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International Capital Mobility and Saving-Investment Correlations: Evidence from Emerging and Developing Economies

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The paper estimates the saving retention coefficients and compares the extent of capital mobility between African and Asian country-groups by applying the panel data approach in addition to panel group FMOLS model on annual data over 1980-2005 period. The panel group FMOLS model estimation results strongly confirm that the F-H hypothesis of perfect capital immobility does not hold in each of these country-groups. The FMOLS model results show that the long-run saving retention coefficients are correctly positive in all but significant only in six African countries and four Asian countries. In contrast, saving retention coefficients are insignificant in other six African countries compared to three Asian countries, suggesting perfect capital mobility in these countries.

Field of Research: International Finance

1. Introduction

The controversial finding of a positive correlation between saving and investment rates by Feldstein and Horioka (1980) in their study of sixteen industrialized OECD countries over the 1960-1974 period remains the focal point of intensive investigation. The finding, which prompted them to reject the perfect capital mobility assumption, seriously challenges the conventional wisdom that followed the abandonment of the Bretton Woods system in 1970s[1] that was seemingly characterized by increased capital mobility and deregulation of capital markets. The implication is that a high proportion of investment is financed from domestic sources (domestic savings). Although rigorous research efforts subsequently followed to validate this relationship (e.g., Bayoumi, 1990), however, most studies unfortunately have corroborated the Feldstein-Horioka (1980) results.

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Capital mobility in both developed and developing economies is important for a number of reasons. First, high capital mobility implies that saving-investment gap does not pose a constraint to economic growth. Capital inflows provide more scope for the home country to diversify risk and ensure that the rate of investment remains high[2]. Secondly, under the Mundell-Fleming framework, perfect capital mobility means that the monetary policy is more effective under the floating exchange rate system while fiscal policy is more effective under a fixed exchange rate regime. Third, massive increase in short term foreign capital flows may initiate capital flow reversals that can cause macroeconomic instability (see Dooley et al., 1996; Kim et al., 2005).

The objective of this paper is first, to estimate the saving-investment correlation coefficient and the implied capital mobility and secondly, to compare the extent of capital mobility between African and Asian countries. To obtain the long-run saving retention coefficients, we estimate the Feldstein-Horioka equation by applying the panel data approach on annual data from twelve African and seven Asian countries. We believe it is insightful to conduct the test on the panel data as they may yield interesting results.

The rest of the paper is organized as follows: Section 2 presents the review of the related literature. Section 3 describes the empirical model and estimation techniques. Section 4 discusses the empirical results while section 5 reports the conclusions and policy implications.

2. Review of Related Literature

In response to the Feldstein and Horioka (1980) finding of high saving-investment correlation that ranged from 0.87 to 0.91, Murphy (1984) challenged this Feldstein-Horioka result by strongly arguing that in a situation whereby some countries (e.g., the US) can influence conditions in world capital market, Feldstein-Horioka null hypothesis could be rejected even if capital is perfectly mobile. Similarly, Miller (1988) detected cointegration between national saving and investment rates prior to 1971, but not in the post-1997 period. However, Krol (1996) observed a considerably smaller impact of national saving on investment than previously reported, implying that capital was mobile.

Similarly, Vamvakidis and Wacziarg (1998) who employed panel data approach strongly rejected that the saving-investment correlation coefficient was close to 1. The slope parameters for the OECD countries were paradoxically larger than those for developing countries. In addition, they observed that saving-investment correlation coefficient increased as income increased, due to the sensitive effects of both the foreign aid and debt payments on investment. In contrast, Wong (1990) cautiously reported that the OECD group showed a higher saving-investment correlation than the LDCs, which was consistent with the hypothesis. Similarly, Holmes (2005) found strong evidence of conintegration between domestic savings and investment although the size of the long-run

saving retention coefficient was relatively small (about one-third), suggesting that capital is mobile but not perfect in LDCs. He detected no significant difference in the size of the coefficients between Latin American and the Asian countries.

In the investigation of international capital mobility in 11 Asian countries using the group FMOLS and DOLS panel cointegration techniques, Kim et al. (2005) observed a significant decrease in long-run saving coefficients between 1960-1979 and 1980-98, say from 0.58 to 0.39 and 0.76 to 0.42 respectively. This implies that capital mobility has increased in these countries in both periods. On the contrary, Tze Haw and Baharumshah (2005) found no long-run relationship between savings and investments for a group of ten Asian countries (including Japan and the US). The estimated coefficient of the retention parameters (β) ranges from 0.76 (Indonesia) to 0.05 (Singapore). In six out of 10 countries they studied, the retention coefficient is less than 0.30.

In relation to the Sub-Saharan continent, two studies are worth noting as they applied the panel data approach. In a study of capital mobility in 36 Sub-Saharan countries, De Wet and Van Eyden (2005) found that the panel saving retention coefficients ranged between 0.286 and 0.349, suggesting a high capital mobility for the region. Similarly, Payne and Kumazawa (2005) in a study of 29 Sub-Saharan countries found that the estimated saving coefficients ranged from 0.209 to 0.243 although they claimed that the inclusion of foreign aid and openness slightly improved the coefficients to 0.309 and 0.370 respectively. These results, which are not very much different from the previous studies, imply a high degree of capital mobility in these African countries.

3. The Empirical Model and Estimation Techniques

Feldstein-Horioka (1980) estimated the following relationship:

$$(I/Y)_t = a + \beta(S/Y)_t + e_t \quad (1)$$

where $(I/Y)_t$ and $(S/Y)_t$ are the investment and saving shares of GDP at time t, respectively, e_t refers to the residual term assumed to be a white noise. If the saving and investment are independent of each other, β should be approaching zero, implying a perfect capital mobility. However, if β is close to one, this would imply that capital is immobile. Values of β that lie between 0 and 1 suggest imperfect or intermediate capital mobility.

3.1 Panel Unit Root Tests

Levin and Lin (1992) and Levin et al. (2002) restated the ADF equation in the first-difference form as follows:

$$\Delta y_{it} = \alpha_{it} + \delta_{it} t + \theta_{it} + \phi y_{it-1} + \varepsilon_{it} \quad \text{i = 1, …, N: t = 1, …, T} \quad (2)$$

where $\varepsilon_{it} \sim$ iid ARMA process. θ_{it} is a common factor, which includes cross-sectional dependence via the factor loadings, δ_{it}, while the parameters α_i and t are the fixed effects and linear trend coefficients, respectively. LL computed the conventional regression t-statistic for testing $\phi = 0$ as given:

$$t_{\phi} = \frac{\hat{\phi}}{STD(\hat{\phi})}, \tag{3}$$

where

$$\hat{\phi} = \frac{\sum_{i=1}^{N}\sum_{t=2+\rho_1}^{T} \tilde{v}_{it}\tilde{e}_{it-1}}{\sum_{i=1}^{N}\sum_{t=2+\rho_i}^{T} \hat{v}_{it-1}^2},$$

$$STD(\hat{\phi}) = \hat{\sigma}_{\hat{\varepsilon}}\left[\sum_{i=1}^{N}\sum_{t=2+\rho_i}^{T}\hat{v}_{it-1}^2\right]^{-1/2},$$

$$\hat{\sigma}_{\hat{\varepsilon}}^2 = \left[\frac{1}{N\tilde{T}}\sum_{i=1}^{N}\sum_{t=2+\rho_1}^{T}(\tilde{e}_{it} - \hat{\phi}\tilde{v}_{it-1})^2\right].$$

Finally, LL calculated the following adjusted t-statistic:

$$t_{\phi}^{*} = \frac{t_{\phi} - N\tilde{T}\hat{S}_N\hat{\sigma}_{\hat{\varepsilon}}^{-2}STD(\hat{\phi})\mu_{m\bar{T}}^{*}}{\sigma_{m\bar{T}}^{*}} \tag{4}$$

where the mean adjustment $\mu_{m\bar{T}}^{*}$ and standard deviation adjustment $\sigma_{m\bar{T}}^{*}$ can be obtained from simulation by Levin et al. (2002) for given deterministic specification (m = 1, 2, 3) and time series dimension.

IM et al. (2003, hereafter IPS) proposed a test[3] based on the average of augmented Dickey-Fuller tests computed for each panel unit in model as follows:

$$y_{it} = a_i + \delta_i t + \rho y_{it-1} + \theta_t + \varepsilon_{it} \tag{5}$$

where ε_{it} can be serially correlated and heteroskedastic, but cross-sectionally independent apart from the presence of the common time effects θ_t. The IPS technique allows heterogeneity in the short-run dynamics, in the error structure and in the form of fixed effects and linear trend coefficients. The estimating equation is

$$\Delta y_{it} = \phi_i y_{it-1} + \sum_{k=1}^{K_i}\gamma_{ki}\Delta y_{it-k} + \varepsilon_{it} \tag{6}$$

IPS proposed the mean of individual specific t-statistic

$$\bar{\tau} = \frac{1}{N}\sum_{i=1}^{N}\tau_i, \tag{7}$$

where τ_i is the Dickey-Fuller t-statistic of cross-section unit.

Assuming that t_{iT} are iid and have finite mean and variance with $N \to \infty$, IPS calculated the t-statistic as $T \to \infty$ followed by $N \to \infty$ sequentially:

$$\tau_{IPS} = \frac{\sqrt{N}(\bar{t} - E[\tau_{iT}|\rho_i = 1])}{\sqrt{Var[\tau_{iT}|\ \rho_i = 1]}} \Rightarrow N(0,1) \tag{8}$$

where $E[\tau_{it}|\rho_i = 1]$ and $Var[\tau_{iT}|\rho_i = 1]$ are the asymptotic values of the mean and variance respectively of the average ADF statistic which IPS tabulated via Monte Carlo simulation for different time periods and lags.

The LR version of the t-ratios of ϕ and ϕ_i is computed as the standardized LR-bar test which uses the average of log-likelihood ratio statistics for testing the null of a unit root in individual ADF equations and is presented as

$$LR_{IPS} = \frac{\sqrt{N(T)}(\overline{LR}_{iT} - E[LR_{iT}|\rho_i = 1])}{\sqrt{Var[LR_{iT}|\ \rho_i = 1]}} \Rightarrow \text{N(0,1)} \quad (9)$$

where $E[LR_{it}|\rho_i = 1]$ and $Var[LR_{iT}|\rho_i = 1]$ are the asymptotic values of the mean and variance respectively, of average LR statistic also tabulated by IPS.

3.2 Cointegration Tests

Pedroni (1997a) proposed seven test statistics[4] for the null of no cointegration three of which are group-mean tests or "between" while the other four are pooled or "within" tests. The starting point is a panel ADF regression as follows:

$$y_{it} = a_i + \beta x_{it} + \varepsilon_{it} \quad (10)$$

The estimated residuals are

$$\hat{e}_{it} = y_{it} - \hat{\alpha}_i - \hat{\beta} x_{it},$$

and $$\Delta\hat{e}_{it} = \rho\hat{e}_{it-1} + \sum_{k=1}^{K}\gamma_{ik}\Delta\hat{e}_{it-k} + v_{it} \quad (11)$$

where γ_{ik} and K_i are allowed to vary across units $v_{it} \sim i.i.d.(0, \sigma_i^2)$. If the autoregressive coefficient of the residuals in the *i*-th unit is ρ_i, the within-dimension or panel imposes a common coefficient under the alternative hypothesis: $H_0 : \rho_i = 0, \quad H_1 : \rho_i = \rho, \ -2 < \rho < 0 \qquad \forall_i;$

The between-dimension or group tests allow for the heterogeneous coefficients under alternative hypothesis: $H_0 : \rho_i = 0, \quad H_1 : -2 < \rho_i < 0 \qquad \forall_i.$

4. Data and Empirical Result Discussion

The paper employs annual data on investment and domestic savings over the period 1980-2005. The data consist of saving and investment, as shares of GDP, derived from the IMF/IFS database. Saving is measured as the sum of gross domestic product and net primary payments from abroad minus government and private consumption while investment is the sum of gross fixed capital formation and changes in inventories. The countries included in this study, as determined by the availability of relevant data, are Algeria, Congo Republic, Côte d' Ivoire, Egypt, Ethiopia, Kenya, Libya, Nigeria, Senegal, South Africa, Tunisia and

Uganda, for the African group and China, Indonesia, Korea, Malaysia, Philippines, Singapore and Thailand for the Asian group. The results for both the IPS w_{IPS} and $\bar{t}_{IPS}$ statistics in addition to *LL* t^* statistic in Table 1 indicate that the series are *I*(0) in case of African countries whereas *I*(1) in case of the Asian countries. So we perform the panel cointegration test for each group separately.

Table 1: Panel unit root test results (1980 – 2005):

	Investment (I/GDP)		Saving (S/GDP)	
African Countries: N = 12, T = 26				
Level	Constant	Constant + Trend	Constant	Constant + Trend
IPS $w-Stat.$	-2.171**	-0.435	-3.092***	-1.206
IPS $\bar{t}-Stat.$	-2.042**	-2.229**	-2.325**	-2.462**
LL $t^*-Stat.$	-2.741***	-0.534	-3.556***	-2.994***
First Difference				
IPS $w-Stat.$	-12.637**	-10.231***	-16.408***	-13.802***
IPS $\bar{t}-Stat.$	-4.930**	-4.809***	-5.826***	-5.628***
LL $t^*-Stat.$	-12.648***	-8.671***	-17.566***	-13.604***
Asian Countries: N = 7, T = 26				
Level				
IPS $w-Stat.$	-0.186	0.147	-0.898	0.341
IPS $\bar{t}-Stat.$	-1.58	-2.121	-1.799	-1.958
LL $t^*-Stat.$	-0.209	-0.283	-1.573	0.100
First Difference				
IPS $w-Stat.$	-8.95***	-7.530***	-7.410***	-6.011***
IPS $\bar{t}-Stat.$	-4.59**	-4.623**	-4.135**	-4.178**
LL $t^*-Stat.$	-9.955***	-8.768***	-7.4730***	-4.858***

Note: ** and * denote 1% and 5% level of significance.

Table 2 presents the results of the two sets of panel cointegration tests. With the exception of group rho-statistic, the other six Pedroni's statistics find that panel saving and investment are cointegrated in the African group when the test contains no deterministic trend while cointegrated in the Asian country-group when the test contains a deterministic trend, suggesting that the panel variables are bound by long-run relationships in these two groups of countries.

Table 2: Panel cointegration tests results

	Panel-Statistics				Group Statistics		
	v-stat.	rho-stat	pp-stat	Adf-stat	rho-stat	pp-stat	Adf-stat
African Group							
Constant	3.002	-2.534	-2.816	-2.156	-0.776	-2.538	-2.066
Constant + Trend	-0.099	-0.062	-1.924	-1.819	-1.044	-1.386	-1.283
Asian Countries							
Constant	2.674	-0.748	-0.465	-0.463	-0.424	-0.132	-0.015
Constant + Trend	1.853	-1.826	-3.00	-3.202	-0.825	-2.866	-3.215

Note: The critical values for the panel cointegration tests, based on Pedroni (1995, 1997a), have the critical values of –1.64 (that is, k < 1-64 implies a rejection of the null) while v-statistic has a critical value of 1.64 (that is, k > 1.64 implies a rejection of the null).

The results of panel FMOLS estimation of long-run saving retention coefficients presented in Table 3 show that the panel saving retention coefficients, estimated at 0.40 and 0.37 for the African group and 0.42 and 0.49 for the Asian group are positive and statistically significant at 1% level. The fact that the panel coefficients fall below 0.60 benchmark suggests that capital is moderately mobile in these two groups of countries. These findings strongly reject the notion that saving-investment correlation coefficient is close to 1, and, hence, concludes that the Feldstein-Horika hypothesis of perfect capital immobility does not hold in these two groups of countries during the study period.

Table 3: Group Panel FMOLS results

Coefficient of Saving	African Countries	Asian Countries
With Time Dummy	0.40***	0.42***
	(23.05)	(5.39)
Without Time Dummy	0.37***	0.49***
	(21.67)	(5.09)

Note: *** denote 1% level of significance.

The individual FMOLS estimation results in Table 4 show that long-run saving retention coefficients are positive in all but significant only in six of twelve African countries compared to four countries of the seven-country Asian group. In contrast, the coefficients of saving-investment correlation are statistically insignificant in the other six African and three Asian countries, strongly suggesting that capital was perfectly mobile between each of these countries and the rest of the world. On the other hand, the significant coefficients of saving-investment correlation are in excess of 0.60, considered benchmark above which a particular capital flow is considered immobile, in four African countries compared to three Asian countries, exceeding 1 in case of Côte d' Ivoire, Congo Republic and Senegal for the African group and China for the Asian group.

Table 4: Panel FMOLS Estimation Results

African Countries	β	$H_0 : \beta = 0$	$H_0 : \beta = 1$	Status of capital
Algeria	0.343			Perfectly
	(0.450)			Mobile
Côte d' Ivoire	0.719*	4.110**	0.630	Perfectly
	(0.054)	(0.043)	(0.427)	Immobile
Congo Rep.	1.135**	6.706***	0.095	Perfectly
	(0.016)	[0.01]	[758]	Immobile
Egypt	0.885***	30.562***	0.208	Perfectly
	(0.000)	[0.000]	[0.649]	Immobile
Ethiopia	0.560			Perfectly
	(0.235			Mobile
Kenya	0.560**	5.436**	3.357*	Intermediately
	(0.029)	[0.020]	[0.067]	Mobile
Libya	0.442			Perfect
	(0.165)			Mobility
Nigeria	0.483			Perfectly
	(0.234)			Mobile
Senegal	1.538***	50.182***	6.138**	Intermediately
	(0.000)	[0.000]	[0.013]	Mobile
South Africa	0.760***	59.433***	5.904**	Intermediately
	(0.000)	[0.000]	[0.015]	Mobile
Tunisia	0.316			Perfectly
	(0.122)			Mobile
Uganda	2.708			Perfectly
	(0.202)			Mobile
Asian Countries				
China	1.212***	27.332***	0.834	Perfectly
	(0.000)	[0.000]	[0.361]	Immobile
Indonesia	0.675***	79.986***	18.551***	Intermediately
	(0.000)	[0.000]	[0.000]	Mobile
Korea	0.737**	5.918**	1.916	Perfectly
	(0.023)	[0.015]	[0.166]	Immobile
Malaysia	-0.149			Perfectly
	(0.353)			Mobile
Philippines	-0.124			Perfectly
	(0.615)			Mobile
Singapore	-0.048			Perfectly
	(0.570)			Mobile
Thailand	0.070			Perfectly
	(0.292)			Mobile

Note: (***), (**) and (*) denote significance level at 1%, 5% and 10% respectively. Figures in parentheses refer to p-values whereas those in squared brackets refer to p-values for Wald test.

The Wald test of variable restrictions was conducted on those countries whose investment-saving correlation coefficients are statistically significant. Based on this test, the FMOLS estimation results reported in Table 4 indicate that both the zero and unity correlation hypotheses are rejected in case of Kenya, Senegal and south Africa for the African group and only Indonesia in the Asian group, suggesting that these three African countries and one Asian country have been enjoying an intermediate capital mobility across the study period. However, the tests reject zero correlation hypothesis while failing to reject the unity correlation hypothesis in case of Côte d' Ivoire, the Congo Republic and Egypt in the African group and China and Korea in the Asian group.

In conclusion, the study finds that capital has been perfectly mobile in six countries (Algeria, Ethiopia, Libya, Nigeria, Tunisia and Uganda), intermediately mobile in three countries (Kenya, Senegal and South Africa) and perfectly immobile in three countries (Côte d' Ivoire, Congo Republic and Egypt) in the African group. In contrast, the study finds that capital has been perfectly mobile in four countries (Malaysia, the Philippines, Singapore and Thailand), intermediately mobile in one country (Indonesia) and perfectly immobile in two countries (China and Korea) in the Asian group.

5. Conclusion and Policy Implications

The paper applies a panel data approach in addition to panel group FMOLS model on annual data from twelve African and seven Asian countries over 1980-2005 period. The panel data approach finds that the variables are I(0) in case of African group and I(1) in case of the Asian group while cointegrated in all cases.

The study finds that capital was perfectly mobile in six countries, intermediately mobile in three countries and perfectly immobile in other three countries in the African group compared to four countries, one country and two countries in which capital has been respectively perfectly mobile, intermediately mobile and perfectly immobile in the Asian-country group.

The important implication of this study is that many countries in both the emerging Asian and developing African economies seem to have benefited greatly from the increased international efforts, which were rigorously mounted towards financial, and foreign exchange markets liberalization during the last two decades. If such efforts continue as they are currently, capital inflows will continue to fill the gap between meagre domestic savings and desired investment, leading to a sustained and rapid economic growth in these countries.

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Endnotes

[1] Nonetheless, some of the more recent studies on the topic present mixed results. Nonetheless, some of the more recent studies on the topic present mixed results. This by no means imply that the extent of capital mobility among the developed economies a settled question.

[2] The reverse can also happen—capital flight can lead to low investment and hence retard economic growth.

[3] In dynamic panel data, Nickell (1981) showed that the presence of heterogeneous intercept (fixed-effects) causes OLS estimator of a common autoregressive coefficient to be biased as $T \rightarrow \infty$ for fixed T. Only when T tends to infinity does the correlation disappear. However, in many practical applications where the time period is relatively short the LSDV estimators suffer from severe bias.

[4] For complete derivation of the seven tests please see Pedroni (1999).