The Feldstein-Horioka puzzle is not as bad as you think

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Abstract

Saving and investment are $I(1)$ processes and generally do not cointegrate. This suggests the need for a nonstationary panel methodology to estimate the long run saving-investment association. We reconsider the Feldstein-Horioka puzzle using a mean group procedure which provides consistent estimates for nonstationary, heterogeneous panels. The resultant slope coefficient estimate for 12 OECD economies 1980I-2000IV is insignificantly different from zero and supports long run capital mobility and the integration of international financial markets. This overturns the finding of low capital mobility found using the traditional cross section estimator and, more generally, in the Feldstein-Horioka literature.

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1 Introduction

The Feldstein-Horioka (1980) (FH hereafter) puzzle continues to exercise the imagination of economists as exemplified by the recent contributions of Coiteux and Olivier (2000), Corbin (2001), Hoffman (2001), Obstfeld and Rogoff (2000) and Sachsida and Caetano (2000). The puzzle refers to the stylised empirical finding that panel estimates of the saving-investment association have remained stubbornly high for OECD countries in recent decades.[1] FH interpreted the high association as implying segmented capital markets or low capital mobility notwithstanding ongoing globalisation of markets. Capital mobility measured by net capital flows is critical both for the efficient allocation of capital to the most productive uses and locations and for consumption smoothing. It is also relevant for policy issues such as the European Union single currency debate (Bayoumi, Sarno and Taylor 1999) and the role of net overseas balances (Lane and Milesi–Feretti 2001).

This paper makes two contributions. First, it exploits recent advances in the nonstationary panel literature. These show that in panels it is possible to estimate consistently the long run association between non-cointegrated $I(1)$ variables. Thus one can avoid the spurious regression problem.[2] The FH puzzle provides a convenient application since, while saving and investment are nonstationary processes, the evidence on cointegration is weak or mixed (Coakley, Kulasi and Smith 1996; Coiteux and Olivier 2000). This paper examines the long run saving-investment association in a panel of 12 OECD economies using a mean group (MG) estimator. Coakley, Fuertes and Smith (2001) show that the latter is consistent in the $I(1)$ error case and has good finite sample properties. This approach thus sidesteps the problems of panel unit root and cointegration testing. There are conceptual difficulties in formulating the appropriate hypotheses for such tests and results are often inconclusive as Baltagi and Kao (2000) emphasise.

Second, the MG estimator permits a high degree of heterogeneity by incorporating country-specific intercepts and slopes. The importance of heterogeneity for the FH puzzle has been stressed by Corbin (2001) and this paper can be seen as an extension of her work. Moreover, it employs a re-

[1] We follow the FH literature in referring to both variables as a proportion of GDP as saving and investment. See Coakley, Kulasi and Smith (1998) for a recent survey of the FH puzzle.

[2] See Phillips and Moon (1999) and Kao (1999) for asymptotic results and Coakley, Fuertes and Smith (2001) for small sample evidence based on Monte Carlo simulations.

cent data set for OECD economies to investigate whether long run capital mobility has remained low. The paper is thus organised. Section 2 outlines the panel framework and analyses the results. A final section concludes.

2 Panel estimation of the FH regression

FH originally used a cross section (CS) or between estimator by taking time averages of saving and investment to avoid common cyclical influences. Their lead has been followed in the literature. The CS regression is given by:

$$\bar{i}_j = \alpha + \beta^{CS}\bar{s}_j + u_j, \ j = 1, ..., N. \tag{1}$$

where j is a country index, $\bar{i}_j = \sum_{t=1}^{T} i_{jt}/T$, $\bar{s}_j$ is similarly defined and u_j is a random error term. A drawback of the CS approach is that it disregards heterogeneity. To overcome this, recent contributions (Coiteux and Olivier 2000; Corbin 2001) employ fixed effects (FE) estimators. These allow for country and/or time dummies but impose a common slope coefficient. The Pesaran and Smith (1995) MG estimator permits heterogeneity in both intercept and slope coefficients.[3]

Another issue is the potential effect of $I(1)$ errors in panels since the evidence on the cointegration of saving and investment is weak. Phillips and Moon (1999) and Kao (1999) prove that in large (T and N) panels the pooled and fixed effects (FE) estimators consistently measure a long run effect even when the variables and error term are $I(1)$.[4] The intuition behind these results is that the noise — the covariance between the $I(1)$ error and the $I(1)$ regressor — that produces the spurious regression problem in time series is attenuated in panels by averaging across independent groups.

To establish the applicability of these asymptotic results, Coakley, Fuertes and Smith (2001) use Monte Carlo simulations to explore the small sample properties of three panel estimators with $I(1)$ variables. They show that $\sqrt{N}$-consistent estimates of the slope coefficient can be obtained in a static regression with $I(1)$ errors using the MG, FE and pooled estimators for panels of typical dimensions. Standard t-tests based on the former are generally

[3] Coakley et al. (1998) show that time series estimates of the slope coefficient reported in the FH literature are very heterogeneous.

[4] Pesaran and Smith (1995) show that the cross section estimator can also provide consistent estimates for nonstationary panels under particular circumstances but the finite sample properties of this estimator remain to be established.

correctly sized irrespective of $I(0)$ or $I(1)$ errors. However, inference based on the latter two estimators is likely to mislead since the standard errors are incorrect (leading to oversized t-tests) both in the $I(1)$ error case and in the case of $I(0)$ errors with heterogeneous slope coefficients. These are precisely the cases which are relevant for the FH puzzle.

To implement the MG procedure the following regression – allowing for country-specific intercepts and slope coefficients – is run separately for each country by OLS:

$$i_{jt} = \alpha_j + \beta_j s_{jt} + u_{jt},\ \ j = 1, ..., N, t = 1, ..., T. \tag{2}$$

to obtain the individual group slope estimates $\hat{\beta}_j$. The MG estimator and its standard error are calculated by:

$$\widehat{\beta}^{MG} = \bar{\beta} = \sum_{j=1}^{N} \hat{\beta}_j / N \tag{3}$$

$$se(\widehat{\beta}^{MG}) = \sigma(\hat{\beta}_j)/\sqrt{N} \tag{4}$$

where

$$\sigma(\hat{\beta}_j) = \sqrt{\sum_{j=1}^{N} (\hat{\beta}_j - \bar{\beta})^2 / (N-1)} \tag{5}$$

The MG estimator provides a measure of the *average long run* saving-investment association in the FH framework.[5]

Quarterly observations on saving and investment 1980I-2000IV are taken for 12 OECD countries, Australia, Canada, Finland, France, Italy, Japan, Netherlands, Norway, Spain, Switzerland, UK and US. This panel is quite heterogeneous ranging from the US and Japan on one hand to Finland, Ireland, and Norway on the other. Table 1 shows that the unit root null cannot be rejected for virtually all the saving and investment series.

[Table 1 around here]

[5] By contrast, the fixed efects and pooled OLS estimators provide estimates of the *long run average* parameter. See Phillips and Moon (1999).

Moreover the augmented Engle-Granger statistic indicates evidence of $I(1)$ errors in all individual group regressions vindicating the use of our nonstationary panel estimator.

Table 2 presents the CS and MG estimates of the long run saving-investment association.

[Table 2 around here]

The results are revealing. The relatively high $\hat{\beta}^{CS}$ of 0.68 is significantly different from zero and from one. Moreover, it is not very different from Feldstein's (1983) estimate of 0.75 for the original FH sample of 15 OECD economies 1960-1980. Thuss these findings not only appear to support the FH puzzle of low long run capital mobility but also reinforce it by indicating no evidence of an increase in recent years.

By contrast, the average long run $\hat{\beta}^{MG}$ estimate at 0.33 is less than half its CS counterpart and suggests precisely the opposite conclusion. Capital is highly mobile in the long run since the hypothesis of perfect capital mobility ($\beta = 0$) cannot be rejected at the 5% significance level. The difference between the CS and MG results can be explained by heterogeneity and $I(1)$ errors. While the latter estimator allows for country-specific intercepts and slopes, the former imposes homogeneity. Our results thus bear out Corbin's (2001) argument that the assumption of homogeneity in analysing the saving-investment association is far from innocuous. When heterogeneity is incorporated into a panel framework capable of dealing with $I(1)$ errors, the FH puzzle virtually disappears.

3 Conclusions

The Feldstein-Horioka puzzle is reconsidered using a new nonstationary panel methodology for 12 OECD economies, 1980I-2000IV. The mean group estimator yields a slope coefficient consistent with long run capital mobility overturning the evidence from the traditional between estimator. The conclusion is that the FH puzzle is not as bad as you think.

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Table 1
Unit root and cointegration tests 1980I-2000IV

	Augmented Dickey-Fuller statistic		*Augmented*
Country	s_t	i_t	*Engle-Granger statistic*
Australia	-3.0097(4T)	-3.1887*(2)	-2.9986(2)
Canada	-0.7642(8)	-0.9039(7)	-1.6980(5)
Finland	0.4060(8T)	-0.6237(5T)	-2.0289(5)
France	-2.7481(3T)	-2.3396(3)	-2.0731(7)
Italy	-2.0566(7)	-3.0223*(1)	-2.8909(1)
Japan	-1.7230(5)	-2.6712(7)	-3.2615(7T)
Netherlands	-4.2931*(3T)	-2.4534(7T)	-2.3727(7)
Norway	-1.2647(7T)	-1.2647(4)	-1.8350(7)
Spain	-1.8203(7)	-1.4042(8)	-1.2870(8)
Switzerland	-2.9652(8)	-3.0797(5T)	-3.3273(5T)
UK	-2.3327(8)	-2.0370(3)	-1.8518(3)
US	-3.6599(5T)	-1.5999(4T)	-2.9151(5)

Notes: Numbers in parenthesis refer to augmentation lag (selected by a testing down procedure at the 10% level starting from $k_{\max} = 8$) and T refers to a time trend.

*Denotes significant at the 5% level using Davidson and MacKinnon (1993) asymptotic critical values for the two tests.

Table 2
FH slope estimates 1980I-2000IV

	CS	MG
$\hat{\beta}$	0.6762	0.3276
$se(\hat{\beta})$	(0.1095)	(0.1765)
t-ratio (β=1)	-2.9572	-3.8091
t-ratio (β=0)	6.1744	1.8557*

*Non-rejection at the 5% significance level.