horioka Puzzle and Capital Mobility: A Review

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This paper reviews how economists responded to the Feldstein–Horioka (FH) view that a high saving-investment association across OECD countries implied low capital mobility. This posed an uncomfortable puzzle since the conventional wisdom in most exchange rate and open-economy macroeconomic models was that capital mobility was high. In the face of a variety of replications, the FH result of a high cross-section association between saving and investment rates in OECD countries has remained remarkably robust. The debate over whether saving-investment comovements are informative about capital mobility is still unresolved although the sceptics appear to be in the ascendancy. © 1998 John Wiley & Sons, Ltd.

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SUMMARY

This paper reviews the extensive literature on how economists responded to the Feldstein and Horioka (1980) (FH) claim that capital was relatively immobile. They based this claim on the results of cross section regressions of investment on saving (both expressed as shares of GDP) across 16 OECD countries for the 1960–74 period. FH reasoned that saving and investment would be perfectly correlated in a closed economy but should be unrelated in an open economy since saving could seek out the highest global returns. The FH view of low capital mobility posed an uncomfortable puzzle since the conventional wisdom embodied in most exchange rate and open-economy macroeconomic models since the 1970s was that capital mobility was high. The issue of capital mobility is significant for diverse policy issues such as the single currency debate within the EU or for questions of taxes on capital and saving.

In this paper we have organized our review of contributions to the FH puzzle in relation to the generic comments suggested by Stigler (1977). The majority of the models and explanations reviewed oppose the FH view of low capital mobility by attempting to construct models which reconcile a high saving-investment association with high physical and financial capital mobility and/or by providing plausible econometric and other data-based refutations of the FH view. These include general equilibrium, real business cycle models and, notably, intertemporal models of the current account.

Against a background of ongoing debate we draw some interim conclusions. Firstly, the FH

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result of a high saving-investment association has remained remarkably robust in OECD cross-sections although the coefficient on saving has shown some tendency to decline over recent years. The result persists in panels and average time-series and has been remarkably robust to the addition of other variables and different estimation methods in the OECD. However, there is less evidence for a close relationship between saving and investment in non-OECD samples, particularly in LDCs. Secondly, using the FH regression for policy purposes is questionable because both saving and investment are endogenous and the FH regression cannot distinguish exogenous shifts in saving from endogenous shifts reflecting factors which may also impact on investment.

Thirdly, the FH result may not be informative about capital mobility since a range of theoretical models can generate high saving-investment correlations even under perfect capital mobility. This now seems to be the emerging consensus in the literature. Nonetheless the FH puzzle is by no means resolved and recent contributions by Bayoumi *et al*. (1996) and Sarno and Taylor (1996) establish high capital mobility within FH-related frameworks. Finally, the debate surrounding the FH puzzle has shown that the notion of capital mobility itself is not analytically straightforward. Obstacles to the movement of financial, physical and human capital may have quite different implications. Assuming perfect capital mobility may produce plausible conclusions in one set of models and not in another.

INTRODUCTION

Economists often use the term puzzle to refer to awkward empirical facts that refuse to comply with their established theoretical frameworks. The equity premium puzzle of Mehra and Prescott (1985) is a well known example. In this survey we review the responses to the puzzle posed by Feldstein and Horioka (1980). FH argued that, under perfect capital mobility, there is no necessary association between national saving and investment since saving can globally seek out the highest returns. The implication is that an exogenous increase in investment in any country can be financed by a perfectly elastic supply of global funds. By contrast, zero capital mobility implies a one-to-one relationship between saving and investment, since saving has to be invested domestically. In this case we have a world of segmented capital markets in which each country's interest rate is determined domestically and domestic monetary and fiscal policies are relatively effective.

In cross-section regressions for 16 OECD countries FH failed to reject the null hypothesis of a one-to-one association between saving and investment. They interpreted this as implying zero capital mobility. This conclusion was unpalatable both because most theoretical, open economy models had assumed perfect capital mobility and because it appeared that financial integration in the industrialized world was high and increasing, particularly since the introduction of floating exchange rates in the early 1970s. The question of capital mobility in contemporary economies is not an arcane issue since it is of critical import for policy issues such as saving and investment subsidies (Summers, 1988; Feldstein, 1994, 1995; Devereux, 1996; Peeters, 1996) or the EU single currency debate (Bayoumi *et al*., 1996).

The high saving-investment association is unusual among stylized facts insofar as it is based on an econometric result. Regression coefficients are rarely sufficiently robust to become established as stylized facts. However the attempts to show that the FH result was fragile did not succeed as underlined by the recent assessment of Baxter and Crucini (1993):

> ''In the field of international macroeconomics, temporally robust stylized facts are few and far between. One of the most stable regularities observed in the data is the fact that national saving rates are highly correlated with national investment rates, both in time-series analyses of individual countries and in cross sections in which each country is treated as a single data point. High saving-investment correlations arise in small economies as well as large economies…'' (*Ibid*. p. 416).

While the high saving-investment association is accepted, debate about its interpretation remains polarized around one major issue: is the high FH coefficient informative about capital mobility as FH argue? Although subsequent work has demonstrated that the FH result is consistent with perfect capital mobility in a variety of theoretical models,

a number of both theoretical and empirical contributions continues to offer support for the FH approach. The resolution of this issue is not helped by the fact that empirical econometric work is subject to a considerable degree of variability and is often interpreted within competing theoretical frameworks. For instance, within the FH framework the consensus is that capital mobility has increased since the 1980s but is higher in particular samples such as the EU. Such inferences are anathema to the many sceptics of the FH approach to capital mobility.

The FH controversy puzzle is illuminating about the various ways in which economists respond to uncomfortable results. The classic compendium of generic responses is given by Stigler (1977) who provided a numbered list of typical comments elicited by (conference) papers. It is striking how many of the responses to FH fall within his categories of criticism, and we have used his comments to organize the responses. We needed to make only one addition, comment 33, ''Have you tested for unit roots and cointegration?'' We introduce sections with his relevant comment(s). In so doing we do not intend to be postmodernist, ironic or relativistic[1], since a less relativistic economist than George Stigler is difficult to imagine. Rather we would emphasize that economists tend to use particular lines of attack to confront difficult problems and that Stigler identifies these lines with humour.

The literature on the FH puzzle is enormous and, in mid-1996, shows no sign of abating. The original FH article was quoted some 142 times in economics and related journals between 1988 and 1995.[2] This article differs from related reviews in that it is more narrowly focused on the FH debate than the reviews of Frankel (1992) or Obstfeld (1995). It is organized as follows. The first section outlines the FH framework in the context of competing approaches to capital mobility. The next section summarizes a variety of extensions, updatings, and tests of the FH result of a high saving-investment association. The section after addresses interpretational problems impinging on the validity of the FH approach. The final section gives our conclusions. Two caveats should be borne in mind. First, since the debate is ongoing, this review probably already is or quickly will become incomplete. Second, many of the responses have depended on subtle, technical points and in summarizing them we may not have accorded them full justice.

FH REGRESSIONS AND CAPITAL MOBILITY

S2. Unfortunately, there is an identification problem that is not dealt with adequately in the paper.

Background and Definitions

The origins[3] of the FH puzzle lie in the 1980 *Economic Journal* article in which they estimated cross section regressions of the form:

$$(I/Y)_i = \alpha + \beta(S/Y)_i + u_i \quad i = 1, 2, 3, \ldots N, \tag{1}$$

where, I is national investment (public and private) by country i, S is national saving and Y is national income. We call such relationships between national investment and saving shares of GDP (hereafter saving and investment unless otherwise specified), including variants such as first differences, *FH regressions* and call β the *FH coefficient* or the *saving-investment association*. The identification problem relates to what exactly the FH coefficient measures. FH interpreted the coefficient as an index of capital mobility. Their results for 16 OECD countries for the 1960–74 period indicated a very high saving-investment association and they could not reject the null hypothesis of $\beta = 1$ or zero capital mobility. FH concluded:

> ''[a]lthough 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'' (*FH* p. 323).

Of itself, the FH finding is not controversial and has been replicated with only minor modifications for OECD countries many times. Despite the apparent robustness of the FH result of a high saving-investment association, the *FH view* or *interpretation* that the FH coefficient (β) can be identified as a measure of international capital mobility has been widely challenged since it is not obvious what structural parameters this equation measures.

The FH equation can also be parameterized in terms of the current account, $B = S - I$:

$$(B/Y)_i = -\alpha + (1-\beta)(S/Y)_i + u_i. \quad (2)$$

In this framework, the FH interpretation is that, given zero capital mobility, changes in saving are reflected in changes in investment and have no effect on the current account. This runs counter to the tradition of exchange rate and open economy models. For example, all contemporary exchange rate models, with the exception of portfolio balance and some Mundell-Fleming models, assume perfect mobility (Taylor, 1995). Dornbusch (1991) sums up how the open economy parameterization above links with the original FH regression:

> ''Feldstein's discovery of the tight link between national saving and investment rates continues to baffle the profession. Ample research over the past few years has failed to reject the basic finding… The Feldstein finding runs counter to the spirit of the open economy literature in which, under of conditions of perfect capital mobility, changes in national saving rates are primarily reflected in the current account, *not* in investment''. (p. 220).

The FH puzzle is further exacerbated by the high degree of capital mobility implied by some interest parity studies[4] and casual empiricism. The 1980s saw widespread deregulation of financial markets involving the removal of impediments to cross-border trading of financial instruments, and information and communication technology (ICT) advances which facilitated the international transfer of capital. Even where formal exchange controls survive, agents seem able to avoid them as is evidenced by the 'flight of capital' from many developing countries.[5]

Approaches to Capital Mobility

The FH puzzle has emphasized that defining and measuring capital mobility is not straightforward. Capital is not homogenous and the obstacles to the mobility of financial, physical and human capital may be quite different. Here we briefly place the FH approach in context by outlining three competing approaches to capital mobility.

FH Quantity Approach

The attractions of the FH approach are its intuitive simplicity and data availability. However its simplicity proves deceptive since the FH regression is neither a structural model of investment nor a reduced form equation which raises an identification problem. Although the original FH (1980) paper did not provide an explicit theoretical framework, we use a linear version of the partial equilibrium model of Feldstein (1983) to examine the identification problem. This is a classical model in which national saving and investment and foreign investment (the balance of payments) are functions of the real interest rate (r) and stochastic shocks. An open economy equilibrium condition determines the real interest rate. The S, I and B variables are implicitly expressed as shares of GDP and, together with r, are measured as deviations from their means. For a sample of countries, $j = 1,2,\ldots,N$, the model is as follows:

$$I_j = -\phi r_j + \epsilon_{1j}, \quad (3)$$

$$S_j = \psi r_j + \epsilon_{2j}, \quad (4)$$

$$B_j = -\eta r_j + \epsilon_{3j}. \quad (5)$$

Equilibrium is given by equilibrium on the world balance of payments:

$$S_j - I_j - B_j \equiv 0, \quad (6)$$

implying that:

$$r_j = \frac{\epsilon_{1j} + \epsilon_{3j} - \epsilon_{2j}}{\psi + \phi + \eta}. \quad (7)$$

The FH coefficient is estimated as:

$$\hat{\beta} = \frac{\sum_{j=1}^{N} I_j S_j}{\sum_{j=1}^{N} S_j^2}, \quad (8)$$

which is a function of all six elements of the variance–covariance matrix and the three structural parameters. Feldstein (1983) gives the detailed formula.

In the case of perfect capital mobility, there is no difference between the country interest rate and the world average ($r_j = 0$) and real interest parity holds. The implication is that testing for capital mobility using the FH approach involves testing a joint hypothesis of a high saving-investment association and real interest parity. Frankel (1991) argues that the failure of real interest parity is the most likely explanation for the positive covariance between saving and investment. The FH coefficient measures the effect of an exogenous shock to saving on investment but will be close to zero only if the covariance between investment and saving

shocks is close to zero. This will not hold if common factors (such as technology shocks, population growth and the like) move both saving and investment. FH readily admitted that the high saving-investment association may be explained by common factors but put the burden of discovering statistically significant common factors on their critics who have largely failed in this respect.

Under imperfect capital mobility, interest rates differ from country to country and, using (3) and (7), investment is given by:

$$I_j = -\phi \frac{\epsilon_{1j} + \epsilon_{3j} - \epsilon_{2j}}{\psi + \phi + \eta} + \epsilon_{1j}\,. \tag{9}$$

If the covariances between ϵ_2, ϵ_1 and ϵ_3 are zero, the effect of a shock to saving (ϵ_2) on investment is given by:

$$\beta = \frac{\phi}{\psi + \phi + \eta}\,. \tag{10}$$

This shows that the estimate of β will not be unity even under low capital mobility ($\eta \approx 0$) unless saving is interest inelastic, $\psi = 0$. In the latter instance, the FH coefficient reduces to $\phi/(\phi + \eta)$ but is less than unity for $\eta > 0$.[6] Thus, even within FH's own framework, it is only under strong identifying assumptions that the FH coefficient has the requisite properties for the FH interpretation. A related difficulty is the absence of a benchmark value for β corresponding to perfect capital mobility. Either perfect capital mobiity or infinitely interest elastic saving (or both) imply β tending to zero and we cannot distinguish these cases.

Interest Parity—No Arbitrage—Relations

These relations can be classified into three separate components: covered interest parity (CIP), uncovered interest parity (UIP), and real interest parity (RIP). We focus on RIP since it is implicitly assumed in the FH approach. We follow Frankel's (1991) decomposition of RIP into two components (note that the variables below such as r, i and P now denote levels):

$$r - r^* = (i - i^* - \mathrm{fd}) + (\mathrm{fd} - \Delta P^{\mathrm{e}} + \Delta P^{\mathrm{e}*}), \tag{11}$$

where r is the real and i the nominal interest rate, ΔP^{e} expected inflation and fd is the forward discount (starred variables refer to their foreign counterparts). The first bracketed term on the right is the 'country premium' or covered interest parity which captures all barriers (such as transaction costs, information costs, capital controls, and various taxes) to integration of financial markets across national boundaries. Obstfeld (1995) shows that, although the offshore–onshore money market links (equivalent to CIP) increased in a sample of leading economies in the 1980s, the risk of government intervention, particularly in times of exchange rate crisis, remains significant. Another complicating factor is that financial markets are less well integrated at long term maturities than at 3 month maturities which are typically used to test covered interest parity (Dooley *et al*., 1987; Frankel, 1991, 1992).

The second bracketed term on the right of (11) is the 'currency premium' which consists of the exchange risk premium ($\mathrm{fd} - \Delta S^{\mathrm{e}}$) and expected real depreciation ($\Delta S^{\mathrm{e}} - \Delta P^{\mathrm{e}} + \Delta P^{\mathrm{e}*}$) where ΔS^{e} is expected depreciation. Frankel argues that a currency premium exists due to real and nominal exchange rate variability. Even with equalization of covered interest rates ($i - i^* - \mathrm{fd} = 0$), large differentials in real interest rates may persist due to volatility in both components of the currency premium. The failure of RIP is also highlighted by Lemmen and Eijffinger (1995). In brief, RIP requires not only perfect capital mobility but also the integration of goods markets and efficiency of exchange markets.

Consumption Smoothing Approach

The basis of this approach is that, in a world of integrated capital markets, consumption risks can be traded to improve welfare. One implication is that consumption paths should be correlated across countries as agents smooth consumption in the face of shocks. However consumption smoothing is possible only if there is no credit rationing in financial markets (Bayoumi, 1990; Artis and Bayoumi, 1992).[7] Bayoumi and MacDonald (1995) argue that their approach has the benefit of allowing tests of RIP without assuming *ex ante* purchasing power parity. Their conclusion that Japan is the only advanced economy for which capital market integration is not rejected typifies the negative findings on capital mobility found using this approach. Since the consumption-smoothing approach is surveyed elsewhere (Obstfeld, 1995) we

focus here on a recent variant found in Ghosh (1995) and Ghosh and Ostry (1995).

Ghosh (1995) starts from Sachs (1981) observation that the current account acts as a buffer or that countries borrow and lend abroad in order to smooth consumption in the face of temporary shocks. Since saving and investment seem to be non-stationary processes and the current account might be expected to be a stationary process, he focuses on current account volatility rather than saving and investment correlations to test for perfect capital mobility. Ghosh constructs a benchmark time series of the optimal consumption smoothing, current account given perfect capital mobility and shocks to the economy. A low variance of the actual to the optimal current account implies that the degree of capital mobility is insufficient to allow the actual current account to absorb shocks to smooth consumption.

Ghosh's null hypothesis is a joint hypothesis of perfect capital mobility and the consumption-smoothing motive. The optimal current account path is defined as:

$$CA_t^* = -E_t \sum_{i=1}^{\infty} (1+r)^{-1} \Delta(Q_{t+i} - I_{t+i} - G_{t+i}), \tag{12}$$

where Q is national output or GDP, I is investment, and G is government expenditure. This states that the optimal current account path is equal to the expected present value of changes in future national cash flows ($Q_{t+i} - I_{t+i} - G_{t+i}$). He compares the variance of the optimal and the actual current accounts of five major OECD industrialized countries from 1960–88. If the two variances are equal, then the null hypothesis is accepted and we have perfect capital mobility and consumption smoothing. For four out of five countries the volatility of the actual current account exceeds the optimal current account by statistically significant margins. He attributed this excess volatility to speculative capital flows. Ghosh and Ostry (1995) apply similar methods to a sample of LDCs for various periods, ranging from 1950–91. The results of Ghosh and Ghosh and Ostry stand out in suggesting excess capital mobility in both advanced and developing countries. These findings run counter not only to those of FH but also those of the consumption-smoothing approach. The Ghosh approach has two difficulties. The first is that that Ghosh does not provide either an empirical or theoretical reconciliation of his contrarian results with alternative approaches which use the saving-investment association. The second is that one may question the manner in which Ghosh constructs his optimal consumption series, upon which his results hinge.

MEASURES OF THE SAVING-INVESTMENT ASSOCIATION

> *S3. The residuals are non-normal and the specification of the model is incorrect.*
> *S8. Have you tried two stage least squares?*
> *S22. What happens when you extend the anlaysis to the later (earlier) period?*
> *''S33. Have you tested for unit roots and cointegration?''*[8]

Econometric results are notoriously fragile since estimates are sensitive to such issues as specification, estimation method, sample and the particular measures used to proxy the theoretical variables. The initial response to FH was to target econometric errors as the explanation for their finding (Tobin, 1983; Westphal, 1983; Murphy, 1984; Frankel, 1986). The problems of the FH regression include identification discussed in the previous section (it is not clear what theoretical parameter the FH coefficient measures), misspecification (relevant common factors may have been omitted), simultaneity bias (saving may be endogenous), permanent and transitory effects (was the FH coefficient measuring short or long-run impacts discussed in the previous section), sample sensitivity, and non-stationarity. In general the FH results have been robust to these empirical critiques in OECD samples.

Replicating the FH Regressions

The main evidence provided by FH and the bulk of the subsequent work has been based on cross-section regressions. FH conducted time-series analysis but pointed out that: ''[s]imultaneous equations bias makes these time-series estimates too unreliable to warrant serious attention'' (fn. 1, p. 327). Other researchers have mainly followed

the FH lead in focusing on cross sections but some have also produced time series and panel estimates of the saving-investment association. Note that as long as the deviations of the time-series FH coefficients from their mean are independent of the saving rate, the cross-section estimate will provide an unbiased estimate of the mean of the time-series coefficients for each country (Zellner, 1969).

Data

FH used gross rather than net national saving and investment flows for two reasons. Firstly it is gross not net saving flows which respond to world wide yield differentials. Secondly, the measurement of depreciation is inaccurate, in particular in the presence of high inflation rates. Removing depreciation from gross saving and investment may cause a spurious correlation between net saving and investment, biasing the FH coefficient upwards. The actual FH estimates of the coefficient on saving in Equation (1) using annual data for 16 OECD countries for the 1960–74 period[9] were 0.89 and 0.94 for gross and net measures, respectively illustrating that the difference between the two estimates is small when the FH coefficient (β) is close to one. In more recent studies in which the FH regression is estimated using gross and net measures, the net measures invariably produce a larger coefficient on saving (see Feldstein, 1983; Feldstein and Bachetta, 1991; Tesar, 1991, 1993).

The OECD publishes net rather than gross measures for public and private saving and investment in the *National Accounts* for its member countries.[10] Net saving is derived by deducting government and private final consumption from national disposable income. Net investment is defined as gross fixed capital formation less stock building and depreciation. Gross investment and saving are calculated as the net measures plus depreciation. Obstfeld (1986), Baxter and Crucini (1993), amongst others, argue that the OECD measure of saving and investment does not reflect true saving and investment. The difference arises when foreign ownership of firms is extensive. Obstfeld (1986) argues that foreign ownership in open economies ''may artificially increase the correlation between measured national saving and domestic investment'' (*ibid*. p. 84). Bayoumi *et al*. (1996) use this insight to construct a new measure of capital mobility based on GNP/GDP ratios.

Cross-Section Results

The FH result based on cross-section data has proved remarkably robust. Table 1 reports on a selection of cross-section estimates of the saving-investment association (β) for different samples of OECD countries using a variety of time periods. Luxembourg has been identified as an outlier in most recent studies and the FH result collapses if it is included. The first part of Table 1 considers the evidence in favour of the FH result. The original FH result was updated by Feldstein (1983) who extended the FH sample period from 1960–74 to 1960–79. He confirmed that the saving-investment association estimates had not declined by extending the sample period. More recently Feldstein and Bachetta (1991) re-estimated the FH equation for the 1960–86 period using a sample of 23[11] OECD countries. They found that the saving-investment association had only marginally declined over the longer sample period.

The rest of Table 1 presents the other replications of the FH result in approximately chronological order. The empirical work in the 1980s appeared to confirm the original FH result and indicated that estimates of the saving-investment association did not decline when the estimation period was extended to 1980 and beyond (Murphy, 1984; Penati and Dooley, 1984; Obstfeld, 1986; Dooley *et al*., 1987; Golub, 1990; Artis and Bayoumi, 1992; Sinn, 1992; Coakley *et al*., 1994, 1995a; Obstfeld, 1995). The only studies which show an estimated value of b less than 0.7 for OECD samples are those where saving and investment are averaged over periods of less than one decade (e.g. Artis and Bayoumi for 1974–80 period).[12] Coakley *et al*. (1994) and Coakley *et al*. (1995a) use the most recent data which yield an estimated β of 0.75 for the 1960–92 period and 0.63 the more recent 1980–92 subperiod.

Time Series

Table 2 presents selected time series estimates of the FH coefficient and, where applicable, of the correlation coefficient between saving and investment. Only a relatively small number of time

Table 1. Cross section estimates of FH regression

Author	Period	β (S.E.)	R^2	OECD[a] sample
Feldstein and Horioka (1980)	1960–74	0.887 (0.074)	0.91	16[b]
Feldstein (1983)	1960–79	0.796 (0.112)	0.75	FH 16 plus Fra
Feldstein and Bachetta (1991)	1960-86	0.833 (0.094)		23
	1960–69	0.848 (0.063)		
	1970–79	0.671 (0.121)		
	1980–86	0.868 (0.126)		
Murphy (1984)	1960–80	0.90 (0.09)	0.85	FH 16 plus Fra
Penati and Dooley (1984)	1971–81	0.88 (6.12)	0.71	19
Obstfeld (1986)	1970–79	0.858 (0.806)	0.07	FH 16 plus Fra
		1.422 (0.456)	0.41	FH 16
Dooley *et al*. (1987)	1960–73	0.746 (0.104)	0.79	FH 16 minus 2
	1974–80	0.736 (0.173)	0.57	
Artis and Bayoumi (1992)	1974–80	0.53 (0.18)		25 plus Yugoslavia
	1981–88	0.79 (0.12)		
	1960–88	0.76 (0.12)		
Golub (1990)	1960–86	0.74 (0.12)	0.75	FH 16
	1960–88	0.76 (0.12)		
Tesar (1991)[c]	1960–86	0.84 (0.13)	0.73	FH 16
	1960–74	0.89 (0.10)	0.85	
	1975–86	0.81 (0.18)	0.58	23
	1960–86	0.84 (0.10)	0.74	
	1960–74	0.87 (0.07)	0.86	
	1975–86	0.85 (0.15)	0.59	
Obstfeld (1995)	1974–90	0.715 (0.131)	0.60	22 minus Lux, Tur
	1974–80	0.867 (0.170)	0.56	
	1981–90	0.636 (0.108)	0.64	
Coakley *et al*. (1994, 1995a)	1960–92	0.752 (0.079)	0.80	23
	1960–74	0.883 (0.063)	0.89	
	1975–92	0.649 (0.104)	0.63	
	1980–92	0.628 (0.090)	0.69	

[a] The full list of OECD countries (with abbreviations in parentheses) comprises: Australia (Aus), Austria (Aut), Belgium (Bel), Canada (Can), Denmark (Dnk), Finland (Fin), France (Fra), Germany (Ger), Greece (Grc), Iceland (Isl), Ireland (Ire), Italy (It), Japan (Jap), Luxembourg (Lux), Netherlands (Nld), Norway (Nor), New Zealand (Nzl), Portugal (Prt), Spain (Esp), Sweden (Swe), Switzerland (Che), Turkey (Tur), UK, and the US.
[b] The FH sample excludes Fra, Isl, Lux, Nor, Prt, Esp, Che and Tur. We refer to these as the FH 16.
[c] Tesar's results are based on net saving and investment rates.

series as compared with cross section replications of the FH result has been undertaken. Nonetheless time series estimates are important especially as a guide for pooling time series observations from different countries as Obstfeld (1986) has argued. The distinguishing feature of Table 2 is the considerable degree of heterogeneity in estimates for individual countries' coefficients. In Obstfeld (1986) the correlation coefficients vary from 0.13 to 0.92 while those of Tesar (1993) vary over a very similar range. Over the entire 1960–92 period, the time series estimates of β by Coakley *et al*. (1994) ranged from 0.025 for Luxembourg to 1.182 for Switzerland.

If the interest sensitivity of saving is not zero and the covariance between the error terms is not zero, then saving will be endogenous and the estimates of the FH coefficient will suffer simultaneity bias. FH were aware of the potential simultaneity problem and employed instrumental

Table 2. Selected time series estimates of the FH regression

	Time period	β (S.E.)	Correlation coefficient	Country
Obstfeld (1986)	1960I–84IV		0.194 (0.106)	Aus
	1970II–84I		0.132 (0.195)	Aut
	1959I–84I		0.550 (0.125)	Can
	1960III–84II		0.649 (0.133)	Ger
	1959I–83IV		0.846 (0.140)	Jap
	1959I–84II		0.604 (0.166)	UK
	1959I–84II		0.908 (0.143)	US
Miller (1988)	1946I–87III	0.571		US
Tesar (1993)	1960–88	na	0.848 (0.102)	Can
			0.929 (0.071)	Fra
			0.886 (0.091)	Ger
			0.063 (0.196)	It
			0.592 (0.154)	UK
			0.752 (0.124)	US
Afxentiou and Serlitis (1993)	1947–89	0.335 (2.2)		Can
Alexakis and Apergis (1992)	1955I–73V	0.796 (10.76)		US
	1974I–90V	0.657 (1.94)		
Coakley *et al*. (1994, 1995a)	1960–92	0.580 (0.087)		Aus
		0.910 (0.086)		Aut
		0.678 (0.073)		Bel
		0.710 (0.086)		Can
		0.745 (0.112)		Dnk
		0.857 (0.102)		Fin
		0.843 (0.045)		Fra
		1.019 (0.092)		Ger
		0.770 (0.050)		Grc
		0.741 (0.145)		Isl
		0.160 (0.319)		Ire
		0.753 (0.078)		It
		1.043 (0.106)		Jap
		0.025 (0.054)		Lux
		0.308 (0.318)		Nld
		0.469 (0.193)		Nor
		0.293 (0.121)		Nzl
		0.293 (0.121)		Prt
		0.758 (0.133)		Esp
		0.740 (0.055)		Swe
		1.182 (0.242)		Che
		0.717 (0.89)		Tur
		0.401 (0.147)		UK
		0.586 (0.096)		US

variable estimators. They reported that this did not alter the main thrust of their original findings. This finding has been supported by others who have used instrumental variable estimators (Dooley *et al*., 1987; Bayoumi, 1990; Tesar, 1991).

Panel Estimates

A few researchers have employed pooled and other panel data estimators (such as the Swamy (1971) random coefficients estimator) to obtain alternative measures of the saving-investment association (Feldstein, 1983; Amirkhalkhali and Dar,

1993; Coakley *et al.*, 1994, 1995b). However, since the cross-section variance dominates the total variation and the time series estimates of β are very heterogenous, the pooled estimates are largely similar to the cross section estimates for the OECD sample, 1960–92. The conclusion from the limited number of studies undertaken seems to be that FH cross section, panel, and average time series estimates are close to unity for OECD but not LDC samples. The cross section estimate matches the average time series levels estimate (Coakley *et al.*, 1995a). Pesaran and Smith (1995) discuss the relationship between cross section, panel, and time series estimates.

Sample Sensitivity

Although the finding of a high saving-investment association seems relatively robust for the OECD group of countries as a whole, some researchers have found anomalies when the sample is disaggregated or changed in various ways. Below we focus on the main anomalies.

Large Country Effect

Murphy (1984) argues that the FH regression tests two hypotheses, perfect capital mobility and small open economies. Small countries are unable to influence world interest rates and prices but large countries are and so can bias the saving-investment correlation towards one even under conditions of perfect capital mobility. FH did recognize the 'large country' effect by arguing, that if a country is large, it will behave like a closed economy:

> ''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 to international trade.'' (*Ibid.* p. 323).

Murphy divided his sample of 17 OECD countries into ten small and seven large countries. He found that his group of large countries had a response coefficient on saving of 0.98 while the small country group had a coefficient of only 0.59. He argues that these results are consistent with the expected effect of country size when capital is mobile between countries.

Harberger (1980) argues that the FH result reflects large country bias rather than low capital mobility. He considers whether capital flows (which he estimates as the current account as a ratio of gross investment) are less variable and smaller in absolute size for large countries than for small or poor countries. A large country will finance most investment projects from domestic saving and thus will have less need to borrow from abroad. He finds that gross capital flows are indeed more variable and greater in absolute value for smaller countries. The views of Murphy and Harberger on the large country effect are echoed elsewhere in the literature (Obstfeld, 1986[13]; Tobin, 1983; Baxter and Crucini, 1993).

EU Effect

Feldstein and Bachetta (1991), Artis and Bayoumi (1992) and Bayoumi *et al.* (1996) argue that, due to informational and institutional links, financial flows between EU countries should be greater than among OECD countries and thus these countries should experience a lower saving-investment correlation. Feldstein and Bachetta split the 23 OECD country sample into the then EU (9) and non-EU country samples for the 1960–86 period. Using net figures they show that the EU countries experienced a small decline in the saving-investment association from the 1960s to the 1970s, followed by a sharp decline in the 1980s. By comparison, the coefficient for the 14 non-EU countries declined much more slowly. These results suggest that capital mobility has been enhanced over the years amongst EU countries, particularly in the 1980s. Using gross measures, the coefficient on saving for the EU countries is substantial throughout the period even though it falls somewhat in the 1980s. However the decline in the corresponding coefficient for non-EU countries is much sharper, suggesting, according to the FH interpretation, that capital mobility has increased more in the non-EU countries. These conflicting findings indicate that the Feldstein–Bachetta results must be interpreted with caution.

Artis and Bayoumi (1992) also claim to have discovered an EU-type effect by focusing on the six core members of the exchange rate mechanism,

the ERM-6. The coefficient on saving for the original ERM-6 countries decreased throughout the sample period 1960–88 and was insignificantly different from zero (0.58, S.E. = 0.33) for the 1981–88 period. For the same sample period, Artis and Bayoumi found the entire OECD group produced a coefficient on saving of 0.78 (S.E. = 0.12). They concluded that within the FH framework, the ERM-6 countries are substantially integrated. Finally Bayoumi *et al*. (1996) confirm a higher saving-investment association for EU economies than for either Europe as a whole (excluding Luxembourg) or for the OECD sample.

Developing Countries

Dooley *et al*. (1987) examined 62 countries, 48 of which were developing countries and the remaining 14 OECD countries. They split the sample into two sub-periods, the fixed exchange rate period, 1960–73, and the floating exchange rate period, 1974–84, when many countries removed capital controls. They find that the saving coefficient is greater for the OECD countries than for the developing countries and that the coefficient is greater in the floating rate period for both groups. They divided the heterogeneous developing countries into 21 market borrowers and 14 countries which depend solely on official financing. The saving-investment correlation was positive and significant for both groups combined and the relationship was stronger in the second sub-period and for the market borrowers than for the official borrowers. They attribute the lower coefficient on saving for the developing countries to the 'country size' factor, since the sample of developing countries comprises small countries which cannot influence the world interest rates and therefore their savings-investment correlation is not biased upwards.

Mamingi (1994) investigated the FH regression using time series estimation for 58 developing countries. Overall he found that the saving-investment coefficient was much weaker for developing countries than the corresponding coefficient in studies of OECD countries. He reached a similar conclusion to Dooley *et al*. and argued that developing countries are essentially small open economies where fiscal policy used for demand management purposes will be unable to crowd out private sector investment.

Other

A number of other disaggregations of the FH equation has appeared in the literature. FH themselves divided national saving and investment into three separate components for nine OECD countries: the government, household and corporate sectors. Their main result is that (gross) corporate investment appears responsive to corporate rather than other forms of saving. Although they claim that this is consistent with their general results, it has to be treated with caution in view of the limited degrees of freedom of their regression equation.

A number of studies has used the FH approach to investigate the question of regional or intra-national capital mobility. For instance, Bayoumi and Rose (1993) used regional UK data over the 1971–85 period and found regional saving and investment rates were uncorrelated. They concluded that their results were consistent with the hypothesis of perfect regional capital mobility but this could also be interpreted as lack of default risk since there is no solvency constraint. Similar results have been reported for other regional studies: Dekle (1996) for Japanese prefectures and Bayoumi and Sterne (1993) for Canadian regions. Finally Bayoumi *et al*. (1996) use a novel approach to confirm that regional capital mobility is higher than international capital mobility by comparing GNP/GDP ratios across EU countries with equivalent ratios across UK regions.

Non-stationarity

In recent years it has been recognized that national saving and investment rates are very persistent series since the null of a unit root cannot be rejected (Miller, 1988; Ballabriga *et al*., 1991; Leachman, 1991; Gulley, 1992; Gundlach and Sinn, 1992; Afxentiou and Serlitis, 1993; Alexakis and Apergis, 1992; Argimón and Roldán, 1994; de Haan and Siermann, 1994; Ghosh, 1995; Lemmen and Eijffinger, 1995; Coakley *et al*. 1996a,b; Coakley and Kulasi, 1997). Coakley *et al*. (1996a) note that although saving and investment shares of GDP are $I(1)$ variables, the difference between them—the current account balance—should be stationary or $I(0)$ as a result of solvency constraints. In the latter case, saving and invest-

ment will cointegrate with a unit coefficient and the time series FH regression in levels will yield super-consistent estimates of β.

Note that evidence in favour of a stationary current account or cointegration of saving and investment can be interpreted in two diametrically opposing manners. On one hand it can be interpreted as confirmation of the FH result; on the other it can be interpreted as evidence of open capital markets imposing a solvency constraint on countries. The empirical evidence on the stationarity of the current account employing conventional cointegration techniques is mixed (Miller, 1988; Gulley, 1992; Gundlach and Sinn, 1992; Argimón and Roldán, 1994; Ghosh, 1995). Some recent approaches have employed panel unit root tests to test for the stationarity of the current account (Coakley *et al*., 1996a,b; Krol, 1996; Coakley and Kulasi, 1997). The panel tests of Im *et al*. (1995) have higher power than individual, pairwise tests and the general conclusion is that the current account is a stationary series in both in developing and OECD countries.

ALTERNATIVE INTERPRETATIONS

General Equilibrium Approaches

S29. The problem cannot be dealt with by partial equilibrium methods: it requires a general equilibrium framework.

The implicit FH theoretical framework previously set out, was a partial equilibrium framework. Several authors have constructed general equilibrium models which simultaneously incorporate a high saving-investment correlation and high or perfect capital mobility (Obstfeld, 1986; Engel and Kletzer, 1989; Finn, 1990; Cardia, 1991; Mendoza, 1991; Backus *et al*., 1992; Baxter and Crucini, 1993; Tesar, 1993; Stockman and Tesar, 1995). One drawback of the general equilibrium models is that they are mainly theoretical in nature and generally lack supporting econometric evidence.[14]

Obstfeld (1986) constructs a simple intertemporal model of a small open economy in which temporary shocks to the productivity of domestic capital and labour cause short run comovements between saving and investment despite perfect capital mobility. Because labour is assumed to be immobile across national boundaries, productivity shocks to labour in the domestic economy cannot be absorbed by foreign labour markets. In order to maintain the equality between the marginal product of capital and the rate of return on capital, namely the world rate of interest, firms must increase their capital stock. Obstfeld (1986) argues ''…the essential reason for this co-movement [between savings and investment] is again the fact that labour is not mobile across national boundaries'' (*ibid*. p. 74). If labour was perfectly mobile across national boundaries, the impact of productivity shocks to labour in the domestic economy would be eliminated since excess domestic workers would be absorbed abroad. Saving may increase but domestic investment need not increase since the marginal product of capital remains unchanged.

Tesar (1993) links the FH result to the low cross-country consumption correlation and the dominance of domestic assets in national portfolios. She reports cross-country consumption correlations for five OECD countries, ranging from -0.35 between Canada and France to 0.58 between France and Germany, with an average correlation of only 0.09. French and Poterba (1991) find that for the five largest national stock markets, domestic ownership range from 79% in Germany to 95.7% in Japan. Tesar argues that these empirical regularities imply a lack of consumption smoothing, even under conditions of perfect capital mobility. She develops a simple two country, exchange model with investment and productivity shocks to non-traded goods. The model demonstrates that these empirical regularities can be explained by productivity shocks to non-traded goods and agents' preferences particularly *vis-a-vis* the composition of traded and non-traded goods in consumption smoothing. In such cases, domestic investors will bias their portfolios towards assets in domestic non-traded goods. Tesar's theoretical model is illustrated by simulation results where productivity shocks are generated from real data from five OECD countries.

Baxter and Crucini (1993) (BC) set out to resolve the conflicting results reported by Sachs (1981) and Feldstein and Horioka (1980) and to offer an expla-

nation for the large country effect put forward by Murphy (1984). Their model shows high time series correlations between saving and investment under perfect capital mobility, higher correlations for larger countries, and a negative relationship between current account deficits and investment as found in Sachs. BC base their conclusions on a two country, one sector growth model driven by exogenous shocks to productivity where the effects of government fiscal policy are assumed neutral. BC conclude:

> ''Sachs's empirical findings have traditionally been interpreted as evidence in favour of international capital mobility, while high values of saving and investment correlations have been interpreted as evidence against capital mobility. Our model starts from the assumption of highly mobile capital and simultaneously accounts for both of these phenomena.'' (p. 428).

Note however that Penati and Dooley (1984) found that the relationship between investment and the current account was statistically insignificant.

Current Account Explanations

S21. The central argument is not only a tautology, it is false.

The tautology is the identity that saving minus investment equals the balance of payments on current account. A number of authors has suggested that, if, in response to balance of payments disequilibrium, public or private decision-makers react in such a way as to restore equilibrium, this would induce an association between saving and investment even under high capital mobility. Several variants of the current account explanation are found in the literature (Bayoumi, 1990; Ballabriga *et al*., 1991; Artis and Bayoumi, 1992; Argimón and Roldán, 1994; Ghosh, 1995; Glick and Rogoff, 1995; Coakley *et al*., 1996a,b).

Sachs (1981, 1982) argued that changes in investment opportunities rather than oil price changes were the main determinant of current account imbalances in the 1970s. Sachs (1981) regressed the average current account (as a proportion of GDP) for 15 industrial countries on their average investment rates and found that the slope coefficient was negative and significantly different from zero. Similar results are reported in Sachs (1982), Table 5.2, for slightly different samples of countries and where the data were averaged over different sample periods. Sachs finds that changes in the balance on the current account are much more closely correlated with changes in investment than changes in saving rates. He concludes that the responsiveness of world capital to changes in investment in the domestic economy implies that world capital markets are integrated to a great extent[15].

Sachs' results sharply contradict the FH result. Penati and Dooley (1984) (PD) hypothesize that if Sachs' results are valid, then Sachs' equation should strengthen over time as international financial markets become more integrated. They replicated both the FH and Sachs equations using 19 industrialized countries. They showed that, while the FH equation remained robust over time, Sachs' relationship breaks down when the sample period is extended to include 1980 and the number of countries is increased to 19. The results led PD to reject capital mobility. In fact Penati and Dooley found that Sachs' results depended heavily on outlier countries, and once these were removed from the sample, an estimate of the slope coefficient not significantly different from zero was obtained.

Another strand of this literature is that the saving-investment correlation is high because governments target the current account using appropriate policy instruments (Bayoumi, 1990; Artis and Bayoumi, 1992 (AB)). For instance, AB argue that governments target the current account using monetary rather than fiscal policy. To examine this they estimated the following reaction function:

$$\Delta r = \alpha + \beta\ \Delta \mathrm{y} + \gamma\ \Delta p + \delta \mathrm{CA}/y + u, \tag{13}$$

where r is a discount rate administered by monetary authorities, Δy is growth, Δp is inflation, CA/y is the current account balance as a ratio to GDP or GNP, and u is a random error term. If governments targeted the current account, δ should be negative. Since there was a decline in the saving-investment association in the 1980s, AB hypothesized that current account targeting by governments had declined in the 1980s. They conclude that their results:

> ''appear to confirm that the current account was a significant policy target for monetary policy in the 1970s, but that its importance diminished somewhat in the 1980s. This behaviour appears to correspond to a reduction in the correlation between saving and investment among OECD countries... it seems likely that government targeting of the current account helps account for the high correlation.'' (*Ibid*. p. 303).

Coakley *et al*. (1996a) propose a resolution of the FH puzzle based on the current account which differs from the previous explanations in several ways. First it stresses capital market constraints rather than government targets for the current account. Unlike the Ballabriga *et al*. (1991) model, the Coakley *et al*. model does not rely on endogenous government policy responding to private sector behaviour or to shocks. Instead it relates saving and investment behaviour to the current account via a market determined risk premium on borrowing. Secondly, their approach does not rely on capital controls. They argue that, even under perfect capital mobility, the interest rate faced by a country will contain two components, the world rate and a risk premium/discount which averages to zero across countries. The risk premium/discount will respond to the balance of payments thus ensuring long-run solvency and making the current account as a share of GDP a stationary process. Since saving and investment rates are integrated processes, a stationary current account implies that they cointegrate with a unit coefficient. It is this solvency constraint that the FH coefficient measures. They adduce empirical evidence for panels of both OECD countries and LDCs to support their theoretical model (Coakley *et al*., 1996a,b).

Human Capital

S16. Of course if you allow for investment in human capital the entire picture changes.

The FH puzzle about capital mobility has also been investigated within the framework of neoclassical growth models (Mankiw *et al*., 1992; Barro *et al*., 1995). Human capital plays a central role in many of these models. Barro *et al*. (1995) use a modified neoclassical growth model to investigate the implications of various assumptions about capital mobility in growth models. Perfect capital mobility carries the implausible implication of immediate convergence to steady state levels of per capita output, physical capital and human capital. To avoid this problem, they consider a case of partial capital mobility where only physical and not human capital can be used as collateral on international financial markets. On this basis they assert:

> ''(a)lthough the credit-constrained open economy converges faster than the closed economy, the speed of convergence is now finite for the open economy and the difference from the closed economy is not large for plausible parameter values'' (p. 112).

Barro *et al*. develop a modified Ramsey, infinite-horizon optimizing model. They analyse the optimal economic growth path using a one sector model with Cobb-Douglas technology, in which output is produced with three inputs, physical capital (k), human capital (h) and non-reproducible labour. They demonstrate that the convergence implications of the partial capital mobility model are similar to those of the closed economy. Both models demonstrate that output is an increasing function of capital stock under conditions of diminishing returns. They argue that the world rate of interest, which is the same as under the closed economy, implies that perfect capital mobility does not affect the steady state values of k and h which are the same as for a closed economy. However, capital mobility does affect the speed of convergence. The Barro *et al*. model predicts a high correlation between saving and investment irrespective of the degree of physical or financial capital mobility. Thus in this model the high FH coefficient sheds no light on physical or financial capital mobility, only on human capital mobility.

Transitory versus Permanent Influences

S12. The analysis is marred by a failure to distinguish between transitory and permanent components.

FH largely relied on cross-section estimates. Initially time-series estimates seemed less supportive of the puzzle, though Coakley *et al*. (1994) show that the average across countries of the long-run

time-series estimate of the FH coefficient is almost exactly the same as the cross-section estimate. However, the time-series estimates, particularly in first differences, are more likely to pick up the short-run transitory responses of investment to savings while cross-section estimates are more likely to capture the long-run permanent response. It is a fairly general result that the short-run estimates of the FH coefficient tend to be much smaller than the long-run ones (Coakley *et al*., 1994). At first sight this seems inconsistent with the interpretation of the FH coefficient as a measure of capital mobility. Suppose there is a transitory increase in saving. Given the frictions involved in international transactions, it may not be worth incurring the costs of finding out about foreign investment opportunities or evading exchange controls. Thus transitory increases in saving would tend to be invested nationally.

However, if there were a permanent increase in savings, then it may be worth incurring those costs and one would expect part of a permanent increase to flow abroad. The finding that transitory changes to saving tend to go abroad and permanent ones stay at home, an implication of the short-run estimate of the FH coefficient being smaller than the long-run estimate, suggests that the explanation is not frictional obstacles to capital mobility. To deal with this issue Feldstein (1983), p. 147, first disparages the time-series estimates, commenting that ''Coefficient estimates based on annual variations in savings and investment are subject to potentially severe simultaneity bias.'' Instead he provides a theoretical explanation based on a portfolio balance model of why the short-run effect of saving on investment should be smaller than the long-run one. His explanation is that, when short-run portfolio adjustments are complete, capital flows revert to a lower level.

The Feldstein explanation has not found favour in the literature but there has been little work on the difference between long run and short run FH coefficients. One notable exception is Sarno and Taylor (1996). Rather than using the usual short and long-run estimates of the FH coefficient they employ the Blanchard and Quah (1989) decomposition to distinguish between temporary and permanent shocks to saving and investment shares of GDP. Using quarterly UK data, they find that the short run saving-investment correlation is significantly higher than the long run correlation as predicted by the FH approach. Thus transitory increases in saving are more likely to remain in the UK while permanent changes tend to flow abroad. They conclude that their results indicate a high degree of capital mobility in the UK especially following the removal of exchange controls in 1979.

Public and Private Saving-Investment Gaps

Some authors have disaggregated national saving and investment into their public and private components to focus on the role of public and private saving-investment gaps. The general conclusion in this approach is that capital is relatively immobile, mainly due to the operation of capital controls. Ballabriga *et al*. (1991) argue that correlations between private and public sectoral gaps have direct implications for the FH view on the degree of international capital mobility. If the sectoral gaps have a unit root, this implies a high correlation between public and private gaps and thus low capital mobility since public and private intertemporal budget constraints impose a long run external solvency condition on countries. They find that the null hypothesis of a unit root for sectoral gaps is not rejected, thereby violating the government budget constraint in a large number of EC countries. Since public and private sector gaps tend to offset one another, the external solvency of the country is preserved by the use of capital controls. Ballabriga *et al*. demonstrate that, although the long run external solvency condition has not been violated, domestic intertemporal budget constraints have been, implying a high correlation between saving and investment. They argue that the associated low capital mobility is the result of governments imposing capital controls to target the current account.

Argimón and Roldán (1994) base their explanation of the FH result on governments' targeting the current account and saving-investment gaps. For five of the nine EU countries in their sample, they found that private and public sector saving-investment gaps were cointegrated and that four of these countries imposed capital controls in the period under investigation. Since the capital account is the mirror image of the current account, any constraint on the former, such as exchange controls,

will necessarily impact on the latter also. This implies that capital is immobile and so saving and investment turn out to be highly correlated. van Wincoop and Marrinan (1993) (VM) develop a partial equilibrium, perfect capital mobility, real business cycle model which is driven by technical, fiscal and interest rate shocks which are correlated across countries. Under conditions of zero capital mobility, the correlation between total saving and investment should equal one and the correlation between public and private saving-investment gaps should be exactly minus one. VM find that, when they control for income movements, the correlations between total saving and investment and public and private saving-investment gaps are 0.78 and -0.81 respectively. They assert that ''we cannot understand the significant correlation between total savings and investment by referring to technology shocks in the context of a model with perfect capital mobility'' (*ibid*. p. 22). They conclude that it is the immobility of capital across countries which is the key factor to the high correlations found in the data.

In a different but related vein, Peeters (1996) carries out estimation and simulations on the Global Econometric Model (National Institute London) using a general equilibrium modelling approach. Her results for the US, Japan, Germany and the UK indicate a lower estimate (compared with partial equilibrium models) of the saving-investment association and would therefore suggest higher capital mobility in both the short and long run. More importantly she finds that private and public saving gaps largely offset one another in the short run. She concludes that increasing private saving would have little effect on the US's twin deficits since it would be almost fully reflected in an increase in the government deficit and thus its impact on the current account negated.

Revised Feldstein Approach

Feldstein (1994) has provided an informal but more sophisticated justification of the FH view. He supports the original FH view by linking it to another puzzle, the 'home country bias' puzzle (Lewis, 1995; Tesar and Werner, 1995) The high saving-investment association is consistent with the documented propensity of fund managers to hold a disproportionately high share of domestic securities or not to diversify their portfolios internationally. Feldstein offers two rationales for such behaviour. One is the political and currency risk of overseas securities holdings. While he concedes that political risk may be negligible for OECD countries, currency risk may not be[16] and this is consistent with the Coakley *et al*. solvency argument. Feldstein's second rationale is that hedging behaviour creates offsetting capital flows so that net capital flows may be zero or negligible. This links in with a more general weakness of the FH approach which is that it focuses on net rather than gross international capital flows.

However Feldstein's hedging example of investment in German government bonds is rather special in that (coupon) income flows in foreign currency can be perfectly anticipated whereas income from overseas equities cannot be similarly predicted. Feldstein also overlooks a potentially more significant source of under recording of capital flows. Increasingly fund managers use futures and other derivatives for tactical (short term) international asset allocation. Such flows are not fully recorded in balance of payments data. For example, the only aspect of investment by an UK fund manager in overseas stock index futures contracts recorded in the balance of payments statistics are the variation margin flows which typically are but a small fraction of the total investment. The recording of derivatives flows in the balance of payments statistics is currently under consideration by central banks and the IMF.

CONCLUSIONS

In this paper we have reviewed the way economists have responded to the FH puzzle, using Stigler's generic comments to introduce their lines of attack. In the process we have examined a large number of competing interpretations of the FH coefficient. It will be apparent that the general tone of contributions is largely but by no means unanimously negative toward the FH interpretation of low capital mobility. The approaches which offer support for the FH view of capital mobility include sectoral gap models, the Barro *et al*. (1995) modified neoclassical growth model in which human capital is immobile, and Sarno and Taylor's

(1996) support for the FH short and long run findings. However the majority of the models and explanations oppose the FH interpretation by attempting to construct models which reconcile a high saving-investment association with high physical and financial capital mobility and/or by providing plausible econometric and other data-based refutations of the FH view. These include general equilibrium, real business cycle models and intertemporal models of the current account.

There is no doubt that the FH debate has been very productive, provoking a wide range of theoretical analysis and empirical work and has increased our understanding of the issues. Although the debate continues, we can draw some interim conclusions. Firstly, the FH result of a high saving-investment association has remained remarkably robust in OECD cross-sections although the coefficient on saving has shown some tendency to decline over recent years. The result persists in panels and average time-series for OECD countries, but not for individual countries where there is a wide dispersion of estimates. The main result has also been remarkably robust to the addition of other variables and different estimation methods in the OECD. However, there is less evidence for a close relationship between saving and investment in non-OECD samples, particularly in LDCs.

Secondly, using the FH regression for policy purposes is questionable because both saving and investment are endogenous and the FH regression cannot distinguish exogenous shifts in saving from endogenous shifts reflecting factors which also impact on investment. In any event, government measures that promote saving are likely to be part of packages that may also promote investment. Thirdly, the FH result may not be informative about capital mobility since a range of theoretical models can generate high saving-investment correlations even under perfect capital mobility. This now seems to be the emerging consensus in the literature. Baxter (1995), p. 1842) says: ''These results show that the time-series savings investment correlation is not an informative statistic concerning the degree of international financial integration.'' Similarly Obstfeld and Rogoff (1995), p. 1779, observe:

> ''Taken together, however, and combined with other evidence indicating substantial international mobility of capital, the arguments below suggest that the Feldstein–Horioka finding provides no basis at all for dismissing the basic premises of the intertemporal approach.''

Nonetheless the FH puzzle is by no means resolved and recent contributions by Bayoumi *et al.* (1996) and Sarno and Taylor (1996) claim to establish high capital mobility within FH-related frameworks.

Fourthly, the debate surrounding the FH puzzle has shown that the notion of capital mobility itself is not analytically straightforward. Obstacles to the movement of financial, physical and human capital may have quite different implications. Assuming perfect capital mobility may produce plausible conclusions in one set of models and not in another. Thus while it may be sensible in open-economy macroeconomics to assume perfect capital mobility, it is certainly not in neoclassical growth models where it would result in all countries jumping immediately to their steady state. In such circumstances it seems sensible to treat perfect capital mobility as Friedman (1953), p.36, treated perfect competition:

> ''Everything depends on the problem; there is no inconsistency in regarding the same firm as if it were a perfect competitor for one problem, and a monopolist for another, just as there is none in regarding the same chalk mark as a Euclidean line for one problem, a Euclidean surface for a second, and a Euclidean solid for a third.''

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NOTES

1. This was how an earlier version (Coakley *et al.*, 1995a) was often received. We are grateful to an anonymous referee who responded in kind by pointing out that Stigler also provided apt responses to this paper in his introductory remarks a) and c).
2. Source: *Social Sciences Citation Index*.
3. For a non-technical overview of the FH puzzle see Feldstein (1994).
4. For an excellent survey of this literature see Obstfeld (1995).

5. Dooley and Kletzer (1994) argue that the increased flow of funds to emerging country markets since the late 1980s may be explained by reductions in the stock of capital flight rather than capital exports by the industrial countries.
6. Feldstein (1983) gives identifying restrictions in the context of his real flows (quantity) model (pp. 141–45). Murphy (1984) modifies the Feldstein model to incorporate a country effect and discusses appropriate identifying restrictions (pp. 330–31).
7. We are grateful to an anonymous referee for this insight.
8. The quotation marks denote that this is our suggested addition to Stigler's original list.
9. The countries excluded were Iceland, Portugal, Turkey, and (former) Yugoslavia due to lack of data, and France, Luxembourg, Norway, Spain, and Switzerland due to a change in methods of national accounting over the sample period.
10. Note that the terms national saving and investment are employed in the literature to include both public and private saving and investment.
11. Their sample excluded Luxembourg (an outlier) and the former Yugoslavia.
12. Sinn (1992) and Coakley *et al*. (1994) show that the FH coefficient is much lower and more volatile when cross sections based on annual data are estimated.
13. Note this effect is not evident in the annual data estimates of Obstfeld (1989).
14. Many of the general equilibrium models are calibrated to match some typical empirical results but these cannot be afforded the same status as econometric studies.
15. The coefficient in the Sachs regression would measure $(1 - \beta)/\beta$ in a determininstic model. So β close to unity in the FH model corresponds to the Sachs regression coefficient being close to zero, ignoring the different exogenity assumptions.
16. Note that this argument overlaps with the currency premium component of real interest parity in Frankel's (1991) exposition.

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