HUMAN CAPITAL AND THE FELDSTEIN-HORIOKA PUZZLE

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Abstract

In this paper we reexamine the Feldstein-Horioka finding of limited international capital mobility by using a broader view (i.e., including human capital) of investment and saving. We find that the Feldstein-Horioka result is impervious to this change.

JEL Code: E2, F2, I2, Q4.

Keywords: human capital, current account, investment-saving correlation, capital mobility.

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1 Introduction

Models that emphasize the accumulation of human capital as an important determinant of growth have come into prominence during the last two decades (see, for example, Lucas (1988), Azariadis and Drazen (1990), Mankiw, Romer and Weil (1992)). In these models the accumulation of human capital is broadly similar to the accumulation of physical capital since a rise in the accumulation of either type of capital increases the amount of output that can be produced in the future. For example, a household may increase its future consumption opportunities not only by increasing its ownership of (claims to) physical capital, but it can do so by increasing the human capital (and future earning opportunities) of its members. Accordingly, in the same way that an economy in which the marginal productivity of physical capital is higher than the world interest rate may use the opportunity to borrow internationally, an economy in which the marginal productivity of human capital is higher than the world interest rate, may decide to borrow internationally to finance the possible excess of its desired human capital investment over what domestic savings can allow. Consequently, by focusing on the narrower view of capital (i.e., the one excluding human capital) one may bias the results regarding the extent to which domestic savings act as a constraint on domestic investment (broadly interpreted).

In this paper we reexamine the celebrated Feldstein and Horioka (1980) [hereafter FH] finding of limited international capital mobility using this broader view of investment (and saving). We find that FH's results are impervious to this change.

2 Econometric Analysis

A large strand of the international macroeconomics literature provides strong evidence for a high saving-investment correlation using both time series and cross section techniques. This empirical regularity suggested by FH has been interpreted as inconsistent with perfect capital mobility, and has as a result triggered a vast response in the literature. In general, one can distinguish among studies that aim at challenging the empirical FH finding [see Sinn (1992) and Caporale et al (2005)] and among those that aim at reconciling this evidence with the existence of full capital mobility [see Bayoumi (1990), Barro et al (1995), Baxter and Crucini (1993) and Coackley et al (1996)].

FH estimate the following cross-section regression for 21 OECD countries:

$$(\frac{I}{Y})_i = a + \beta(\frac{S}{Y})_i + u_i \tag{1}$$

where I denotes gross domestic investment, S denotes gross domestic

saving , Y denotes gross domestic product and i stands for the individual country. All data are averages of the 1960-1974 period. FH find that β is close to one. The estimate for β is 0.89 for the whole period and between (0.87-0.91) for the various 5-year sub-sample periods. This finding has been characterized as a paradox since perfect capital mobility would imply a value of β close to zero. Subsequent studies have to a large extent confirmed the FH paradox.

Our aim is to investigate whether ignoring a commonly neglected but nevertheless important component of investment, namely the investment in human capital has a significant effect on the saving-investment correlation. In order for our results to be comparable to FH's result we first run equation (1) for our sample of 25 OECD countries and then we compare the derived estimates of β with those derived if the measure of investment includes investment in human capital. To this purpose we also estimate the following equation:

$$(\frac{IT}{Y})_i = a + \beta(\frac{\overline{S}}{Y})_i + u_i \tag{2}$$

where IT denotes gross domestic investment including investment in human capital, Ih; $IT/Y = I/Y + Ih/Y$. We also adjust the total saving ratio by excluding private sector education expenditures from consumption expenditure. Thus, the measure of savings used in equation (1) is augmented by adding to it the private expenditure on education (Ih_{pr}), and so $\overline{S} = S + Ih_{pr}$.

As an approximation of investment in human capital, Ih, we use data for total expenditure for education from the OECD Education at a Glance. Ih is defined as total expenditure for education excluding government expenditure designated for augmenting the physical capital used for educational purposes. The reason is the latter expenditures are already included in total investment as part of public investment. Although these data exist for the 1992-2002 period there is very poor coverage before 1997. Specifically, there is no data coverage for 7 out of the 25 countries of our sample prior to 1997. Ih is divided by GDP from the OECD Economic Outlook. Gross national saving (as % of GDP), $\frac{S}{Y}$, is also taken by OECD Economic Outlook. Finally, gross capital formation (as % of GDP), $\frac{I}{Y}$, is from the World Bank, WDI.

Table 1 presents estimates of equation (1) for the 1985-2002 period.

TABLE 1 : Feldstein-Horioka equation 1			
	$(\frac{I}{Y})_i = a + \beta(\frac{S}{Y})_i$		
method	Ordinary Least Squares		
period	a	β	Adj.R^2
$86-2002$	9.747 (5.047)	0.572 (6.767)	0.65
$86-90$	9.597 (6.313)	0.611 (9.446)	0.79
$91-95$	6.736 (3.637)	0.702 (8.344)	0.74
$96-2000$	14.044 (4.980)	0.372 (3.069)	0.26
$97-2002$	16.441 (5.945	0.261 (2.187)	0.14

Notes: t-Statistics in parentheses.

Although one can observe a significant decrease in adjusted R^2 after 1995, β coefficients are significant in all sub-samples. Our results are consistent with Sinn (1992) and Taylor (1996) who observe a fall in β in the 80's. This fall has apparently become more significant after 1995 and it may well be related to the process of monetary integration among European Union countries which culminated in the adoption of the Euro; see Blanchard and Giavazzi (2002) for more details.

Our next step is to see whether including investment in human capital as a part of total investment will affect the investment-saving correlation. For this purpose, we estimate equation (2) for the 1997-2002 period. This gives us:

$$(\frac{IT}{Y})_i = \underset{(8.11)}{21.32} + \underset{(2.55)}{0.277}(\frac{\overline{S}}{Y})_i \tag{3}$$

with an adjusted R^2 of 0.19. Clearly our results indicate that there is no significant change in the correlation between investment and savings when human capital investment is taken into account. The estimate of β is significant and very similar to the one reported in the last raw of Table 1 whereas $\frac{S}{Y}$ seems to explain 19% of the variation in $\frac{IT}{Y}$.

Some authors, including Feldstein (2005), have suggested that the above results need to re-examined by taking into account the issue of the country size effect: A large country relies less on external borrowing since it is more diversified and national saving may have an impact on world interest rate [see Harberger (1980), Dooley et al (1987) and Sinn (1992)].

An obvious way of testing for a possible size effect is using the ratio of the country's GDP in total GDP as a weight in Weighted Least Squares (WLS).[1] This is equivalent to running OLS after multiplying all the data

[1] Alternatively one can assume that β depends on the country size. However,

by the weight series, w so that:

$$(\frac{I}{Y})_i^* = w_i a + \beta(\frac{S}{Y})_i^* + u_i^* \tag{4}$$

where $(\frac{I}{Y})_i^* = w_i(\frac{I}{Y})_i$, $(\frac{S}{Y})_i^* = w_i(\frac{S}{Y})_i$ and $u_i^* = w_i u_i$.

It is straightforward to show that rejecting model (1) for model (4) improves efficiency if model (1) suffers from heteroskedasticity. Since $Var(u_i^*) = w_i^2 Var(u_i)$ and $w_{i \neq} w_j$, it is clear that if model (1) does not suffer from heteroskedasticity, the use of WLS would introduce heteroskedasticity in our model. The White-heteroskedasticity test of equations (1) and (2) cannot reject homoskedasticity for all periods (apart from the 91-95 period) at the one percent significance level, as reported in the second and third columns of table 2. Furthermore, rerunning equations (1) and (2) using White's heteroskedasticity consistent method results in very similar standard errors apart from the 91-95 period. Still, it is important to test whether equations (1) and (2) suffer from heteroskedasticity of the exact form which can be corrected by the use of w_i in WLS. This would be the case if

$$w_1^2 Var(u_1) = w_2^2 Var(u_2) = ... = w_n^2 Var(u_n)$$

If w_i is the right weight in an WLS regression then the squared residuals of equations (1) and (2), RSQ, should be correlated with w_i. Thus, in order to test whether our initial model suffers from heteroskedasticity which can be corrected by the use of w_i, we run simple OLS regressions of RSQ on w_i.The results are reported in the last columns of table 2. One can see that in all cases the coefficient on w_i is insignificant. This implies that using WLS would introduce heteroskedasticity in our model for the majority of sub-periods, and for this reason we abstain from further examination of this issue.[2]

recursive estimates of β suggest that β is stable across countries.

[2]Nevertheless, we have chequed whether our results depend on the use of WLS. We found that the inclusion of human capital does not alter the saving-investment correlation even if the latter is estimated by WLS. The results are available upon request.

TABLE 2 : Heteroskedasticity Tests				
	White test		Ordinary Least Squares	
	equation (1)		Dep var: RSQ of equation (1)	
period	F-statistic	Probab.	*constant*	w_i
$86-2002$	4.4942	0.0231	4.704 (5.049)	−16.288 (−1.531)
$86-90$	2.6587	0.0935	3.176 (3.392)	−9.405 (−0.895)
$91-95$	7.0659	0.0043	6.004 (4.239)	−21.677 (−1.330)
$96-2000$	1.0825	0.3561	9.712 (4.322)	−28.536 (−1.121)
$97-2002$	0.3060	0.7394	8.85 (4.015)	−21.89 (−0.878)
	equation (2)		Dep var: RSQ of equation (2)	
	F-statistic	Probab.	*constant*	w_i
$97-2002$	1.559	0.2326	7.578 (4.169)	−20.62 (−1.00)

Notes: t-Statistics in parentheses

Concluding, our analysis indicates that the traditional saving-investment correlation does not alter significantly once we broaden the measure of investment and saving by taking human capital into account. Moreover, our analysis confirms the widespread belief, and the finding of previous studies, that the degree of international capital mobility has increased significantly since the mid-seventies.

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