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CAPITAL MOBILITY, SAVING AND INVESTMENT LINK: EVIDENCE FROM SUB-SAHARAN AFRICA[1]

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ABSTRACT

The saving- investment correlation and its implication for capital mobility across borders has been sharply debated in the literature since the pioneering work of Feldstein and Horioka (1980). In this paper, the debate is extended to six emerging economies in Africa using cointegration tests proposed by Johansen and Juselius, and causality tests based on an error correction model. The results indicate that saving and investment are integrated of order one. Furthermore, cointegration tests show that the two series share a long-run equilibrium association in the six countries, and therefore lend support to the Feldstein-Horioka conclusion that long-term capital is not mobile internationally. The causality tests indicate a unidirectional causality from saving to investment in Ghana, Ivory Coast, Kenya, Nigeria, and Zambia, and a bi-directional causality for South Africa. These results have important policy implications, especially for these and other small open economies where increases in domestic saving will not necessarily translate into higher domestic investment.

Key Words:

Domestic saving, domestic investment, equilibrium, unit roots, cointegration, causality, Sub-Saharan Africa.

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[1] Ghana, Ivory Coast, Kenya, Nigeria, South Africa, and Zambia.

1. INTRODUCTION

The seminal empirical finding by Feldstein and Horioka (1980) that saving and investment are highly correlated has generated intense debate in the literature. According to Feldstein and Horioka (1980), the correlation between national savings and domestic investment can be used as a measure of international capital mobility. Since the rate of return is the most relevant factor to investors if capital is perfectly mobile, domestic saving will not, necessarily be related to domestic investment. Feldstein and Horioka's findings and interpretation of the high correlation coefficients between saving and investment as evidence of imperfect capital mobility across national boundaries conflict with conventional wisdom of international capital mobility, which argues that in the absence of financial controls, capital should flow between countries in search of a higher rate of return.

Feldstein and Horioka (1980) generated a large body of research that supports the original empirical finding. These include Feldstein (1983), Feldstein and Bacchetta (1989), Summers (1988), Baxter and Crucini (1993), Dooley, Frankel, and Mathieson (1987), Caprio and Howard (1984), and Miller (1988). In general, these studies contend that capital is not internationally mobile. Therefore, increases in domestic saving, other things equal, will flow into domestic investment.

Other researchers strongly disagreed with Feldstein-Horioka's results. Murphy (1984), Obstfeld (1986), Finn (1990), Stockman and Tesar (1991), and Barkoulas, Filizetkin, and Murphy (1996) have challenged the existence of high correlation between domestic saving and investment, and contend that capital is internationally mobile. Under this hypothesis, foreign capital will flow into regions or countries with higher real interest rates. Obviously, this has important policy implications, especially for small open economies where increases in domestic saving will not necessarily translate into higher domestic investment under perfect capital mobility thesis.

It is worth noting that although existing studies in the literature have furnished insights with regard to the saving-investment relationship, there are a number of concerns about the conceptual and methodological approaches employed in the earlier studies on this issue. First, most of the studies used single equation ordinary least squares regression method to examine the relationship between saving and investment, and are therefore, likely to suffer from simultaneous equation bias. Second, studies that employed ordinary least squares regression analysis did so without first examining the time series properties of saving and investment series. As Nelson and Plosser (1982) have shown, most macroeconomic time series data are nonstationary in their levels, but stationary when differenced. Third, a number of the studies used cross-section data, thereby making it difficult to apply their results to any particular country. Fourth, most of the studies in the literature concentrated on the relationship between saving and investment in the developed countries, with little focus on developing countries in the African sub-region.

The present study seeks to fill this gap. It uses recent advances in cointegration techniques and country-specific time series data to examine the long-run equilibrium relationship between saving and investment for six African countries. In particular, we employed unit root tests to determine the order of integration, since variables with the same order of integration must be included in the cointegrating equation. In addition, cointegration tests utilizing the maximum-likelihood procedure suggested by Johansen and Juselius (1990) and Johansen (1991) were used to examine the long-run relationship between saving and investment. Finally, the Granger causality tests based on the vector error-correction model (VECM) were conducted to determine the direction of causality between the saving and investment time series data.

A number of researchers including Barkoulas, Filizetkin, and Murphy (1996), Bodman (1995), Gulley (1992), Jansen and Schulze (1996), Taylor (1996), and Miller (1988) have examined the relationship between saving and investment using cointegration techniques. Again, these authors focused mainly on Organization of Economic Cooperation and Development (OECD) countries. The present study employs cointegration-based techniques to extend the saving-investment debate to developing African countries. Such analysis is worthwhile given that the economic experiences of these countries are obviously quite different from those of OECD countries. In particular, the African economies are plagued with inefficient state enterprises, inadequate and deficient infrastructure, pervasive and burdensome trade restrictions, highly restrictive financial sector and trade regulations, poor corporate governance, political instability, and heavy external debt problems. It is therefore; natural to expect the macroeconomic forces and dynamics generating the relationship between savings and investment in these countries to be quite different from those found in the OECD group of countries and other developing regions of the world.

In this paper, the savings-investment correlation is re-examined using data for a group of African countries. The rest of the paper is organized as follows: Section II presents the data and methodology. Section III presents the model's predictions and results. In section IV, summary results and policy implications are presented.

II. METHODOLOGY, DATA AND UNIT ROOTS

The study utilizes annual data on gross domestic saving (SV) and investment (IT) for Ghana, Ivory Coast, Kenya, Nigeria, South Africa, and Zambia. The data cover the period 1960 through 1998, and are all derived from the World Development Indicators 2000 database. In conducting cointegration tests, the time series are required to be nonstationary in their levels. Moreover, it is important that all time series in the cointegrating equation have the same order of integration. Consequently, the study first ascertains the time series properties of gross domestic saving and investment by employing both the DF and ADF tests for stationarity. The equation estimated for the ADF test takes the form:

$$\Delta y_t = a_0 + g\, y_{t-1} + a_{2t} + \sum_{t=1}^{m} b_i \Delta y_{t-1} + e_t \qquad (1)$$

Where,) is the difference operator, t is the time trend, and e_t is the stationary random error, and the maximum lag length is m.

We used Johansen (1991) and Juselius (1990) cointegration procedure to determine whether saving and investment are cointegrated. The procedure involves estimation of vector error correction (VECM) model to obtain the likelihood ratios (LR). Formally the relationship between the two series can be written in vector-error correction model (VECM) form as:

$$? (IT) = ?_0 + \sum_{t=1}^{k=t} ?_1 \Delta(IT) + a ß' (IT)_{t-1} + e_t \qquad (2)$$

$$? (SV) = ?_0 + \sum_{t=1}^{k=t} ?_1 \Delta(SV)_{t-1} + a ß' (SV)_{t-1} + e_t \qquad (3)$$

where,) is the difference operator, (SV), (IT) denote gross domestic saving and gross domestic investment respectively, 2_0 represents the intercept, and γ_t represents the vector of white noise process. The matrix ∃'consists of r cointegrating vectors. On the other hand, the matrix ∀ contains the error-correction parameters.

In order to empirically test the causal relationship between gross saving and investment, it is common to apply the Granger causality test (Granger, 1969, Sims, 1972). Moreover, the cointegration technique pioneered by Engle and Granger (1987) and Granger (1986) makes a significant contribution towards testing causality. In this study, Granger causality test based on error correction model is used. This procedure is preferred to the standard vector autoregressive model because it permits temporary causality to emanate from (i) the sum of the lagged coefficients of the explanatory differenced variables and (ii) the coefficient of the lagged error-correction term. In addition, the error correction model allows causality to emerge even if the lagged differences of the explanatory variables are not jointly significant [see Granger (1988), Miller and Russek (1990), Miller (1991), and Garcia and Zapata (1991)]. The error-correction model derived from the cointegrating equations reintroduces the long-run information lost through differencing of time series with unit roots as well as open up an additional channel of Granger causality so far ignored by the standard causality tests of economic time series data. We formulate a vector error-correction model comprising of gross domestic saving (SV) and gross domestic investment (IT).

Formally, the model is represented as:

$$? (IT) = a z_{1-1} + \sum_{i=1}^{a} ß_i \Delta(IT)_{t-1} + \sum_{i=1}^{b} \Phi_i \, ? (SV)_{t-1} + e_t \qquad (4)$$

$$? (SV) = f \, z_{t-1} + \sum_{j=1}^{c} ?_i ? (SV)_{t-1} + \sum_{j=1}^{d} {}_i l_j \Delta(IT)_{t-1} + e_t \qquad (5)$$

where, z_{t-1} represents the error correction term lagged by one period, (SV) is gross domestic saving as a ratio of GDP, (IT) stands for gross domestic investment scaled by GDP, *a, b, c, d* represent the optimal lags lengths obtained from the Akaike Information Criterion (AIC). In equation (4), the rejection of the null hypothesis that gross domestic saving does not Granger Cause investment requires that (i) the M_j's co-jointly be statistically significant and/or (ii) the error correction term z_{t-1} be statistically significant.

Similarly in equation (5), the null hypothesis that gross domestic investment does not Granger-cause saving is rejected provided that the 8_j's are jointly statistically significant and/or the error-correction term z_{t-1} is statistically significant. Following Granger (1969), **x** is said to Granger Cause **y** if **y** is predicted better by using the past history of **x**, together with the past history of y itself, rather than by using only the past history of **y**.

III. TESTS AND RESULTS

The results of model selection procedure are shown in Table 1. The null hypothesis of nonstationarity of saving and investment is tested against the alternative hypothesis of stationarity. On the basis of the results shown in Table 1, the null hypothesis of nonstationarity can not be rejected in all cases considered The results indicate that both saving and investment are not stationary in their levels. However, after first differencing, the null hypothesis of no unit root is rejected in all of the cases. The nonstationarity of the time series in their levels calls for the application of cointegration procedure to avoid the problem of spurious regression.

Having determined the order of integration, we next apply the Johansen procedure to ascertain whether investment and saving are cointegrated for each of the countries under consideration. Johansen procedure of cointegration provides two statistics, namely the value of the Likelihood Ratio test based on the maximum eigenvalue of the stochastic matrix and the value of the Likelihood Ratio test based on the trace of the stochastic matrix. Under the trace test, the null hypothesis is that H_O has zero rank (r = 0) and the alternate hypothesis H_A is that $r \leq 1$. However, the null hypothesis for the maximum eigenvalue test is that $r = 1$, while the alternate hypothesis is that $r \leq 2$. The existence of at least one cointegrating vector in the system indicates the presence of causality between saving and investment. Table 2 shows the results from the cointegration analysis in the VEC model for the six countries in our sample. The null hypothesis of no cointegration between saving and investment (i.e. r = 0) is rejected by both the trace and maximal eigenvalue (8_{max}) tests at the 5 percent significance level in all cases. Nevertheless, the null hypothesis that $r \leq 1$ could not be rejected for all six countries. The cointegration results demonstrate that the two variables are tied together by a long-run equilibrium relationship. The fact that saving and investment are found to be cointegrated suggests that capital is immobile internationally relative to the sample countries, and is consistent with Feldstein and Horioka, Caprio and Howard (1984), Feldstein and Bacchetta (1989), Baxter and Crucini (1993), and Dooley, Frankel, and Mathieson (1987).

Results for the error-correction based Granger causality tests are presented in Table 3. The evidence of cointegration rules out the possibility of the estimated relationship being "spurious" and implies that Granger causality must exist between the two series in at least one direction, either unidirectional or bidirectional. We have found evidence which indicates that for Ghana, Kenya, and Zambia, we cannot reject the hypothesis that investment does not Granger cause saving, but cannot reject the hypothesis that saving does not Granger cause investment. For these three countries, causality runs from saving to investment, and not the other way. The null hypothesis that saving does not Granger cause investment is rejected because the error-correction terms and the lagged differences of investment are found to be conjointly significant. In the case of South Africa and Cote d'Ivoire, the evidence shows that causality runs in both directions with the error-correction term and lagged differences as channels of influence for Cote d'Ivoire, and the significant lagged differences for South Africa. The evidence is different for Nigeria where a unidirectional Granger causality runs from investment to saving, and the error-correction terms as the only channel of influence since the lagged differences of investment are not co-jointly significant.

IV. CONCLUSIONS

The paper applies a vector error-correction model to African data in order to examine the long-run equilibrium relationship between saving and investment in six African countries namely—Ghana, Ivory Coast, Kenya, Nigeria, South Africa, and Zambia. Unit-root tests show the saving and investment time series are non-stationary in their levels. Johansen cointegration test results confirm the existence of a long-run economic relationship between I [1] variables for all six countries. This result is consistent with a number of earlier studies in the literature that found saving and investment to be cointegrated in the long run. The results also support the Feldstein-Horioka (1980) conclusion that long-term capital is not mobile internationally. Furthermore, the error-correction based Granger causality tests indicate a unidirectional causality from saving to investment in

Ghana, Ivory Coast, Kenya, Nigeria and Zambia, and a bi-directional causality for South Africa. These results have important policy implications, especially for these and other small open economies where increases in domestic saving will not necessarily translate into higher domestic investment under perfect capital mobility thesis

REFERENCES

Barkoulas, John, Filizetkin, Alpay and Murphy, Robert (1996), "Time Series Evidence On the Saving-Investment Relationship," *Applied Economics Letters*. 3, 77-80.

Baxter, M. and Crucini, M. J. (1993) “Explaining Saving/Investment Correlations, *American Economic Review*.

Bodman, P. (1995) “National Saving and Domestic Investment in the Long Term,” *International Economic Journal*, 9, 37-60.

Caprio, G.A and Howard, H.D. (1994), “Domestic saving, Current Accounts, and International capital Mobility,” Board of Governors of the Federal Reserve System, *International Finance Discussion Paper* No. 244.

Dickey, D. A., and Fuller, W.A. (1979), "Distribution of Estimates of Autoregressive Time Series with Unit Root," *Journal of the American Statistical Association*, 427-431.

Dooley, M., Frankel, J.A. and Mathieson, D. (1987), “International Capital Mobility in Developing Countries vs. Industrial Countries: What Do the Savings-Investment Correlations Tell Us?” *IMF Staff Papers* 34, 503-529.

Engle, R. F. and Granger, C. W. J. (1987), "Cointegration and Error Correction: Estimation and Testing." *Econometrica*, 55, 251-276.

Feldstein, Martin and Horioka, C. (1980), "Domestic Saving and International Capital Flows," *Economic Journal*, 90, 314-329.

Feldstein, Martin (1983), "Domestic Saving and International Capital Flows," *European Economic Review*. 21, 129-151.

Feldstein, M and Bachetta, P. (1989) “National Saving and Investment,” *National Bureau of Economic Research Working Paper*, N. 3164.

Granger, Clive W. J. (1969), "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods" *Econometrica*, 37, 424-438.

_______ (1983),"Co-integrated Variables and Error-Correcting Models." *Working Paper* 83-13. University of California, San Diego.

________ (1988), "Some Recent Developments in a Concept of Causality," *Journal of Econometrics*, 39, 199-211.

________ and P. Newbold (1974), "Spurious Regression in Econometrics," *Journal of Econometrics*, 2, 111-120.

Jansen, W. J. and Schulze, G.G. (1996), "Theory-Based Measurement of the Saving Investment Correlation with an Application to Norway." *Economic Inquiry*, 34, 116-132.

Johansen, S. (1991), "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models," *Econometrica*, 59, 1551-1580.

________ and K. Juselius (1990), "Maximum Likelihood Estimation and Inference on Cointegration--with Applications to the Demand for Money," *Oxford Bulletin of Economics and Statistics*, 52, 169-210.

Murphy, Robert, G. (1984), "Capital Mobility and the Relationship Between Saving and Investment in OECD Countries," *Journal of International Money and Finance*, 3, 327-342.

Nelson, C. R. and Plosser, C. I. (1982),"Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications," *Journal of Monetary Economics*, 10, 139-162.

Taylor, Alan M. (1996),"International Capital Mobility in History: The Saving-Investment Relationship," *NBER Working Paper*, No. 5743.

Table 1

<u>Unit Root Tests (1960-1999)</u>

COUNTRY	SERIES	DF		ADF		LAG ORDER
		Level	Difference	Level	Difference	
Ghana	(IT)	T =-1.63 T_o=-1.69	T =-6.75^{a} T_o=-6.16^{a}	T =-1.21 T_o=-1.24	T =-6.58^{a} T_o=-5.51^{a}	3
	(SV)	T =-3.37 T_o=-3.40	T =-9.39^{a} T_o=-9.47^{a}	T =-1.75 T_o=-1.90	T =-5.03^{a} T_o=-4.96^{a}	3
Ivory Coast	(IT)	T =-1.75 T_o=-1.26	T =-4.96^{a} T_o=-5.08^{a}	T =-1.72 T_o=-1.47	T =-3.94^{a} T_o=-3.93^{a}	4
	(SV)	T =-2.67 T_o=-2.03	T =-6.61^{a} T_o=-6.69^{a}	T =-2.54 T_o=-1.79	T =-4.58^{a} T_o=-4.65^{a}	
Kenya	(IT)	T =-2.70 T_o=-2.64	T =-7.42^{a} T_o=-7.44^{a}	T =-2.23 T_o=-2.40	T =-5.63^{a} T_o=-5.55^{a}	4
	(SV)	T =-3.87 T_o=-4.02	T =-7.05^{a} T_o=-6.96^{a}	T =-3.94 T_o=-4.14	T =-7.62^{a} T_o=-7.39^{a}	4
Nigeria	(IT)	T =-2.03 T_o=-2.18	T =-5.44^{a} T_o=-5.46^{a}	T =-2.28 T_o=-2.41	T =-4.41^{b} T_o=-4.35^{a}	3
	(SV)	T =-2.49 T_w=-2.27	T =-6.79^{a} T_o=-6.57^{a}	T =-2.10 T_o=-1.96	T =-4.25^{a} T_o=-4.27^{a}	
South Africa	(IT)	T =-2.54 T_o=-167	T =-5.78^{a} T_o=-5.69^{a}	T =-3.23 T_o=-1.88	T =-4.91^{a} T_o=-4.73^{a}	3
	(SV)	T =-2.25 T_o=-1.23	T =-6.69^{a} T_o=-6.54^{a}	T =-1.53 T_o=-0.52	T =-4.86^{a} T_o=-4.57^{a}	
Zambia	(IT)	T =-2.34 T_o=-2.21	T =-6.79^{a} T_o=-6.89^{a}	T =-2.05 T_o=-1.91	T =-5.75^{a} T_o=-5.79^{a}	3
	(SV)	T =-3.64 T_o=-1.71	T =-8.93^{a} T_o=-9.06^{a}	T =-2.58 T_o=-1.06	T =-6.48^{a} T_o=-6.56^{a}	

Note: The superscripts "*a* ", " *b* " and "c" indicate rejection of the null hypothesis of zero restriction at 1%, 5% and 10% significance level, respectively. T= with trend, To= without trend. DF = Dickey-Fuller statistic, ADF = augmented Dickey-Fuller statistic, i=ratio of gross domestic investment to GDP, s= ratio of gross domestic savings to GDP. The MacKinnon critical values at the 1% level of significance are 3.61 and 4.21respectively for without trend and with trend. The optimal lags used for conducting the ADF test statistic were selected based on Akaike Information Criterion (AIC).

Table 2
Johansen Cointegration Test Results (1960-1999)

Country	Null: r = 0 Trace	Null: r = 0 Maximum Eigenvalue (l_{max})	Null: r < 1 Trace	Null: r < 1 Maximum Eigenvalue (l_{max})
Ghana	22.48[b]	18.77[b]	3.67	3.67
Cote d'Ivoire	36.15[b]	24.11[b]	12.04[b]	12.03[b]
Kenya	30.76[b]	26.53[b]	4.22	4.22
Nigeria	27.20[b]	17.25[b]	10.03[b]	10.03[b]
South Africa	34.04[b]	29.90[b]	4.14	4.14
Zambia	30.21[b]	23.47[b]	6.73	6.73

Note: The superscript "*b* " indicates rejection of the null hypothesis at 5% significance level. The critical values for the trace test hypothesis $r \leq 1$, and r = 0 are 9.24 and 19.96 respectively. The critical values for the maximum eigenvalue test hypothesis $r \leq 1$, and r = 0 are 9.24 and 15.67 respectively. The critical values are obtained from E-Views statistical program.

Table 3

F-Statistics for Bivariate Causality Tests Based on VECM

	Ghana	**Ivory Coast**	**Kenya**	**Nigeria**	**South Africa**	**Zambia**
A: Saving						
Z_{t-1}	1.27	2.19	1.39	1.37	1.41	1.12
$\sum_{t}^{k}(IT)$	0.28	0.44	1.62	0.89	4.02[a]	1.51
B: Investment						
Z_{t-1}	4.87[a]	1.46	3.71 [a]	4.62[a]	4.45[a]	2.63 [b]
$\sum_{t}^{k}(SV)$	2.49	6.45 [a]	6.30 [a]	4.77[a]	4.91[a]	2.45
	Causality from saving to investment. (SV) → (IT)	Causality from saving to investment (SV) → (IT)	Causality from saving to investment. (SV) → (IT)	Causality from investment to saving. (SV) → (IT)	Bidirectional: Causality from saving to investment with feedback. (SV) □ (IT)	Causality from saving to investment. (SV) → (IT)