An Extended Feldstein-Horioka Test for the Degree of Capital Mobility

Alexis Wadsley, Bruce Felmingham and Arusha Cooray
(University of Tasmania)
An Extended Feldstein-Horioka Test for the Degree of Capital Mobility

Alexis Wadsley¹, Bruce Felmingham² and Arusha Cooray³**

School of Economics
University of Tasmania
Private Bag 85
Hobart Tasmania 7000

Abstract

The paper proposes a test for degrees of capital mobility utilising an extended Feldstein-Horioka condition. In applying the extended condition, we find that high international capital mobility was not strongly correlated with development and only small open economies displayed results consistent with perfect capital mobility.

JEL Classification:
F36, F41, F21

Keywords:
International Capital Mobility, Feldstein-Horioka Condition, Savings-Investment Ratio

¹ Tel: +61 3 6226 2820; Fax: +61 3 6226 7587; e-mail: Alexis.Wadsley@utas.edu.au
² Tel: +61 3 6226 2312, Fax: +61 3 6226 7587; e-mail: Bruce.Felmingham@utas.edu.au
³ Tel: +61 3 6226 ; Fax: +61 3 6226 7587; e-mail: Arusha.Cooray@utas.edu.au
** Wadsley, Felmingham and Cooray: School of Economics, University of Tasmania, Private Bag 85, Hobart 7001, Tasmania, Australia. This research is funded by the Institutional Research Grant Scheme, University of Tasmania.
An Extended Feldstein-Horioka Test for the Degree of Capital Mobility

1. Introduction

The purpose of the paper is to test the hypothesis that the degree of capital mobility will vary with stages of economic development and financial crises utilising an extended version of the Feldstein-Horioka condition. Capital mobility has been identified as an important issue for development and welfare. Relatively free capital mobility is assumed to enhance welfare by enabling capital resources to be deployed more efficiently where they will generate the highest return. Developing nations are assumed to be capital poor with higher marginal returns on capital, and therefore improved access to capital markets may assist in increasing the rate of growth and development of developing countries, with higher returns on investment for capital from developed nations. More recently, international capital mobility has been identified as a source of development risk, with rapid capital movements being a strong factor in explaining the Asian crisis of 1997-1998.

The paper tests the extended version of the Feldstein-Horioka (FH) model by creating six country panels representing different stages of economic development. The larger developed countries are represented by the G7, while the smaller developed nations outside the G7 are labelled the ‘small open’ economies. In addition, a Newly Industrialised Group is distinguished from Developing Asia and Latin American groupings. Fifty five countries are included in six country panels, so panel estimation methods are applied to assess the degree of capital mobility in each panel. The analysis begins with a modification of the original FH Condition to allow both foreign and domestic savings to finance domestic investment.
2. Extended Version of the Felstein-Horioka Condition

We develop a model which takes into account both domestic (S) and foreign savings (S*) as funding sources for domestic investment. To achieve this we identify four conditions from the capital market integration literature as follows:

Financial Autarky: \[
\frac{I}{Y} = \frac{S}{Y}
\] (1)

Investment Rules:
\[
\frac{I}{Y} = \alpha_0 - \alpha_1 \cdot r
\] (2)
\[
\frac{I^*}{Y^*} = \alpha_0^* - \alpha_1^* \cdot r^*
\] (3)

Real Interest Rate (Restricted Capital Mobility) \[
r_o = \theta \cdot (r_o - r^*) + r^*
\] (4)

Expression (1) represents financial isolation (autarky) where all of the investment in domestic capital is funded from domestic savings as defined by Feldstein and Horioka (1980). The linear investment demand functions are rationalized in Frankel (1992) and by Dooley, Frankel and Mathieson (1987) while the domestic real rate of interest is given by (4) where \(\theta \cdot (r_o - r^*)\) measures the differential yield required between domestic and international capital. This is graphically illustrated in Figure 1.

\(\theta\) includes all forms of flow restrictions or biases such as taxes, capital controls, information costs, portfolio preferences, home bias or risk differentials, effectively representing all factors influencing perceptions of the after tax returns following Dooley and Isard (1987). The effective home bias premium is \(\theta \cdot (r_o - r^*)\). A domestic investor internalises this cost for international investment. The premium is assumed to be proportional to the difference between the rate of interest that would exist under autarchy and the world rate of interest. The normal expectation is that \(\theta\) lies in the range \(0 \leq \theta \leq 1\). Negative values of \(\theta\) represent
negative home bias, where the preference is for savings to be invested abroad rather than domestically. Negative home bias is consistent with lifetime wealth portfolio diversification given a high proportion of non-internationally diversifiable human capital, Baxter and Jerman, (1997). Values of $\theta$ in excess of 1 imply some form of dysfunctionality in capital markets.

The value of $\theta$ determines the real borrowing rate imposed upon the borrowing country. For example, if $\theta = 0$, there is perfect capital mobility and $r_\theta = r^*$. The price of a loan is the foreign (global) rate $r^*$. If $\theta = 1$, the real rate on loans is the domestic financial autarky rate $r_a$. In between $0 < \theta < 1$, we have a rate payable on international loans which is the weighted sum of the autarkic rate $r_a$ and the foreign rate $r^*$. These building blocks (1) to (4) may be used to derive a domestic investment ratio function when capital flows are restricted \( \frac{I_{\theta}}{Y} \).

The derivation is the subject of the following theorem:

**Theorem:**

The investment ratio in the case of restricted capital flows \( \frac{I_{\theta}}{Y} \) is the weighted sum of domestic \( \frac{S}{Y} \) and foreign savings ratios \( \frac{S^*}{Y^*} \):

**Proof:**

Note from (2) and (3) above that

\[
 r = \frac{\alpha_0}{\alpha_1} \frac{S}{Y} \quad \text{(T-1)}
\]

\[
 r^* = \frac{\alpha_0^*}{\alpha_1^*} \frac{S^*}{Y^*} \quad \text{(T-2)}
\]
Now the restricted capital flow investment ratio is written:

\[ \frac{I^\theta}{Y} = \alpha_0 - \alpha_1 \cdot r^\theta \]  

(T-3)

Substitute (4) into (T-3), expand and then simplify:

\[ \frac{I^\theta}{Y} = \beta_0 + \beta_1 S^\theta Y + \beta_2 S^\theta \]  

(T-4)

where

\[ \beta_0 = \alpha_0 (1 - \theta) - \alpha_1 (1 - \theta) \frac{\alpha^*_{0}}{\alpha^*_{1}} \]  

(T-5)

\[ \beta_1 = \theta \]

\[ \beta_2 = \frac{\alpha_1 (1 - \theta)}{\alpha^*_{1}} \]  

(T-7)

Q.E.D

We can see all of the special cases in (T-4) above. In particular if \( \theta = 1 \), \( \beta_0 = 0 \), \( \beta_1 = 1 \) and \( \beta_2 = 0 \); and \( \frac{I^\theta}{Y} = S^\theta / Y \). This is defined as complete immobility and financial autarky as defined by FH. At the other extreme, if \( \theta = 0 \) then \( \beta_1 = 0 \) and \( \beta_2 = \frac{\alpha^*_{1}}{\alpha^*_{1}} \), so that all of the investment loans required are secured internationally at the rate \( r^* \), and, \( \frac{I^\theta}{Y} = \beta_2 S^\theta / Y^* \).

This represents perfect capital mobility in this extended framework.

We now proceed to test the extended version of the model utilising panel estimation methods.

3. Data

Data on Gross Investment, Gross Savings and Gross Domestic Product is taken from the IMF International Financial Statistics Database. Table 1 indicates the countries in each panel. Unit Root Tests indicated the likely presence of non-stationarity in the data in levels, but not in first-difference form for many of the 55 countries included in panels.
4. Results

Equation (T-4) is run in first difference form so that the issue of non-stationarity does not arise.

\[
\left( \frac{I_t}{Y_t} - \frac{I_{t-1}}{Y_{t-1}} \right) = \beta_0 + \beta_1 \left( \frac{S_t}{Y_t} - \frac{S_{t-1}}{Y_{t-1}} \right) + \beta_2 \left( \frac{S^*_t}{Y^*_t} - \frac{S^*_{t-1}}{Y^*_{t-1}} \right)
\]

(5)

Equation (5) is tested using six country panels: the G7, Newly Industrialised, Small Open economies, Transition economies, Developing Asia and Latin America. Panels were estimated utilising Pooled Least Squares. Results for the Pooled Least Squares for the panels are reported in Table 2. Developing Asia and Latin America are tested over two periods firstly 1993-2002 and secondly 1981 to 1997 to examine the possible effects of financial crises over the 1997-1998 period.

The Panels were tested for fixed and random effects including the Hausman test and alternative parameter estimates made utilising Pooled Least Squares assuming fixed effects and Pooled Generalised Least Squares assuming random effects. In all cases and tests, parameter estimates of \( \beta_1 \) and \( \beta_2 \) were not impacted by the potential for cross-sectional fixed or random effects. \(^1\)

The estimated value of \( \beta_1 \) are always significant in equation (5) except for the Transition, Developing Asia 1993-2002 and Latin America 1993-2002 which included the 1997-1998

---

\(^1\) Panel Data results were generated utilising Eviews-5. Panel Data results for the Pooled Least Squares (assuming neither fixed nor random effects) are shown in Table 2. Results of Redundant Fixed Effects Likelihood Ratio tests and Hausmann Tests are available from the Authors. Additional panel data results for the Pooled Least Squares assuming fixed effects and Panel Data results for the Pooled Least Squares assuming random effects are available from the Authors.
emerging market financial crises. The largest value of $\beta_1$ is 0.5 for the Newly Industrialized Group, its smallest value (-0.157) relates to the Small Open Economies group reflecting a non-home biased portfolio preference.

If a country’s domestic investment is not financed by domestic savings, then it implies that its investment is financed by foreign savings, $\frac{S^*}{Y^*}$. In this case, the parameter $\beta_2$ should take a value equal to $\alpha_1/\alpha*_1$. The coefficients on the $\Delta(S^*/Y^*)$ ratio are significant for determining the $\Delta(I/Y)$ ratio for all countries and periods except the Transition group, Developing Asia 1993-2002 and Latin America 1993-2002. For the Newly Industrialised countries, small open economies and Latin America 1981-1997 groups, the coefficient on the $\frac{S^*}{Y^*}$ is not significantly different from one, supporting the hypothesis that domestic investment is strongly influenced by foreign savings.

Negative $\beta_2$ coefficients occurred in three of the panels, Transition, Latin America 1993-2002 and Developing Asia 1981-1997. Only the latter was statistically significant. It is intriguing to consider whether this statistical signal of ‘dysfunctionality’ was a harbinger of the financial crisis to come.

5. **Conclusion**

The authors have attempted to extend the F-H model to include a role for both domestic and international savings in determining domestic investment and as a measure of degrees of capital mobility. The results show empirical support for the extended model as a test for capital mobility. The model performs poorly over periods of crisis and economic transition,
this is potentially indicative of the capacity of these factors to disrupt international capital flows and the effective operation of capital markets through capital flight.

The empirical analysis provided support for the hypothesis that the effective harnessing of domestic savings could be important for successful economic development. By this measure, the Newly Industrialised Group of countries performed well, while Latin America did not. High levels of international capital mobility were not consistently correlated with development.

A general conclusion is that capital mobility must be considered a question of degree rather than perfection. All groups displayed evidence of international capital mobility, with no group results consistent with autarchy. Only the ‘small open economies’ displayed results which are generally consistent with perfect capital mobility. The modified version of the F-H condition provides significant potential for further research on capital mobility and tests of the linkage between degrees of capital mobility and economic development.
References


Table 1: Panel Group Countries

<table>
<thead>
<tr>
<th>Panel Group</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘G7’</td>
<td>United States, United Kingdom, France, Germany, Italy, Canada and Japan.</td>
</tr>
<tr>
<td>‘Newly Industrialised’</td>
<td>Greece, Ireland, Portugal, Spain, Hong Kong, Korea, Singapore, and Taiwan.</td>
</tr>
<tr>
<td>‘Transition’</td>
<td>Poland, Czech Republic, Slovenia, Estonia, Latvia, Lithuania, Slovakia,</td>
</tr>
<tr>
<td></td>
<td>Russia, Bulgaria, Roumania, Ukraine, Kazakhstan and Belarus</td>
</tr>
<tr>
<td>‘Small Open’</td>
<td>Austria, Switzerland, Netherlands, Belgium, Sweden, Finland, Norway,</td>
</tr>
<tr>
<td></td>
<td>Denmark and Australia</td>
</tr>
<tr>
<td>‘Developing Asia’</td>
<td>Bangladesh, Myanmar, Sri Lanka, Pakistan, Vietnam, Indonesia, Malaysia,</td>
</tr>
<tr>
<td></td>
<td>Philippines, Thailand, China and India.</td>
</tr>
<tr>
<td>‘Developing Latin America’</td>
<td>Argentina, Brazil, Chile, Mexico, Colombia, Ecuador and Paraguay</td>
</tr>
</tbody>
</table>

Table 2: Results of Panel Estimation – Pooled Least Squares

<table>
<thead>
<tr>
<th>Panel Group</th>
<th>Period</th>
<th>$\Delta S / \Delta Y$ $\beta_1$</th>
<th>$\Delta S^* / \Delta Y^*$ $\beta_2$</th>
<th>Constant $\beta_0$</th>
<th>Adjusted $R^2$</th>
<th>DW Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>G7</td>
<td>1993-2002</td>
<td>0.283***</td>
<td>0.523***</td>
<td>-0.001</td>
<td>0.226</td>
<td>1.507</td>
</tr>
<tr>
<td>Newly Industrialised</td>
<td>1993-2002</td>
<td>0.512***</td>
<td>1.449**</td>
<td>0.002</td>
<td>0.184</td>
<td>2.346</td>
</tr>
<tr>
<td>Small Open Economies</td>
<td>1993-2002</td>
<td>-0.157**</td>
<td>1.030***</td>
<td>0.002</td>
<td>0.117</td>
<td>1.668</td>
</tr>
<tr>
<td>Transition</td>
<td>1993-2002</td>
<td>0.038</td>
<td>-0.413</td>
<td>0.000</td>
<td>-0.003</td>
<td>1.654</td>
</tr>
<tr>
<td>Developing Asia</td>
<td>1993-2002</td>
<td>0.211**</td>
<td>-0.153</td>
<td>-0.003</td>
<td>0.023</td>
<td>1.612</td>
</tr>
<tr>
<td>Latin America</td>
<td>1981-1997</td>
<td>0.172***</td>
<td>-0.90***</td>
<td>0.001</td>
<td>0.081</td>
<td>1.400</td>
</tr>
<tr>
<td></td>
<td>1993-2002</td>
<td>0.089</td>
<td>-0.031</td>
<td>-0.001</td>
<td>0.001</td>
<td>1.828</td>
</tr>
<tr>
<td></td>
<td>1981-1997</td>
<td>0.108***</td>
<td>1.019**</td>
<td>-0.001</td>
<td>0.135</td>
<td>1.906</td>
</tr>
</tbody>
</table>

***, **, * Significant at the 1%, 5% and 10% probability levels respectively
Figure 1: Graphical Illustration Savings, Investment and Yield Differentials

\[ r_\theta = \theta (r_a - r^*) + r^* \]

\[ I/Y(r) \]

\[ I/Y \]

Yield Differential

\[ \theta (r_a - r^*) \]
Economics Discussion Papers

2005-01 Investment and Savings Cycles and Tests for Capital Market Integration, Arusha Cooray and Bruce Felmingham

2005-02 The Efficiency of Emerging Stock Markets: Empirical Evidence from the South Asian Region, Arusha Cooray and Guneratne Wickremasinghe

2005-03 Error-Correction Relationships Between High, Low and Consensus Prices, Nagaratnam Jeyasreedharan

2005-04 Tests for RIP Among the G7 When Structural Breaks are Accommodated, Bruce Felmingham and Arusha Cooray

2005-05 Alternative Approaches to Measuring Temporal Changes in Poverty with Application to India, Dipankor Coondoo, Amita Majumder, Geoffrey Lancaster and Ranjan Ray

2005-06 Intertemporal Household Demographic Models for Cross Sectional Data, Paul Blacklow

2005-07 Some Recent Evidences about the Global Integration of Chinese Share Markets, Yong Hong Yan and Bruce Felmingham

2005-08 Managerial Objectives and Use Limits on Resource-Based Recreation, Hugh Sibly

2005-09 The Feldstein-Horioka Model Re-Visited for African Countries, Arusha Cooray and Dipendra Sinha

2005-10 Analysis of Changes in Food Consumption and Their Implications for Food Security and Undernourishment: The Indian Experience in the 1990s, Ranjan Ray

2005-11 An Extended Feldstein-Horioka Test for the Degree of Capital Mobility, Alexis Wadsley, Bruce Felmingham and Arusha Cooray

2005-12 Extreme-Valued Distributional Relationships in Asset Prices, Nagaratnam Jeyasreedharan

2004-01 Parametric and Non Parametric Tests for RIP Among the G7 Nations, Bruce Felmingham and Arusha Cooray


2004-05 Gender Bias in Nutrient Intake: Evidence From Selected Indian States, Geoffrey Lancaster, Pushkar Maitra and Ranjan Ray

2004-06 A Vector Error Correction Model (VECM) of Stockmarket Returns, Nagaratnam J Sreedharan

2004-07 Ramsey Prices and Qualities, Hugh Sibly

2004-08 First and Second Order Instability of the Shanghai and Shenzhen Share Price Indices, Yan, Yong Hong


2004-10 Derivation of Nutrient Prices from Household level Food Expenditure Data: Methodology and Applications, Dipankor Coondoo, Amita Majumder, Geoffrey Lancaster and Ranjan Ray

Copies of the above mentioned papers and a list of previous years’ papers are available on request from the Discussion Paper Coordinator, School of Economics, University of Tasmania, Private Bag 85, Hobart, Tasmania 7001, Australia. Alternatively they can be downloaded from our home site at http://www.utas.edu.au/ecoфин

13