# REVISITING THE FELDSTEIN-HORIOKA PUZZLE: AN INSTITUTIONAL SECTOR VIEW

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## ABSTRACT

Working on a sample of OECD countries spanning the period 1970-2003, this paper contributes to the Feldstein-Horioka literature by making three main innovations: (1) It estimates, for the first time, regressions at the institutional sector level (households, corporations, and government); (2) It explores the asymmetry between current account deficits and surpluses; and (3) It uses advanced panel data techniques to deal with endogeneity and to distinguish long- and short-run effects. The conclusions of the paper are that: (i) The national Feldstein-Horioka coefficient is in the vicinity of 0.5, but sectoral coefficients are much lower, a puzzling result possibly explained by endogenous intersectoral saving and investment links; (iii) The FH coefficients are higher in deficit than in surplus years; and (iv) The long-run relationship is in all cases below 1, which raises the question as to whether the intertemporal budget constraint should be interpreted.

*JEL Classification:* F16, F32
*Keywords:* Felstein-Horioka Puzzle, saving, investment, institutional sectors

# REVISITING THE FELDSTEIN-HORIOKA PUZZLE: AN INSTITUTIONAL SECTOR VIEW

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## I. Introduction

The seminal paper of Martin Feldstein and Charles Horioka (1980) unleashed a heated debate that still mesmerizes scholars and remains at the center of the macroeconomic research agenda. In its simplest form, the Feldstein-Horioka (henceforth, FH) test consists of running a regression of the national investment rate on the national saving rate, either for cross-section, time series or panel data. Let $\beta$ be the estimated coefficient. Allegedly, $\beta=1$ indicates financial autarky (the usual macroeconomic identity of a closed economy) and $\beta=0$ signals full capital mobility. FH´s finding that the investment and saving rates are highly correlated has proven to be a robust stylized fact for both industrial and developing countries over time. Our principal goal is to bring attention into the institutional sector breakdown of saving and investment under the conviction that it should enrich our understanding of this famous and polemic issue in international finance. We will be working with a unbalanced sample of OECD countries spanning the period 1970-2003. The choice of this particular dataset was motivated by the unavailability of investment and saving time series by institutional sector in most countries and because the odds that Feldstein-Horioka should fail are the highest in view of their level of economic, institutional and financial development. The widespread statistical acceptance of a sizable yet decreasing correlation becomes, as a result, both intriguing and challenging.

Indeed, the correspondence between high capital mobility and the value of

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[1] * We would like to acknowledge the research assistantship of Federico Traverso, Federico Grillo, Máximo Sangiácomo and Alvaro Aguirre. Lorena Garegnani provided invaluable support on econometric issues. Luciano Digresia helped us handling some computer programs. The paper greatly benefited with fruitful comments from Rodrigo Cerda, Rodrigo Fuentes, Rómulo Chumacero and Kevin Cowan, as well as other participants in a seminar held at the Central Bank of Chile. A previous version was published in *Ensayos Economicos*, Central Bank of Argentina; comments from two anonymous referees are appreciated. We are also grateful for the insightful remarks of José Fanelli. Remaining errors are our sole responsibility.

$\beta$ is disputable on intuitive grounds. For example, as discussed in Sachsida and Caetano (2000), a country running each year a constant current account deficit to GDP of 10% with investment and saving to GDP moving upward and downward at the same pace would yield a $\beta$ coefficient equal to one, even though most people would characterize this country as facing high capital mobility. One can come up with other odd cases: The same country with its constant 10% external deficit, but with investment and saving stuck over time at 30% and 20% of GDP, would have now a zero $\beta$ coefficient. Moreover, some empirical studies take the proportion of the change in investment financed with external saving as a measure of capital mobility (see Sachs (1981) and Glick and Rogoff (1995)), but such measure is difficult to reconcile with the Feldstein-Horioka coefficient. Put in other words, FH is a nice measure of how well the current account varies to fill the gaps between investment and saving, when the latter variables are subjected to large and asymmetric shocks, but it is not the ultimate test of capital mobility.

Nevertheless, the intellectual and policy value of the Feldstein-Horioka test should not be undermined by this controversy. At the end of the day, it remains a powerful test of international financial constraints. In perfect international capital markets (free from intermediation costs, asymmetric information, and other frictions), a country should be indifferent to finance its investment with domestic or foreign saving. On the contrary, evidence that domestic investment tracks domestic saving implies that international capital mobility is not perfect. Rephrasing, a $\beta$ coefficient positive and significantly different from zero supports the lack of full capital mobility. This approach is borrowed from the test designed for individual companies by Fazzari, Hubbard and Petersen (1988), who run investment equations on internal funds, claiming that a positive and significant coefficient, after controlling for investment opportunities, is an indication of financial constraints.[2,3]

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[2] Hubbard (1998) extensively reviews the literature and cites several sources of disagreement over the validity of the test, some of them along the same lines as those against the Feldstein-Horioka test. But as in the latter case, this test has been resilient to criticism and is still widely used in finance.

[3] For the most part, studies on national and corporate financial constraints do not take into account wealth stocks. This might give rise to misleading conclusions, as a non significant correlation of investment and saving may be due to fluid access to credit and/or the use of accumulated financial assets. However, we will not pursue this issue throughout the paper.

The critique that has shed the darkest shadows over the validity of this test as a measure of capital mobility is that they might be an artifact of economic and statistical shortcomings. For the sake of exposition, we can classify the arguments into the following categories:

a. *Endogeneity*. Whenever the saving rate is positively correlated with the error term, the β coefficient will be upward biased, regardless of the true degree of financial constraints. One frequently raised case in the literature is that saving and investment might react in a similar fashion to third economic forces other than financial constraints (see for example Payne (2005), and Loayza et al. (2000) and Serven (2002) on the empirics of private saving and investment, respectively). As an illustration, a higher GDP growth rate is likely to simultaneously increase current saving and investment. Likewise, as governments may set narrow targets of current account imbalances, measures may be in place to maintain a tight correlation of saving and investment by, say, modifying interest rates or the fiscal balance.

Nevertheless, a note of caution is in order. The endogeneity argument may wrongly lead to believe that one should ideally specify a full model of the saving and the investment rate before running the Feldstein-Horioka test. This is not the spirit behind this test. For one, no matter how many saving and investment determinants one can come up with, in a closed economy both variables will be equalized due to the binding financial constraint. Consequently, the Feldstein-Horioka coefficient will be one, truthfully reflecting the fact that the country has no financial ties with the rest of the world. Secondly, in a more realistic setting of imperfect capital mobility, one might want to control for the effect of omitted variables causing a correlation between investment and saving *not explained by financial constraints*. As usual in the instrumental variables literature, this task can prove to be formidable and not entirely convincing. Financial constraints are not directly observable, and their intensity is intertwined with several macroeconomic variables in a complex way. For example, a temporary productivity shock tends to increase both saving and investment. As a result, we are tempted to control for, say, the GDP growth rate. However, the macroeconomic literature states that the excess sensitivity of saving and investment to current GDP growth may well be explained also by myopia or financial constraints. In the latter case, the unexplained residuals –after controlling for the productivity shock- will not necessarily capture the financial constraint that was intended to isolate in the first place, rendering a low but not fully reliable coefficient.

In sum, by controlling for other saving and investment determinants, one is taking the delicate risk of transforming a supposedly spurious coefficient biased upward (towards one) into another potentially spurious coefficient biased downward (towards zero). Even though there is no obvious solution for this caveat, our results, to be shown momentarily, seem to be robust enough to the available endogeneity tests.

b. *Intertemporal budget constraint*. In order to meet this budget constraint, saving and investment should be equal to each other in the long run, but not necessarily in the short run.[4]

This paper makes an original contribution to the FH literature by exploring the institutional sector dimension in OECD countries. The mounting work on this puzzle has so far neglected the implications of the household, corporate and government components of the national saving and investment rates.[5] Why this research angle is of utmost relevance comes from the very fact that countries are just abstract entities. Actually, those who engaged (or not) in financial relations with the rest of the world and with each other are the households, the corporations, and the government. To draw any sound policy advice on financial openness, a clear understanding of sectoral behavior is called for. For instance, from an economic growth perspective, a financially-constrained corporate sector is more pervasive than the household or the government sector going through such situation; on the contrary, financial stability would likely be less at risk with a financially-constrained government sector, especially in developing economies. Equally important, the comparison between the national β coefficient and the sectoral β coefficients provides a priori a nice test of international vis-à-vis intranational financial constraints, allowing to have a better grasp about how financial markets work within

[4] Another related criticism is that the Feldstein-Horioka coefficient may approach one with a sufficiently large sample of countries. Take the extreme case of a sample including all countries in the world.. It is true that the correlation between world saving and investment is by construction one (the world is a closed economy), but as long as there exists capital movements across countries, the resulting Feldstein-Horioka estimate may take any value.

[5] The only (at least to our knowledge) two papers that test FH paying attention to sectoral decomposition reach conflicting results. Argimon and Roldan (1994) investigate the casual relationship between the saving-investment gaps of the government and the private sector in European countries over 1960-1988 without finding any connection. However, Iwamoto and van Wincoop (2000) report negative correlations of more than 80% for OECD countries in 1975-1990.

countries by taking a closer look at intersectoral flows.

Beyond the data-related value added, our work advances in other fronts, especially in tackling the caveats cited above. First, we test the robustness of our results by using different panel data techniques and by accounting for common and fiscal factors affecting saving and investment. Second, we split the sample into current account deficits and surpluses to unveil possible asymmetries. Finally, we employ novel dynamic panel data estimators to distinguish long- and short-run investment-saving comovements.

The structure of the paper is as follows: In Section 1, we describe our database and highlight some stylized facts. In Section 2, we run our baseline national and sectoral Feldstein-Horioka regressions, with and without controlling for potential common factors. A fiscal behavior approach is put forward in Section 3 to interpret our findings, which are further dissected by separating deficit and surplus years in Section 4. The distinction between long-run and short-run sensitivity of investment to saving is discussed in Section 5. Some conclusions close.

## II. Stylized Observations

Before going into the econometrics, several patterns in the series (in all cases, gross rates to GDP) involved will be underlined, some of which will help rationalize later findings. Tables 1 to 8 report country averages and standard deviations of the saving, investment and current account rates to GDP at the national and sectoral levels. The following facts stand out:

(i) In spite of being a rather homogeneous set of countries, pronounced differences in investment and saving rates strike the eye, both for national and sectoral figures. For example, the national saving rate ranges from 15.7% in the UK to 32.6% in Korea and 31.2% in Switzerland. Incidentally, the dispersion is higher in saving than in investment rates;

(ii) The corporate sector generates on average more saving than any other sector in the economy, although in 6 out of the 16 countries it is the household saving the one leading the saving statistics. On the investment side, the corporate sector contributes with the bulk of the national investment (57.9%), although the household and government sectors are responsible for significant fractions (28.7% and 13.4%).[6] This defies the usual textbook claim that

[6] Conventional national accounting may misclassify some expenditures items such as durable

households save and businesses invest, with the financial system acting as the intermediary of funds;

(iii) The average national current account is just 0.6%, but, again, huge differences across countries are found. The range goes from –4.4% in Australia to 7.6% in Switzerland. These figures indicate that foreign saving finances a marginal portion of domestic saving (2.4% on average and a maximum of 17.5% in Australia);

(iv) Current accounts behave quite differently across sectors. Households have an average surplus of 3.4% of GDP (with only 3 deficit countries), while corporations and governments display deficits of 1.6% and 1.2% respectively;

(v) Elemental macroeconomic theory leads us to expect that the current account is more volatile than both consumption and investment, based on the role of shock absorber of the current account under capital mobility. Strikingly, we find in the sample that the current account is roughly as volatile as the saving rate in national and sectoral data, and that the saving rate is on average at least as volatile as the investment rate, even though this is not a regularity on a country-by-country basis (see Fanelli (2005a, 2005b) for a thorough discussion on volatility in macroeconomic variables).[7]

## III. Baseline Econometric Results

We start by running the FH equation for national investment and saving, as well as for household, corporate and government figures, using three panel data techniques: pooled OLS, Random Effects, and Fixed Effects. The results presented in Table 9 point towards a national coefficient ranging between 0.43 and 0.60, much in line with previous studies.[8] Our main interest, though, are

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goods and education as household consumption rather than investment, and something similar can be said of public expenditures on education and health, among others. Unfortunately, data is not readily available to produce these alternative measures of saving and investment for the complete sample. However, such statistical adjustment is most unlikely to alter our econometric results in a significant way. For that to happen, we should assume that the degree of financial constraints for the additional investment items is utterly different than for the type of expenditures currently recorded in our investment measures. Since there is neither theoretical nor empirical support for this assumption, we believe that the results would be robust to this test.

[7] It could be argued that it is private saving and investment what should be looked at, as stated by the corporate veil literature. Nevertheless, results do not change qualitatively.

[8] For example, Boyreau and Wei (2004) obtain for the whole, balanced OECD sample an estimate of 0.71 in 1960-1977 and 0.46 for 1978-2001. Blanchard and Giavazzi (2002) show

the sectoral coefficients, and they are consistently lower than the national one. The household FH coefficient is always significant and varies from 0.15 to 0.17. The corporate and government coefficients are not significantly positive, except in the pooled OLS specification. However, a Chow test indicates that the latter method is inconsistent vis-à-vis Fixed Effects, implying that the intercept homogeneity constraint is rejected, so we will disregard the pooled model and focus instead in the other estimators from now on.[9] Consequently, we are able to claim that the household coefficient is about one third of the national one, and that the positive investment-saving correlation disappears at the corporate and government levels. In Chart 1 we show rolling estimates of β covering the entire 1970-2003, from which it can be observed a marked reduction of the national and corporate coefficients, yet not steady, from the 1970s to the early 2000s. In turn, the household and government βs seem to have been more stable over time. For all time windows, the fact remains that the national coefficient exceeds the sectoral coefficients, and the government always displays the lowest one.[10]

As mentioned in the Introduction, FH exercises are sometimes said to be driven by the existence of common factors explaining saving and investment and not by imperfect capital mobility. To put our results to the test, we will follow two procedures. The first one builds on Iwamoto and van Wincoop (2000), who perform a conditional FH test for OECD countries and Japanese regions to eliminate usual suspects that may jointly shape saving and investment decisions, and then use the unexplained residuals of the corresponding regressions to estimate a common-factor-free FH coefficient. The estimated β become insignificantly different from zero in their time-series exercises as such controls are entered. While an ingenious procedure, it is disputable whether to attribute the weakening of the saving-investment relationship to a successful elimination of the endogeneity bias, as discussed

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even lower values for the European Union over the 1990s.

[9] Hausman tests were unconclusive regarding the choice between random and fixed effects across the different regressions. However, as the coefficients are quite similar to each other, this does not represent a serious dilemma.

[10] We used a recursive method, by which we start with the period 1970-1979, and then we add additional observations to obtain estimates for 1970-1980, 1970-1981, and so on until getting the value for 1970-2003. The reported coefficient corresponds to the random effects estimation. It must be recalled that the number of observations increases with the span of the (unbalanced) sample.

above in the paper. Nonetheless, as far as the estimated coefficients do not change in response to the inclusion of new controls in both sides of the equation, the baseline results should look more reliable.

After demeaning annual data by subtracting annual cross-country averages –which is equivalent to introducing time dummy variables but preserves degrees of freedom- as a means of eliminating common international systemic factors, we controlled both investment and saving for GDP growth, the inflation rate and per capita GDP and used the resulting residuals to compute the FH coefficient, yielding the estimates shown in Table 10. Previous results in this Section stay the same to a great extent, with the exception of the government coefficient that becomes significant, but still below a value of 0.05.

Yet another test of robustness is to employ internal instruments by applying the GMM system technique on both the unconditional and the conditional regressions as a way of dealing with the potential endogeneity of saving –see the Annex for a description of this method.[11] Again, no noteworthy change is observed, as revealed by Table 11.[12]

After discarding the presence of spurious correlations, we are prepared to concentrate ourselves on a new puzzle within the FH puzzle, as the marked contrast between the national and sectoral results begs some interpretation.

## IV. A New Feldstein-Horioka Puzzle?

Is it sensible to expect the national FH coefficient to be higher than sectoral coefficients? Since the interaction between the private and the public sector is key to approach this question, we will do some elementary algebra to shed light on this finding. FH states that $i = \beta s$, where $i$ and $s$ are the investment and saving rates, respectively, and $\beta$ is the FH coefficient. As national investment can be expressed as $i = i_p + i_g$, that is, the sum of private and

[11] We used the second to the sixth lags as instruments in the GMM exercises conducted throughout the paper. Results were in general (but not always) robust to changes in the lag structure. Sargan and first- and second-order autocorrelation tests indicate that no specification problems were present.

[12] Actually, the irrelevance of common factors should not come as a total surprise. Recalling that past studies encountered that FH coefficients declined in a noticeable way over time, it is difficult to attribute this downward trend to a time-varying influence of third variables.

public investment, and that there exist sectoral FH relationships of the form $i_p = \beta_p s_p$ and $i_g = \beta_g s_g$, the national FH coefficient can be written as $\beta = \beta_p (s_p / s) + \beta_g (s_g / s)$, namely, a weighted average of sectoral coefficients, with the weights being the proportions in national saving.[13] This gives an intuitive answer that clashes with the empirical results: a country cannot be more financially-constrained than their domestic institutional sectors. Rephrasing, if the Fisher separation theorem between saving and investment holds for each sector, it must necessarily hold for the country as a whole, once the national saving and investment rates are just the sum of the sectoral rates –all coefficients, national and sectoral, must be closed to zero. Likewise, if each sector finances its investment solely with its own saving (the sectoral coefficients are one), the national coefficient must also be one.

The previous relationship implicitly assumes that there is no systematic linkage among the sectoral current accounts. If we rule out this assumption, it is possible to rationalize the coexistence of a high national and low sectoral FH coefficients. Suppose the case in which $s_g - i_g = \alpha(s_p - i_p)$ and $s_h - i_h = \gamma(s_c - i_c)$, where $\alpha \leq 0$ and $\gamma \leq 0$. Redefining the national FH equation as $s - i = (1\text{-}\beta)\ s$ and inserting the above equations, then $\beta = 1\text{-}[(1+\alpha)(1+\gamma)\ (1\text{-}\beta_c)\ s_c/s]$. Note for any given value of $\beta_c$, the lower $\alpha$ and $\gamma$, the higher $\beta$.[14] As an extreme example, if $\alpha = -1$ and $\gamma = -1$, then $\beta = 1$ even with $\beta_c = 0$. Therefore, under this framework, we may observe a national coefficient higher than the sectoral ones, the reason being that the independence between saving and investment for any particular sector (implying a low sectoral β) will be partially mirrored, with the opposite sign, by one or both of the other sectors, thus causing a high national β.

What is more challenging is the interpretation of this evidence, which is consistent with at least four storylines: (a) The government aims to target a balanced national current account by running a surplus (deficit) every time the private sector runs a deficit (surplus); (b) There exists a negative relationship between private and public saving via Ricardian equivalence; (c) There is a crowding-out effect in financial markets, by which whenever the government

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[13] As a matter of fact, taking into account the usual constant term in each regression, one should add a new term equal to the sum of the sectoral constants minus the national constant.

[14] The argument does not change if the equation is defined in terms of any of the other two sectoral coefficients.

runs a deficit, the interest rate goes up, boosting private saving and hampering private investment, namely, reducing the current account deficit of the private sector or increasing its surplus;[15] (d) Household saving responds negatively to changes in corporate saving, as posited by the corporate veil literature; and finally, (e) There is limited international capital mobility but high intranational capital mobility across sectors, so surplus sectors finance deficit sectors.

Ideally, we would like to be able to discern whether the explanation for our finding has to do with capital mobility consideration, the latest argument in the previous paragraph, or with any of the other conjectures.[16] Unfortunately, it would be excessively daring on our part to settle this debate without a fully specified model, which is well beyond the scope of this paper -we aim instead to presenting some stylized facts about these investment-saving correlations at the sectoral level.

## V. Deficits, Surpluses and the Feldstein-Horioka Puzzle

The basic notion behind FH is that investment and saving move in tandem because the country or sector cannot invest beyond the amount of own resources it disposes of. This opens up the possibility of asymmetric correlations under current account deficits and surpluses. We should expect that investment would not deviate much from saving when facing a deficit under less-than-full capital mobility, but there is no reason to predict the same close relationship under a surplus, as saving can be as much larger than investment as desired.[17] To test the hypothesis, we created two annual dummy variables, with value 1 if a current account deficit (surplus) is observed, and 0 otherwise, which we then interacted with the saving rate. A positive and larger coefficient is expected on the Deficit vis-à-vis the Surplus resulting explanatory variables. Table 12 shows the estimates obtained by the same

[15] It is possible for a crowding-in effect to exist between public and private investment when public investment foster the marginal productivity of private projects. However, this would create a positive rather negative interaction between the public and private current accounts (for given saving rates).

[16] Through elemental unreported regressions we find preliminary support for all these hypotheses.

[17] Of course, the latter assertion relies on the realistic assumption that there are no capital controls limiting financial investment for surplus units, which became the predominant case in the sample from the early 1970s, when our sample begins –until then, controls were in place in some countries for investments abroad.

methods used in earlier sections, confirming our belief: FH correlations are in general much stronger for deficit than for surplus years –although the coefficient on corporate deficits is not significant in the GMM regression. For the Deficit variable, the correlation climbs to around 0.5 for households and to 0.3 for corporations, while for the Surplus variable, it reaches about 0.2 for households but stays non-significant for corporations (save for the significant 0.1 with the random effects estimation). As in previous sections, we find higher values at the national level vis-à-vis sectoral levels and, once again, the government sector happens to yield non-positive correlations in all cases.

We will highlight two new findings. First, the recovered significance of the FH correlation for deficit figures implies that financial constraints do seem to exist at the end of the day for the household and corporate sectors every time investment exceeds saving. Even though the estimates are in the lower bound within the empirical FH literature, they are still far from negligible. In turn, the higher correlation for household vis-à-vis corporations looks a priori reasonable, once one should believe the average household to be more financially constrained than the average corporation because of differences in size, age, and available collateral, all of which have a bearing on intermediation costs and the extent of informational asymmetries. These frictions become especially acute in international borrowing, where exchange rate uncertainty, exacerbated informational problems, and judicial and institutional barriers are at play –indeed, households rarely access international credit markets.

The second and more intricate fact is the significant household surplus coefficient, , which is certainly not what the standard theory predicts regarding the separation of investment and saving decisions in the absence of financial constraints. Even though, as mentioned above, the correlation coefficient is rather low, it is highly significant and robust, thus deserving some brief analysis. The obvious candidate for explaining this is, once more, the influence of common factors on saving and investment, but we can quickly reject it after recalling that common factors did not appear to drive our baseline results. Anyway, we repeated the procedure of Section 2 and ran individual regressions of investment and saving on GDP growth, the inflation rate and per capita GDP for deficit observations, on one hand, and for surplus observations, on the other hand, and then computed the FH coefficient for the corresponding residuals. Had the surplus coefficient dropped significantly, there would have been some ground to blame common factors for the positive correlation in surplus times, but the (unreported) results were similar to the previous ones. A plausible alternative rationale is that, in simultaneously deciding saving and investment, each sector would be trying not to run excessive surpluses. After all, sacrificing current consumption pays off as long as the ensuing wealth accumulation allows economic units to avoid undesirable fluctuations in future consumption and investment. In this view, economic agents likely set an optimal rate of wealth accumulation based, among other factors, on their current wealth stocks, their forecasted income volatility, and their attitude towards risk. Once reached this optimal level, agents would prefer raising their consumption rather than their wealth, limiting their current account surpluses and strengthening the investment-saving correlation.

## VI. Intertemporal Budget Constraint and the Feldstein-Horioka Puzzle

Perhaps the most popular explanation for the strong correlation between saving and investment is that a country must meet its budget constraint in the long run, so current account deficits (surpluses) will be compensated by future surpluses (deficits). We study this issue by looking at the total and sectoral investment-saving relationships in the long- and short-run using the Pooled Mean Group (PMG) methodology, adopting a ARDL (1,1) structure.[18] This methodology is appealing because it enables to distinguish long-run and short-run effects in panel data, testing at the same time whether there is long-run homogeneity across units while maintaining short-run country heterogeneity. We offer additional details on this technique in the context of our present application in the Annex. We will work with unconditional Feldstein-Horioka regressions because the core of the argument revolves around the observed levels of investment and saving, no matter what underlying factors explain them.

The regression output appears in Table 13. Regarding total investment and saving, our first finding is that the long-run relationship is 0.75, with a lower short-run response of 0.25. The negative error correction term of 0.29 ensures the stability of the model and shows that half of the adjustment takes place in just 2.4 years.[19] Does the rejection of the hypothesis that the long-run

[18] Results were not sensitive to the change in the lag structure.

[19] Also using PMG, Pelgrin and Schich (2004) find for a balanced sample of 20 OECD countries a long-run coefficient of 0.93 for 1960-1999 and 0.92 for 1970-1999, with an error correction estimate of -0.33 in both cases and short-run effects of 0.25 and 0.22.

coefficient is equal to 1 immediately mean that the intertemporal budget constraint is not satisfied? Our answer is no, as the notion of long run is somewhat arbitrary for a country, whose planning horizon is quite long. Particularly, for industrial countries, current account imbalances are observed for extended periods of time.[20] In the end, the need to have a balanced current account over rather short periods obeys to reputational considerations in international markets, which affect more heavily developing countries. At any rate, our sample does not look long enough to expect a one-to-one relationship between saving and investment in OECD countries. It must also be noted that the fact that the coefficient is not above 1 guarantees that the stock of external debt does not grow unboundedly.

All the sectoral long-run results are well below 1, with the corporate sector in the upper limit (0.58) and the household and government sectors in the lower one (0.078 and 0.062, respectively). In all cases, the error correction term is negative, as surprisingly are the short-run impacts. According to the Hausman test, the long-run parameter homogeneity cannot statistically be rejected in any of the equations, even though country-specific short-run responses vary in a noticeable fashion.[21] This homogeneity constraint explains the efficiency gains of the PMG over the MG reflected in the lower standard deviations of the estimates.

At this point we are concerned about the different long-run coefficient across sectors. For the non-significant government coefficient, the most sensible motive is that sovereign borrowers, especially in developed countries, enjoy a reputational and tax-levying advantage over private borrowers in local and foreign capital markets, which allows them to issue debt with much longer maturities and easy rollover. As for the difference between the corporate and the household sector, our main hypothesis goes along the same lines as those sketched in Section 4: the time frame to meet the intertemporal budget constraint is different for deficit and surplus economic units. Our previous analysis documented that financial constraints do arise once investment exceeds saving. In our sample, households are typically surplus units and corporations are deficit units.[22] In this light, the corporate sector is forced to, at

[20] A case in point, among others, is Australia, whose current account has been strongly negative in all but 18 years since 1861 (see Cashin and Wickham (1998)).
[21] For space reasons, the short-run coefficients are not reported, but are available from the authors upon request.
[22] Over the total sample of 390 observations, a current account deficit was recorded in 55 cases

least partially, repay its debt in the long-run, creating a positive nexus between investment and saving. The surplus household sector, on the contrary, is in position to decide more freely its saving and investment rates not only in the short- but also in the long-run.[23] A complementary reason that warrants the less-than-unitary coefficient is an aggregation issue: while the government is both a sector and a legal unit per se, there are millions of corporations and households. As a result, even though each of them may satisfy their own budget constraints, the sector as a whole may look as if not. In a simplistic example, suppose non-overlapping corporations living each just one period. At the end of the first period, the first company pays its debt and ceases to exist, but simultaneously the second one starts up and raises debt. Going on and on, corporate debt as a whole will not necessarily go down, regardless of the fact that each individual company respects its budget constraint in the short-run.[24] In our particular empirical application, this atomization blurs to some extent the long-run analysis on the household and corporate sectors.

Of importance here is also to underline that the fiscal view is still valid here: if the government targets the current account –as advanced in Section 3-, then the long-run national coefficient may be high even if the country is not required to meet its intertemporal budget constraint.[25] In consequence, the presence of a national coefficient higher than each and every sectoral long-run FH coefficient can be interpreted as before, with the additional upward influence of the high and positive corporate sector coefficient.

To close, it is worth noting that the cross-section regressions, a crude approximation to the long-run relationship, yield estimates of 0.59, 0.51, 0.19 and 0.16 for the national, corporate, household and government equations, somewhat similar to the PMG long-run coefficients of 0.75, 0.58, 0.078 and 0.062.

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(14.1%) for households and in 276 cases (70.8%) for corporations.

[23] Of course, in the long-run (whatever long-run means in our intertemporal problem) households have to satisfy their transversality condition (not leaving unconsumed wealth), unless bequests or other motives cause them to deviate from it.

[24] The usually growing levels of domestic credit to the private sector in most countries is an eloquent piece of evidence of this kind of heterogeneity at the interior of the corporate and household sectors.

[25] But this does not work the other way around, as a high long-run coefficient does not necessarily imply a high short-run coefficient.

## VII. Conclusions

Our goal in this paper was to re-examine the so-called Feldstein-Horioka puzzle introducing several data, economic and statistical innovations. Our findings, some of which question established assumptions and previous results in the literature, can be summarized as follows: (i) The national Feldstein-Horioka coefficient is in the vicinity of 0.5, but sectoral coefficients are much lower and even insignificantly different from zero; (ii) Such positive and significant national coefficient do not necessarily reflect frictions in international credit markets but might be related to endogenous intersectoral saving and investment links; (iii) Nevertheless, when the sample is split into deficit and surplus years, a higher and significant correlation emerges for the former at the national, household, and corporate level, implying that credit imperfections may still play a role for the private but not for the public sector; and (iv) Against the background of a unitary long-run coefficient to satisfy the intertemporal budget constraint, the long-run relationship is 0.75 for national data, 0.6 for the corporate sector, and marginally or non-significant at the household and government level.

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**Appendix: GMM and PGM estimators**

Two modern dynamic panel data procedures are employed along with the more usual random and fixed effect techniques, namely, the Generalized Method of Moments (GMM) and the Pooled Mean Group (PMG) estimators. Given their relative novelty in the applied macroeconomic field, we devote a few lines to explain how they work.

GMM has two evident advantages: first, it allows to deal with the inconsistency created by the presence of the lagged dependent variable as a regressor; second, it allows to relax the assumption of strict exogeneity of the explanatory variables. Our basic regression will be of the form:

$$inv_{i,t} = \beta_1 inv_{i,t-1} + \beta_2 sav_{i,t} + \mu_i + \varepsilon_{i,t} \qquad i = 1, ..., N \qquad t = 1, ..., T$$

where *inv* is the investment rate, *sav* is the saving rate, *i* stands for each of the N cross-section units, t represents each of the T time-series units, $\beta_1$ and $\beta_2$ are scalar, $\mu_i$ and $\varepsilon_{i,t}$ are an individual-specific effect and an error term, respectively, with zero mean and constant and finite variance and independent of each other.

A major drawback with this specification is that the introduction of the lagged dependent variable as an explanatory variable gives rise to biased and inconsistent estimators. The reason is that both $inv_{i,t}$ and $inv_{i,t-1}$ are functions of $\mu_i$. By first-differencing the previous equation, it is possible to account for the unobserved individual effects to obtain:

$$inv_{i,t} - inv_{i,t-1} = \beta_1 (inv_{i,t-1} - inv_{i,t-2}) + \beta_2 (sav_{i,t} - sav_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1})$$

It can be observed that there still is correlation between the lagged dependent variable and the new error term. If the error $\varepsilon_{i,t}$ is serially uncorrelated $[E(\varepsilon_{i,t}\varepsilon_{i,s})=0$ for $t \neq s]$, values of *inv* lagged two periods or more are valid instruments, so for $t \geq 3$ the following linear moment restrictions are satisfied:

$$E[(\varepsilon_{i,t} - \varepsilon_{i,t-1}) inv_{i,t-2}] = 0 \qquad t = 3, ..., T$$

Furthermore, we will assume that the saving rate weakly exogenous, meaning that future (but not necessarily contemporaneous and lagged) realizations of the error term are uncorrelated with the x set. Formally, $E(sav_{i,t}\varepsilon_{i,s})\neq 0$ for $t\geq s$ and $E(sav_{i,t}\varepsilon_{i,s})=0$ otherwise. This suggests that values of x lagged two periods or more serve as instruments, with the associated additional linear moment restrictions:

$$E[(\varepsilon_{i,t}-\varepsilon_{i,t-1})sav_{i,t-2}]=0 \qquad t = 3, ..., T$$

Arellano and Bond (1991) develop a consistent Generalized Method of Moments (GMM) estimator from these moment restrictions. This method has the additional advantage that does not rely on any particular probability distribution. Moreover, they distinguish a one-step and a two-step estimator, the difference being that in the latter case the residuals from the former are used to reestimate the coefficients.

Nonetheless, Blundell and Bond (1998) notice that lagged levels of the dependent variable may become poor instruments as far as this variable is highly persistent over time –as a matter of fact, the estimated coefficient is biased toward zero when the autorregressive parameter approaches one. In such a case, lagged differences of the dependent variable can serve as suitable instruments in the level regressions, provided this new instrument is uncorrelated with the fixed effect, which in turn require that the dependent variable be mean stationary. All this boils down into an additional set of moment restrictions:

$$E[(inv_{i,t-1}-inv_{i,t-2})(\eta_i+\varepsilon_{i,t})]=0$$
$$E[(sav_{i,t-1}-sav_{i,t-2})(\eta_i+\varepsilon_{i,t})]=0 \qquad t = 3, ..., T$$

By stacking the equations in differences with the equations in levels, a GMM system estimator results with superior performance in terms of unbiasedness and asymptotic efficiency.

An additional issue we would like to address is whether short- and long-run effects can be distinguished. Standard panel data techniques restrict the estimated coefficients to be the same for all cross-section units, allowing at most for group-specific intercepts by using fixed-effects. At the other extreme, in the case of full panel heterogeneity, a mean group (MG) estimator -the average of the estimated coefficients from separate equations for each group- is consistent. Since in most cases we should expect parameter homogeneity in the long-run but not in the short-run, an intermediate estimator should be considered. The Pooled Mean Group (PMG) estimator developed by Pesaran, Shin and Smith (1999) appears as a sensible alternative. If the long-run homogeneity constraint is valid, the PMG will be consistent and efficient, but if it is not, it will be, unlike the MG estimator, inconsistent. This constraint can be tested with a Hausman test on each explanatory variable. Another caveat of the MG estimator is that, when the time and cross-section dimensions are short, it is quite sensitive to outliying country estimates. This comes from the fact that the MG estimator is an unweighted average of individual group estimators, and thus it suffers from the same problem as any average. The PMG estimator is more akin to a weighted average. Specifically, the method first estimates the common or pooled long-run coefficients, and then uses them to estimate the short-run coefficients and the speed of adjustment. The unweighted average of all these estimates is a consistent estimate of the short-run effects.

Suppose that the investment rate follows an autorregressive, distributed lag (ARDL) process of order (1, 1):

$$inv_{it} = \mu_i + \beta_1 inv_{i,t-1} + \beta_2 sav_{it} + \beta_3 sav_{i,t-1} + \varepsilon_{it}$$

Subtracting $inv_{it,-1}$ from both sides and adding and subtracting $\beta_3 sav_{it}$ in the right-hand side, we obtain the error correction equation:

$$\begin{aligned}\Delta inv_{it} &= -(1-\beta_1)\left[inv_{i,t-1} - \frac{\mu_i}{(1-\beta_1)} - \frac{(\beta_2+\beta_3)}{(1-\beta_1)} sav_{it}\right] + \beta_3 \Delta sav_{it} + \varepsilon_{it} \\ &= -(1-\beta_1)\left[inv_{i,t-1} - s^*_{it}\right] + \beta_3 \Delta sav_{it} + \varepsilon_{it}\end{aligned}$$

where $s^*$ is the common long-run solution and $\Delta$ is the difference operator. The PMG first estimates the common long-run effects $\left[\mu_i/(1-\beta_1)\right]$ and

$\left[(\beta_2 + \beta_3)/(1-\beta_1)\right]$ to later on estimate the short-run coefficient $\beta_3$ and the speed of adjustment $\left[-(1-\beta_1)\right]$.

**Figure 1**
**Feldstein-Horioka Coefficient: Rolling recursive estimations, 1970-2003**

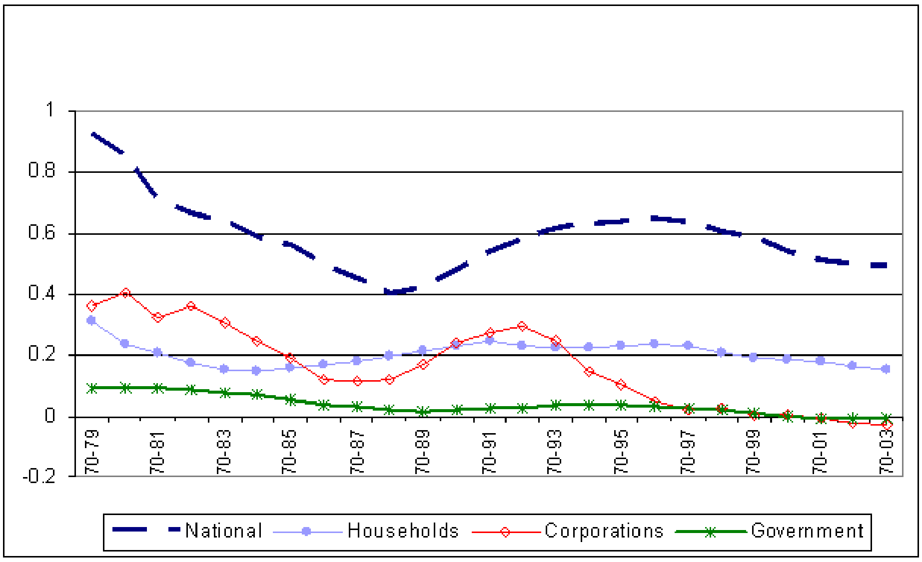

**Table 1**
**Gross National Saving and Investment to GDP: Country Averages**

| Country | S | I | S-I |
|---|---|---|---|
| Belgium | 23.7 | 20.1 | 3.7 |
| UK | 15.7 | 17.9 | -2.1 |
| Switzerland | 31.2 | 23.6 | 7.6 |
| Italy | 21.2 | 21.4 | |
| Japan | 31.0 | 29.0 | 2.0 |
| Norway | 28.3 | 24.6 | 3.7 |
| US | 17.2 | 19.2 | -2.0 |
| Netherlands | 25.0 | 21.4 | 3.6 |
| Spain | 21.0 | 22.5 | -1.5 |
| Finland | 24.1 | 23.8 | 0.2 |
| Germany | 20.7 | 21.0 | -0.3 |
| Australia | 20.8 | 25.1 | -4.4 |
| Denmark | 19.3 | 19.8 | -0.5 |
| France | 20.2 | 20.5 | -0.3 |
| Canada | 20.5 | 21.7 | -1.1 |
| Korea | 32.6 | 32.1 | 0.5 |
| *Average* | *23.3* | *22.7* | *0.6* |
| *St. Dev.* | *5.1* | *3.7* | *2.9* |

Coverage: Belgium, 1985; UK, 1987-2003; Switzerland, 1990-2002; Italy, 1980-2003; Japan, 1980-2002; Norway, 1978-2003; US, 1970-2003; Netherlands, 1980-2003; Spain, 1981-2003; Finland, 1975-2003; Germany, 1991-2003; Australia, 1970-2003; Denmark, 1981-2003; France, 1978-2003; Canada, 1970-2003; Korea, 1975-2003.
Spurce: OECD (www.sourceoecd.org)

**Table 2**
**Gross Household Saving and Investment to GDP**
**Country Averages**

| **Country** | **S** | **I** | **S-I** |
|---|---|---|---|
| Belgium | 11.7 | 5.7 | 6.0 |
| UK | 5.3 | 4.3 | 1.0 |
| Switzerland | 11.2 | 5.9 | 5.3 |
| Italy | 19.3 | 7.9 | 11.5 |
| Japan | 13.2 | 6.8 | 6.3 |
| Norway | 5.3 | 5.9 | -0.7 |
| US | 8.5 | 7.2 | 1.4 |
| Netherlands | 10.7 | 6.0 | 4.7 |
| Spain | 7.9 | 5.5 | 2.4 |
| Finland | 5.9 | 7.1 | -1.1 |
| Germany | 11.1 | 7.5 | 3.6 |
| Australia | 11.6 | 9.8 | 1.8 |
| Denmark | 3.8 | 4.4 | -0.6 |
| France | 9.8 | 6.7 | 3.1 |
| Canada | 10.4 | 6.4 | 4.0 |
| Korea | 13.1 | 6.8 | 6.3 |
| *Average* | *9.9* | *6.5* | *3.4* |
| *St. Dev.* | *3.8* | *1.3* | *3.3* |

Coverage: Belgium, 1985; UK, 1987-2003; Switzerland, 1990-2002; Italy, 1980-2003; Japan, 1980-2002; Norway, 1978-2003; US, 1970-2003; Netherlands, 1980-2003; Spain, 1981-2003; Finland, 1975-2003; Germany, 1991-2003; Australia, 1970-2003; Denmark, 1981-2003; France, 1978-2003; Canada, 1970-2003; Korea, 1975-2003.
Spurce: OECD (www.sourceoecd.org)

**Table 3**
**Gross Corporate Saving and Investment to GDP**
**Country Averages**

| Country | S | I | S-I |
|---|---|---|---|
| Belgium | 14.1 | 12.4 | 1.8 |
| UK | 10.3 | 11.7 | -1.4 |
| Switzerland | 17.4 | 14.6 | 2.8 |
| Italy | 6.1 | 10.7 | -4.5 |
| Japan | 14.3 | 16.8 | -2.5 |
| Norway | 14.2 | 15.3 | -1.1 |
| US | 9.2 | 9.6 | -0.4 |
| Netherlands | 10.7 | 12.1 | -1.4 |
| Spain | 12.2 | 13.5 | -1.3 |
| Finland | 12.1 | 13.4 | -1.3 |
| Germany | 9.3 | 11.4 | -2.1 |
| Australia | 8.3 | 12.3 | -4.0 |
| Denmark | 14.6 | 13.5 | 1.1 |
| France | 9.1 | 10.7 | -1.6 |
| Canada | 10.3 | 12.2 | -2.0 |
| Korea | 11.9 | 20.5 | -8.6 |
| *Average* | *11.5* | *13.2* | *-1.6* |
| *St. Dev.* | *2.9* | *2.7* | *2.6* |

Coverage: Belgium, 1985; UK, 1987-2003; Switzerland, 1990-2002; Italy, 1980-2003; Japan, 1980-2002; Norway, 1978-2003; US, 1970-2003; Netherlands, 1980-2003; Spain, 1981-2003; Finland, 1975-2003; Germany, 1991-2003; Australia, 1970-2003; Denmark, 1981-2003; France, 1978-2003; Canada, 1970-2003; Korea, 1975-2003.
Spurce: OECD (www.sourceoecd.org)

**Table 4**
**Gross Government Saving and Investment to GDP**
**Country Averages**

| Country | S | I | S-I |
|---|---|---|---|
| Belgium | -2.1 | 2.0 | -4.1 |
| UK | 0.1 | 1.9 | -1.8 |
| Switzerland | 2.6 | 3.1 | -0.5 |
| Italy | -4.2 | 2.9 | -7.1 |
| Japan | 3.5 | 5.4 | -1.9 |
| Norway | 8.8 | 3.4 | 5.4 |
| US | -0.5 | 2.5 | -3.0 |
| Netherlands | 3.6 | 3.2 | 0.4 |
| Spain | 0.9 | 3.5 | -2.6 |
| Finland | 6.1 | 3.4 | 2.6 |
| Germany | 0.3 | 2.1 | -1.8 |
| Australia | 0.9 | 3.1 | -2.2 |
| Denmark | 0.9 | 1.9 | -1.0 |
| France | 1.2 | 3.1 | -1.9 |
| Canada | -0.1 | 3.0 | -3.1 |
| Korea | 7.6 | 4.8 | 2.8 |
| *Average* | *1.9* | *3.1* | *-1.2* |
| *St. Dev.* | *3.4* | *1.0* | *3.0* |

Coverage: Belgium, 1985; UK, 1987-2003; Switzerland, 1990-2002; Italy, 1980-2003; Japan, 1980-2002; Norway, 1978-2003; US, 1970-2003; Netherlands, 1980-2003; Spain, 1981-2003; Finland, 1975-2003; Germany, 1991-2003; Australia, 1970-2003; Denmark, 1981-2003; France, 1978-2003; Canada, 1970-2003; Korea, 1975-2003.
Spurce: OECD (www.sourceoecd.org)

**Table 5**
**Gross National Saving and Investment to GDP**
**Standard Deviation of Country Rates**

| Country | S | I | S-I |
|---|---|---|---|
| Belgium | 2.4 | 1.4 | 1.8 |
| UK | 1.2 | 1.8 | 1.3 |
| Switzerland | 1.9 | 2.6 | 2.7 |
| Italy | 1.7 | 2.5 | 1.6 |
| Japan | 2.4 | 2.4 | 1.0 |
| Norway | 3.4 | 3.9 | 5.7 |
| US | 2.1 | 1.5 | 1.3 |
| Netherlands | 1.7 | 1.3 | 1.5 |
| Spain | 1.6 | 2.0 | 1.7 |
| Finland | 3.5 | 5.0 | 4.3 |
| Germany | 1.0 | 2.1 | 1.3 |
| Australia | 3.0 | 2.5 | 1.7 |
| Denmark | 2.5 | 1.8 | 2.5 |
| France | 1.8 | 1.9 | 1.7 |
| Canada | 2.7 | 2.3 | 2.0 |
| Korea | 5.1 | 4.0 | 4.7 |
| *Average* | *2.4* | *2.4* | *2.3* |

Coverage: Belgium, 1985; UK, 1987-2003; Switzerland, 1990-2002; Italy, 1980-2003; Japan, 1980-2002; Norway, 1978-2003; US, 1970-2003; Netherlands, 1980-2003; Spain, 1981-2003; Finland, 1975-2003; Germany, 1991-2003; Australia, 1970-2003; Denmark, 1981-2003; France, 1978-2003; Canada, 1970-2003; Korea, 1975-2003.
Spurce: OECD (www.sourceoecd.org)

**Table 6**

**Gross Household Saving and Investment to GDP**
**Standard Deviation of Country Rates**

| Country | S | I | S-I |
|---|---|---|---|
| Belgium | 1.6 | 0.7 | 1.7 |
| UK | 1.7 | 0.6 | 2.2 |
| Switzerland | 0.7 | 0.7 | 1.1 |
| Italy | 5.7 | 1.2 | 4.8 |
| Japan | 2.2 | 1.1 | 1.4 |
| Norway | 1.5 | 1.9 | 2.7 |
| US | 2.3 | 0.9 | 2.2 |
| Netherlands | 1.5 | 0.7 | 2.1 |
| Spain | 0.9 | 0.7 | 1.3 |
| Finland | 1.6 | 2.0 | 2.4 |
| Germany | 0.5 | 0.6 | 0.9 |
| Australia | 3.8 | 1.4 | 3.3 |
| Denmark | 2.0 | 0.8 | 2.4 |
| France | 1.4 | 1.3 | 1.5 |
| Canada | 3.3 | 0.8 | 3.1 |
| Korea | 4.0 | 2.0 | 3.2 |
| *Average* | *2.2* | *1.1* | *2.3* |

Coverage: Belgium, 1985; UK, 1987-2003; Switzerland, 1990-2002; Italy, 1980-2003; Japan, 1980-2002; Norway, 1978-2003; US, 1970-2003; Netherlands, 1980-2003; Spain, 1981-2003; Finland, 1975-2003; Germany, 1991-2003; Australia, 1970-2003; Denmark, 1981-2003; France, 1978-2003; Canada, 1970-2003; Korea, 1975-2003.
Spurce: OECD (www.sourceoecd.org)

**Table 7**
**Gross Corporate Saving and Investment to GDP**
**Standard Deviation of Country Rates**

| Country | S | I | S-I |
|---|---|---|---|
| Belgium | 1.5 | 1.1 | 1.2 |
| UK | 1.7 | 1.4 | 2.4 |
| Switzerland | 1.5 | 1.7 | 2.0 |
| Italy | 1.7 | 1.0 | 2.4 |
| Japan | 2.0 | 1.7 | 3.2 |
| Norway | 1.0 | 2.3 | 2.0 |
| US | 0.8 | 1.0 | 1.1 |
| Netherlands | 1.5 | 1.2 | 1.5 |
| Spain | 1.3 | 1.3 | 1.9 |
| Finland | 3.3 | 2.9 | 4.9 |
| Germany | 0.8 | 1.3 | 1.4 |
| Australia | 1.8 | 1.4 | 2.4 |
| Denmark | 2.0 | 1.5 | 2.4 |
| France | 1.7 | 1.0 | 2.0 |
| Canada | 2.0 | 1.5 | 2.5 |
| Korea | 1.9 | 2.7 | 3.3 |
| *Average* | *1.7* | *1.6* | *2.3* |

Coverage: Belgium, 1985; UK, 1987-2003; Switzerland, 1990-2002; Italy, 1980-2003; Japan, 1980-2002; Norway, 1978-2003; US, 1970-2003; Netherlands, 1980-2003; Spain, 1981-2003; Finland, 1975-2003; Germany, 1991-2003; Australia, 1970-2003; Denmark, 1981-2003; France, 1978-2003; Canada, 1970-2003; Korea, 1975-2003.
Spurce: OECD (www.sourceoecd.org)

**Table 8**

**Gross Government Saving and Investment to GDP**
**Standard Deviation of Country Rates**

| Country | S | I | S-I |
|---|---|---|---|
| Belgium | 3.4 | 0.4 | 3.6 |
| UK | 2.6 | 0.5 | 2.9 |
| Switzerland | 1.4 | 0.4 | 1.5 |
| Italy | 3.4 | 0.5 | 3.9 |
| Japan | 2.7 | 0.6 | 2.8 |
| Norway | 3.8 | 0.5 | 4.1 |
| US | 2.0 | 0.2 | 1.9 |
| Netherlands | 3.6 | 0.3 | 3.7 |
| Spain | 1.9 | 0.6 | 2.0 |
| Finland | 4.2 | 0.4 | 4.1 |
| Germany | 0.9 | 0.5 | 0.7 |
| Australia | 2.1 | 0.7 | 2.2 |
| Denmark | 2.8 | 0.3 | 3.0 |
| France | 1.8 | 0.3 | 1.8 |
| Canada | 3.3 | 0.5 | 3.3 |
| Korea | 2.2 | 0.7 | 1.8 |
| *Average* | *2.6* | *0.5* | *2.7* |

Coverage: Belgium, 1985; UK, 1987-2003; Switzerland, 1990-2002; Italy, 1980-2003; Japan, 1980-2002; Norway, 1978-2003; US, 1970-2003; Netherlands, 1980-2003; Spain, 1981-2003; Finland, 1975-2003; Germany, 1991-2003; Australia, 1970-2003; Denmark, 1981-2003; France, 1978-2003; Canada, 1970-2003; Korea, 1975-2003.
Spurce: OECD (www.sourceoecd.org)

**Table 9**
**Baseline National and Sectorial Feldstein-Horioka Regressions**

| | National | Household | Corporate | Government |
|---|---|---|---|---|
| Pooled OLS | 0.60<br>(16.45)*** | 0.173<br>(9.29)*** | 0.385<br>(10.4)*** | 0.089<br>(7.84)*** |
| Random Effects | 0.496<br>(11.88)*** | 0.15<br>(6.87)*** | -0.028<br>(-0.6) | -0.008<br>(-0.92) |
| Fixed Effects | 0.479<br>(10.62)*** | 0.146<br>(6.4)*** | -0.059<br>(-1.21) | -0.011<br>(-1.33) |

**Table 10**
**Conditional FH Tests**

| | National | Household | Corporate | Government |
|---|---|---|---|---|
| Random Effects | 0.482<br>(13.27)*** | 0.126<br>(5.41)*** | 0.055<br>(1.13) | 0.049<br>(4.8)*** |
| Fixed Effects | 0.462<br>(11.49)*** | 0.118<br>(4.77)*** | 0.01<br>(0.21) | 0.046<br>(4.5)*** |

**Table 11**
**GMM System FH Estimates**

| | National | Household | Corporate | Government |
|---|---|---|---|---|
| Unconditional FH coefficient | 0.543<br>(4.02)*** | 0.136<br>(1.00) | 0.21<br>(0.92) | -0.054<br>(-1.48) |
| Conditional FH coefficient | 0.433<br>(3.25)*** | 0.163<br>(2.18)** | -0.241<br>(-2.08)** | -0.067<br>(-2.39)** |

**Table 12**
**FH Correlations for Deficit and Surplus Years**

| | Random Effects | Fixed Effects | GMM System |
|---|---|---|---|
| National (Deficit) | 0.742 (22.92)*** | 0.695 (19.89)*** | 0.766 (9.75)*** |
| National (Surplus) | 0.558 (18.72)*** | 0.513 (15.59)*** | 0.539 (7.85)*** |
| Household (Deficit) | 0.536 (11.32)*** | 0.524 (10.9)*** | 0.456 (1.27) |
| Household (Surplus) | 0.221 (10.37)*** | 0.216 (9.69)*** | 0.192 (2.6)** |
| Corporate (Deficit) | 0.301 (5.93)*** | 0.249 (4.82)*** | 0.344 (2.32)** |
| Corporate (Surplus) | 0.101 (2.35)** | 0.057 (1.28) | 0.072 (0.77) |
| Government (Deficit) | -0.004 (-0.27) | -0.007 (-0.52) | -0.04 (-1.18) |
| Goverment (Surplus) | -0.01 (-0.97) | -0.014 (-1.3) | -0.066 (-6.2)*** |

**Table 13: Feldstein-Horioka Sectoral Regressions (Pooled Mean Group)**

| | Pooled Mean Group | Mean Group | Hausman Test (p-value in parenthesis) | Dynamic Fixed Effects |
|---|---|---|---|---|
| Total Saving Rate | | | | |
| Long-Run Coefficient (Total Saving) | 0.750 (10.021)*** | 1.052 (4.488)*** | 1.84 (0.17) | 0.709 (4.583)*** |
| Error Correction Coefficient | -0.291 (-7.431)*** | -0.337 (-9.950)*** | | -0.278 (-6.361)*** |
| Short-Run Coefficient (Δ Total Saving) | 0.253 (2.510)** | 0.193 (2.138)** | | 0.131 (1.009) |
| Constant | 1.437 (3.998)*** | 0.491 (0.363) | | |
| Household Saving Rate | | | | |
| Long-Run Coefficient (Household Saving) | 0.078 (2.233)** | -0.901 (-1.176) | 2.75 (0.10) | 0.394 (1.12) |
| Error Correction Coefficient | -0.229 (-5.105)*** | -0.261 (-5.517)*** | | -0.159 (-5.841)*** |
| Short-Run Coefficient (Δ Household Saving) | -0.129 (-1.382) | -0.106 (-1.186) | | 0.499 (3.142)*** |
| Constant | 1.364 (3.831)*** | 1.552 (4.847)*** | | |
| No. of Countries | 16 | 16 | | 16 |
| No. of Observations | 374 | 374 | | 374 |

Note: t-statistics in parenthesis. ***Significant at 1%, **Significant at 5%, *Significant at 1%.

**Table 13: Feldstein-Horioka Sectoral Regressions (Pooled Mean Group) (Cont.)**

| | Pooled Mean Group | Mean Group | Hausman Test (p-value in parenthesis) | Dynamic Fixed Effects |
|---|---|---|---|---|
| Corporate Investment Rate | | | | |
| Long-Run Coefficient (Corporate Saving) | 0.585 (5.451)*** | 6.286 (1.168) | 1.12 (0.29) | 0.439 (3.257)*** |
| Error Correction Coefficient | -0.337 (-12.291)*** | -0.337 (-8.727)*** | | -0.329 (-9.75)*** |
| Short-Run Coefficient (Δ Corporate Saving) | -0.214 (-2.96)*** | -0.231 (-3.144)*** | | -0.081 (-1.09) |
| Constant | 1.99 (9.6)*** | 1.187 (1.036) | | |
| Government Investment Rate | | | | |
| Long-Run Coefficient (Government Saving) | 0.062 (4.451)*** | 1.72 (1.117) | 1.16 (0.28) | 0.083 (2.759)*** |
| Error Correction Coefficient | -0.233 (-7.84)*** | -0.284 (-6.306)*** | | -0.194 (-6.733)*** |
| Short-Run Coefficient (Δ Government Saving) | -0.049 (-3.066)*** | -0.058 (3.030)*** | | -0.051 (-6.151)*** |
| Constant | 0.678 (5.828)*** | 0.748 (5.426)*** | | |
| No. of Countries | 16 | 16 | | 16 |
| No. of Observations | 374 | 374 | | 374 |

Note: t-statistics in parenthesis. ***Significant at 1%, **Significant at 5%, *Significant at 1%.