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

Capital Mobility, Foreign Aid, and Openness: A Reappraisal

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Abstract

Payne and Kumazawa (2005) examine the effect of domestic savings, foreign aid, the evolution of capital mobility over time, and openness on investment rates using a panel of sub-Saharan African countries. They find that capital mobility has increased over time and that foreign aid and openness positively impact investment. We extend their work by accounting for business cycle effects and endogeneity issues. Accounting for these factors does not qualitatively change their findings except that we find a substantially larger impact of foreign aid in supporting domestic investment.

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1. Introduction

In a recent article, Payne and Kumazawa (2005) investigate the effect of domestic savings, foreign aid, the evolution of capital mobility over time, and openness on investment rates in 29 sub-Saharan African countries. They find that capital mobility has increased from 1980 to 2001 and that foreign aid and openness have had a significantly positive effect on investment rates. Their findings are important for a couple of reasons. First, the impact of foreign aid on domestic investment is relevant given recent calls for developed nations to increase their share of GDP going to foreign assistance [Sachs (2003)]. Second, their finding of increased capital mobility over time during this period is important because it suggests that efforts to liberalize financial and capital markets in the world are having an impact.

Payne and Kumazawa follow convention in using the Feldstein-Horioka (1980) investment-saving equation to study capital mobility. In addition, they employ three alternative estimation techniques to test the robustness of the results. Their careful approach gives a large degree of certainty to their results. However, unlike nearly all panel data studies employing the Feldstein-Horioka specification [see, for example, (Kasuga (2001), Isaksson (2001), and Vamvakidis and Wacziarg (1998)], they do not employ long-run averages of the data to deal with business cycles effects. Instead, they use yearly data which allows them to investigate the short-run impact of domestic saving, foreign aid, openness and the capital mobility over time on investment rates. An econometric analysis of investment and capital mobility is likely to suffer from business cycle effects, and given the procyclical nature of the investment-to-GDP ratio, the use of annual data can impart a bias in the estimated coefficients [Bayoumi (1990)]. In addition, existence of potential endogeneity of explanatory variables may lead to biased and inconsistent estimation results.

In this paper we extend Payne and Kumazawa's work by addressing these issues. We find that after accounting for the business cycle effects and endogeneity issues their results largely continue to hold. Trade openness and foreign aid are both statistically significant and have a positive effect on investment rates. The size, sign and significance of the coefficients on the savings rate (which according to Feldstein-Horioka measures the degree of capital mobility), trade openness and the interactive time trend with the savings rate are similar to what Payne and Kumazawa found. One difference with their finding is that after employing an instrumental variable approach to address endogenity, using both yearly and 5-year averaging of the data, we find a significantly higher estimated coefficient on foreign aid. This suggests that foreign aid has a substantially larger impact in supporting domestic investment than was previously believed. Section 2 briefly describes the empirical model and data, section 3 explains estimation results and section 4 concludes.

2. Empirical Methodology and Data

Our econometric model is taken directly from Payne and Kumazawa (2005). The econometrics models used here estimate the following two regression equations:

1) Basic Feldstein-Horioka equation:

$$(I/Y)_{it} = \beta_0 + \beta_i + \beta(S/Y)_{it} + v_{it} \quad (1)$$

2) Augmented Feldstein-Horioka equation:

$$(I/Y)_{it} = \alpha_0 + \alpha_i + \beta(S/Y)_{it} + \gamma(A/Y)_{it} + \delta(T^*(S/Y))_{it} + \theta((Ex + \mathrm{Im})/Y)_{it} + \varepsilon_{it} \quad (2)$$

Where subscripts i and t indicate country and time period, respectively. The intercept includes a component, $\alpha_0 (\beta_0)$, that is common to all countries, and a country-specific fixed effect, $\alpha_i (\beta_i)$ that is specific to each country but fixed over time. Since a pooling model cannot control for unobserved country-specific heterogeneity (i.e., culture, language, religion, race, historical background, etc), it is rational to use a panel data estimation technique. The cross country regression panel data has a natural appeal because of the existence of country-specific and time-invariant fixed factors. Thus, any remaining unobserved heterogeneity that the ordinary least square model does not control for will be captured by the panel framework.

All variables in equations (1) and (2) are defined as a ratio to GDP. *I* is gross fixed capital formation which is used as a measure of investment, *S* is gross domestic savings, *A* is official development assistance used as a measure of foreign aid, *Ex* is exports, *Im* is imports (*Ex plus Im* as ratio to GDP used as a measure of trade openness) and *T*S/Y* is an interactive variable of time trend with the savings rate that is aimed at capturing capital mobility over time due to financial markets liberalization around the world.[1] Savings is calculated as gross domestic product minus private and government consumption.

Data for all variables is taken from World Bank Development Indicators (WDI) CD-Rom (2006). The countries included in the data set are identical to Payne and Kumazawa's.[2] We take advantage of having more years to estimate by extending the sample to include data through 2004. The sample period of 1980-2004 is then divided into five five-year periods in order to conduct the long-run approach to estimating the Feldstein-Horioka specification. The result is a balanced panel data set containing data on 29 sub-Saharan countries from 1980-2004. Although the Hausman test rejects the null hypothesis of no correlation among the individual effects, for comparison purposes with Payne and Kumazawa the results for all three panel data estimation models [pooled

[1] Gross fixed capital formation, as defined in WDI (2006), consists of outlays on additions to the fixed assets of the economy, net changes in the level of inventories, and net acquisitions of valuables. Bayoumi (1990), Sinha and Sinha (2004) and Payne and Kumazawa (2005) use gross fixed capital formation as a measure of investment because it does not include highly procyclical components of inventories.

[2] The countries are Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Comoros, Congo, Democratic Republic of; Congo, Republic of; Cote d'lvorie, Gabon, Ghana, Guinea-Bissau, Kenya, Lesotho, Malawi, Mali, Mauritius, Mozambique, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Swaziland, Togo, Zambia and Zimbabwe.

ordinary least square (POLS), fixed effects (FE), and random effects (RE)] are reported here.

Another potential issue we try to address is endogeneity of the independent variables which, if not controlled for, can contaminate estimation results. We address the potential endogeneity problem by employing an instrumental variables (IV) approach for all three models. Following Haque and Montiel (1990), we use the lagged values of all right hand side variables as instruments.[3]

3. Estimation Results

3a. Findings with yearly data

For comparison purpose we derive estimation results using yearly data for the period 1980-2004. Panel A of Table 1 presents the results of the basic Feldstein-Horioka specification (equation 1), using POLS, FE, and RE as well as the IV approach for all three models and panel B follows the same approach for the augmented Feldstein-Horioka specification (equation 2). The specification tests in table 1 suggest that the FE model is the most appropriate approach. The only notable difference with Payne and Kumazawa's results is that after employing the IV approach (the IV-FE model), the coefficient on foreign aid is significantly larger: 0.316 as compared to 0.197. Accounting for the endogeniety issues in the model, we find a significantly larger impact of foreign aid on investment rates.

3b. Findings with 5-year data averaging

Panels A and B of table 2 present the estimation results using 5-year averaging of data for the basic and augmented Feldstein-Horioka specifications, respectively. Again, specification tests reveal that the FE model is superior to the POLS and RE models. The POLS and IV-POLS results in Panel A show that the savings rate coefficient is negative and statistically insignificant. The estimated coefficient on the savings rate is positive and significant at conventional levels of significance for both the FE and RE models. IV estimation shows that the savings rate coefficient is statistically significant only in IV-FE. These estimates are at par with Payne and Kumazawa's results.

Panel B shows that for POLS and IV-POLS the estimated coefficients for the savings rate are positive as expected, but they are statistically insignificant. The inclusion of country fixed effects (FE, RE, IV-FE and IV-RE) results in saving rates estimates that range from 0.225 to 0.419 and are statistically significant at the one percent level. The effect of foreign aid is positive and statistically significant at the one percent level in all models. Its estimated coefficient from the IV-FE estimation suggests that a ten percent increase in foreign aid as a ratio to GDP would result in increased investment of around 3.19 percentage points. The estimated coefficient on the interactive variable of time trend

[3] The correlation of the instruments with the instrumented variables was found to be fairly high. Haque and Montiel (1990), in their study of capital mobility in developing countries, used lagged values of the real GDP, external interest rate, investment, the money supply, imports and few others. They explain that main reason of using lagged values as instrument was to ensure that they were uncorrelated with the residuals.

with the savings rate is negative, as expected, and significant. The capital mobility over time appears to have increased with financial market liberalization and economic openness around the world. Trade openness has a positive and significant effect across all models. Like the estimation results in table 1, the notable difference with Payne and Kumzawa's results is that, after accounting for business cycle effects and endogeiety issues, we find a significantly larger coefficient on foreign aid.

4. Conclusion

Payne and Kumazawa's (2005) findings are important because they give development economists an idea of the importance of foreign aid in sub-Saharan African countries. The objective of this paper is to confirm their results using the long-run approach employed in the majority of the literature involving panel data estimation techniques. We also address potential endogeneity issues. Following the approach employed by Payne and Kumazawa, we apply panel data estimation techniques (POLS, FE, and RE) together with an IV approach to investigate the effect of domestic saving, foreign aid, trade openness and the capital mobility over time on investment rates for 29 sub-Saharan African countries over the period 1980-2004 and find nearly identical results in terms of the significance and magnitude of the coefficients on explanatory variables. Accounting for business cycle effects and endogeneity issues does not significantly change their findings. The size, sign and significance of the coefficients on the savings rate, trade openness and the interactive variable of time trend with the savings rate that measures the capital mobility over time are nearly identical. Compared to Payne and Kumazawa, we find a significantly higher estimated coefficient on foreign aid, suggesting that foreign aid has a substantially larger effect in supporting domestic investment in sub-Saharan Africa.

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Table 1: Estimations Results
Estimation technique: yearly data for the period 1980-2004
Dependent variable: investment rates

Variables	POLS [1]	FE [2]	RE [3]	IV-POLS [1]	IV-FE [2]	IV-RE [3]
Panel A						
β	-0.024 (0.032)	0.241[a] (0.029)	0.207[a] (0.027)	-0.041[b] (0.021)	0.258[a] (0.039)	0.208[a] (0.056)
R^2 (adjusted R^2 for POLS)	0.002	0.097	0.002	0.001	0.096	0.002
Specification Tests:						
a. F-test for (POLS vs. FE)	F(28, 666) = 38.91[a] (rej POLS)			F(28, 115) = 37.50[a] (rej POLS)		
b. Hausman test for (RE vs. FE)	χ^2 (1) = 16.27[a] (rej RE)			χ^2 (1) = 9.88[a] (rej RE)		
Panel B						
β	0.077[b] (0.033)	0.363[a] (0.028)	0.297[a] (0.027)	0.089[a] (0.029)	0.421[a] (0.039)	0.320[a] (0.034)
γ	0.148[a] (0.029)	0.208[a] (0.019)	0.196[a] (0.018)	0.175[a] (0.023)	0.316[a] (0.032)	0.281[a] (0.029)
δ	-0.004[c] (0.002)	-0.007[a] (0.002)	-0.008[a] (0.002)	-0.006[a] (0.002)	-0.008[a] (0.002)	-0.008[a] (0.002)
θ	0.155[a] (0.012)	0.103[a] (0.014)	0.124[a] (0.013)	0.161[a] (0.008)	0.101[a] (0.020)	0.134[a] (0.015)
R^2 (adjusted R^2 for POLS)	0.400	0.347	0.290	0.400	0.321	0.301
Specification Tests:						
a. F-test (POLS vs. FE)	F(28, 663) = 28.16[a] (rej POLS)			F(28, 663) = 25.63[a] (rej POLS)		
b. Hausman test (RE vs. FE)	χ^2 (4) = 25.93[a] (rej RE)			χ^2 (4) = 21.81[a] (rej RE)		
No of Observations	696	696	696	696	696	696

Note: rej=reject. All variables are defined as a ratio to GDP. The standard errors (robust for POLS) are shown in the parentheses. Superscripts a, b and c refer to significance at 1 percent, 5 percent, and 10 percent levels, respectively.

Table 2: Estimations Results
Estimation technique: 5-year data averaging
Dependent variable: investment rates

Variables	POLS [1]	FE [2]	RE [3]	IV-POLS [1]	IV-FE [2]	IV-RE [3]
Panel A						
β	-0.028 (0.069)	0.275[a] (0.068)	0.132[b] (0.054)	-0.045 (0.042)	0.231[a] (0.072)	0.096 (0.056)
R^2 (adjusted R^2 for POLS)	0.003	0.124	0.003	0.002	0.121	0.003
Specification Tests:						
a. F-test for (POLS vs. FE)	F(28, 115) = 9.57[a] (rej POLS)			F(28, 115) = 9.29[a] (rej POLS)		
b. Hausman test for (RE vs. FE)	χ^2 (1) = 12.09[a] (rej RE)			χ^2 (1) = 8.96[a] (rej RE)		
Panel B						
β	0.093 (0.060)	0.419[a] (0.061)	0.229[a] (0.052)	0.092 (0.056)	0.416[a] (0.068)	0.225[a] (0.052)
γ	0.162[a] (0.057)	0.299[a] (0.048)	0.225[a] (0.043)	0.173[a] (0.043)	0.319[a] (0.050)	0.243[a] (0.045)
δ	-0.005 (0.005)	-0.008[a] (0.003)	-0.009[a] (0.003)	-0.006 (0.004)	-0.008[a] (0.002)	0.009[a] (0.003)
θ	0.159[a] (0.023)	0.092[a] (0.068)	0.150[a] (0.020)	0.162[a] (0.015)	0.106[a] (0.033)	0.156[a] (0.020)
R^2 (adjusted R^2 for POLS)	0.461	0.476	0.426	0.444	0.473	0.433
Specification Tests:						
a. F-test (POLS vs. FE)	F(28, 112) = 8.05[a] (rej POLS)			F(28, 112) = 7.91[a] (rej POLS)		
b. Hausman test (RE vs. FE)	χ^2 (4) = 38.01[a] (rej RE)			χ^2 (4) = 33.31[a] (rej RE)		
No of Observations	145	145	145	145	145	145

Note: rej=reject. All variables are defined as a ratio to GDP. The standard errors (robust for POLS) are shown in the parentheses. Superscripts a and b refer to significance at 1 percent and 5 percent level, respectively.