E C O N O M I C S B U L L E T I N

International Capital Flows and the Frankel-Dooley-Mathieson Puzzle

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Abstract

Frankel et al (1986) pointed out that industrialized countries have larger saving rate coefficients than do developing countries in the framework of Feldstein-Horioka puzzle. This is referred to as the Frankel-Dooley-Mathieson puzzle in this paper. This paper extends past analyses by incorporating indices of a domestic institutional and policy environment. Applying the resulting model to Sub-Saharan African countries, saving rate coefficients larger than those previously imagined were obtained. These results are consistent with the reality of capital regulations and other factors resulting in low capital flows in developing countries.

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1. Introduction

Since the groundbreaking work of Feldstein and Horioka (1980), the measurement of the freedom of international capital flows has been a central research theme in the field of international economics and has captured the interest of many researchers.

In the absence of international capital flows, borrowing from abroad cannot compensate for shortages in domestic saving. Consequently, shortages in domestic saving lead to shortages in domestic investment. Conversely, when domestic saving increases, the entirety of the saving increase is directed to domestic investment. In a closed economy, therefore, domestic saving and domestic investment are highly positively correlated.

In the case of economies in which capital flows into or out of a country freely, borrowing from abroad can compensate for shortages in domestic saving. Therefore, declines in domestic saving do not necessarily lead to declines in domestic investment. From the opposite perspective, increases in domestic saving do not necessarily flow into domestic investment; they may be directed abroad in search of higher investment return opportunities. Hence, in an open economy, domestic saving and domestic investment are not highly positively correlated.[1]

To empirically test the above relationship between saving and investment rates, Feldstein and Horioka (1980) used the following equation:

$$(1) \qquad \frac{I}{Y} = \alpha + \beta(\frac{S}{Y}).$$

Here, I/Y is the investment rate and S/Y, the saving rate. If international capital flows are completely unrestrained, the saving rate coefficient, β, should approach zero. In contrast, if there are no international capital flows, nearly all increases in saving would be used for domestic investment, and β would approach one.

Feldstein and Horioka (1980) used data from 16 industrialized nations (Australia, Austria, Belgium, Canada, Denmark, Finland, Germany, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Sweden, the United Kingdom, and the United States) for the period from 1960 to 1974 to analyze the relationship between saving and investment rates, and obtained a β estimate close to one. This result was clearly in contrast with the hypothesis that capital flows are unrestrained and gave rise to the "Feldstein-Horioka puzzle." The research of Feldstein and Horioka (1980) gained significant attention and has been examined by numerous researchers. Subsequent research (Feldstein, 1983; Murphy, 1984; Obstfeld, 1986; Golub, 1990; Feldstein and Bachetta, 1991; Tesar, 1991; Obstfeld, 1995) has suggested that results similar to those

[1] Each country suffers from not only global shocks but also idiosyncratic shocks. A change in global conditions causes a rise and fall in investment opportunities and thus the incentive to save. Thus, if all countries are strongly correlated, then the coefficient should still be close to one regardless of the degree of international capital flows. However, each country always faces idiosyncratic shocks such as natural disasters, political turmoil, ethnic clashes, relaxation of regulations, the opening of the market, changes in the educational system, and growth (fall) in population. Such idiosyncratic shocks lead to a difference in the expected return of investment in each country. Investors diversify their investment not only in domestic markets but also in foreign markets and thereby gain more profits.

of Feldstein and Horioka (1980) can be obtained for the OECD countries.

Aiming to resolve the Feldstein-Horioka puzzle, many researchers have experimented with various devices, three of which are presented here. The first (Obstfeld, 1986; Bayoumi, 1990) was the supplementation of the regression equation with a fiscal explanatory variable, shocks to both domestic investment and saving, the effect of nontraded commodities, and other factors to lower the regression coefficient for domestic saving. The second (Bayoumi and Rose, 1993; Dekle, 1995) was the use of cross-selection data for various regions in a country to test the assertions of Feldstein and Horioka (1980). The third was an attempt (Coiteux and Olivier, 2000; Ho, 2002) to test the results of Feldstein and Horioka (1980) with explicit consideration of the nonstationarity of data.

This manuscript considers a different perspective—one that has yet to gain significant attention—for approaching the problem at hand. This perspective focuses on the disparity between the saving-investment correlation in industrialized countries and that in developing countries. Frankel et al (1986) clearly showed that industrialized countries have larger saving rate coefficients than do developing countries. This finding overturned common wisdom because it was believed that open markets made capital flows relatively free in industrialized countries. This implied that domestic saving and investment were not strongly linked and that the saving rate coefficient should be small. In the case of developing countries, a relatively high level of regulation was considered to mean that inward and outward capital flows were relatively restricted. In this regard, the implication was that domestic saving and investment were strongly linked and that the saving rate coefficient should be large. Frankel et al (1986), however, obtained results that directly contradicted these assumptions. These were important findings and raised the critical question as to why the saving rate coefficients of developing countries are small (this issue is henceforth referred to as the "Frankel-Dooley-Mathieson puzzle").

This paper adopts a new perspective in attempting to resolve the Frankel-Dooley-Mathieson puzzle by considering in its analysis the institutional and policy environment. Sustainable economic growth requires a policy environment that permits capital accumulation, the acquisition of education and knowledge, technological innovation, and macroeconomic stability. In turn, this type of policy environment should be supported by factors like protection of intellectual property; highly transparent judicial, legislative, and executive systems that allow for the control of corruption; and the construction of prudential restrictions that promote the development of a sound, stable banking system. Additionally, as factors supporting economic growth, factors such as a government capable of smoothly and efficiently implementing economic policies and structural reforms; systems for providing and administering infrastructure services; and a trading, investment, and competitive environment promoting smooth business activity are critical. An effective government; judicial, legislative, and executive systems; a financial system; a market environment; and other factors supporting economic growth are collectively referred to as an "institutional and policy environment." For economic development, developing countries require not only improved macroeconomic development policies but also a sound institutional and policy environment. Burnside and Dollar (2000) and Rodrik (2000) performed pioneering research that explicitly considered an institutional and policy environment.[2]

[2] Also see Rodrik and Subramanian (2003).

This paper explicitly incorporates this perspective in applying the Feldstein and Horioka (1980) analytical approach to Sub-Saharan African countries and obtained saving rate coefficients larger than those obtained by Frankel et al (1986). These results raise the possibility that Frankel et al (1986) obtained spurious values as results. It is conceivable, in other words, that in countries with a poor institutional and policy environment, rather than exhibiting a trend toward capital accumulation, savings tend to flow outward.

2. Empirical Analysis

2.1 Data

This paper uses annual data for the period 1980 to 2005 for analyses targeting 29 Sub-Saharan African countries. Specifically, these countries include Angola, Botswana, Burkina Faso, Cameroon, Democratic Republic of the Congo, Republic of Congo, Cote d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, Zambia, and Zimbabwe.

The data used include investment rates, saving rates, and composite political, financial, and economic risk ratings for a country; these data have been prepared by the PRS Group. Investment rates and saving rates were obtained from the publication, *World Development Indicators* (World Bank).[3] Table 1 shows the investment and savings in Sub-Saharan African region. As is clear from the table, savings tend to be larger than investment in many cases.

The PRS Group's composite political, financial, and economic risk ratings (CR) were calculated as described below:

(2) $$CR = 0.5(PR + FR + ER).$$

In this equation, PR denotes political risk; FR, financial risk; and ER, economic risk. PR represents a country's political stability on a scale of 0 (highest risk) to 100 (least risk) and specifically considers government stability, socioeconomic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability, and bureaucracy quality. FR represents a country's ability to pay its way by financing its official, commercial, and trade debt obligations, reflecting it on a scale of 0 (highest risk) to 50 (least risk). Specifically considered in assessing financial risk are foreign debt as a percentage of GDP, foreign debt service as a percentage of exports of goods and services (XGS), the current account as a percentage of XGS, net liquidity as months of import cover, and exchange rate stability. ER represents a country's current economic strengths and weaknesses on a scale of 0 (highest risk) to 50 (least risk) and specifically considers GDP per capita, real annual GDP growth, the annual inflation rate,

[3] Investment rate is the ratio of gross capital formation to GDP, and saving rate is the ratio of gross domestic savings to GDP. Both variables are expressed as percentages. Note that gross capital formation (formerly gross domestic investment) comprises outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. (Source: World Bank national accounts data and OECD National Accounts data files.)

budget balance as a percentage of GDP, and current account balance as a percentage of GDP. The CR values range from 0 to 100, with larger values reflecting lower risk.

2.2 Empirical Models

The following model was used to test the results obtained by Feldstein and Horioka (1980).

$$(3) \qquad \left(\frac{I}{Y}\right)_{i,t} = \alpha_i + \beta\left(\frac{S}{Y}\right)_{i,t} + u_{i,t}, \; i = 1, 2, \cdots N, t = 1, 2, \cdots, T \; .$$

In the above expression, I represents domestic investment; S, domestic saving; Y, GDP; T, number of observations over time; and N, the number of individual members in the panel. To explicitly consider country risk, the model was expanded as follows.

$$(4) \qquad \left(\frac{I}{Y}\right)_{i,t} = \alpha_i + (\beta_0 + \beta_1 CR_{i,t})\left(\frac{S}{Y}\right)_{i,t} + \beta_2 CR_{i,t} + u_{i,t}, \qquad i = 1, 2, \cdots N, t = 1, 2, \cdots, T \; .$$

In the above, country risk is represented by the variable CR.

2.3 Empirical Results

The analysis begins with panel unit root tests of saving rates, investment rates, and country risk. In performing a positive analysis, it is necessary to pay attention to the issue of the stationarity of variables. As Ho (2002) pointed out, it is possible that saving and investment rates are nonstationary. Therefore, prior to estimating equations (3) and (4), it was necessary to perform panel unit root tests on each variable to confirm the stationarity of each variable. For the present analysis, the LLC (Levin, Lin and Chu) and IPS (Im, Pesaran and Shin) tests were used (Levin, Lin and Chu, 2002; Im, Pesaran and Shin, 2003). Deterministic specifications for two cases, one for individual effects and individual linear trends and the other for individual effects only were employed for these tests. As Table 2 clearly shows, the null hypothesis that each variable has a unit root was rejected in most cases.

Confirmation that none of the variables had a unit root made it possible to proceed with the empirical analysis based on equations (3) and (4). Since the explanatory variables for equation (3) were endogenous, it was not appropriate to estimate the models using ordinary least squares (OLS). The analysis, therefore, was performed using the generalized method of moments (GMM).

Table 3 presents the empirical results for equation (3), which describes the basic model. A fixed effect model was used to perform the panel data analysis.[4] The instrumental variables used are given below:

[4] We performed the Hausman test and found that the random effect model was rejected.

$$z1 = \left[1, \left(\frac{I}{Y}\right)_{i,t-1}, \left(\frac{S}{Y}\right)_{i,t-1}\right],$$
$$z2 = \left[1, \left(\frac{I}{Y}\right)_{i,t-1}, \left(\frac{I}{Y}\right)_{i,t-2}, \left(\frac{S}{Y}\right)_{i,t-1}, \left(\frac{S}{Y}\right)_{i,t-2}\right].$$

Here, $z1$ includes variable values for the previous period; and $z2$, for the previous period and two periods prior.

As the table clearly shows, the saving rate coefficient, β, was estimated to be positive in both cases, i.e., 0.3869 for $z1$ and 0.3076 for $z2$. In both cases, the estimates were statistically significant. From these β estimates, it can be seen that when the saving rate increases, a portion of the increase tends toward investment, but that portion is relatively small. These results are consistent with the empirical results Frankel et al (1986) obtained for developing countries. Moreover, the relatively small J-statistics—16.5200 for $z1$ and 15.3112 for $z2$—that were obtained indicate that the over-identifying restrictions were met.

Table 4 presents the fixed effect model estimation results for equation (4), the expanded model. The instrumental variables used in this case were as follows.

$$z3 = \left[1, \left(\frac{I}{Y}\right)_{i,t-1}, \left(\frac{S}{Y}\right)_{i,t-1}, CR_{i,t-1}, CR_{i,t-1} \times \left(\frac{S}{Y}\right)_{i,t-1}\right]$$
$$z4 = \left[1, \left(\frac{I}{Y}\right)_{i,t-1}, \left(\frac{I}{Y}\right)_{i,t-2}, \left(\frac{S}{Y}\right)_{i,t-1}, \left(\frac{S}{Y}\right)_{i,t-2}, CR_{i,t-1}, CR_{i,t-2}, CR_{i,t-1} \times \left(\frac{S}{Y}\right)_{i,t-1}, CR_{i,t-1} \times \left(\frac{S}{Y}\right)_{i,t-2}\right]$$

$z3$ includes the variable values for the previous period; and $z4$, for the previous period and two periods prior.

As is clear from the table, the saving rate coefficient, β_0—at 0.7399 for $z3$ and 0.7292 for $z4$—is estimated to be positive in both cases. Both values are statistically significant. Particularly notable is that the saving rate coefficient estimates are larger for equation (4) than for equation (3). In other words, increases in domestic saving are directed toward investment at a certain rate, and this rate is higher than the expectation. These results indicate the possibility that the results obtained by Frankel et al (1986) were spurious values. The product coefficient, β_1, for country risk and saving rate was estimated to be negative and is statistically significant. Therefore, it appears that improvements in the domestic institutional and policy environment weaken the saving-investment link by promoting international capital flows. The country risk coefficient, β_2, was estimated to be positive and is statistically significant. Therefore, it is considered that, at a certain domestic saving rate, savings in a country with a poor domestic institutional and policy environment tend to flow abroad, rather than exhibit a tendency toward domestic capital accumulation. Further, the low J-statistics of 19.0371 for $z3$ and 19.5428 for $z4$ indicate that the over-identifying restrictions were met.

3. Some Concluding Remarks

If capital flows are free, increases in saving shift from countries with low investment returns to those with high investment returns. Consequently, even if the domestic saving rate falls, the shortage is compensated for by capital from abroad, and hence, the

investment rate cannot decline like the saving rate. However, if capital flows are not unrestricted, the flows from abroad cannot compensate for a capital shortage and the investment rate will follow the saving rate's downward movement. In such cases, the saving and investment rates are highly correlated.

As Frankel et al (1986) pointed out, however, the saving rate coefficient for industrialized countries approach one while those for developing countries are low. In this paper, this contradiction of ideas surrounding the freedom of capital flows is referred to as the Frankel-Dooley-Mathieson puzzle.

This paper employed models similar to those used by Feldstein and Horioka (1980) to analyze the relationships between saving and investment rates using the panel data of Sub-Saharan African countries and found low saving rate coefficients of approximately 0.3. These results are consistent with those obtained by Frankel (1986). Then, this paper extended past analyses by incorporating indices of a domestic institutional and policy environment. Applying the resulting model to Sub-Saharan African countries, saving rate coefficients larger than those previously expected were obtained. These results are consistent with the reality of capital regulations and other factors resulting in low capital flows in developing countries. They also clearly show that (i) improvements in a domestic institutional and policy environment weaken the saving-investment link by promoting international capital flows and (ii) at a certain domestic saving rate, savings in a country with a poor domestic institutional and policy environment tend to flow abroad, rather than exhibit a tendency toward domestic capital accumulation.

Despite its contributions, this paper also has some limitations. For example, a great deal of investment in LDC (least-developed countries) may be government-sponsored or may come from the World Bank (directly or indirectly). Thus, some portion of investment might not come from the international capital market or local savings. The analysis of this problem is left for future research.

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Table 1. Investment and Saving in the Sub-Saharan African Region
(millions of dollars)

Year	1980	1985	1990	1995	2000	2005
Investment	60389	33748	51226	59719	60972	119291
Saving	81893	48618	60040	51670	71077	126072

Source: World Development Indicators (World Bank)

Table 2. Panel Unit Root Results

Variable	Method	Specification	Test Statistic	*p*-value
$\frac{I}{Y}$	LLC	(TR and F)	–4.3519	0.000
		(F)	–4.1339	0.000
	IPS	(TR and F)	–4.8150	0.000
		(F)	–4.9133	0.000
$\frac{S}{Y}$	LLC	(TR and F)	–5.2417	0.000
		(F)	–5.2059	0.000
	IPS	(TR and F)	–2.8828	0.002
		(F)	–4.0245	0.000
CR	LLC	(TR and F)	–4.4847	0.000
		(F)	–3.7982	0.000
	IPS	(TR and F)	–2.7850	0.003
		(F)	–0.6759	0.250

Note:
LLC denotes the Levin, Lin and Chu test.
IPS represents the Im, Pesaran and Shin test.
(TR and F) indicates the individual effect and individual linear trend.
(F) indicates the individual effect.

Table 3. Panel Estimation Results

$$(\frac{I}{Y})_{i,t} = \alpha_i + \beta(\frac{S}{Y})_{i,t} + u_{i,t}, \ \ i = 1,2,\cdots N; t = 1,2,\cdots,T$$

$\hat{\beta}$ SE ($\hat{\beta}$)	J-Statistic	Instrumental Variables
0.3869** (0.0362)	16.5200	$z1$
0.3076** (0.0248)	15.3112	$z2$

Note:

** and * indicate significance at the 1% and 5% levels, respectively.

$$z1 = \left[1, (\frac{I}{Y})_{i,t-1}, (\frac{S}{Y})_{i,t-1}\right]$$

$$z2 = \left[1, (\frac{I}{Y})_{i,t-1}, (\frac{I}{Y})_{i,t-2}, (\frac{S}{Y})_{i,t-1}, (\frac{S}{Y})_{i,t-2}\right]$$

Table 4. Panel Estimation Results

$$\left(\frac{I_{i,t}}{Y_{i,t}}\right) = \alpha_i + (\beta_0 + \beta_1 CR_{i,t})\left(\frac{S_{i,t}}{Y_{i,t}}\right) + \beta_2 CR_{i,t} + u_{i,t},\ i = 1,2,\cdots,N; t = 1,2,\cdots,T.$$

$\hat{\beta}_0$ SE($\hat{\beta}_0$)	$\hat{\beta}_1$ SE($\hat{\beta}_1$)	$\hat{\beta}_2$ SE($\hat{\beta}_2$)	J-Statistic	Instrumental Variables
0.7399** (0.1558)	–0.0080* (0.0032)	0.2053** (0.0458)	19.0371	$z1$
0.7292** (0.1313)	–0.0083** (0.0027)	0.2070** (0.0347)	19.5428	$z2$

Note:

** and * indicate the significance at the 1% and 5% levels, respectively.

$$z1 = \left[1, \left(\frac{I}{Y}\right)_{i,t-1}, \left(\frac{S}{Y}\right)_{i,t-1}, CR_{i,t-1}, CR_{i,t-1} \times \left(\frac{S}{Y}\right)_{i,t-1}\right]$$

$$z2 = \left[1, \left(\frac{I}{Y}\right)_{i,t-1}, \left(\frac{I}{Y}\right)_{i,t-2}, \left(\frac{S}{Y}\right)_{i,t-1}, \left(\frac{S}{Y}\right)_{i,t-2}, CR_{i,t-1}, CR_{i,t-2}, CR_{i,t-1} \times \left(\frac{S}{Y}\right)_{i,t-1}, CR_{i,t-1} \times \left(\frac{S}{Y}\right)_{i,t-2}\right]$$