A pairwise-based approach to examine the Feldstein-Horioka condition of international capital mobility

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December 2014

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Motivation

Importance of capital mobility

- Provision of capital where domestic savings are limited
- Efficient allocation of financial resources across international markets
- Connectedness of international financial markets

Measuring economic and financial integration

Economic integration

- Goods market integration (absolute and relative PPP)

Financial integration

- Price approaches to financial integration
  - Covered interest parity (capital mobility)
  - Uncovered interest parity (asset substitutability)
  - Real interest parity

- Quantity approaches to financial integration (capital mobility)
  - Feldstein-Horioka (FH): Savings-Investment correlations
  - Sachs: Current Account-Investment (Savings) correlations
  - Obstfeld: Consumption correlations

Feldstein and Horioka (1980) Hypothesis

A seminal paper: Under perfect capital mobility, domestic savings will search for the capital markets with the highest real returns, with no effect whatsoever of domestic savings (S) on domestic investment (I).

Surveys by Lapp (1996); Coakely et al. (1998); Apergis & Tsoumas (2009).

However, using the degree of correlation between S and I in order to judge the extent of international capital mobility has proved to be controversial.

Why? Because the relationship between S and I may be driven by productivity shocks, demographic changes, government policies etc (which have little to do with capital mobility).

Our contribution

We apply a pairwise framework that tests the bilateral relationships between domestic I and foreign S across countries.

This framework:

- Provides a measure of the extent of capital mobility that a country may have with respect to any other country in the world.
- Allows us to determine the number of cases in which the null of perfect capital mobility is not rejected.

We also show how our pairwise approach enables us to relate FH capital mobility measurement against alternative measures such as one based on real interest rate differential (Frankel, 1992).

Empirical modelling strategy

Starting point in FH is the cross-section model:

$$I_i = \alpha_0 + \alpha_1 S_i + u_i, \tag{1}$$

where I and S are domestic investment and savings (as a percentage of GDP), u is the error term, and $i = 1, ..., N$ denotes countries.

The proportion of incremental savings that is invested domestically, also known as the saving retention coefficient, is α_1. (α_0 accounts for the fact that the series have non-zero means).

While $\alpha_1 = 0$ is consistent with perfect capital mobility, a value of one would be supportive of no capital mobility.

FH puzzle: The estimates of α_1 originally obtained by FH strongly contradicted the hypothesis of perfect world capital mobility.

Empirical modelling strategy

A number of authors have also employed an alternative avenue of research based on time-series data:

$$I_t = \beta_0 + \beta_1 S_t + u_t, \tag{2}$$

where $t = 1, ..., T$ denotes time.

Taylor (1996) highlights a key distinction in interpreting α_1

- Cross-section: Long-run saving retention coefficient
- Time-series: Short-run saving retention coefficient

This setup has also been extended using (heterogeneous) panel data.

Empirical modelling strategy

Common feature in all studies: Domestic investment is regressed on domestic savings.

Little or no explicit recognition that domestic investment may in fact be correlated with savings in one or more other countries.

How can this be addressed?

Empirical modelling strategy

Start by postulating the well-known relationship that in the presence of perfect capital immobility, domestic investment must be equal to domestic savings:

$$I_{i,t} = S_{i,t}, \tag{3}$$

Then, departing from the existing literature, multiply (3) by minus one, and add foreign savings at time t in both sides, which we denote $S_{j,t}$ where $j = 1, ..., N$ and $i \neq j$:

$$S_{j,t} - I_{i,t} = S_{j,t} - S_{i,t}. \tag{4}$$

In regression terms:

Empirical modelling strategy

$$(S_{j,t} - I_{i,t}) = \alpha_{0,ij} + \alpha_{1,ij}(S_{j,t} - S_{i,t}) + u_{ij,t}. \tag{5}$$

Cases of interest:

1. Perfect capital immobility
   - $\alpha_{1,ij} = 1$ in which case $I_{i,t} = S_{i,t}$.
2. Perfect capital mobility
   - $\alpha_{1,ij} = 0$ in which case $I_{i,t}$ moves in tandem with $S_{j,t}$.

Estimation of (5) for all possible country pairs (i, j), where $i \neq j$ provides a measure of the extent of capital mobility that a country may have with respect to any other country in the world.

Empirical modelling strategy

The pairwise approach enables us to assess the extent of capital mobility through considering the percentage of cases whereby the null of perfect capital mobility, i.e. $\alpha_{1,ij} = 0$, is not rejected.

An increased acceptance rate of the zero null will imply that perfect capital mobility has become more broadly based involving a greater number of countries.

By contrast, in the FH approach if one finds that the saving retention coefficient is equal to zero, then domestic investment must therefore be surely being financed through foreign savings.

Foreign savings are kept in the background as an aggregate variable.

Empirical modelling strategy

Frankel (1992) argues that the FH definition of capital mobility requires the validity of real interest rate parity.

Interestingly, the pair-wise approach allows to merge quantity (FH) and price (interest rate differentials) approaches of capital mobility.

Data

Obtained from the OECD iLibrary consists of 42 annual observations from 1970 to 2011 on investment, gross savings and the current account for 25 OECD member countries.

Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.

All three variables are measured in levels in US$ millions, current prices and current PPPs, and expressed as a proportion of GDP.

Choice of countries and of the sample period is dictated by the need to assemble a consistent balanced data panel.

Pesaran's CD cross-section independence test

The null of cross sectional independence is clearly rejected for both the investment and savings ratios.

Panel	CD test	p-value
Investment	18.386	[0.000]
Savings	21.745	[0.000]

Time-series properties of the data

Individual KPSS suggest that in the overwhelming majority of the cases the series appear to be stationary.

- 22 out of 25 in the case of investment
- 19 out of 25 in the case of savings

Same result when the series are considered as a panel (Hadri test), and after allowing for cross sectional dependence (using a bootstrap).

Stationarity rules out the possibility of an analysis of I and S using cointegration techniques, but rather using standard tools from regression analysis.

Trend-stationarity tests

	Investment		Savings	
Country	Lag	KPSS	Lag	KPSS
Australia	1	0.058	1	0.077
Austria	1	0.043	1	0.082
Belgium	2	0.085	5	0.290‡
Canada	2	0.085	1	0.041
Denmark	2	0.114	6	0.242‡
Finland	2	0.096	2	0.084
France	2	0.111	1	0.059
Germany	2	0.125	1	0.093
Greece	2	0.106	1	0.102
Iceland	5	0.045	1	0.065
Ireland	6	0.140	6	0.173†
Italy	2	0.111	1	0.036
Japan	6	0.115	1	0.028
Luxembourg	1	0.052	1	0.124
Mexico	2	0.099	1	0.030

Trend-stationarity tests (continued)

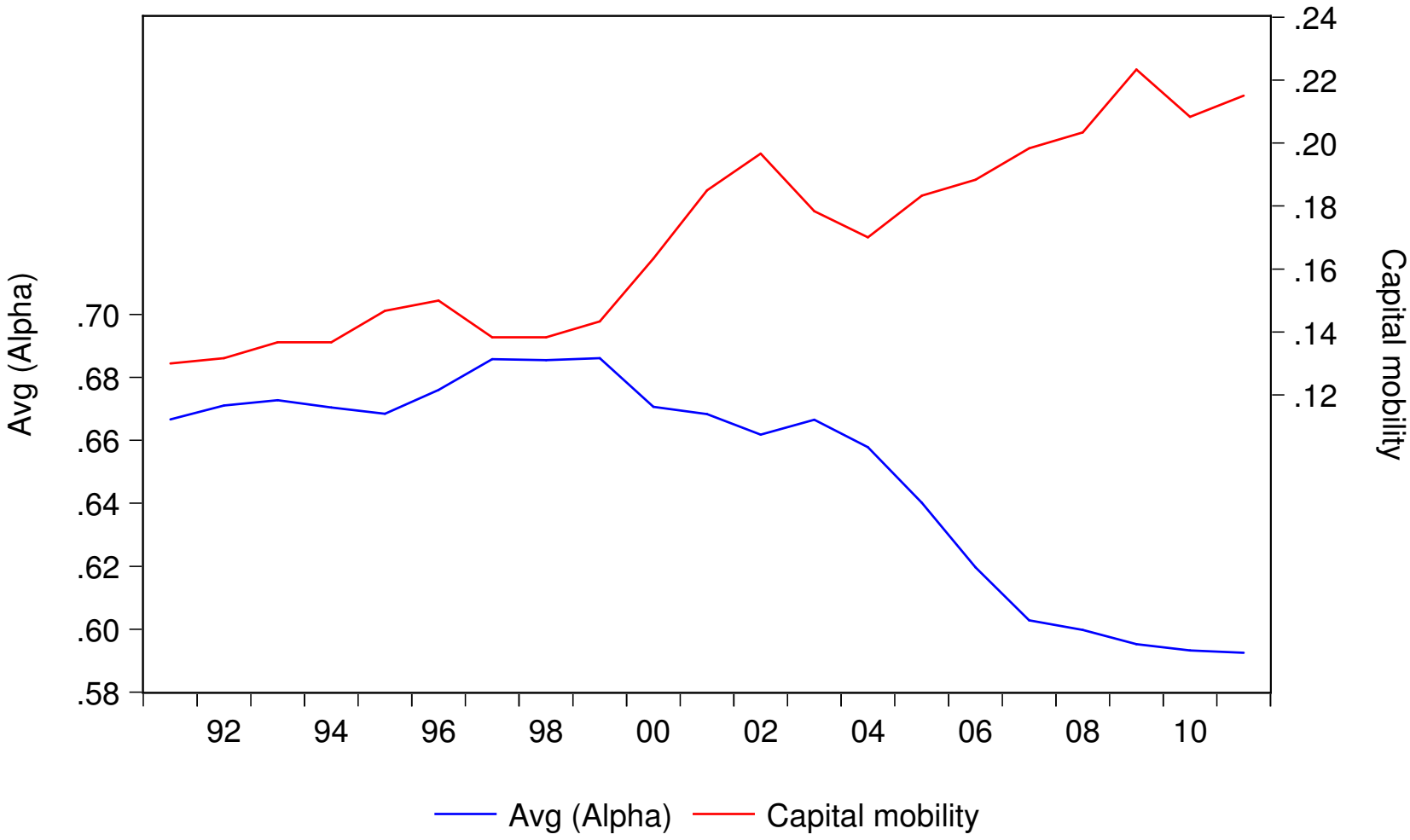
	Investment		Savings	
Country	Lag	KPSS	Lag	KPSS
Netherlands	2	0.117	1	0.045
New Zealand	2	0.077	6	$0.210^{\dagger}$
Norway	2	0.079	1	0.091
Portugal	6	$0.180^{\dagger}$	2	0.115
Spain	2	0.087	2	0.089
Sweden	2	0.078	6	$0.418^{\ddagger}$
Switzerland	2	0.101	5	$0.382^{\ddagger}$
Turkey	1	0.072	1	0.060
United Kingdom	6	$0.283^{\ddagger}$	2	0.116
United States	6	$0.180^{\dagger}$	6	0.149
Hadri test		4.436		7.242
Bootstrap p-value		[0.986]		[0.439]

Pairwise test of the FH definition of capital mobility

Start	End	$\overline{\hat{\alpha}}_{1,ij}$	Capital mobility
1970	2011	0.612	0.138
1970	1991	0.667	0.130
1971	1992	0.671	0.132
1972	1993	0.673	0.137
1973	1994	0.670	0.137
1974	1995	0.668	0.147
1975	1996	0.676	0.150
⋮	⋮	⋮	⋮
1986	2007	0.603	0.198
1987	2008	0.600	0.203
1988	2009	0.595	0.223
1989	2010	0.593	0.208
1990	2011	0.593	0.215

Pairwise test of the FH definition of capital mobility

Estimates based on rolling window of 21 years



A closer look at the pairwise results

Total number of pairs = 600	
Euro-only	132
At least one non-Euro	468

Cases for which $\hat{\alpha}_{1,ij} < 0{,}5$		
Euro-only	56/132	42 %
At least one non-Euro	167/468	36 %

The majority of the non-Euro sub-sample is characterised by domestic investment being more strongly correlated with domestic rather than foreign savings.

Merging quantity and price approaches of capital mobility

Frankel (1992): The FH definition of capital mobility requires the validity of real interest rate parity.

Let us define $ind_{ij} = 1$ if the null of perfect capital mobility (i.e. $\hat{\alpha}_{1,ij} = 0$) is not rejected at the 10 % significance level.

$$ind_{ij} = \delta_0 + \delta_1 |r_i - r_j| + \varepsilon_{ij}. \tag{6}$$

To answer if there is there an association between ind_{ij} and $r_i - r_j$, test $H_0 : \delta_1 = 0$, against $H_1 : \delta_1 < 0$.

Merging quantity and price approaches of capital mobility

Data period 1990-2011

We obtain the following probit estimates:

$$\begin{aligned} ind_{ij} &= \underset{}{-} \underset{(0,098)}{0,610} \underset{}{-} \underset{(0,078)}{0,172} \, |r_i - r_j|, \\ & \text{Pseudo}-\text{R}^2 = 0,008, \ \text{Obs.} = 600, \end{aligned} \tag{7}$$

Increased capital mobility (as implied by the FH definition of capital mobility) is associated with a reduced absolute real interest differential.

Consistency between the FH hypothesis (a quantity measure) and other ways of judging financial integration (a price measure).

Concluding remarks

We have proposed an alternative way of testing for capital mobility based on a pairwise procedure that explicitly incorporates the potential correlation between domestic investment and foreign savings.

Our results using a panel of OECD economies suggest that the depth and extent of capital mobility remains generally limited, and that mobility has increased over the past twenty years.

Stronger support for capital mobility is found among the single currency Euro-only (i.e. domestic investment appears more strongly correlated with other Euro-member savings rather than with domestic savings).

Concluding remarks

Correlations between foreign savings and domestic investment for country pairs are inversely related to the relevant real interest rate differential.

Our pairwise view indicates consistency between the assessment of capital mobility offered by Feldstein-Horioka (a quantity approach) and a price approach to financial integration based on interest differentials.