

**SAVING-INVESTMENT NEXUS IN DEVELOPING COUNTRIES:
DOES FINANCIAL DEVELOPMENT MATTER?**

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The Feldstein-Horioka puzzle is re-examined using a sample of 20 sub-Saharan Africa (SSA) countries. Unlike the extant literature we demonstrate the expediency of sustenance of financial sector reforms for the saving-investment nexus in SSA. Findings showed saving retention coefficients similar in magnitude to those already reported for developing countries, particularly SSA. In addition, however, the results uncovered a telling intervening role for financial deepening in the saving-investment space. Going forward, the precise nature and corresponding policy implications of this role should form an integral part of discussions in both academic and policy circles.

Keywords: Feldstein-Horioka Coefficient, Panel Mean Reversion, Fixed Effects, Sub Saharan Africa

JEL classification: C23, F21, F36, K11

1. INTRODUCTION

A distinguishing feature of Africa's twenty first century epoch, especially in the wake of the recent global economic cum financial crisis, appears to be the declining trends in traditional sources of investments, especially Official Development Assistance (ODA), foreign direct investment (FDI) as well as remittances, emanating from the developed countries. This evolving investment regime could potentially persist as a result of a number of factors chief among which are binding budget constraints, macroeconomic imbalances and challenges in terms of reaching parliamentary consensus in these African investment supply hubs. The current global economic outlook thus situates Africa in a position of grappling with declining trade flows, a collapse of commodity prices, reduced access to international private financing, falling government revenues, reductions in remittances, and, to some degree, uncertainty about

*The valuable comments of an anonymous referee are greatly appreciated. Any error, however, is ours.

future commitments of official development assistance (Heintz and Ndikumana, 2010). There is no gainsaying the stymieing effects these turn of events could have on the growth trajectories of African economies.

The foregoing, both from policy and strategic perspectives, should prod the minds of policymakers within the African continent on intensifying efforts towards better domestic resource mobilization. This should be with a view to ensuring that the investment resources needed for growth can be partly offset from within, particularly amid unfavorable external conditions. Received economic wisdom offers a clear, arguable though, association between saving and investment on one hand and the growth promoting influence of investment on the other. Theoretically, in the absence of capital mobility, domestic investment financing should be largely saving-based, implying between these variables, a correlation metric in the neighbourhood of unity. Thus, under perfect capital mobility, savings should flow to the most attractive investment projects globally. The puzzle, however, was that Feldstein and Horioka (1980), FH hereafter, using data on 16 of the Organisation for Economic Cooperation and Development (OECD) countries over the 1960-1974 period reported the existence of rigidities and preferences which tend to keep saving locked in investments within the country of origin. This was clearly at variance with the intuition of near perfect capital mobility expected among the OECD economies, particularly in such an era characterized by ample push for global capital markets integration.

Also, in a parallel but relatively older literature, McKinnon (1973) and Shaw (1973) working independently identified a key role for financial intermediaries in matching funds from surplus to deficit units in the economy during the growth process. Thus, well functioning financial markets ought to minimize the divergence between domestic saving and available investment opportunities. Therefore, the higher the extent of financial sector advancement, the higher is the level of investment that can be financed via an efficient allocation of saving (Bencivega and Smith, 1991; Guiso *et al.*, 2004). The potential envisaged here is that owing to the, at present, relatively low levels of financial development in sub Saharan Africa (SSA), there might be sufficient scope for improvements in the delivery of financial services which bodes well for home-grown mobilization of development finance through strengthening the chord between saving and investment.

Sequel to FH's seminal contribution, several studies¹ have queried the saving-investment nexus with particular controversy trailing the interpretation of the saving retention coefficient. While some studies, in line with the FH conjecture, elicit information on capital mobility, others opine that such saving-investment ratio largely

¹ Coakley *et al.* (1998) is an excellent survey of the literature on the Feldstein-Horioka puzzle. Also, Apergis and Tsoumas (2009) offer a more recent synopsis covering a substantial number of newly minted studies.

mirrors the underlying current account solvency condition.²

This study reexamines the “mother of all puzzles”³ within an Africa-specific setting. It seeks answers to some key questions viz: Do saving and investment have a long-run linkage in sub Saharan Africa (SSA)?; How does the degree of financial sector sophistication influence this relationship?; and Does the effect of financial sector development hinge on the particular measure of the size and coverage of the financial system adopted?

While a number of insightful studies have delved into the FH puzzle using entirely African samples, what remains a conspicuous lacuna in the extant literature is a consistent attempt at investigating the role of domestic financial markets in the saving-investment space within the confines of Africa. To pursue this germane contribution to the FH puzzle discourse further, the intuition that is to be tested empirically here is that greater financial development should help forge closer ties between domestic saving and investment culminating in more efficient local resource mobilization. This inventive reasoning is empirically implemented via the inclusion of interaction terms between saving and each of the indicators of financial sector sophistication. Since different measures of financial system advancement imply different degrees of involvement for the public and private sectors, it is posited that analyzing using multiple measures of financial development would provide clearer indications on which explicit elements of the financial sector to rally in the mobilization of resources for growth and eventual development.

As a foretaste, saving retention coefficients similar in magnitude to those reported for developing countries, particularly SSA, were found. More interesting is the fact that, for SSA, a prominent role for financial deepening in the saving-investment association emerges from the estimates. This demonstrated intervening role for financial development in the saving-investment linkage not only sheds fresh light on issues but also leaves much for pondering particularly by policy makers in SSA.

Following this introductory section, there is a brief peep into a few key facts on saving and investment in SSA in section 2. Also, the section goes further to look at the trends in some SSA financial development indicators. Section 3 gives a snapshot of the empirical literature with the bulk of its emphasis on SSA-centric studies. The data description as well as the estimation methodology adopted for the study is detailed in

² Without altering the orientation of the present study, however, we evade the fairly murky issues regarding the precise economic interpretation of the saving retention coefficient. Rather, we home in on the likelihood of cointegration between saving and investment for starters and then examine in what way(s) financial development matters.

³ This name was appended, by Sinha and Sinha (2004), to the FH findings due to the robustness observed over different country samples, estimation techniques and time periods. Although, the interpretation of the saving retention (FH) coefficient remains amenable to debate, the magnitude of its estimates have been found to be robust for both developed and developing country samples thus in a way perpetuating the puzzle.

section 4 while section 5 houses the empirical results presentation and discussion. The sixth and final section offers the papers parting comments.

2. TRENDS IN SAVING, INVESTMENT AND FINANCIAL DEVELOPMENT IN SUB-SAHARAN AFRICA

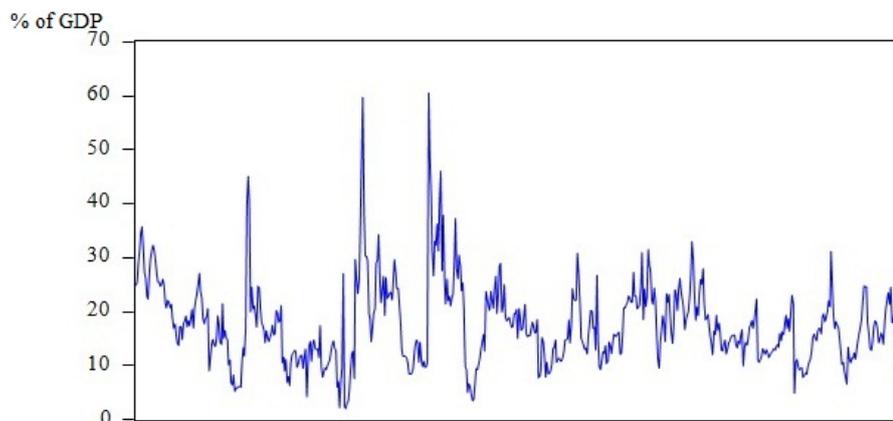
This section, though terse, preoccupies itself first with a visual and verbal description of the trends in saving and investment in SSA over the study period. Next, is to characterize the share size and precise coverage of the financial sectors of the countries in the sample with a view to highlighting similarities and divergences in their drive towards the path of financial development.

Figure 1 gives an apt expression to the underlying data. In SSA, on average, there appears to be no clear-cut support for a substantial ramping up of either saving or investment. Instead, what is evident is a steady decline in investment from about the mid-1990s to 2005. There are however three striking spikes in domestic investment in the one half decade prior to the onset of the investment drag. It is also instructive that investment in 2005 (about 15 per cent) falls significantly short of the 25 per cent recorded in 1976. The lower panel of the same figure tells the saving side of the story. Like investment, domestic saving has also been low in SSA. There is hardly any conspicuous peak except for the jump to a little less than 70 per cent in the early 1990s. What is particularly telling about saving dynamics in this period is that it coincides with one of the peaks in investment, indicative plausibly of some co-movement between these variables. Beyond that, there is no palpable pattern of improvement in domestic saving behaviour.

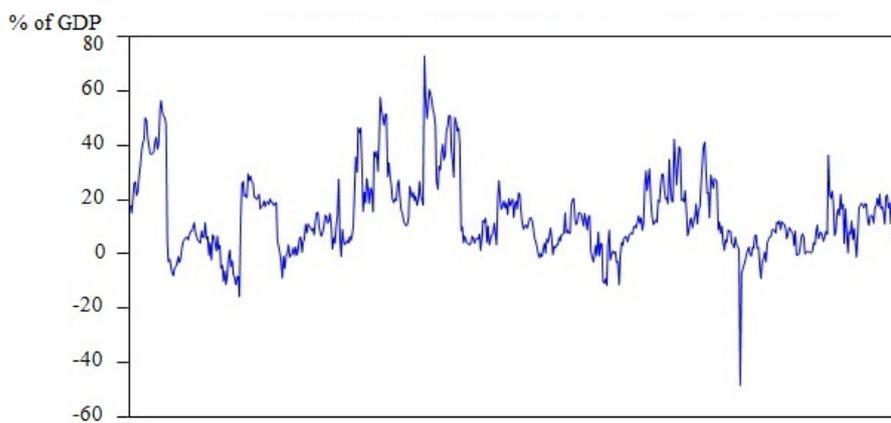
However, this broad view masks quite a lot of the specificities in saving and investment trends in each country. Specifically, on a country-by-country basis, saving actually displayed an increasing trend in Botswana, Burkina Faso, Central African Republic, Republic of Congo, Madagascar, Mali and Senegal. The absence of contiguity therefore precludes any explanation on the basis of synchronization of regional policies. On the other end of the spectrum, declined saving rates are obvious for Burundi, Cameroon, Malawi as well as Zimbabwe. In most of the remaining countries, there is no discernible pattern in saving behaviour. Particularly striking also is the sharp drop in saving in Rwanda between 1993 and 1994.

A similar haphazard picture epitomizes the investment contour of these SSA countries. While substantial increases were recorded in Ghana, Madagascar, Senegal, Uganda and Mali to some extent, investment seems to have plummeted in Cameroon, Cote'd' Ivoire and Gabon. Kenya displays a somewhat similar declining trend but investment appears to have climbed sufficiently from 2003 to 2005. For most of the other countries it is difficult to place the investment contour. Also, Nigeria which could boast of one of the highest investment rates in SSA as at 1976 had a little less than the sample average by 2005.

Taken together, these trends reveal at least two key issues. First, on average, both investment and saving were low within and across the countries. Second, and related to the first, some linkage between saving and investment could be “crudely” inferred from the trends. Therefore, what is needed is the creation of an enabling environment that could help boost domestic savings and subsequently investment. A sound domestic financial sector, both in its intuition and design, is an important candidate when thinking goes in the direction of suitable economic environment. Thus, financial development indicators are examined subsequently.



Domestic Investment in the Selected SSA Countries, 1976-2005



Domestic Saving in the Selected SSA Countries, 1976-2005

Figure 1. Trends in Domestic Saving and Investment in Selected Sub-Saharan African Economies

We now turn to financial system evolution, where for ease of appreciation each country and indicator is viewed quinquennially. Domestic credit provided by the banking sector (% of GDP), shown in Table 1, doubled in Rwanda from 5.27 to 11.54 per cent between the period 1976-80 and 2001-05.⁴ Similarly, over the same time span, Burundi recorded a three-fold increase.

An overwhelming majority, precisely around 70 per cent, of the countries in the sample, however, showed a decrease in this financial indicator over time. The contour of this financial development measure for Ghana was static, at about 30.25 per cent, while Nigeria witnessed a sharp drop from 42.61 percent in 1981-85 to 16.78 per cent by 2001-05.

Table 1. Domestic Credit provided by the Banking Sector (% of GDP), 1976-2005

Country/Year	1976-80	1981-85	1986-90	1991-95	1996-2000	2001-05
Botswana	4.63	-2.00	-41.69	-40.10	-60.36	-20.35
Burkina Faso	14.03	12.41	10.99	7.96	11.48	13.85
Burundi	12.09	23.96	24.61	20.89	27.52	36.62
Cameroon	24.12	24.93	26.64	26.39	16.96	13.95
Central African Republic	21.30	20.08	13.39	13.56	11.04	14.87
Congo, Dem. Rep	14.24	9.53	12.09	10.78	11.06	1.48
Congo, Republic	27.62	21.27	30.63	23.17	16.33	10.20
Cote d'Ivoire	35.09	45.81	44.98	37.65	24.21	19.66
Gabon	22.68	16.48	30.58	19.72	17.82	16.04
Ghana	30.32	20.84	22.31	19.12	28.06	30.25
Kenya	34.98	47.01	49.64	50.91	40.38	39.51
Madagascar	26.73	41.88	34.54	27.24	15.04	16.08
Malawi	33.95	42.01	28.61	24.32	10.51	20.66
Mali	39.96	31.15	19.28	12.23	13.76	16.99
Nigeria	18.23	42.61	33.20	27.52	14.70	16.78
Rwanda	5.27	7.39	14.15	17.51	12.35	11.54
Senegal	39.60	51.95	39.12	29.37	23.59	23.10
Uganda	19.07	25.10	22.82	13.26	8.01	11.81
Zambia	62.87	73.29	57.51	59.77	60.17	38.51
Zimbabwe	78.76	35.38	40.76	45.13	52.63	59.12

Source: Averages computed based on the underlying data from IMF's *International Financial Statistics*, 2007.

⁴ It is noteworthy that the patterns in the other two financial development metrics -domestic credit to the private sector as a share of GDP and total liquid liabilities to GDP ratio- are in large part similar to the one detailed in the ensuing discussion on domestic credit provided by the banking sector. This is not so surprising as the correlation coefficients between total banking sector credit and each of the other two indicators are 0.98 and 0.52 correspondingly.

Another interesting feature from the data is the encouraging figures, especially for 1986-90, for most of the countries. However, the data also point to the fact that some ground seems to have been subsequently lost in the quest for better functioning financial systems. While financial reforms have been widespread in SSA, the foregoing raises questions on the credibility of any claim to improved financial development in the region. To sum up, a salient potential exists amid this unsatisfactory saga. There seems to be abundant leeway for improvements in both the quantity and quality of financial services in SSA. It is hoped that in time the evolution of such financial system would help foster the much desired linkage between saving and investment in these economies.

3. LITERATURE REVIEW

The empirical literature on the FH puzzle is vast and deep. We, therefore, do not pretend to offer an exhaustive coverage of the subject in this section. Rather, the review proceeds in a fairly simple fashion beginning with the Feldstein and Horioka (1980) paper which originated the debate. Some reactions to the conclusions reached by this seminal article are briefly reviewed next, while in line with the scope and interest of the present study a more detailed focus on empirical attempts using entirely SSA datasets is ultimately pursued. It winds up with a succinct narrative on grounds yet to be explored in the literature and the specific attempt made with a view to addressing some of the outstanding issues. Hence, we commence with Feldstein and Horioka (1980) who used data on saving and investment rates for a sample of 16 OECD countries over the fifteen year period spanning 1960 to 1974. They found, using cross sectional regressions, a saving retention coefficient of between 0.85 and 0.95 (Apergis and Tsoumas, 2009). This result was counterintuitive as it ran out of sync with the prior expectation of almost complete capital mobility in the OECD, particularly in an era when concerted efforts were geared towards the enhancement of global capital market integration (De Wet and Van Eyden, 2005). Feldstein's (1983) study on 17 OECD countries using a more expanded dataset also confirmed the existence of this "home-biased" investment climate. This was trailed by the avalanching of empirical assessments of the FH puzzle.

Since then several studies have examined this relationship within single country time series, cross sectional (for ease of direct comparison with FH) as well as panel contexts. In sum, while the finding of a high saving retention coefficient has been replicated often and tagged "remarkably consistent" (Glick and Rogoff, 1995), the bulk of prevailing criticism of the FH notion are in terms of whether the saving-investment association provides credible evidence on the extent of capital mobility across national borders. Here, we cut the Gordian knot by restricting attention to studies that look at the saving-investment relation as it relates to SSA economies. While the balance of empirical studies has unarguably tilted towards the developed countries, it is fair, at this juncture, to highlight some of the few ingenuous exercises conducted on African data.

Specifically, De Wet and Van Eyden (2005) applied stationary panel data techniques

to data on a sample of 36 SSA countries from 1980 to 2000. They include, following Vamvakidis and Wacziarg (1998) and Isaksson (2001), foreign aid as an additional variable to capture the nuances with respect to the dependence of most of these small countries on external finance. They also included other control variables such as current account to GDP ratio and openness. Deploying both fixed and random effect models, they found low saving retention coefficients of between 0.286 and 0.349 indicative of high capital mobility in the region. This finding bodes well when juxtaposed with previous empirical studies on other developing regions (see Dooley *et al.*, 1987; Wong, 1990; Vamvakidis and Wacziarg, 1998; Isaksson, 2001; Mamingi, 1997; Payne and Kumazawa, 2005, among others). The caveat, in their view, however, is that the introduction of aid, openness and current account, which are all potential investment drivers, could raise questions on the reliability of the obtained estimates due to endogeneity. Another concern was the difficulty in controlling for the influence of measurement error.

Payne and Kamazawa (2005) arrived at a similar conclusion but explained more aptly the impact of substantial non-market flows to SSA economies. According to them “if foreign aid is important but omitted, this weakens the saving-investment correlation, which would suggest greater capital mobility than is actually the case”. A panel cointegration approach was employed by Adedeji and Thornton (2006) using data on six African countries during 1970-2000. The result of the ensuing panel regressions, using alternative estimators, suggest moderate to high saving-investment coefficient within the range of 0.39 to 0.73. Using a far more elaborate sample of 37 African countries over the period spanning 1970 to 2006 and a newly developed Pool Mean Group (PMG) estimator (in addition to the FMOLS and DOLS used by Adedeji and Thornton, 2006), Bangake and Eggoh (2011) reported cointegration between saving and investment. Their estimates of the FH coefficient are 0.36, 0.38 and 0.58 for the PMG, FMOLS and DOLS in that order. They however found marked differentials in the coefficients obtained for different country groupings. In an earlier related paper, but with focus on legal origins, Bangake and Eggoh (2010) found saving retention coefficients of 0.34 and 0.85 for common law and French civil law countries, respectively. Their submission of a close linkage between the strength of legal investor protection and capital mobility appears to comport well with suggestions by some economists that countries with better investor protection are more suited to attract capital from external sources.

While these studies have explored some key aspects of the saving-investment nexus, a void still stirs one in the eye. There seems to be little attention devoted to the role of the domestic financial sector in the linkage between domestic saving and investment in SSA.⁵ This should be particularly informative since well functioning financial markets

⁵ Kasuga (2004)'s inventive study had an infusion of finance arguing that information asymmetries create financing constraints which hamper investment. Thus, finance was suggested as an intervening variable in the saving-investment association. This notwithstanding, a point of departure is that we explicitly crafted a role

ought to minimize the divergence between domestic saving and available investment opportunities. This study, thus, extends and compliments its SSA centered predecessors by examining the influence of the extent of financial sector development on the relationship of interest (FH Puzzle). This view, to our mind, has waited furtively enough in the fringes of the FH empirical sphere. Digging further therefore, different measures of financial development are also probed to ascertain the sensitivity of results to the measure adopted on one hand and to glean useful policy information in terms of specific elements of the financial sector which reforms ought to target on the other.

4. DATA AND METHODOLOGY

The cross-cutting aim of this study is to investigate the linkage between saving and investment in selected SSA countries. In furtherance of this broad objective, attempt is made to gauge the influence of financial development on the saving-investment nexus. Conceptually distinct measures of financial development are also explored for the reasons adduced to earlier. Taking off from this juncture, this fourth section is bifurcated into a description of data and model specification as well as a portrayal of the methodology, in particular, the estimation procedure.

4.1. Data

A balanced panel covering 20 SSA countries⁶ spanning the three decades from 1976 to 2005 is used. On the basis of data availability and uniformity, the initial sample was systematically trimmed to twenty one. Data on the key variables were obtained from the World Bank's *World Development Indicators* CD-ROM 2008 and the International Monetary Fund's *International Financial Statistics* CD-ROM 2007. The variables used and their definitions are covered in what follows.

Following what seems to have become the standard practice in the empirical studies of the FH conundrum, we define saving as gross domestic saving as a share of GDP, while investment is proxied by gross fixed capital formation as percentage of GDP as advanced by Bayoumi (1990) and Sinha and Sinha (2004). Both studies expressed preference for gross fixed capital formation since it somewhat purges the influence of

for the financial sector in an unadulterated African sample, albeit the closeness (in terms of spirit but not context) of the Kasuga paper is acknowledged. Also, the difficulty in distilling coherent policy implications from cross-sectional regressions, used by Kasuga (2004), is obviated since our panel econometric approach gives more observations and less worries with respect to degrees of freedom.

⁶ The countries included in our sample are Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Congo Democratic Republic, Congo republic, Cote'd' Ivoire, Gabon , Ghana, Kenya, Madagascar, Malawi, Mali, Nigeria, Rwanda, Senegal, Uganda, Zambia and Zimbabwe.

procyclical inventories which typically produce spurious correlations between saving and investment. Also, the gross, as opposed to the net, measures of these two key variables are used in our analysis. This is essentially to avoid the knotty issues around the components and computation of depreciation allowances across countries.

The financial sector indicators, the key forcing variables incorporated in this attempt, and their definitions are in turn detailed. As a lead up it is pertinent to note that financial deepening is conventionally viewed as the process which culminates in improvements in the quality and quantity as well as the efficiency of financial services. However, since these services are multifarious, using a single measure to capture their effect may not be informative enough. As a result, three alternative indicators of financial market sophistication with a view to ascertaining the robustness of ensuing findings are explored. The three measures are the ratio of M3/GDP, domestic credit to the private sector as a share of GDP and total domestic credit provided by the banking sector as a percentage of GDP.

These alternative measures⁷ of financial development are used in order to reflect the diversity of opinions on the precise definition of financial sector development. The ratio of M3/GDP captures the total liquid liabilities of the financial system by broadly including key financial institutions such as the central bank, deposit money banks and other non-bank financial institutions (NBFIs). It is thus an encompassing measure of the overall size of the financial sector (Alfaro *et al.*, 2004). The second indicator, domestic credit to the private sector, distinguishes between the end users of the claims of financial intermediaries. It includes only the claims on the private sector. Total banking sector credit as a percentage of GDP, the third measure, excludes non-bank credit to the private sector and may be less comprehensive than the second measure (claims on the private sector as a ratio of GDP).

4.2. Estimation Procedure and Model Specification

This subsection begins by performing unit root tests on all the series in order to avoid the spuriousness emblematic of conducting least squares type regressions on

⁷ Yartey and Adjasi (2007) list the following 19 exchanges; The Botswana Stock Exchange, The Ghana Stock Exchange, The Cairo and Alexandria Stock Exchange (Egypt), the Douala Stock Exchange (Cameroon), The BRVM-Bourse Régionale des Valeurs Mobilières-The West African Regional Bourse (Cote d'Ivoire), Nairobi Stock Exchange (Kenya), Namibian Stock Exchange, The Stock Exchange Mauritius, Casablanca Stock Exchange (Morocco), Maputo Stock Exchange (Mozambique), Johannesburg Securities Exchange (South Africa), Khartoum Stock Exchange (Sudan), Swaziland Exchange, Tanzanian Stock Exchange, Tunis Stock Exchange (Tunisia), Uganda Stock Exchange, Lusaka Stock Exchange (Zambia) and Zimbabwe Exchange. Notwithstanding, attention is restricted to bank based measures as capital markets in most African countries and SSA in particular were either nascent or non-existent over the chunk of the period covered in this study.

non-stationary data. The empirical model is specified and the motivation for the inclusion of the key right hand side variables is briefly mentioned. The pros and cons of the adopted estimation approaches make an appearance at the tail of this sub-section.

The discussion takes off with the Levin-Lin-Chu (2002) as well as the Im-Pesaran-Shin (2003) panel unit root tests. The focus here is to provide a formal, without any particular claim to detail, description of two of the main panel unit root tests employed in empirically testing the saving-investment correlation in the selected African countries. Levin, Lin and Chu (2002), LLC henceforth, assume that the stochastic process $\{Y_{it}\}$ is observed for a panel of individuals $i = 1, \dots, N$ each with a time dimension $t = 1, \dots, T$. The intuition is to ascertain if this process is integrated for each individual in the panel. In line with the conventional single time series approach, individual regressions may contain an intercept and time trend. Also, all the parameters in the error process are assumed to vary across individuals, except for the first-order autocorrelation coefficients. More formally, LLC considered a sample of N cross-sectional units observed over T periods. The process y_{it} is generated by an AR (1) model thus:

$$y_{it} = (1 - \varphi_i)\mu_i + \varphi_i y_{i,t-1} + \varepsilon_{it}, \quad i = 1, \dots, N, \quad t = 1, \dots, T. \quad (1)$$

The primary concern is to test the null hypothesis of unit roots, that is $\varphi_i = 1$, in expression (1). Subtracting $y_{i,t-1}$ from both sides of the expression yields;

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + \varepsilon_{it}, \quad (2)$$

where $\alpha_i = (1 - \varphi_i)\mu_i$, $\beta_i = -(1 - \varphi_i)$, and $\Delta y_{it} = y_{it} - y_{i,t-1}$.

The null hypothesis of unit roots is then stated as:

$$H_0 : \beta_i = 0, \text{ for all } i,$$

and the alternative as:

$$H_A : \beta_i < 0, \quad i = 1, \dots, N. \quad (3)$$

This formulation of the null hypothesis only allows for homogeneity in the β 's across the groups. All of the individual series are assumed to have unit roots under the alternative hypothesis. Although the null is intuitive under certain conditions, this kind of alternative hypothesis may however be too restrictive and hence uninformative, especially in empirical works (Maddala and Wu, 1999). To better approximate reality, Im, Pesaran and Shin (2003), IPS from now on, relax the homogeneity assumption imposed by LLC under the alternative hypothesis.

The alternative, in this case, is that;

$$H_A: \beta_i < 0, \quad i = 1, \dots, N_i, \quad \beta_i = 0, \quad i = N_1 + 1, N_1 + 2, \dots, N. \quad (4)$$

IPS developed a t-bar statistic for testing unit roots given as:

$$\sqrt{N} \frac{(\bar{t}_{N,T} - \mu)}{\sigma} \Rightarrow N(0,1), \quad \text{where } \bar{t}_{N,T} = \frac{1}{N} \sum_{i=1}^N t_{i,T}.$$

Therefore, using data on the 20 selected African countries, the t-bar statistic is calculated using the mean value of the individual ADF statistics based on each φ_i .

Against the backdrop of this reconnaissance stationarity testing, the appropriate cointegration test⁸ such as the ones proposed in Pedroni (1999) can be conducted on Equation (5) below;

$$Y_{it} = \alpha_i + \beta X_{it} + \psi Z_{it} + \eta_{it}. \quad (5)$$

Y represents gross domestic investment, X is the vector of our baseline control variables (aid and openness), while Z summarises all three financial development measures. As a step towards arriving at an estimable model, a more explicit variant of Equation (5) which spells out the exact variables of interest is given as;

$$INV_{it} = \lambda_i + \delta_1 SAV_{it} + \delta_2 AID_{it} + \delta_3 OPEN_{it} + \delta_4 FINDV_{it} + \varepsilon_{it}, \quad (6)$$

where INV is investment as a share of GDP , SAV denotes saving as a percentage of GDP , AID captures the proportion of foreign aid in GDP , $OPEN$ is the degree of openness of the economy and $FINDV$ designates the aforementioned indicators of financial system refinement.⁹ As usual ε , i , and t are the white noise disturbance term, country and time

⁸ For the panel cointegration tests, unlike the unit root tests detailed earlier, deployed in this paper we sidestep the considerably messy algebra with a view to keeping an eye on a key aim which is to query the existence of any long-run relation between saving and investment in SSA. For this exercise we use the Pedroni residual-based, Fischer Johansen-type as well as the Kao tests. Nonetheless, the works by Pedroni (1999) and Kao and Chiang (2000) are quite informative if the interest is in the mechanics of these tests.

⁹ While the use of the ratio of M2 to GDP, as an additional financial development indicator, in some studies is acknowledged, we refrain from doing the same owing to more recent convincing evidences which have adjudged it a poor measure of financial system development. This line of reasoning is especially appealing since the sheer amount of money in circulation relative to the size of the economy really does not tell much about the allocation of such resources by financial intermediaries within the domestic economy. Beyond this, the liquid liabilities (alias M3/GDP) measure we adopted comprehensively covers not only M2

indexes respectively. λ_i is a time-invariant and unobserved country-specific effect.

Three different panel estimation techniques -pooled OLS, fixed effects and random effects- are used.¹⁰ From a theoretical lens, modelers are supposed to view the most appropriate option through a number of standard diagnostic tests on a given dataset. In practice, however, it is frequently difficult to know which technique is the most reliable since each of the techniques has its strengths and weaknesses. For instance, a pooled OLS model implicitly assumes there are no problems of omitted variables in a model, which is hardly likely to be true.

The fixed effects specification allows for intercept shifts for each country. This is accomplished by creating dummies for all but one of the countries in the sample. The upshot of this is a marked reduction in degrees of freedom, the severity of which deepens as the size of the sampled countries increases. Finally, the random effects model also allows for a different intercept for each country in the sample but isolates these individual country effects in the error term, and therefore does not reduce degrees of freedom in the manner of the fixed effects estimator. Its own underside, however, relates to the tricky requirement that the effect of omitted variables effects be uncorrelated with the explanatory variables. For these range of reasons, expounded quite appositely in Pollin and Zhu (2006), we therefore touch on results for the three approaches with a view to ascertaining the robustness of our study findings.

5. ESTIMATION RESULTS AND INTERPRETATION

This section first presents and then discusses the key results. The discussion encompasses the stationarity tests, the corresponding cointegration tests and the eventual panel estimations.

but also other near monies by definition. In terms of market based measures such as market capitalization to GDP ratio, total stock value traded as a share of GDP and market turnover ratio, our strict SSA focus precludes their inclusion in the empirical strategy on two important levels. First, the majority of countries in the sample do not have capital markets. Second, the few with functioning stock markets have in large part only operated for a few years. Hence, no meaningful panel econometric approaches could be deployed with respect to doing the usual bank- versus market- comparisons the list presented in footnote 7 notwithstanding.

¹⁰ Nonetheless, it is apposite to emphasize at this juncture that in order to facilitate congruence with the empirical strand of the literature interested precisely in panel cointegration estimation, some alternative estimators such as dynamic ordinary least squares (DOLS) and fully modified ordinary least squares (FMOLS) estimation are conventionally carried out. The mandate of the present study is, however, on obtaining empirical estimates of the saving retention (FH) coefficient which the panel OLS with fixed effects model convincingly delivers on. This estimation method is particularly attractive in our instance as it accounts for both time invariant and country specific effects.

5.1. Stationarity Testing

As Table 2 shows, the null hypothesis of unit roots for the entire panel can be rejected in the level of all the series. The only exceptions being the Levin *et al.* (2002) statistic for FINDV 3 and the Im *et al.* (2003) result for FINDV 2 in that order. However, there is a rejection of this null when both of these series are differenced once. Overall, these tests are indicative of stationarity in the level of the variables. This implies that a static regression would not be spurious for the panel as a whole.

Table 2. Panel Unit Root Test Results

	Levin <i>et al.</i> (2002)				Im <i>et al.</i> (2003)				Decision
	Level		1 st Diff		Level		1 st Diff		
	Statistics	P-value	Statistic	P-value	Statistics	P-value	Statistic	P-value	
AID	-1.472	0.071***	-	-	-1.891	0.029**	-	-	I(0)
INV	-1.801	0.036**	-	-	-1.843	0.033**	-	-	I(0)
SAV	-1.834	0.033**	-	-	-2.180	0.014**	-	-	I(0)
OPEN	0.470	0.081***	-	-	-2.197	0.011**	-	-	I(0)
FINDV 1	-1.466	0.070***	-	-	-1.563	0.059***	-	-	I(0)
FINDV 2	-1.480	0.069***	-	-	-0.577	0.282	-11.633	0.000***	I(0)/I(1)
FINDV 3	-1.237	0.108	-7.717	0.000	-2.159	0.015**	-	-	I(0)/I(1)

Notes: *, ** and *** connote statistical significance at the 1, 5 and 10 per cent levels in that order. FINDV 1 is the ratio of banking sector credit, FINDV 2 is credit to the private sector and FINDV 3 is the total liquid liabilities, all as percentages of GDP, respectively.

5.2. Tests for Cointegration in Panel

For the sake of completeness, however, formal cointegration tests are carried out¹¹ since the conclusion on the stationarity of FINDV 2 and FINDV 3 appears shaky. Hence, rather than take a somewhat middle-of-the-road stance, the Pedroni (1999) and Fischer cointegration tests were conducted. This was done with the inclusion of these variables within the cointegration space.

The results reported in Tables 3 and 4 principally suggest the existence of a long-run relationship, which means that static panel estimators such as the pooled OLS, fixed effects and random effects suit the subsequent analyses.

¹¹ We refrain, for want of space, from reporting the results for the Kao residual-based cointegration test. The results and attendant conclusion mirrors those of the two approaches detailed.

Table 3. Pedroni Panel Cointegration Test Results

	Within-dimension (panel)				Between-Dimension (group)		
	v-Stat	rho-Stat	PP-Stat	ADF-Stat	rho-Stat	PP-stat	ADF-Stat
With FINDV 2	-1.564***	1.028	-2.096**	-1.609***	-1.857**	-4.735*	-2.173**
With FINDV 3	-1.641***	1.033	-1.724**	-1.093	1.889**	-3.729*	-1.768**

Notes: The test statistics are normalized to approximate, asymptotically, a standard normal distribution. *, ** and *** represent 1, 5 and 10 per cent levels of significance based on critical values of 2.326, 1.644 and 1.281 respectively. FINDV 2 and FINDV 3 are as defined in the notes accompanying Table 2.

Table 4. Fischer Panel Cointegration Test Results

	Hypothesis on No. of Cointegrating Vectors	Fischer-Stat	Prob	Fischer-Stat	Prob
		(Trace test)		(Maximum-Eigen test)	
Model	None	246.70*	0.000	189.80*	0.000
with	1	101.30*	0.000	77.23*	0.001
FINDV 2	2	51.00	0.161	33.60	0.819
Model	None	222.40*	0.000	187.90*	0.000
with	1	86.01*	0.001	59.49**	0.039
FINDV 3	2	48.65	0.223	32.42	0.856

Notes: * and ** imply that the computed statistic exceeds the critical values at 1 and 5 per cent significance levels. FINDV 2 and FINDV 3 are as defined in the notes attached to Table 2.

5.2. Panel Estimation Results

The result of the estimation is laid out as follows. Table 5 shows a saving retention coefficient of 0.32, on average, for the pooled OLS specification. This coefficient remains robust not only to the addition of forcing variables like foreign aid and openness but also the inclusion of financial deepening. FINDV 1 and FINDV 3 do not exert any statistically significant influence on domestic investment in our sample of SSA countries in all the OLS models.¹² This is at variance with the conjecture, *ab initio*, that efficient financial markets should bridge the saving-investment gap. For foreign aid and openness, the sign and significance of their coefficients are very much in line with the findings of some comparator studies.

¹² On the contrary, Esso (2010) provides support for finance as a driver of growth in Mali and Ghana, while this hypothesis failed to hold in the remaining Economic Community of West African States (ECOWAS) countries in his sample. However, his work differs in focus since growth rather than investment was the explained factor.

Table 5. Panel Estimates for the Feldstein-Horioka Equation

	Model 1		Model 2		Model 3		Model 4		Model 5	
	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
CONSTANT	13.18 (40.07)*		9.91 (15.92)*		9.93 (15.86)*		9.92 (15.86)*		9.88 (15.75)*	
SAV	0.32 (19.85)*	0.20 (7.25)*	0.31 (13.26)*	0.21 (7.31)*	0.31 (13.25)*	0.21 (7.30)*	0.31 (13.25)*	0.21 (7.30)*	0.31 (13.24)*	0.21 (7.31)*
AID			0.11 (3.92)*	0.07 (2.33)**	0.11 (3.88)*	0.07 (2.32)**	0.11 (3.90)*	0.06 (2.02)**	0.11 (3.93)*	0.07 (2.33)*
OPEN			0.05 (3.53)*	0.08 (3.98)*	0.05 (3.51)*	0.08 (3.96)*	0.05 (3.52)*	0.07 (3.94)*	0.05 (3.54)*	0.08 (4.04)*
FINDV 1					0.01 (-0.53)	0.04 (2.07)**				
FINDV 2							0.12 (7.45)*	0.17 (8.33)*		
FINDV 3									0.02 (1.21)	0.06 (2.58)**
ADJ- R SQUARED	0.38	0.52	0.41	0.54	0.42	0.53	0.42	0.54	0.41	0.56
Number of Observations	600	600	600	600	600	600	600	600	600	600
Hausmann Test		12.63 [0.00]		14.12 [0.00]		17.08 [0.00]		17.67 [0.00]		22.89 [0.00]

Notes: The dependent variable is domestic investment (proxied by Gross fixed capital formation). The t-ratios are in parentheses. FINDV 1, FINDV 2 and FINDV 3 remain as defined in the note to Table 2. *, ** and *** represent statistical significance at the 1, 5 and 10 per cent levels respectively. All coefficients are expressed in the nearest 2 decimal places. The figures in brackets are the corresponding probability values for the Hausmann test.

As expected, a more outward oriented economy will comport with capital flows and by extension higher investment. In a similar manner, the significant and positive aid term reflects the importance of this non-market flow in most SSA economies. The improvement in the adjusted- R^2 from 0.38 to 0.41, on the inclusion of aid and trade, lends further credence to the foregoing claim. However, an underside of the pooled regression is that it does not explicitly account for heterogeneity in the cross-sections. This fitting of a single intercept for the entire panel may pave way for bias.

The fixed effects (FE) model results show a decline in the saving-retention coefficient.¹³ This might be symptomatic of the potential specificities in political,

¹³ As Table 5 vividly displays, the decision -Hausmann- test showed a preference for the fixed effects

institutional as well as economic policy spheres which the preceding least squares type estimation overlooks. The better performance of the FE models is echoed by a marked improvement in model fit. More than half, precisely 56 per cent, of the variations in investment is accounted for by the explanatory variables taken together. Also, the performance of all the financial indicators is now satisfactory both in terms of magnitude and significance. Particularly noticeable is the positive and significant impact of credit provided to the private sector (FINDV 2) on investment. The magnitude of this effect is some three to four times more than recorded for the other two financial sector indicators. This plausibly points to a relatively more crucial role for private sector directed credit provision by the domestic financial systems with a view to upgrading capital stock in SSA. Finally, the coefficients on aid and trade remain positive and statistically significant though there is a moderate reduction (0.11 in OLS to 0.07 in FE) in the size of the aid parameter. The obverse is reflected in the coefficients of openness.

The estimates of the random effects (RE) specification, not reported here, are in concert with the FE coefficients. Specifically, the RE estimates of the FH coefficient range between 0.22 and 0.24 across models. Financial indicators also did a fairly good predictive job in explaining movements in investments in these 20 SSA countries.

It is pertinent to note, however, that the estimates of the FH coefficient, the prime parameter of interest, do not diverge in any marked way from similar studies on SSA data. For instance, Bangake and Eggoh (2010) found saving retention coefficients of 0.36, 0.38 and 0.58 using PMG, FMOLS and DOLS estimators, respectively, while Adedeji and Thornton (2006) wound up in the precincts of 0.51 and 0.73 using DOLS and FMOLS. In the strict sense, however, the two major studies that can be most credibly compared¹⁴ to ours are Payne and Kamazawa (2005) and De Wet and Van Eyden (2005). The estimates recorded were 0.20 (OLS), 0.23 (FE), 0.24 (RE) and 0.31 (OLS), 0.34 (FE), 0.28 (RE) for the former and latter in that order. Our estimated FH coefficients, 0.32 (OLS), 0.21 (FE) and 0.24 (RE), lie within the boundaries defined by prior SSA-centered attempts.

To tentatively sum up here, the inclusion of all financial deepening measures did not alter the size of our FH estimates. This suggests, to a large part, that improving the quality and quantity of financial service provision might not lead to a better mobilization of domestic saving in SSA for the purpose of investment. Hence, finance seemingly matters little in the saving-investment nexus for sampled countries.

(FE) specification over the random effects (RE) model across all models. Hence, to economise on space, we refrain from reporting the RE model estimates (which by and large are indistinguishable from their FE counterparts) here.

¹⁴ We are comfortable with attempting a direct comparison here since both of these studies used the same pooled OLS, fixed effects and random effects models. However, neither of them probed into the likely role of financial system development which this study gives a shot.

Despite the foregoing, with a view to digging further on the purported role for finance in the saving- investment nexus, each of the financial development measures is interacted with saving. The aforementioned interaction terms are to elicit information on the extent to which finance, augmenting saving, alters the magnitude of the FH coefficient. In Table 6, there is a jump in the FH coefficient from the 0.21 (in the FE models of Table 5) to 0.33 when credit provided to the private sector (FINDV 2) is interacted with saving. This specific finding encapsulates the unique value which this study adds to the FH literature with prime reference to SSA economies. It is pertinent to note also that this interaction term exerts a positive and significant influence on investment. A change of this magnitude would imply telling evidence of some role for financial development in mobilizing domestic saving for investment. There is only a moderate increase in the saving retention coefficient from 0.21 to 0.23 with saving interacted with both total banking sector credit (FINDV 1) and total liquid liabilities (FINDV 3), albeit the interaction terms are statistically insignificant. Again, aid, openness and financial indicators generally retain their size and significance in the presence of interaction terms. The degree of openness, of course, shows an increase in magnitude.

Table 6. Alternative Estimates of Feldstein-Horioka Equation (Interaction terms)

	FE	FE	FE
SAV	0.23 (3.18)*	0.33 (6.29)*	0.23(8.50)*
AID	0.05 (2.83)*	0.06 (4.39)*	0.07(2.53)**
OPEN	0.19 (4.57)*	0.16 (4.08)*	0.21 (3.86)*
FINDV 1	0.04 (0.79)		
FINDV 2		0.28 (5.76)*	
FINDV 3			0.06 (1.03)
SAV*FINDV 1	0.02 (1.01)		
SAV*FINDV 2		0.06 (3.47)*	
SAV*FINDV 3			0.05 (1.39)
ADJ-R SQUARED	0.51	0.57	0.54

Notes: The dependent variable is domestic investment (proxied by Gross fixed capital formation). The t-ratios are in parentheses. FINDV 1, FINDV 2 and FINDV 3 remain as defined in the note to Table 2. *, ** and *** represent statistical significance at the 1, 5 and 10 per cent levels respectively. All coefficients are expressed to the nearest 2 decimal places.

In sum, while the financial sector indicators as a whole do not appear to affect the saving-investment ratio substantially, evidence is uncovered here pointing to a potential role for financial development in better matching domestic saving with investment opportunities within SSA. In particular, domestic credit provided to the private sector should play a key role in this respect.

6. CONCLUDING COMMENTS

Traditional sources of development finance are likely to be increasingly threatened particularly in the wake of evolving global economic malaise. Therefore, policymakers in sub Saharan Africa need to ponder more on the need for improved mobilization of domestic resources. To drive home this point, this study re-examined the classic Feldstein-Horioka puzzle using a sample of 20 SSA countries. Panel stationarity, cointegration and estimation were conducted on annual time series data spanning 1976 to 2005. However, unlike most other attempts, the role of financial development in the saving-investment linkage was explicated.

The estimates of the FH coefficients, viz., 0.32 (OLS), 0.21 (FE) and 0.24 (RE) are in line with the findings in the extant literature. Interestingly also, there was a jump in the saving retention coefficient from 0.21 to 0.33 when credit provided to the private sector was interacted with saving. This offers evidence of some role for financial development, especially domestic credit provided to the private sector, in mobilizing domestic saving for investment. The precise nature of this role as well as attributable policy implications should lie close to the heart of subsequent academic and policy debates. Moreover, future research on the subject could explore the use of alternative estimators such as DOLS and FMOLS.¹⁵ Another potentially fruitful line of enquiry could be a finer-grained analysis of SSA sub-regions as a means of investigating the existence or otherwise of differences. Finally, it is equally key to acknowledge the low quality of national accounts data particularly on savings for developing countries, which is typically obtained as a residual or the residual of a residual. Hence, the reported results are to an appreciable degree indicative and should be viewed as such.

¹⁵ We are grateful to an anonymous referee for pointing out this insightful possibility.

APPENDIX

Data Definition and Sources

Variables	Definition	Source
Credit to the Private Sector	The value of credits by financial intermediaries to the private sector divided by GDP. This excludes credit to the public sector as well as cross claims of one group of intermediaries on another	International Financial Statistics
Total Liquid Liabilities	Currency plus demand and interest bearing liabilities of financial intermediaries and non-bank financial institutions divided by GDP	International Financial Statistics
Total Banking Sector Credit to the Private Sector	Credit by deposit money banks to the private sector as a ratio of GDP	International Financial Statistics
Aid	The amount of foreign aid disbursed as a percentage of GDP	World Development Indicators
Domestic Investment	The gross fixed capital formation as a share of GDP	International Financial Statistics
Openness	The measure of economic integration proxied by the ratio of imports plus exports to GDP	World Development Indicators
Domestic Saving	Total domestic saving from all sources as a percentage of GDP	International Financial Statistics

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