INTERNATIONAL CAPITAL MOBILITY AMONGST THE G5 ECONOMIES

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ABSTRACT

One of the major controversies in the area of "Open Economy Macroeconomics" is the continued use of the Feldstein-Horioka savings-investment (S/I) correlation. The extant volume of work on this topic is far from conclusive, and so this study plans to re-examine the hypothesis using the FM-OLS panel cointegration test. The panel tests are statistically more powerful and can expose the short run dynamics of the data structure.

This study plans to concentrate on the G5 economies, namely USA, France, Germany, Japan and the United Kingdom. The aim is to see if trade and economic openness has impacted capital mobility among these 5 economies in any significant way. The lack of cointegration in our sample implies greater capital mobility, as domestic saving is not the driving force behind domestic investment and vice versa. **JEL Classification:** F410

INTRODUCTION

The Feldstein-Horioka (1980, F-H henceforth) hypothesis states that a high positive correlation between domestic investment (I) and domestic saving (S) would imply low international capital mobility. This means that domestic savings are being translated into domestic investments, with very little of the international capital component. They contended that if the domestic S and I (both expressed as a ratio of GDP) were cointegrated, that would imply low capital mobility amongst countries. For every country the dictum "our money finances our investment" would be true. There is ample empirical evidence to suggest a high positive correlation between I and S.

Now for closed economies (autarkies) this may be true, but it need not be so for open economies where international capital could be an alternative conduit to finance domestic investment. This should be true to a large extent since in the last quarter century capital has become very mobile, especially among similarly situated (economically, politically, culturally socially etc.) developed countries.

Real world experience suggests that in today's electronic world where information dissemination is instantaneous and money transfer (even in bulk) can be done within seconds and at low transaction costs. Thus countries could raise money from international capital markets where the cost of capital is the lowest. But empirical evidence still suggests a high S/I ratio.

But with increasing allocative efficiency and lowering of per unit transaction costs, capital should be more and more mobile over time. The real world provides ample evidence of ever increasing capital mobility among countries, especially among the developed economies, OECD countries and the European Union. So why would empirical evidence still point to a high S/I correlation and hence low capital mobility? This begs the question “is this an indicator of low capital mobility or is the F-H hypothesis as postulated, not a good indicator of capital mobility?”

The results from the extant literature are across the board. So, there seems to be a conceptual contradiction alive and kicking. There is no reason for capital not to be mobile among developed economies. They are all stable economies and informational efficiency is at its highest level ever with instantaneous electronic transfers. Hence Obstfeld and Rogoff (2000) identify this as one of the six major puzzles in the area of international macroeconomics. This topic is highly researched because academics / researchers / practioner’s are not able to reconcile the contrary evidence between high domestic S/I ratios and the highly efficient international capital markets out there, use of which should indicate high capital mobility. Since the literature is far from unanimous on this topic, this study will revisit this controversy with a different approach and in the process possibly shed some additional light.

This study proposes to analyze the S/Y and I/Y ratios using the Pedroni (2001, 2004) panel cointegration technique for the G-5 countries, France, Germany, Japan, United Kingdom, and the United States, and use savings, investment and GDP data for each country. This is expected to shed some additional light on the relationship between these ratios. The next section gives a brief review of the literature in the field. This is followed by a description of the data set used in this study and a description of the Pedroni procedure. This is followed by a discussion of the empirical results and some concluding remarks.

LITERATURE REVIEW:

The first and indeed a seminal study in this topic was the F-H (1980) paper which correlated the domestic S/I relationship with international capital mobility. In their Economic Journal (1980) study they looked at 16 OECD countries data in a cross sectional set up, between 1960–74. They estimated a regression of the investment/GDP ratio on the Saving/GDP ratio. The F-H correlation is based on the economic rationale that high capital mobility would imply low conversion of domestic savings into domestic investment, since savers would be facing the same world interest rates. But conversely if capital mobility is low, that will drive a wedge between domestic and foreign borrowing costs. F-H found the saving-retention coefficient in their model to be “not significantly different from 1” indicating low capital mobility. This is so because the savings retention coefficient is measured as the proportion of incremental saving invested domestically. If international capital mobility is perfect, this coefficient would be close to zero. Thus very little home investment is financed by foreign money, i.e., international capital mobility is very low. It may be because borrowers have a home country bias (when deciding the source of their funding) which is indeed an accepted norm in international economics. But with increasing allocative efficiency and lowering of per unit transaction costs, capital should be more and more mobile over time. But for this to be true the saviretention coefficient in the model should support this claim.

Next Feldstein (1983) reported similar results. The disconcerting fact was that at the same time there was evidence of the world capital markets getting more and more deregulated, with increasing purchasing power parity and capital allocation being made based on interest rate differentials among economies. These all indicate an increasing degree of capital mobility, hence it was dubbed a puzzle.

The degree of capital mobility is important from the economic development and long run growth point of view also. Efficient capital markets can make the much needed funds available to developing and underdeveloped economies. Allocative efficiency results in the lowest per unit loan costs, thus helping in consumption-smoothing, helping in ones monetary and fiscal policy applications and also help economies cope with sudden exogenous shocks.

But the real world provides ample evidence of ever increasing capital mobility among countries, especially among the developed economies, OECD countries and the European Union. So why would the empirical evidence still point to a high S/I correlation and hence low capital mobility?

Well many reasons have been proposed for this. One line of reasoning states that if both S and I are driven by factors like the growth rate of the economy, the betterment in income distribution and the endogeneity of savings, they would be strongly correlated, even though they may actually be unrelated. Since none of these factors were considered by F-H, according to O, 1986 this could result in a misspecified econometric model with omitted variables, and / or simultaneous equation bias, all of which would bias the statistical values of β.

To get a flavor of the state of the literature, let us look at the results of just a few of the studies done over the last 3 decades, using both time series and cross-sectional techniques. Dooley, Frankel and Mathiesen (1987) found results consistent with the original F-H study. But Bayoumi (1990) contrarily found indication of high capital mobility as evidenced through liberalization of domestic financial markets and dismantling of capital controls. Given this dichotomy Krol (1996) contented that the F-H results were dependent on the estimation techniques used, namely that fixed-effect panel regression had a downward bias.

Obstfeld (1986a) used 70 OECD countries and found the S/I correlation to be significantly different from 1, implying low capital mobility. Miller (1988) found S/I cointegrated, hence indicative of low capital mobility, but only under the fixed exchange rate system for USA. Gulley (1992) found opposite results, especially when a constant was included in the equation. Jansen (1996, 1997) found strong S-I correlation, but this was due to a strong inter-temporal budget constraint effect. He contends that it is this effect which answers the F-H puzzle.

Then there is Coakley, Fuertes and Spagnolo (2003) who also finds a high S/I correlation, implying low capital mobility. Levy (2004) using post war US data (and a neoclassical inter-temporal budget constraint model) finds I/S to be cointegrated, but contends that this is not a good indicator of the degree of international capital mobility.

The variables (S/GDP) and (I/GDP) show characteristics akin to unit roots, and so cointegration analysis can be applied. Thus a number of recent studies have used cointegration processes to evaluate this relationship.

Here Adey (2003) use the original F-H regression for 21 OECD and European Union countries from 1970-2000. They broaden the definition of the S/I terms to resolve the "inherent endogeneity" in the original specification. To this end they start off with a "simultaneous equation model" and then move to "panel estimation techniques." Their results confirm the F-H hypothesis with similar results (80–100 % correlation range) or high correlation between S and I.

Then Bebezuk and Schmidt-Hebbel (2006) use 16 OECD country data between 1973-2003, with sector level economic regression, done by breaking the country into household, corporation and government data. The original F-H (1980) hypothesis in its simple form implies that the correlation coefficient estimate (call it β) will be one with no capital mobility, and will be zero with perfect capital mobility. They find a β coefficient of 0.5, but once the sectoral coefficients are considered, β gets close to zero, implying a high degree of capital mobility.

Next Caporale, Panopoulou and Pitts (2007) use 23 OECD countries data, and find little evidence supporting the F-H hypothesis. Starting with the 1980's, international capital mobility has increased by leaps and bounds. All indicators point in this direction. The US stock market crash of 1987 was almost instantaneously transmitted around international markets. The huge and ever increasing Foreign Direct Investment (FDI) from OECD countries to the emerging economies and portfolio investment across countries, all point to an ever increasing direction of international capital mobility. Also on the bureaucratic side, more and more government barriers are going down, with increasing deregulation and the increasing efficiency of international capital markets. In spite of this, the evidence in the literature on the F-H hypothesis is mixed and hence dubbed a puzzle.

DATA DESCRIPTION

We estimate and test models of cointegration for the France, Germany, Japan, United Kingdom, and United States using the saving/GDP and Investment/GDP ratios. All data were obtained from the OECD National Accounts database. All data is quarterly. Data for all five countries is from 1960 quarter 1 to 2013 quarter 1.

PEDRONI'S PANEL COINTEGRATION TESTS

Cointegration techniques are commonplace in the economics literature, when studying long run relationships among variables. The problem with these tests is that they inherently suffer from low power and confidence. Increasing the time span of the variable series increases its credibility, but in reality it is a difficult proposition. The time span availability of the variables is not dependent on the researcher's discretion. On the other hand if one blindly increases the data time span, the test strength will possibly increase but one could very well have introduced major policy shifts and structural economic changes. An example of this would be using pre-war and post-war data together, just to increase the time span.

Another possibility is to increase the data frequency keeping time span the same. An example would be to use daily instead of weekly data or weekly data in place of monthly data. This increases the number of observations, but that does not necessarily increase the strength of the results.

One remedy to solve this dilemma has been proposed by Pedroni (2001 a, 2001 b, and 2004) where he introduces similar cross-sectional data over the available time period. This pooling of similar data will help in the above stated situation. One example would be where he pooled data from economically similar countries to study PPP (Pedroni, 2004.) The problem here is that simple pooling of time series data would involve "in model" heterogeneity. Here he has constructed "panel cointegration" test statistic (Pedroni , 2004) which allows for one to vary the degree of heterogeneity among the panel members.

Moreover Pedroni (1995, 1997 and 2001 a) has done residual based tests for the null of "no cointegration" for heterogeneous data. In Pedroni (2004) he extends the same test to include heterogeneous dynamics and slope coefficients. It examines both the between dimension and within dimension residuals. The strength of this test is that the resultant "test statistic" is able to accommodate short run dynamics, deterministic trends and also different slope coefficients. This test statistic is "standard normal' and free of nuisance parameters. Given below is a description of the asymptotic properties of the cointegration unit root statistic. The starting point is the standard equation:

$$y_{it} = \alpha_i + \delta_{it} + \beta X_{it} + e_{it} \tag{1}$$

Where y_{it} = dependent variable i= 1, 2….N observations and t= 1, 2….T time periods.
Xit = m-dimensional column vector for each member i
t= time period under consideration,
βi == m-dimensional row vector for each member i,

First, the order of integration(non-stationarity) of the raw data series yit and xit is tested. They are integrated of order one i.e., I(1.) The null hypothesis of no cointegration with an I(1) error structure. Here αi, δi and βi are allowed to be heterogeneous. The null is: Ho : Panel series are not cointegrated, versus the alternative HA : Panel series are cointegrated

Here when the different data series are pooled, the slope coefficient βi will not be of a common slope across different data series. If forcefully a common slope coefficient is imposed (inspite of the true slopes being heterogeneous) the residuals of the data series whose slope differs from the others will be stationary, although in truth they may be cointegrated.

The strength of these pooled tests is that the slope coefficients are not constrained to be the same, but rather allowed to be heterogeneous (i.e., allowed to vary across individual data series.) Here are the results of the tests distributional properties:

1) The standard central limit theorem (CLT) is assumed to hold for each individual series, as the time span grows. The advantage here is that the error struicture includes all auto regressive moving average (ARMA) processes.

2) The matrix structure is (m+1) x (m+1) in size where the off diagonal entities Ω2li capture the feedback between the regressors and the dependent variable. This is the invariance principle.

3) Also cross sectional independence or process i.i.d. (independent and identically distributed) is assumed. This allows for the application of the standard CLT even in the presence of heterogeneous errors. Here Ωi >0 ensures that there is no cointegration between yit. The invariance and cross sectional independence help construct the asymptotic properties of the test statistic. It allows the test statistic to converge asymptotically to the actual values.

$$T^{-2} \sum_{t=1}^{T} z_{it-1}\, z'_{it-1} \Rightarrow L'_i \int_0^1 Zi(\mathrm{r})\; Z_i(\mathrm{r})'\, d_r\, L_i \tag{2}$$

$$T^{-1} \sum_{t=1}^{T} z_{it-1}\, \xi'_{it} \Rightarrow L'_i \int_0^1 Z_i(\mathrm{r})\; d\, Z_i(\mathrm{r})'\, dr\, L_i + \Gamma \tag{3}$$

These convergence results hold under standard assumptions. The assumption of sectional independence allows for "averaging" over the cross sectional sums of the panel statistic. Moreover it also reduces the effect of "nuisance parameters" due to serial correlation in the data as $T \to \infty$. This makes the computation a lot simpler. It also has another distinct advantage. Applying the limit $T \to \infty$ results in higher order terms being eliminated prior to "averaging," leaving only the first order terms of the time series.

Here Pedroni (2004) then demonstrates the asymptotic distribution of the residual based tests for the null of "no cointegration" in heterogeneous panels. His results are fairly general and assumes 'only finite second moments." These results apply to all cases using the generalized format of equation (1) and for any number of regressors, when the slope coefficients are measured separately for each panel data series. He also conducts Monte Carlo simulations to study the small sample properties of the 'statistic' for different panel dimensions. It also includes the consequences of the time series dimensions growing (over time) and at different rates for different variables. He demonstrates excellent convergence of the "t" statistic (as "T" increases beyond 150 observations) keeping N fixed. Then he keeps "T" fixed and varies "N." As the index becomes larger and larger the convergence properties becomes more stable. He also studies the strength and stability of his test statistic against various 'alternative hypotheses." Now regarding the data generating process, it is:

$$y_{it} = x_{it} + e_{it} \tag{4}$$

where $e_{it} = øe_{it-1} + \eta_{it}$, and
$\Delta\, x_{it} \sim N(0,1)$
$\eta_{it} \sim N(0,1)$
ø = {0.9, 0.95, and so on…}

The alternative hypothesis here is that the residuals eit is stationary. They use the autoregressive (AR) process, rather than a moving average (MA) error correction process. They test the empirical power of their test statistic at the 5% level. They also include different combinations of panel dimensions for N and T. The tests are powerful enough to show that using monthly data with more than 20 years of observations, it is quite easily possible to distinguish the cases from the null of "no cointegration" when the data is pooled. Moreover the Monte Carlo simulations show that:

Case 1: For small panels, the group-rho statistic rejects the null of 'no cointegration."

Case 2: For large dimensional panels, the panel –v statistic has the best power. The other statistics lie in between the two extremes of case 1 and case 2.

Pedroni is a residual based test of the "null of no cointegration" hypothesis to estimate the slope coefficients across a panel of countries. The biggest advantage of this procedure is that it takes into consideration heterogeneous effects and economic deterministic trends. The test statistic is asymptotically "normal" and free of "nuisance parameters."

EMPIRICAL RESULTS

The S/Y and I/Y ratios for each of the countries are tested for the presence of unit roots, and all series are found to have unit roots (the results are not included in the paper as they are standard results). This study then proceeda to apply the

Pedroni (2004) tests, which is a test of the null hypothesis that all the individuals in the panel are not cointegrated against the alternate hypothesis that a significant portion of the individuals are cointegrated. This study also goes on to estimate the Pedroni (2001) Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) tests which test whether the coefficient of the cointegrating equation is equal to one, which would imply an absence of capital mobility as described in F-H (1980).

The results give in table 1 are for the Pedroni (2004) tests and there is weak evidence in favor of cointegration between the countries as in 5 out of 8 cases this study is unable to reject the null hypothesis (H0: all countries in the panel are not cointegrated) in favor of the alternative hypothesis (H1: a substantial portion of the countries in the panel are cointegrated). This is evidence against the Feldstein-Horioka hypothesis existing among the G-5 members in the period 1960-2010.

The results in table 2 are for the Pedroni (2001 a) test which is carried out on a data set which is cointegrated and the null hypothesis is that the coefficient in the cointegrating equation is equal to one, which would be evidence against the F-H (1980) hypothesis as F-H stated that even for developed countries the coefficient should be about 0.10. The null hypothesis is rejected in all cases indicating that there is evidence in favor of the F-H hypothesis. However, due to our inability to find strong evidence that the is cointegration between the Investment-GDP and Saving-GDP ratios, the evidence from the Pedroni (2001) test is suspect and requires further investigation.

CONCLUSION

We have looked at the relationship between the saving-GDP and investment-GDP rations for the G-5 countries France, Germany, Japan, U.K, and U.SA. The evidence in favor of cointegration is weak at best. A previous study done by the authors on the NAFTA countries (USA, Canada, and Mexico) show evidence against the F-H hypothesis (evidence in favor of capital mobility among the countries) post 1994 implying that the trade agreement increased capital mobility among the three NAFTA members. The lack of cointegration in our sample implies greater capital mobility, as domestic saving is not the driving force behind domestic investment and vice versa. The Pedroni (2004) procedure's ability to not have to impose a common slope coefficient on the cointegrating regression makes the results more rigorous. The results are not surprising given the low level of U.S. savings and yet high level of investment in the U.S. which has been primarily financed by savings from other countries like Japan and Germany.

REFERENCES

Adey, H.A., (2003), "An investigation into the Feldstein-Horioka puzzle: Does the puzzle persist" Department of Economics, Final Report, Georgetown University.

Bayoumi, T., (1990), "Saving-investment correlations: Immobile capital, government policy or endogenous behavior" *IMF* Staff Papers, 37 (2), pp.

Bebczuk, R. and Schmidt-Hebbel, K., (2006), "Revisiting the Feldstein-Horioka puzzle: An institutional sector view" *MPRA* Paper # 1802.

Bodman, P.M., (1995), "National savings and domestic investment in the long term: Some time series evidence from the OECD" I*nternational Economic Journal*, 9, pp. 37-60.

Caporale, G.M., Panopoulou, E. and Pittis, N., (2007), " The Feldstein-Horioka puzzle revisited: A Monte-Carlo study" University of Piraeus Working Paper.

Coakley, J., Fuertes, A and Spagnolo, F., (2003), "The Feldstein-Horioka puzzle is not as bad as you think" *Money Macro and Finance Research Group* Conference Paper, 17, pp. 1-21.

Dooley, M., Frankel. J and Mathieson, D., (1987), "International capital mobility. What do saving-investment correlations tell us?" *IMF* Staff Papers, 34, pp.503-30..

Feldstein, M. and Horioka, C. (1980), "Domestic saving and international capital flows" *The Economic Journal*, 90, pp. 314 -29.

Feldstein, M., (1983), "Domestic saving and international capital movements in the long run and the short run" *European Economic Review* 21, 129–151

Gulley, O. (1992), "Are savings and investments cointegrated: Another look at the data" *Economics Letters*, 39, pp. 55-58.

Jansen, J., (1996), "Estimating saving-investment correlations: evidence for OECD countries based on an error correction model" *Journal of International Money and Finance*, 15, pp. 749-81.

Jansen, J., (1997), "Can the inter-temporal budget constraint explain the Feldstein-Horioka puzzle" *Economics Letters*, 56, pp. 77-83.

Krol. R., (1996), "International capital mobility: evidence from panel data" *Journal of International Money and Finance*, 15 (3), pp. 467-74.

Levy, D., (2004), "Is the Feldstein-Horioka puzzle really a puzzle?" in Aspects of Globalization: Macroeconomic and Capital Market Linkages in the Integrated World Economy, ed. by C. Tsoukis, G. Agiomirgianakis and T. Biswas. Published by Kluwer Academic Publishers, 2004.

Miller, S.M. (1988), Are saving and investment cointegrated" *Economics Letters*, 27, pp. 31-34.

Obstfeld, M., (1986), "Capital mobility in the world economy" *Carnegie-Rochester Conference Series on Public Policy*, 24, pp. 55-104.

Obstfeld, M. and Rogoff, K., (2000), "The six major puzzles in international macroeconomics: is there a common cause? *NBER* Working Paper # 7777.

Pedroni, Peter, (1995), "Panel Cointgration: Asymptotics and Finite Sample

Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis," *Indiana University Working Papers in Economics*, 95-013.
Pedroni, Peter, (1997), "Panel Cointgration: Asymptotics and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis: New Results, *Indiana University Working Papers in Economic*s.
Pedroni, Peter, (2001 a), "Panel Cointgration: Asymptotics and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis," revised Working Paper, Indiana University.
Pedroni, Peter, (2001 b), "Purchasing Power Parity tests in cointegrated panels, *Review of Economics and Statistics* 83, pp. 727-31.
Pedroni, Peter, (2004), "Panel Cointgration: Asymptotics and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis," *Econometric Theory*, Vol. 20, No. 3, pp. 597-625.

Table 1:

S/Y and I/Y: Pedroni (2004) tests for Panel Cointegration, full time period (1960, Q1 – 2010, Q4)

	v-stat	Rho-stat	t-stat	ADF-stat
Panel Statistics				
Standard	2.84*	-1.72*	-1.30	-0.84
Time demeaned	2.20*	-1.58	-1.16	-0.63

NOTE: All reported values are distributed as N (0,1) under the null hypothesis. An asterisk indicated rejection of the null hypothesis at the 10% level or higher.

Table 2:

S/Y and I/Y: Pedroni (2001) tests for Panel Cointegration, (1960, Q1 – 2010, Q4)

Country	FMOLS	t-stat	DOLS	t-stat
France	0.58	-6.38**	0.64	-6.24**
Germany	0.61	-2.36*	0.59	-2.40*
Japan	0.82	-5.12**	0.85	-4.94**
U.K.	0.48	-7.26**	0.49	-6.03**
U.S.A.	0.28	-12.48**	0.24	-13.04**
Panel results				
Without Time Dummies				
Between	0.56	-13.88**	0.56	13.61**
With Time Dummies				
Between	0.46	-10.40**	0.48	-10.03**