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Developing Countries and the Feldstein-Horioka Puzzle[1]

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Abstract

The previous literature points to a high correlation between domestic rates of investment and savings among OECD countries. Some take this as evidence of limited financial integration in the industrialized world. This paper presents new empirical results, based on an extended sample of countries. The correlation coefficient in a regression of the rate of domestic investment on the rate of domestic savings is statistically insignificant most of the time and generally smaller than 0.3 for any sample other than the OECD. This finding is robust with respect to alternative time periods, subsample and estimation methods. In particular, we control for measurement error, business cycle effects, and country-specific fixed effects.

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SUMMARY

The previous literature points to a high correlation between domestic rates of investment and savings among OECD countries. Some take this as evidence of limited financial integration in the industrialized world. This paper shows that this result holds only for OECD countries and vanishes when any other sample of countries is considered.

Based on a longer time period (1970-93) and a more recent data set than the previous literature, we show that when we analyze different samples that include low– and middle–income countries the strong positive correlation between domestic investment and domestic savings no longer holds. The correlation coefficient in a regression of the rate of domestic investment on the rate of domestic savings is statistically insignificant most of the time and generally smaller than 0.3 for any sample other than the OECD. This finding is robust with respect to alternative time periods, subsamples, and estimation methods.

Finally, we estimate a fixed effects regression using panel data (previous literature has focused only on cross-country regressions), which also shows a very high correlation of domestic investment and domestic saving for OECD economies and a very low one for any other sample of countries.

1. INTRODUCTION

The Feldstein and Horioka (1980) finding that changes in domestic investment are very sensitive to changes in domestic savings for OECD countries launched a debate regarding the degree of financial integration and financial openness within the industrialized world. The existing literature supports the empirical finding that domestic investment and domestic savings are closely correlated across OECD countries, but there is substantial disagreement about the interpretation of this result.

The issue of the sensitivity of domestic investment to changes in domestic savings has been tackled mainly in the case of industrialized nations. However, it is also relevant for developing countries. Questions such as the potential role of foreign capital in financing domestic capital formation, the appropriate monetary and exchange rate policies in the presence of tight financial constraints, as well as problems of tax evasion, are very specific to developing countries. Applying the Feldstein-Horioka methodology to LDC data may highlight some of these specificities.

Our paper shows that the Feldstein-Horioka result holds only for OECD countries and vanishes when any other sample of countries is considered. Summers (1985) also found that the correlation of domestic investments and domestic savings is much smaller, 0.31 (statistically significant) when non-OECD countries are included in the sample, for the period 1973-80. However, Fieleke (1982) found much larger coefficients for the period 1968-1977: 0.662 for the world (87 countries) and 0.654 for 69 non-industrialized countries (the coefficient is equal to 0.816 when Saudi Arabia is excluded from the sample). Dooley, Frankel and Mathieson (1987) found a coefficient of 0.455 for the period 1960-73 and 0.610 for the period 1974-84, for 48 developing countries. However, when they pooled developed and developing countries together they did not find the difference of the correlation of domestic investments and domestic savings between the two groups of countries to be statistically significant. Our estimates differ from these results. Based on a longer time period (1970-1993) and a more recent data set, we show that when we analyze different samples that include low and middle income countries the strong positive correlation between domestic investment and domestic savings no longer holds. The estimated coefficient in most cases is insignificantly different from zero and in every case statistically different from one. Instrumental variable estimates, to account for measurement error, also confirm our findings. Finally, we estimate a fixed effects regression using panel data (previous literature has focused only on cross-country regressions), which also shows a very high correlation of domestic investment and domestic saving for OECD economies and a very low one for any other sample of countries.

Our paper is organized as follows: Section 2 we briefly discuss past empirical work and relevant conceptual considerations. Section 3 describes our results based on cross country and panel data regressions. Section 4 contains concluding remarks.

II. THE FELDSTEIN-HORIOKA PARADOX

A. The Feldstein-Horioka Paradox in Industrial and Developing Countries

There are several reasons to expect the Feldstein-Horioka results to change when developing countries are explicitly brought into the picture. Firstly, heterogeneity in financial characteristics or factor endowments may drive international diversification. Competitive trade theory predicts that countries which differ substantially in factor endowments will not experience factor price equalization through trade in goods (Appendix 1). This would provide incentives for factors to move internationally. Indeed, migration occurs mainly between developing and developed countries; similarly, in the absence of capital controls, capital can be expected to move mainly between dissimilar countries. When factor endowments are relatively similar across countries, trade in goods can achieve the same outcomes as trade in factors; and since factor prices are equalized, factors face much lower incentives to move internationally.

Consider an alternative explanation for the Feldstein-Horioka puzzle. Under uncertainty, risk-return considerations imply that diversifying investors should invest in markets which differ significantly in terms of movements in asset values (Appendix 2). For instance, when stock prices are highly correlated across stock markets, opportunities for international diversification are lower. A simple way to understand this point is to consider two assets with identical rates of return. If both assets move systematically in opposite directions, a rational investor will want to devote half of her portfolio to each. If their prices are perfectly positively correlated, on the other hand, the investor will be indifferent as to which asset she will hold. Appendix 3 presents correlations of stock returns for a selection of countries. While the correlation of returns between the U.S. and U.K. stock markets is equal to .41, correlations with emerging markets and within the group of emerging markets are much lower (in most cases insignificantly different from 0). This suggests that opportunities for diversification are indeed greater among developing countries than among industrial countries.

A third consideration specific to developing countries relates to their access to foreign capital. During the 1970s, after the increase in international liquidity that followed the first oil crisis, the developing world found access to foreign capital in the form of cheap government debt and foreign aid. Foreign capital inflows increased, allowing a rise in domestic investment. At the same time, domestic savings declined, mainly through a significant increase in government deficits. In contrast, in the second half of the 1980s, the debt crisis prevented developing countries from gaining access to new foreign borrowing. Foreign capital inflows dropped significantly, causing a significant drop in domestic investment, while domestic savings increased, mainly through a reduction in government spending and other measures of adjustment. Therefore, we should expect that investment in developing countries during the 1970s and 1980s was more sensitive to foreign capital inflows and outflows than changes in domestic savings. Actually, in many such countries domestic investments and savings tended to evolve in opposite directions. In this case, a low

correlation of domestic investment and domestic saving in developing countries will not necessarily imply that capital markets were well integrated during this period, since capital movements were mainly the result of official transactions and private investors were often facing capital controls.

B. Lessons from the Literature

A high correlation of savings and investment may not necessarily signal a low degree of financial integration (Frankel, 1991, 1992). Two alternative explanations may account for this observation. The first hypothesis is that common factors such as economic or population growth could codetermine the rates of domestic savings and investment, an explanation favored by Obstfeld (1985). This would account for the observed correlation, even in the presence of open capital markets. Feldstein and Bacchetta (1990) pointed out, however, that the data for industrial countries were not consistent with the Obstfeld hypothesis. Other sources of endogeneity have been explored in theoretical models. Frankel (1985) argues that the existence of non-traded goods or immobile factors of production (such as labor) imposes a constraint which may produce covariations in savings and investment. Sustained productivity shocks such as technological change can also cause savings and investments comovements even in an open economy framework (Obstfeld, 1985).

A second general hypothesis is that a high correlation of savings and investment rates does not necessarily signal limited international financial transactions. For instance, policymakers may seek to attain a target current account balance (typically a low one), through appropriate regulations, fiscal or balance of payments policies. Summers (1985) discusses such a policy-reaction explanation. If cross-country target levels are similar, the high correlation of savings and investment across countries follows automatically.

Lastly, a low estimated correlation between the rates of domestic savings and investment would mean that net capital inflow is an important determinant of domestic investment. However, there are also potential sources of downward bias in the estimated correlation of savings and investment rates. Measurement error is probably the dominant source of bias. The official data do not capture the activities in the underground economy, which is of considerable size in many middle and low income countries. Another source of bias would be some form of endogeneity of the savings rate. Bhagwati (1978) suggested that the saving rate in LDCs could be inversely related to net foreign capital inflows, because governments tend to implement policies of substitution between foreign capital and domestic savings, in order to increase the internal level of consumption and welfare in the short and medium terms.

Sinn (1992) estimated the Feldstein-Horioka model using annual data. It is recognized that, in the absence of measurement error, business cycle effects induce an upward bias in the estimated coefficient, because they induce positive comovements in savings and investment rates. However, Sinn argued, based on current account theory, that the current account balance tends to move over time from deficit to surplus and vice versa (in order to satisfy

some intertemporal budget constraint). Hence, estimation using decade averages would lead to an upward bias in the estimated coefficient, a fact that motivated his use of annual data. His sample included only OECD countries. The estimated partial correlation coefficient was found to be close to one, but fell in the 1980s.

Other authors have focused on the stringent requirements needed to interpret the Feldstein-Horioka result as evidence of limited capital mobility. Frankel (1992) argued that various forms of interest rate parity had to hold in order for a high coefficient in a regression of investment on savings to signal a lack of integration. The empirical results that he reports indicate that the covered interest rate parity seems to hold for a sample of 25 countries (5 of which are developing), suggesting a substantial degree of capital mobility among these countries. However, both the uncovered and the real interest rate parity conditions fail in the same sample. This signals that "a currency premium remains, consisting of an exchange risk premium plus expected real currency depreciation". In this context, the Feldstein-Horioka result is not as surprising as it seems. It stems from the failure of some form of interest rate parity, for which many conventional arguments can be made (transactions costs, regulation etc). This reasoning hinges on a crucial assumption, namely that financial assets across the countries in the sample under scrutiny be perfect substitutes. While this may seem a reasonable assumption to make when considering the subset of developed countries, it cannot be plausibly maintained in the case of developing countries. As we suggested above, opportunities for portfolio diversification, originating in inter-country heterogeneity in financial characteristics (namely risk and returns) and factor endowments, may be important forces driving capital flows to and from developing countries. Hence, Frankel's argument cannot apply to our larger sample. It is clear a priori that interest rate parity is unlikely to hold across developing countries, but as long as opportunities for diversification exist, capital movements will take place.

III. EMPIRICAL RESULTS[2]

The basic empirical specification consists of the following equation, which is identical to the Feldstein-Horioka specification:

$$(I / Y)_i = \alpha + \beta (S / Y)_i + \epsilon_i ; \qquad (1)$$

where I is gross domestic investment, Y is GDP and S is gross domestic savings in country i. Feldstein and Horioka argued that if β, the 'savings retention coefficient', is significantly different from one, the hypothesis that financial markets are at least partially integrated is accepted. The existing literature on the issue, however, has shown that the opposite

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[2] Data was taken from the World Bank, World Tables, 1994.

conclusion does not follow directly from a β coefficient of 1. A substantial degree of capital mobility is consistent with a value of β=1.

Testing the hypothesis that β=0 is also interesting. If foreign borrowing is significant, this hypothesis should be true if most of the countries in the sample are small in terms of their capital stock, relative to the rest of the world. This is indeed the case for many developing countries. As stated by Feldstein and Horioka, "even for a relatively large country, the value of β would only be of the order of magnitude of its share in total world capital".

The basic specification was extended to control for the degree of trade openness and demographic effects. We first added the interaction of an openness indicator with the share of savings. We used the Sachs and Warner (1995a) index, which is based on tariff and non-tariff barriers, black market premia and government intervention in the economy. We would expect the degree of trade openness to be positively related to its financial openness. Second, we add the growth rate of population as an independent variable: It has been suggested that population growth may cause both investment and savings to move in the same direction, causing a positive correlation between the two.

A. Decade Averages

In order to avoid cyclical effects, we constructed decade averages of gross savings and investment ratios. The data set is for the time period 1970-1993 (data for developing countries in earlier periods are very limited). We also computed overall averages for the entire period. Additionally, we took four year averages for the 1990-1993 period, not covered by previous studies. Simple OLS estimates based on decade averages are reported in Table 1.

We replicated the Feldstein-Horioka regression for 20 OECD countries for all time periods. The coefficients that we find are smaller than those reported by Feldstein and Horioka but they are not statistically different from one. We also find that the correlation between the shares of investment and savings is greater for the 1980s (β=0.799) than for the 1970s (β=0.690) and decreases substantially in the first years of the 1990s (β=0.631). The first of these results disagrees with Feldstein and Bacchetta (1990) that found the opposite to be true using a different data set from ours. The estimated coefficient of the interaction term of openness and the share of savings has a negative sign, indicating that, within the OECD, economies that are more open to foreign trade display a lower correlation of domestic savings and investment. Nonetheless, the coefficient of the saving share does not change significantly, even when we control for this interactive effect. The inclusion of the growth rate of population does not affect the results and leads to a statistically insignificant coefficient. The value of the R-squared statistic is of the order of magnitude of the β coefficient, ranging from 0.54 to 0.84. These results are therefore similar to those obtained in the previous literature for OECD countries.

Table 1. OLS Estimates Applied to Period Averages

	1970-1979		1980-1989		1990-1993		Full period	
Full sample								
Constant	0.198 (0.024)	0.128 (0.017)	0.215 (0.032)	0.146 (0.015)	0.211 (0.242)	0.142 (0.017)	0.217 (0.038)	0.149 (0.016)
Savings rate	0.211 (0.113)	0.527 (0.075)	0.013 (.170)	0.342 (0.071)	0.022 (0.232)	0.302 (0.070)	0.022 (0.204)	0.387 (0.055)
Openness interaction		-0.039 (0.045)		-0.004 (0.043)		0.103 (0.071)		0.0065 (0.046)
Population growth		0.472 (0.640)		0.367 (0.513)		0.091 (0.513)		-0.022 (0.53)
# of obs.	103	86	103	86	103	86	103	86
R-squared	0.195	0.580	0.0007	0.385	0.0009	0.355	0.001	0.445
OECD								
Constant	0.083 (0.62)	0.081 (0.061)	0.038 (0.018)	0.040 (0.020)	0.062 (0.037)	0.062 (0.041)	0.037 (0.020)	0.042 (0.022)
Savings rate	0.690 (.240)	0.745 (0.299)	0.799 (0.077)	0.887 (0.087)	0.631 (0.184)	0.628 (0.189)	0.795 (0.091)	0.869 (0.113)
Openness interaction		-0.052 (0.046)		-0.099 (0.029)		all open		-0.070 (0.045)
Population growth		0.060 (0.634)		-0.002 (0.48)		0.048 (0.563)		-0.396 (0.373)
# of obs.	20	19	20	19	20	19	20	19
R-squared	0.579	0.582	0.815	0.815	0.554	0.542	0.837	0.838
All developing countries								
Constant	0.199 (0.023)	0.129 (0.019)	0.217 (0.031)	0.149 (0.016)	0.215 (0.042)	0.146 (0.018)	0.220 (0.038)	0.156 (0.018)
Savings rate	0.202 (0.117)	0.523 (0.077)	0.0004 (0.175)	0.325 (0.074)	0.023 (0.250)	0.285 (0.070)	0.014 (0.215)	0.356 (0.056)
Openness interaction		0.015 (0.086)		0.060 (0.064)		0.230 (0.072)		0.160 (0.061)
Population growth		0.493 (0.806)		0.389 (0.594)		-0.022 (0.609)		-0.262 (0.625)
# of obs.	83	67	83	67	83	67	83	67
R-squared	0.180	0.577	0.000	0.379	0.001	0.434	0.0005	0.478
Low income countries								
Constant	0.182 (0.027)	0.128 (0.029)	0.215 (0.018)	0.161 (0.025)	0.223 (0.037)	0.156 (0.026)	0.223 (0.029)	0.172 (0.029)
Savings rate	0.105 (0.212)	0.483 (0.116)	-0.269 (0.162)	0.198 (0.145)	-0.376 (0.389)	0.231 (0.097)	-0.329 (0.293)	0.212 (0.091)
Openness interaction		all closed		0.670 (1.17)		0.374 (0.190)		1.133 (0.722)
Population growth		0.527 (1.15)		0.487 (0.892)				-0.523 (1.098)
# of obs.	36	33	36	33	36	33	36	33
R-squared	0.061	0.433	0.254	0.092	0.133	0.229	0.181	0.236
Middle income countries								
Constant	0.231 (0.044)	0.146 (0.032)	0.171 (0.049)	0.114 (0.019)	0.137 (0.038)	0.110 (0.015)	0.167 (0.044)	0.117 (0.011)
Savings rate	0.148 (0.184)	0.513 (0.147)	0.281 (0.199)	0.502 (0.067)	0.455 (0.170)	0.469 (0.108)	0.329 (0.183)	0.529 (0.052)
Openness interaction		0.0076 (0.099)		0.025 (0.070)		0.234 (0.083)		0.119 (0.061)
Population growth		-0.071 (1.601)		0.092 (0.815)		-0.621 (0.758)		-0.257 (0.578)
# of obs.	47	34	47	34	47	34	47	34
R-squared	0.089	0.489	0.177	0.649	0.335	0.713	0.250	0.761

Heteroskedasticity consistent standard errors in parentheses.

Table 1 also presents estimates when both developed and developing countries are included in one sample (full sample). All the countries with available data in all years are included (103 countries). The R-squared statistic is considerably lower than before, especially for the basic regression where the share of savings is the only independent variable. Looking at this basic regression, the estimated coefficient for the share of savings is significantly different from zero in the 1970s (at the 95% level) and when the whole time period is considered, and statistically different from one in all regressions. The coefficient is greater than 0.5 only for two specifications in the 1970s. In all other time periods and specifications, the estimated coefficient is lower than 0.5 and decreases in the 1980s and in the 1990s. We also find that the coefficient on the interaction term between openness and the saving share, as well as the growth rate of population, were not statistically different from zero in any time period. However, the inclusion of these additional regressors increased the β coefficient, which is a surprising result (the fact that the sample size is less when we control for openness may be the reason for this result). Finally, for the full sample we do find a smaller estimated coefficient for the 1980s than for the 1970s. However, the coefficient rises again in the 1990s.

Considering developing countries *only* yielded coefficients similar to those obtained for the whole sample. The coefficient on the savings rate went from 0.2 in the 1970s to zero in the 1980s and 1990s. Again, the inclusion of the openness interaction term and of population growth increased the estimated coefficients, but these remained within a range of 0.3-0.5, well below the coefficients obtained for the OECD countries. These additional regressors were never statistically different from zero. When subdividing the sample of LDCs between low income and middle income countries, we found that the coefficient on the savings rate was somewhat larger for the latter subsample. The estimated β coefficient was even negative for low income countries during the 1980s and 1990s, as well as for the full period. The coefficient increased over time for the middle income subsample, suggesting some form of convergence in financial integration with OECD countries over time.

One concern is by how much measurement errors are driving our results. If the series for the savings rate are measured with error, a downward bias will result in the estimated β coefficient. If data in developing countries are measured less accurately than in developed countries, as seems plausible, much of our results could be seen as the consequence of attenuation bias. Measurement errors may be expected to be more of a concern for developing countries with very low income. However, comparing the estimates for low income countries with those for middle income countries we see that they lead to similar conclusions about international financial integration.

A more formal method to control for measurement errors is the use of instrumental variables. We used the past savings rate as an instrument for the current savings rate. This is not an ideal instrument, but it is the best (or more accurately the only one, as far as we know) available in the existing literature. It is very hard to find a good instrument, since it needs to have uncorrelated measurement errors across time. We believe that the past saving rate meets this criterion.

Results from this instrumental variables procedure are presented in Table 2. They confirm our previous findings. The estimated β coefficients went down for the subsample of developing countries, not up as expected under measurement error. They were still not significantly different from zero in the full sample of 103 countries, even closer to one for the OECD subsample, and not greatly different than in Table 1 for the other subsamples under consideration. Hence, we find evidence that our result is robust even when controlling for the measurement error problem.

Tables 1 and 2 present the fundamental findings of this paper. The existing literature considers the Feldstein-Horioka result as given and disagrees with its interpretation. We have shown that the correlation of investment and savings is much smaller than one, often insignificantly different from zero, whenever a much larger sample of countries is considered. By considering different samples of countries, we have shown that domestic investment and savings do not display systematically high correlations, except for OECD countries considered in isolation. When any larger sample is considered, including the OECD countries or not, the correlation is much smaller than one, or insignificantly different from zero.

This result would be a puzzle if we believed the original interpretation of the Feldstein-Horioka methodology to be a test for the integration of world financial markets. Financial markets are more developed in OECD countries and it is therefore more reasonable to expect them to be more integrated than developing countries' financial markets. However, it would be wrong to draw this conclusion from the findings of this section. We have previously argued that the Feldstein-Horioka methodology is not broadly accepted as a test for financial integration. Our results simply suggest that net capital inflows are a major determinant of investment in non-OECD countries. These inflows may be the result of official transactions (government borrowing from other governments and foreign financial aid) and do not necessarily signal evidence of financial markets integration. Given that many developing countries implement some form of capital controls this interpretation of our findings appears plausible. We now turn to panel data estimation in order to test the robustness of our conclusions.

B. Panel Data Estimation

To account for country specific characteristics, we ran the Feldstein-Horioka test using a fixed effects estimator. More specifically, we estimated the following model:

$$\frac{I_{it}}{Y_{it}} = \alpha + \beta \frac{S_{it}}{Y_{it}} + \varepsilon_{it} \qquad (2)$$

Table 2. Instrumental Variables Estimates

Period	1975-1979	1980-1984	1985-1989	1990-1993	1975-1993
Instruments	Savings rate 1970-1974	Savings rate 1975-1979	Savings rate 1980-1984	Savings rate 1985-1989	Savings rate 1970-1974
Full sample					
Constant	0.209 (0.023)	0.230 (0.022)	0.219 (0.028)	0.232 (0.043)	0.231 (0.032)
Savings rate	0.194 (0.113)	-0.019 (0.11)	-0.052 (0.153)	-0.111 (0.245)	-0.068 (0.177)
# of obs.	103	103	103	103	103
R-squared	0.11	0.01	0.0001	0.001	0.0004
OECD					
Constant	0.109 (0.068)	0.071 (0.042)	-0.002 (0.032)	0.033 (0.030)	0.013 (0.025)
Savings rate	0.571 (0.280)	0.673 (0.181)	0.961 (0.126)	0.762 (0.139)	0.896 (0.107)
# of obs.	20	20	20	20	20
R-squared	0.47	0.60	0.70	0.55	0.81
All developing countries					
Constant	0.211 (0.024)	0.232 (0.021)	0.220 (0.026)	0.234 (0.041)	0.234 (0.032)
Savings rate	0.199 (0.118)	-0.025 (0.113)	-0.078 (0.155)	-0.122 (0.261)	-0.085 (0.185)
# of obs.	83	83	83	83	83
R-squared	0.11	0.01	0.003	0.001	0.0001
Low income countries					
Constant	0.194 (0.022)	0.205 (0.013)	0.220 (0.013)	0.234 (0.029)	0.222 (0.025)
Savings rate	0.140 (0.178)	-0.159 (0.078)	-0.365 (0.090)	-0.608 (0.289)	-0.301 (0.269)
# of obs.	36	36	36	36	36
R-squared	0.012	0.18	0.25	0.13	0.19
Middle income countries					
Constant	0.243 (0.043)	0.273 (0.065)	0.155 (0.053)	0.149 (0.042)	0.247 (0.049)
Savings rate	0.132 (0.177)	-0.010 (0.279)	0.303 (0.231)	0.397 (0.195)	-0.057 (0.216)
# of obs.	47	47	47	47	47
R-squared	0.07	0.10	0.20	0.34	0.26

Heteroskedasticity consistent standard errors in parenthesis

where the error term ϵ_{it} contains a country specific effect v_i assumed to bear some correlation with the savings rate:

$$\varepsilon_{it} = u_{it} + v_i \tag{3}$$

The gain from exploiting the panel nature of the data set is clear: If country fixed effects are correlated with the domestic savings rate, the use of decade averages, as above, will lead to a bias in the estimated β coefficient. Allowing for heterogeneity in unobservable country characteristics, on the other hand, eliminates this bias. Another source of gain is linked to the nature of the Feldstein-Horioka test. The specification they consider is in no way a theoretical relationship. Rather, it is closer to a simple correlation test. There is no clear meaning in the contention that the savings rate *determines* the investment rate. Rather, if financial markets are closed, the amount of available domestic savings will constrain the level of domestic investment, leading to a correlation between the two both within and between countries. Hence, there are large gains in terms of information from using data from several years for each country.

The potential downside of using panel data techniques in the current context are twofold: First, the use of annual observations may exacerbate measurement error, a problem that is likely to affect LDCs in a particularly acute way. While a zero-mean serially independent error in measurement for the domestic investment rate can only reduce the precision of the estimates, a similar type of error in the domestic savings rate can lead to attenuation bias in the β coefficient. Second, the use of annual data may lead to an upward bias in the β coefficient due to business cycle effects. Existing evidence points to the procyclicality of both the savings and investment rates. Hence, business cycle effects tend to increase the correlation of savings and investment across years within countries. This should be a source of concern because the fixed effects estimator uses only the within-country variation. To deal with this issue, we also estimate a fixed effects model using five year average values. A more proper treatment of this problem would include the specification of a full model for domestic rates of both savings and investment, and the estimation of the structural parameters from the reduced form estimates. This is left for future research.

Results from fixed-effects estimation are presented in Table 3. The estimates lead to the same conclusion obtained in the cross-sectional case, in the sense that only the sample of OECD countries taken in isolation displayed large savings retention coefficients. For the full sample, we obtained a coefficient of 0.26. For OECD countries, the β coefficient had a value of 0.67 (statistically smaller than 1), while for the sample of 83 developing countries the estimated slope fell to 0.25. In sub-samples of LDCs, the β coefficient again decreased with the level of income of countries within the sub-samples. For instance, low income countries displayed a β of 0.18, while middle income countries had a β of 0.29. Note that these coefficients for LDCs are larger than those obtained with cross-sectional data. Again, the

Table 3 - Panel Data - Fixed Effects Estimates

	Fixed effects	Fixed effects	Fixed Effects	IV-Fixed Effects*
Data Frequency	Yearly 1970-1993	Yearly 1970-1993	5 year averages (5 obs. per country)	Yearly 1974-1993
Full sample				
Savings rate	0.258 (0.018)	0.423 (0.035)	0.244 (0.042)	0.183 (0.142)
Openness interaction		-0.166 (0.031)		
# of countries	103	103	103	103
R-squared	0.53	0.54	0.64	0.56
OECD				
Savings rate	0.671 (0.052)	0.938 (0.062)	0.714 (0.115)	1.113 (0.257)
Openness interaction		-0.490 (0.070)		
# of countries	20	20	20	20
R-squared	0.61	0.65	0.69	0.54
All developing countries				
Savings rate	0.246 (0.020)	0.385 (0.039)	0.227 (0.047)	0.141 (0.159)
Openness interaction		-0.138 (0.034)		
# of countries	83	83	83	83
R-squared	0.53	0.54	0.64	0.56
Low income countries				
Savings rate	0.181 (0.033)	0.398 (0.060)	0.099 (0.089)	(instrument is too weak)
Openness interaction		-0.223 (0.051)		
# of countries	36	36	36	36
R-squared	0.48	0.49	0.58	
Middle income countries				
Savings rate	0.291 (0.023)	0.341 (0.052)	0.301 (0.050)	0.307 (0.111)
Openness interaction		-0.049 (0.046)		
# of countries	47	47	47	47
R-squared	0.52	0.52	0.65	0.50

Standard errors in parentheses.

* Instrument is savings rate lagged by 5 years

inclusion of an openness interaction term tended to increase the estimated β coefficient, but not enough to modify our basic conclusion.

To eliminate the possibility that these larger estimated coefficients were due to business cycle effects, we ran the fixed effects estimator using data that was averaged over five-year time periods. Hence, each country had five separate data points. The hope was that business cycle effects will be largely washed away by the averaging. The coefficients that we obtained (column 3 of Table 3) were very close to the fixed-effects estimates based on yearly data. They increase or decrease depending on the subsample, but the magnitude of the change is always small. We take this as evidence that business-cycle effects do not greatly affect the fixed-effects estimates based on yearly data.

Lastly, to control for the possibility that measurement error may have been exacerbated by the use of yearly data, we again used past savings rates as instruments in a fixed effects-IV procedure based on yearly data. The results of this procedure are reported in column 4 of Table 3. The savings rate bears a coefficient of 1.11 for OECD countries, and of 0.141 for LDCs. Controlling for both fixed effects and measurement error, therefore, does not modify our basic findings.

IV. CONCLUDING REMARKS

This paper provides new empirical evidence concerning the correlation of domestic investment and domestic savings around the world. In particular, the conventional wisdom, which points to a correlation equal to 1, is overturned for any sample of countries other than the OECD. Results are robust with respect to different time periods, various subsamples of countries and alternative estimation methods.

These results can be explained as follows: if cross-country heterogeneity drives capital flows, either through factor endowments theory or through portfolio diversification, we should expect relatively little capital flows between 'similar' countries (where 'similar' means that their factor endowment ratios are similar or their capital markets comove strongly). As the size of the sample is increased to include more diverse countries, the correlation of domestic savings and investment rates should fall. Our empirical findings exactly confirm this pattern. Alternatively, official capital transactions may cause a low correlation of domestic investment and domestic saving even if capital markets are not well integrated.

Future research should seek to determine the precise nature of the flows that lead to a breakdown of the Feldstein-Horioka result for developing countries. One large source of capital inflows for low and middle income countries is linked to aid. From the viewpoint of outflows, debt repayments play a crucial role. In LDCs, the volume of these inflows and outflows is often large relative to the size of domestic investment and savings. Hence, such sources of capital flows might drive much of our empirical findings.

Trade in Goods and Trade in Factors

In the absence of uncertainty, a general statement of the implications of country heterogeneity on the extent of capital movements uses the concept of integrated equilibrium as a useful theoretical construct (see Helpman & Krugman, 1985, p.12-17). Consider economies that are able to trade freely in goods but not in factors of production. There is a set of initial factor endowments that allows these partitioned economies to replicate the equilibrium of the fully integrated economy (where both goods and factors are mobile). This set is commonly called the Factor Price Equalization (FPE) set.

If initial relative factor endowments are similar, as in the case of developed countries, it is likely that the endowment point will lie inside the FPE set (point A in figure I below). These economies will be able to replicate the integrated equilibrium by using trade in goods only, without any flows in factors and in particular without capital flows. If factor endowments are relatively different (point B), as we might expect when comparing a developing country to an industrialized country (or even two developing countries with different structural characteristics), it is likely that the endowment point will lie outside the FPE set, hence trade in goods will not suffice to replicate the integrated equilibrium. In this case, there will be an incentive for factors to move in order to achieve factor prices equalization.

This trade-based view of inter-country heterogeneity provides a theoretical explanation for the Feldstein-Horioka paradox without departing from a full information, perfectly competitive world.

APPENDIX I

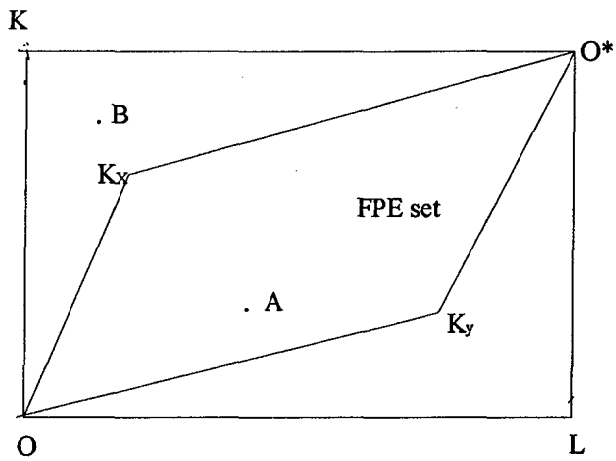

Figure I: In the context of the two countries, two factors and two goods Edgeworth box model, countries with similar relative endowments of factors (i.e. countries with bilateral endowment points lying close to the diagonal such as point A here) will replicate the integrated equilibrium using trade in goods only. k_x here is the capital-labor ratio of the capital intensive sector.

A Mean-Variance Analysis

Adding uncertainty, we can consider a mean-variance analysis based on the classic work of Markowitz (1952). We make the standard assumptions of zero transaction costs and no taxes.

Consider two countries, A and B, and one investor located in country A. The stock market returns are α_A for country A and α_B for country B, with variances σ_A^2 and σ_B^2 respectively. Suppose for simplicity that there is no risk free asset. The exchange rate of country A's currency in terms of country B's at time t is denoted by e_t and its variance by σ_e^2. All returns are expressed in terms of country A's currency. We denote by W(t) the value of investor's portfolio at time t and by w_A (t) and w_B (t) the fractions of his portfolio value allocated to each of the two assets. These fractions can be negative in the case of short sales. It is obvious that:

$$w_A + w_B = 1 \tag{1}$$

The variance of the portfolio return, assuming that movements in the exchange rate are not correlated with movements in the two stock markets, is given by:

$$\sigma_p^2 = [1 - w_B]^2.\sigma_A^2 + 2[1 - w_B].w_B.\sigma_{AB} + w_B^2.(\sigma_B^2 + \sigma_e^2) \tag{2}$$

The expected portfolio return is:

$$\begin{aligned} E_t(\alpha_{p(t+1)}) &= w_A E_t(\alpha_{A(t+1)}) + w_B E_t(a_{B(t+1)}) \\ &= w_B\left[E_t(a_{B(t+1)}) - E_t(\alpha_{A(t+1)})\right] + E_t(\alpha_{A(t+1)}) \end{aligned} \tag{3}$$

where

$$a_B = \alpha_{B(t+1)} + \frac{e_{(t+1)} - e_t}{e_t}$$

For optimality, the investor maximizes $E_t(\alpha_{p(t+1)})/\sigma_p$ subject to (1). The solution to this problem for the portfolio weights is the following:

$$w_B(t) = \frac{E_t(a_{B(t+1)})\sigma_A^2 - E_t(\alpha_{A(t+1)})\sigma_{AB}}{E_t(a_{B(t+1)})\sigma_A^2 + E_t(\alpha_{A(t+1)})(\sigma_B^2 + \sigma_e^2) - E_t(\alpha_{A(t+1)})\sigma_{AB} - E_t(a_{B(t+1)})\sigma_{AB}} \qquad (4)$$

$$w_A(t) = 1 - w_B(t)$$

So a share $w_B(t)$ of the portfolio is invested in country B and $w_A(t)$ in country A. $w_B(t)$. W(t) is the amount invested in country B at time t (an amount $w_A(t)$.W(t) is invested in country A). Hence, this setup fully determines the amount that the investor invests in each country.

This model shows that smaller comovements of the two stock markets create larger incentives for international diversification. For example, if the correlation coefficient ρ_{AB} is equal to -1, then:

$$w_B(t) = \frac{\sigma_A(a_{B(t+1)}\sigma_A + \alpha_{A(t+1)}\sigma_B)}{(\sigma_A + \sigma_B)(a_{B(t+1)}\sigma_A + \alpha_{A(t+1)}\sigma_B) + \alpha_{A(t+1)}\sigma_e^2} \qquad w_{A(t)} = 1 - w_{B(t)} \ , \qquad (5)$$

When the two assets have equal standard deviations and there is no exchange rate risk (or such a risk is adequately hedged), the optimal shares will be equal to 0.5. The exchange rate risk increases the share of the portfolio invested in the country where the investor is located.

It is a stylized fact that the stock markets in developed countries comove. In contrast, developing countries stock markets are not very correlated with stock markets in either industrialized or other developing countries. For instance, Harvey (1995) reports that the (unweighted) average correlation between the US stock market returns and the stock market returns of 20 developing countries is equal to 0.12, while the average correlation between US returns and the returns of 15 other developed countries is 0.39 (Harvey, 1991).

Based on these stylized facts, our conceptual framework predicts that foreign stock investments will be small among developed countries, relative to the size of their capital markets. On the other hand, foreign stock investments towards developing countries, both from developed countries and from other developing countries, will be large, relative to the

small capital market size of the developing countries[1]. The potential benefits to developed countries investors from diversifying their portfolios towards emerging markets have been stressed, among others, by Harvey (1993 and 1995), Bekaert (1993), Buckberg (1993) and De Santis (1993). A high correlation of savings and investment shares among developed countries is compatible with a low correlation among developing countries because the size of the involved transactions differ, namely financial flows towards developing countries represent a much larger share of their capital formation.

The theoretical framework presented above shows that, with or without uncertainty, international capital movements will be more important for developing than for developed countries, relative to their capital market sizes. Therefore, the theory explains the high correlation of savings and investments for OECD countries. It also predicts that this coefficient will be much smaller for developing countries.

[1] In order for this argument to be accurate, however, the exchange rate risk must be modest or hedging instruments must exist.

IFC Global Composite Index Total Return Correlations

(US$; December 1990-December 1995)

U.S., S&P 500																
U.K., FT 100	0.41	1														
Argentina	0.31	0.12	1													
Chile	0.26	0.08	0.26	1												
China	0.00	0.01	0.07	0.14	1											
India	-0.08	-0.08	0.12	0.40	0.16	1										
Indonesia	0.28	0.12	-0.04	0.23	0.27	0.18	1									
Korea	0.00	0.22	-0.05	0.18	0.09	0.05	0.09	1								
Malaysia	0.20	0.24	0.00	0.11	0.27	0.13	0.49	0.14	1							
Mexico	0.19	0.14	0.41	0.32	0.07	0.18	0.20	0.25	0.26	1						
Nigeria	0.00	0.18	-0.04	0.11	-0.02	0.02	0.06	0.16	-0.18	0.02	1					
Pakistan	0.02	0.00	0.06	0.07	-0.13	0.05	0.17	0.05	0.21	0.17	0.06	1				
Taiwan	0.05	0.28	0.02	0.10	0.01	0.06	0.36	0.21	0.41	0.13	-0.09	0.15	1			
Thailand	0.19	0.05	0.11	0.33	0.20	0.26	0.52	0.12	0.62	0.20	-0.11	0.28	0.40	1		
Turkey	-0.11	0.07	-0.13	-0.09	0.25	0.11	0.28	0.06	0.16	-0.13	-0.08	0.09	0.17	0.19	1	
Venezuela	0.03	0.11	0.08	0.01	0.24	0.02	0.06	0.11	0.08	-0.05	0.12	0.15	0.01	0.13	0.11	1
Zimbabwe	0.04	0.18	0.04	0.04	0.13	-0.10	0.29	0.02	0.23	0.15	0.12	0.00	0.03	0.09	-0.12	0.25
	U.S.	U.K.	Arg	Chile	China	India	Indonesia	Korea	Mal.	Mexico	Nigeria	Pakistan	Taiwan	Thailand	Turkey	Ven.

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