Capital Mobility in Developing Countries: evidence from Panel Data

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Some researchers have examined the relationship between saving and investment to test the degree of international capital mobility in developing countries. Using time-averaged data, they find saving and investment to be related, and conclude that capital is relatively immobile. The purpose of this paper is to provide further evidence on the degree of capital mobility in developing countries pooling annual data for the period 1960-1996 for 36 countries. Using panel data, however, the estimated impact of saving on investment is considerably smaller. In order to verify if the movement to more flexible exchange rates and liberalization of financial markets in the 1970s affected capital mobility, separate regressions are estimated for the 1975-1996 period. An increase has been observed in capital mobility over time.

1. Introduction

It seems to be an accepted fact that the great majority of developing countries keep significant legal restrictions over capital movements (inflows and outflows). However, empirical research on the effective degree of capital mobility in developing countries have increased recently. This has occurred despite the widely known importance of the extent of international capital mobility in theoretical and applied economics, for example, the optimal choice of monetary and fiscal policy (Fleming (1962), Mundell (1968)), the exchange rate determination (Levich (1985)), the incidence of capital income taxation (Feldstein and Horioka (1980)), and the inflation tax analysis (Easterly et al. (1995)).

Evidence on capital mobility in developing countries is usually obtained through four criteria : saving-investment correlations, interest parity conditions, Euler equation tests, and the consumption smoothing approach to the current account. The results are mixed. The purpose of this paper is to present some additional empirical evidence on the degree of capital mobility in developing countries. The procedure , based on the saving-investment correlation approach established by Feldstein and Horioka (1980), exploits the fact that the current account balance of a country is equal to the gap between investment and saving. Given that the country has to obey its intertemporal budget constraint , the present value of the current account must be zero, and so the difference

between saving and investment. This introduces a correlation between this two variables. Therefore, cross-sectional regressions using time-averaged data will bias the results towards rejection of capital mobility. In order to deal with this problem, capital mobility is assessed in a sample of 36 developing countries using annual data (1960-1996).

The paper is organized as follows. Section 2 points out some theoretical limitations of Feldstein and Horioka's approach. Section 3 presents and discusses some previous results on the developing countries, obtained using the four different measurement criteria listed before. Section 4 points out the problems in using time-averaged data for saving-investment regressions, brought by the intertemporal approach to the current account. Section 5 shows the results of the pool estimation of annual data for the period 1960 to 1996 for 36 developing countries. Section 6 concludes and presents some suggestions for further research.

2. Feldstein-Horioka's test for capital mobility

Feldstein and Horioka (1980) propose assessing the degree of capital mobility by measuring the correlation between saving and investment. They estimate the following cross-section regression :

$$(I/Y)_i = a + b(S/Y)_i + u \qquad (1)$$

where (I/Y) is the ratio of gross domestic investment to gross national product (GNP), and (S/Y) is the ratio of national saving to GNP. i is a country index, a and b represent parameters to be estimated and u is the error term. For small countries, b should be close to zero under the null hypothesis of perfect capital mobility.When b equals zero there is no relationship between domestic saving and investment; "any additional saving is part of a world pool of saving seeking the highest return worlwide". On the other hand, if b is large, capital is considered immobile. If b equals 1, for example, then all additional saving goes to finance domestic investment.

Using a sample of OECD countries Feldstein and Horioka (1980) find an estimate of b equal to 0.89 for the entire sample (1960-74). This result implies a low degree of

capital mobility among industrial countries, in contradiction with the belief that the industrial countries had few barriers to capital movements.

Feldstein and Horioka's results were also obtained by other researchers using different samples and different empirical techniques. However, the close correlation between savings and investment is taken more as an empirical regularity than as evidence for capital immobility. There are basically two resasons why saving and investment could be correlated even if capital is mobile. First, changes in an exogenous variable can affect both saving and investment. I/Y and S/Y are known to be prociclycal. Therefore, the state of the economy (the growth rate of income) may affect saving and investment. Obstfeld (1986) argues that temporary real shocks to the productivity of domestic capital and labor, to the prices of imported inputs, or to world real interest rates would move domestic saving and investment in the same direction.The presence of a non-traded consumption good can also produce this result (Murphy(1986),Wong(1990)). [1] The high correlation between saving and investment is sometimes also attributed to government action. Governments do not like current account deficits (increase in I/Y in relation to S/Y) so they respond to them by contracting fiscal policy to achieve a current account target. Since national saving is the sum of private and public saving, national saving becomes endogenous through its public component (Summers (1988)). Second, the effect of the country size can also imply a high correlation between saving and investment ratios under capital mobility. There are two versions of the country size argument. According to the first one, "as countries become larger, they become more diversified and the need to borrow from abroad in the event of shock declines" (Harberger (1980)).[2] The second one, argues that if a country is large enough to affect the world interest rate, an increase in national saving would reduce the world interest rate and, therefore, increase domestic investment.[3]

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[1] Feldstein and Horioka (1980) deal with the potential endogeneity of the saving and investment ratio using instrumental variables. The parameters estimates do not change much.

[2] Since Feldstein and Horioka's sample includes some large countries, this argument could be an explanation for the high estimate of the b coefficient. Dooley et al., however, argue that "Harberger argument only predicts that the ratio of the current account balance to GNP should be smaller for larger countries (as indeed it is), but not that a regression coefficient for saving and investment shares should be smaller for a sample of large countries".

[3] This argument, however, requires two points in time. Therefore, it does not apply to cross-section studies where only the observations of one point in time are used.

3. Previous results concerning developing countries

Although the question of international capital mobility in developing countries has gained increased attention, the existing evidence is much smaller than the one available to developed countries. Mainly four measurement criteria are used : saving-investment correlation, interest parity conditions, Euler equation tests, and the consumption smoothing approach.

Following Feldstein and Horioka, Dooley et al. (1987) estimated regression (1) with cross-section data on the developing countries. Their evidence suggests a close association between saving and investment , indicating a low degree of capital mobility. The positive correlations are found both when levels and changes in saving rates and investment rates are used. They run the regressions for two periods (1960-73 and 1974-84) since it would be expected a higher degree of capital mobility in the second period when the industrial countries removed their capital controls and the surpluses of OPEC were recycled. Surprisingly, the correlations were smaller in the first period. Their results seem robust to a variety of econometric objetions. In order to deal with the government policy-reaction argument and the endogeneity of saving, instrumental variables regression were performed. The results are similar to the ones obtained using ordinary least-squares regressions.

Montiel (1994) performs uncovered interest parity tests for 48 countries during the period January 1985 to December 1990. The tests were based on the return differential, that is, the difference between the domestic interest rate and the foreign interest rate corrected by the exchange rate. With rational expectations, the mean value of the return differential should be zero and the deviations from the mean should be serially uncorrelated. Thirty-two countries in the sample showed mean deviations that were different from zero.He also calculated for each country “the ratio of its mean absolute deviation from UIP (that is, the mean over the sample period of the absolute value of the return differential observed each month) to the mean of the exchange rate-corrected foreign interest rate. Because the foreign interest rate indicates what the domestic interest rate would have been if ex post UIP had held exactly during each month of the sample

period, the computed ratio measures how far the domestic interest rate deviated from what would have been observed under strong financial integration". This ratio was calculated for the first and the second half of the period in order to obtain some evidence of an increase in capital mobility in the most recent years. Overall, there was little evidence of an increase in the degree of integration.

Montiel (1994) verifies Obsfeld's (1986) test based on the equation that characaterizes the optimal intertemporal behavior of consumption. According to this test the expected marginal rates of substitution between current and future units of the domestic currency must be equal for foreign and domestic residents. The results, for the great majority of countries, indicate a high degree of capital mobility.

Several authors have also tested the saving –investment correlation in individual countries using time-series techniques. Since investment and saving ratios seem to have a unit root, the regressions are run using changes of these variables in order to avoid spurious correlation problem (Granger and Newbold (1974)). Mamingi (1993) and Montiel (1994) work with changes in saving and investment ratios, but assume that saving and investment ratios are cointegrated, given that solvency does not allow saving and investment to deviate permanently.[4] Mamingi (1993) estimates a time-series version of (1) adopting the "fully modified OLS" estimator (Phillips and Hansen , 1990). Montiel (1994) estimates an error-correction version of the Feldstein-Horioka regression. A simple especification is chosen, given the small number of observations : the change in the investment ratio is regressed on a constant, the lagged residual from the cointegration regression, and the change in the saving ratio. Ordinary least-squares and instrumental variables regressions were performed.

Bagnai and Manzocchi (1996) try to avoid imposing the cointegration assumption. They argue that if the saving and the investment ratios are I(1), the Feldstein and Horioka hypothesis of perfect capital mobility corresponds to the hypothesis that $(S/Y)_i - (I/Y)_i$ is I(0). Given that by definition the current account is equal to the difference between saving and investment, if it is not possible to reject the hypothesis of non-stationarity of the current account it can be concluded that the perfect correlation

hypothesis is rejected, and then capital is mobile. The results indicate that in 14 out of 37 developing countries, although capital is far from perfectly mobile, there is some degree of mobility. The results based on time series analysis of the saving-investment correlation approach suggested by Feldstein and Horioka indicates that the mobility of capital in developing countries is higher than expected, although there is no consensus regarding the extent of capital mobility in each individual country. Their results are summarized in Table 1.

Table 1

Capital mobility in developing countries : some previous results

Countries	Mamingi 1970-1991	Montiel Several intervals	Bagnai/Manzocchi Several intervals
Argentina		Inconclusive	Immobility
Brazil	Intermediate	Mobility	Mobility
Chile	Intermediate	Immobility	Immobility
Colombia	Mobility	Mobility	Immobility
Ecuador	Intermediate	Mobility	Immobility
El Salvador	Intermediate	Mobility	Immobility
Guatemala	Immobility	Inconclusive	Mobility
Honduras	Immobility	Inconclusive	Immobility
India	Intermediate	Inconclusive	Mobility
Indonesia		Inconclusive	Immobility
Israel	Mobility	Mobility	Mobility
Jamaica	Immobility	Mobility	Immobility
Kenya		Mobility	Immobility
Korea	Mobility	Mobility	Mobility
Malawi	Immobility	Inconclusive	Mobility
Malaysia	Inconclusive	Mobility	Immobility
Mexico	Mobility	Mobility	Immobility
Morocco	Inconclusive	Mobility	Mobility
Nigeria	Intermediate	Immobility	Immobility
Paraguay	Mobility	Mobility	Mobility
Peru	Mobility	Mobility	Immobility
Phillipines	Immobility	Intermediate	Immobility
Senegal	Intermediate	Mobility	Immobility
Thailand	Intermediate	Inconclusive	Mobility
Tunisia	Immobility	Intermediate	Mobility
Uruguay		Mobility	Immobility
Venezuela	Mobility	Immobility	Immobility
Zambia	Immobility	Inconclusive	Immobility

[4] In fact, Montiel (1994) is aware that the null hypothesis of no cointegration could be rejected only for few coutnries but argues , using the solvency argument, that the failure to reject cointegration is due to the small sample size used.

Notes : Previous results are showed only for countries considered in this paper. Mamingi, 1993, tab.6. Montiel, 1994, tab. 2 (instrumental variables results). Bagnai and Manzocchi, 1996, tab.2.
"Intermediate" means that both the perfect capital mobility and the capital immobility hypothesis were rejected; "mobility" means that only the hypothesis of perfect capital mobility was not rejected; "immobility" means that only the hypothesis of no capital mobility was not rejected; "inconclusive" means that it was not possible to discriminate among mobility and immobility.

As we can see only 3 out of the 28 countries (Israel, Korea and Paraguay) are equally classified by Mamingi (1993), Montiel(1994), and Bagnai and Manzocchi (1996). On the other hand, 9 countries have their degrees of capital mobility classified differently by the three tests (Ecuador, El Salvador, Guatemala, India, Malawi, Malaysia, Senegal, Thailand, Tunisia).

Finally, Ghosh and Ostry (1995) use the consumption-smoothing approach to assess capital mobility. If the degree of capital mobility is high, the economy as a whole should be able to completely smooth consumption in the face of shocks. This implies that the current account should be used as a buffer to smooth agregate consumption in the presence of shocks to national cash flow (output minus investment minus government spending). If cash flow is expected to grow on average over time, the country find that it is optimal to accumulate debts by running a current account deficit. On the other hand, if cash flow is expected to fall over time, the country find that it is optimal to run a current account surplus (increase its savings) in order to be able to consume in the future at a level consistent with its permanent income. If the level and volatility of actual current account movements are smaller than the movements predicted under the assumption of full smoothing then capital has low degree of mobility.They conclude that in around 30 out of 45 countries the null hypothesis that consumption is fully smoothed in the face of shocks could not be rejected, suggesting a relatively high degree of capital mobility in developing countries. Hussein and Mello Jr. (1999) also use the intertermporal consumption-smoothing framework to test the degree of capital mobility in developing countries. They find evidence that capital is quite mobile in the nine countries in their sample.

4. Time-averaged data x annual data : implications of a country's intertemporal budget constraint to saving-investment correlations

Usually regressions based on equation (1) have used long-term averages of saving and investment ratios from a cross-section of countries. This approach is used in order to try to eliminate the effects of the business cycle as observed by Bayoumi (1990). Essentially, this argument implies that the use of annual data imparts an upward bias to the b coefficient given that I/Y and S/Y are prociclycal.

According to Sinn (1992), however, the use of an intertemporal framework calls attention for a new empirical problem. This approach applies the idea of the permanent income hypothesis (households smooth their consumption over time when they face changes in their income) to countries.

Assuming that all bonds have a one period maturity, the external budget constraint at period t can be written as :

$$M_t - X_t + r_t B_{t-1} = \Delta B_t = B_t - B_{t-1} \qquad (2)$$

where M_t is imports, X_t is exports, B_t is the foreign debt , and r_t is the (one-period) interest rate. Equation (2) is the usual external budget equation stating that a current account deficit should be financed by new debt creation.

Solving the sequence of period by period constraints of the type (2) leads to the following equation :

$$B_0 = \sum_{t=1}^{\infty} \frac{1}{(1+r)^t}(X_t - M_t) + \lim_{n\to\infty} \frac{1}{(1+r)^n} B_n \qquad (3)$$

Equation (3) is the intertemporal external budget constraint. It states that when the last term equals zero, the amount that a country borrows (lends) in international markets equals the present value of future trade surpluses (deficits). In other terms, the borrowing that occurs in period t must be paid back in the future. When the limit term does not equal zero the country is “bubble financing” its external debt, that is, it is paying the old maturing debt by issuing new debt.

In other terms, a country can not borrow or lend indefinitely, or current account surpluses (deficits) should be followed by current account deficits (surpluses). By

definition, the current account balance of a country in any period is equal to the difference between investment and saving. Given that the current account balances add up to zero in the long run, so must the difference between saving and investment. Since saving and investment shares are approximately equal if they are averaged over time, the use of averaged data would introduce a correlation between these two variables (see Appendix). Therefore, cross-sectional investment-saving regressions using time-averaged data will errouneously signal a low degree of international capital mobility.

Therefore, the business cycle argument implies that when annual data is used the b coefficient calculated is higher than the calculated using time-averaged data, and the consumption smoothing argument, on the other hand, suggests the opposite.

In order to avoid both sources of potential biases panel data analysis will be performed. A set of annual observations of investment and saving ratios from 1960 to 1996 is used for 36 developing countries : Argentina, Botswana, Brazil, Chile, Colombia, Ecuador, Egypt, El Salvador, Ghana, Guatemala, Honduras, Hong Kong, India, Indonesia, Israel, Jamaica, Kenya, Korea, Malawi, Malaysia, Mauritius, Mexico, Morocco, Nigeria, Pakistan, Paraguay, Peru, Phillipines, Saudi Arabia, Senegal, Singapore, Thailand , Tunisia, Uruguay, Venezuela and Zambia is considered. The data are from the World Bank.

The use of panel data brings in two advantages besides avoiding the bias towards low capital mobility brought by the use of annual data discussed before. It is possible to control for country effects (like a country's size) as well as for time period effects such as the business cycle (the other source of bias presented before)[5].

The model estimated is a least square dummy variable (LSDV) model extended to include a time-specific effect as well: [6]

[5] Sinn (1992) tries to solve this question empirically. He runs regressions for 1960-1988 using annual data (29 regressions) and time-averaged regressions (average 1960-69, average 1970-79 and average 1980-89) for 23 OECD countries. He concludes that the annual values of b usually are smaller than the time-averaged values of b, indicating that the consumption smoothing approach has a point in what regards the suspect of an upward bias for averaged data.

[6] The random effects model including a time-specific component as well as the individual effect is :

$$y_{it} = a + b'x_{it} + e_{it} + u_i + w_t .$$

The value of the Hausman test (6.22) , however, argues in favor of the fixed effects model over the random effects model. The point estimates obtained using the two methods are quite similar though.

$$y_{it} = a_0 + a_i + g_t + b'x_{it} + e_{it} \qquad (4)$$

where y_{it} equals I(i,t)/Y(i,t), x_{it} equals S(i,t)/Y(i,t), the index i represents the country and the index t represents time. The model has an overall constant and a "group" effect for each country. It is assumed that differences across units can be captured in differences in the constant term, that is, a_i removes fixed differences between countries (size). The model has yet a "time" effect for each period. g_t is included in order to eliminate time related factors common to all countries included in the sample.[7]

5. Results

Estimates of equation 4 are presented in Table 2 below :

Table 2

Estimates of the saving-investment equation : 1960-1996

a	b	R^2
0.1448*	0.3617*	0.6208
(0.0159)	(0.0034)	

Notes: Standard errors in parentheses. * means that the coefficient is significant different from zero and one at the 1% level.

The estimated slope coefficient b is 0.3617. It is statistically different from both zero and unity at the 1% level, implying that both the perfect capital mobility and the capital immobility hypohtesis are rejected. If, however, the value of 0.6 derived by Murphy (1984) is considered as the "representative" industrial-country value , the value obtained is considerably smaller than this benchmark. Therefore, the Feldstein-Horioka test applied to developing countries indicate a high degree of capital mobility.

[7] If output varies positively across countries, saving and investment can move together even if capital is mobile and this has to be considered empirically.

If the country effects alone are considered, the null hypothesis that there are no country effects is rejected at the 1% level (F-statistic equals to 16.802). When a model with country effects is compared to other with country and time effects the F-statistic (5.916) indicates that the international business cycle also appears as a significant element in the analysis.

In order to verify if the adoption of flexible exchange rates and the liberalizaion of financial markets in the 1970s affected capital mobility, separate regressions were estimated for 1960-1974 and for 1975-1996. The results are presented in Table 3.

Table 3

Estimates of the saving-investment equation: 1960-1974 and 1975-1996

1960-1974		
a	b	R^2
0.0461	0.9925	0.8664
(0.0165)	(0.0904)	
1975-1996		
a	b	R^2
0.1665	0.3104	0.6941
(0.0060)	(0.0279)	

Note : Standard-errors in parentheses.

The estimated slope coefficient for 1960-74 is 0.9925. It is statistically different from zero but is not statistically different from one. This result indicates that capital was quite immobile during the sixties and the first half of the seventies in the developing countries. The estimated slope coefficient for 1975-96 is 0.3104. It is statistically different from zero, and is also statistically different from one. As pointed out before, however, 0.3104 is much smaller than the benchmark value of 0.6 for the developed

countries. Therefore, not only capital mobility is observed but it has increased dramatically over time.[8]

In what concerns the importance of the country effects and the time effects, for the first period the F-statistics indicate that country effects are important but time effects are not (the F-statistics are 31.582 and 0.861, respectively). For the second period both effects seem to be important (the F-statistics are 13.002 and 4.767, respectively).

6. Conclusions

This paper tries to get additional information on the extent of international capital in developing countries. The evidence about developing countries is much smaller than the available to developed countries and the results are mixed.

The test procedure is based on the saving-correlation approach developed by Feldstein and Horioka (1980). It does not have to deal with the assset heterogeneity problem as the test for parity conditions and it does not embody multiple hypothesis as the Euler equation tests or the consumption smoothing approach. However , the Feldstein-Horioka test is subject to some criticisms. From a theoretical point of view, it is vulnerable to indirect sources of saving-investments correlations, especially the business cycle and the country size. From an econometric point of view, the tradional use of cross-section analysis results in a bias towards immobility.The testing procedure adopted here tries to deal with both of these problems. Panel data estimations are performed. Besides avoiding the bias towards low capital mobility brought by the use of annual data, the use of a model with “group” and time effects allows control for country size effects as well as business cycle effects.

The analysis of the data suggests that the degree of capital mobility in developing countries is higher than usually believed. Furthermore, capital mobility increased dramatically after 1975.

[8] Dooley et al. (1987) find no evidence of the expected increase in capital mobility after 1973 both for industrial countries and developing countries. In fact, they find that the positive correlations between

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Appendix :

As can be seen in Table A.1 25 countries out of the 36 in the sample the gap between saving and investment ratios is less than 5% of GNP. A good example to illustrate this point is Chile. Figure 1 shows the current account balance for Chile from 1960-1996. It can be observed an huge rise in the current deficit in 1981, followed by an even faster decline of the deficit in 1983. In fact, within two years from a deficit of 10% of GNP the current account balance moves to a surplus of almost 3% of GDP. From Table A.1, however, it can be observed that the gap between saving and investment rates when averaged data is considered is only 0.2%.

Table A.1

Time-averaged saving and investment ratios

Countries	S/Y	I/Y	Difference
Argentina	21.7	22.8	1.1
Botswana	27.1	24.9	2.2
Brazil	21.0	21.4	0.4
Chile	19.8	19.6	0.2
Colombia	18.8	19.2	0.4
Ecuador	20.0	19.1	0.9
Egypt	21.8	13.0	8.8
El Salvador	15.9	10.2	5.7

Ghana	12.4	8.00	4.4
Guatemala	14.2	11.0	3.2
Honduras	20.6	16.4	4.2
Hong Kong	23.9	28.4	4.5
India	20.5	18.7	1.8
Indonesia	21.4	23.3	1.9
Israel	23.1	13.1	10
Jamaica	27.2	21.8	5.4
Kenya	21.4	19.3	2.1
Korea	27.6	23.3	4.3
Malawi	18.9	7.50	11.4
Malaysia	27.3	30.3	3
Mauritius	22.5	18.9	3.6
Mexico	21.0	20.5	0.5
Morocco	19.9	13.9	6
Nigeria	17.8	17.6	0.2
Pakistan	17.7	10.5	5.2
Paraguay	20.7	16.9	3.8
Peru	25.5	23.8	1.7
Phillipines	22.9	20.5	2.4
Saudi Arabia	20.6	40.8	20.2
Senegal	13.6	6.5	7.1
Singapore	34.3	26.9	7.4
Thailand	28.3	24.9	3.4
Tunisia	26.1	24.7	1.4
Uruguay	16.4	16.9	0.5
Venezuela	24.8	30.9	6.1
Zambia	21.8	25.0	3.2