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The pooled mean group approach on saving and investment link in Africa: Implication on capital mobility

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Abstract

This paper examines the link between saving and investment in Africa. Pooled Mean Group (PMG) is used in investigating the link. The global data sample covers thirty (30) African countries and a period of thirty-five (35) years. The analysis result reveals that there is a positive link between saving and investment, and the saving-retention coefficient is found to be 38.05 per cent, which implies relative capital mobility in the continent. However, there is a slight decline in capital mobility when compared to what was obtainable a decade ago. On average, the speed of adjustment has slightly increased (-0.25); convergence from short-run to long-run would take place within three (3) months in an instance of homogeneity. Nigeria and Malawi having the highest speed of adjustment (-0.57) among the countries in the global sample used. Meanwhile, Gambia happened to be the country with the highest capital mobility at the short-run. All these three (3) countries are Western-Africa countries, which means there are lessons to draw from them towards enhancing high convergence coefficient and increased capital mobility, especially, the management of their economic structures, savings and exchange rate policy. This paper concludes that there is an existence of relative capital mobility in Africa.

Keywords: Saving, Investment, Capital movement, Economic Integration
JEL Code: O16, E22, F15, F21

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1. Introduction

Age-long, saving has been a concept of keen interest in the field of Economics that much had been devoted to its study starting from the renowned work of Solow in the mid-20th century. All over the world, countries are much concerned about their saving patterns and even strategies to improve their saving levels because they take it to connote better welfares of the citizens and economy as a whole. Shortly after the Feldstein and Horioka puzzle of 1980, a series of studies that investigated the S-I (saving and investment) relationship had emerged. Why should a government have a keen interest in saving (being contractual saving and any other forms of saving)? A low level of saving in an economy may signal future political tensions. In addition, a low saving rate could imply less future resources and thus greater conflict. More so, the saving rate is relevant to the adequacy of the pension in an economy, even though, the direct way of inferring this is yet to be established. Notwithstanding, the saving that is of concern in this study is the gross domestic saving, which is the total national disposable income after final consumption expenditure (total consumption) as defined in the national accounting system (Barro, 2009; United Nations, 2009).

African countries are expected to at least have saving and investment at par, possibly, because saving or investment serve(s) as a feeder to each other. Mobilised monetary resources for reallocation towards investible purpose is very low in the continent of Africa, aside from the fact of saving promotion in the continent. Majority of countries in the continent of Africa, especially, sub-Saharan countries do not save one-quarter of their Gross National Disposable Income (GNDI), while Asian counterpart saved far-above one-quarter of their GNDI, all on the average (Loaya, Schmidt-Hebbel, & Serven, 2000). Ensuring free capital movement would be an enormous task without adequate domestic saving if the part position of Seka (2011) is worthy of consideration. This position may not be out of reason because the availability of investible resources would spur more investment spotting, to the point of attracting foreign capital. Meanwhile, a continental economy striving to have some developed countries in the nearest future would need a substantial monetary resource to catalyse the desired development. This development is a call for expanded capital mobility in the continent to drive in the necessary financial resources needed to spur the growth that will engender the desired development.

Adedeji and Thornton (2007) examined S-I link but considered only six (6) African countries (using FMOLS, DOLS, with 0.73 and 0.45 coefficients respectively), and found a moderate degree of capital mobility. In addition, Bangake and Eggoh (2012) considered thirty-seven (37) African countries with heterogeneous panel approach (found 0.36). The study estimated long-run average and S-I coefficients based on self-categorisations (CFA and Non-CFA; and civil law and common law). This study is unique by estimating adjustment and short-run S-I coefficients for the individual countries and by using large observations (30 African countries over a period of 35

years), also, by applying a heterogeneous panel. On this background, it becomes imperative to investigate the S-I link in Africa and assess the extent of saving-retention in the continent. This paper would build on the existing studies by equally estimating the average S-I relationship position. This would serve as the update of the existing studies, which is essential since the S-I relationship does change over time due to economic structure. Furthermore, this study would estimate country-specific S-I relationship position and see how countries in the UN classified regions in the continent are faring about the free capital movement, even in the face of the dire need of investible resources towards the development of the African countries. The rest of the paper is structured into, literature review, model specification, analysis and results, and conclusion.

2. Review of Literature

Saving-investment correlations

The FH model is prominent for their correlation of saving and investment in the measurement of capital mobility. The FH model regressed the ratio of savings to income on the ratio of investment to income, to determine the state of capital mobility in the economies of interest (Feldstein & Horioka, 1980). Econometrically, the FH model is expressed as $(I/Y)_i = \alpha + \beta(S/Y)_i$. In explaining the ratio of investment to income with the ratio of the saving to income, the coefficient of the later variable measures the degree of association between the two variables. Research outcomes indicate that zero slope-coefficient signifies – the non-existence of association between the two variables, perfect free movement of capital in the economy. Contrarily, a slope coefficient of the ratio of saving to income would indicate a higher degree of association, which implies less or restricted capital movement in the economy of interest (Feldstein & Bacchetta, 1991).

The truth is that no economy has a constant capital movement index because as the economic structure (ranging from saving pattern, investment, trade openness, and exchange rate regime among others) and activities are changing, so is the capital structure is changing; from globalisation, xenophobia to deglobalisation, so also, the capital movement index would likely change. A closed-economy would have a high degree of association between the ratio of investment and saving, both to income, until possible opening-up, towards embracement of union (regional, trade, economy and political among others) or globalisation in the general sense of it. In the 23 OECD-countries, the beta-coefficient, which captured the degree of association is near to unity, that is, a hundred per cent between the periods of the 1960-70s and declined during the 1980s, an indication that there is low capital mobility until 1980s (Feldstein & Bacchetta, 1991; *Cf.* Sinn, 1992).

Some researchers scrutinized Feldstein and Horioka with other works on the theme, co-authored by Feldstein. These researchers majorly accepted the reality of high degree of association between

saving and investment as a verified and true postulation, but unable to substantiate the less degree of association between saving and investment, that is evidence of capital movement (Sinn, 1992). Some of the researchers who were of the opposite opinion found that the ratio of saving and investment, both to income may exhibit a high degree of association, even when there is the existence of free and perfect capital movement because both saving and investment are affected by an exogenous factor. The impact factor/variable here was observed to be different by different researchers. Although, Feldstein and Bacchetta (1991) disprove the fact that the degree of the association worked out cannot be policy irrelevant as a result of an omitted variable, which may account for economic growth. Thereby, the earlier assertion about the degree of association based on the verified work of FH model onward was held relevant for this paper.

Empirical Review

Some related studies carried out by different researchers are reviewed in this section. Elbahnasawy and Adom, (2014) investigated saving-investment and economic growth in five African countries, namely: Cote d'Ivoire, Egypt, Ghana, Kenya and Nigeria; using Ramsey model in the general equilibrium framework as analysis model. They identified a substantial gap compared to the optimal and actual levels of saving-investment degree of association based on the calibrations and simulations of the data used (Elbahnasawy & Adom, 2014). They favoured free and perfect capital movement to facilitate closure of the existing gap in the optimal and actual financial resources in the face of the dire need of resources for economic expansion.

In another study that investigated the FH model in the high-income countries divided into 21 OECD and 17 non-OECD, totalling thirty-eight countries. The study used a dynamic heterogeneous model. Findings from the study supported the existence of free capital movement for the OECD and rejected the same for the non-OECD (Hassan, Azali & Lee, 2014). The failed reality of FH model on the non-OECD prompted the study to conclude that the model may not be a feasible measurement of free capital movement (Hassan, Azali & Lee, 2014). Recurrence of what Feldstein and Bacchetta (1991) disprove is not new.

Furthermore, another study examined differently the association between investment and saving for the Euro adopted and non-Euro adopted European countries before and during the Euro crisis (Johnson & Lamdin, 2014). The study made use of a fixed-effects model, though termed to be insufficient because it is a static panel model. The study found investment having a significant positive relationship with saving and confirm this to be stronger during the euro crisis. The study concludes that the FH relationship remains positive, even when one would have expected contrary due to other factors such as the stochastic effect of the financial system on the FH model, as well as capital movement in the period. The study asserts that capital movement was

attenuated. Finally, it suggests the continual assessment of this relationship as to ascertain whether the study's result is a temporary shock or permanent shock (Johnson & Lamdin, 2014).

Another similar study on advanced EU countries precisely eight (8), using the ARDL approach to test for the association between saving and investment. The study concludes that in terms of fiscal consolidation strategies and growth-promoting policies, it would be expedient for Denmark, Germany, and Luxembourg not to reduce public expenditures because of its positive impact on private investment by which saving would be better served (Onafowara, Owoye & Huart, 2011). It furthers concert that the Netherlands and the United Kingdom need not to temper with their tax rate to deepen the private saving, which would in-turn boost aggregate saving.

Seka (2011) works on saving and investment in West African Economic and Monetary Union (WAEMU) using Granger causality test, the study buttressed FH model of low degree of association between saving and investment to imply capital movement. It concluded that saving is essential for free capital movement in the investigated economies, that is, domestic saving is more of a pre-condition to realise substantial capital movement that will spur investment. In addition, Gidigbi and Akanegbu (2017) investigated the existence of financial integration in the Economic Community of West-Africa States (ECOWAS). The found that there is a relative existence of capital mobility in the region. Also, found that language inhibits financial integration in the region and that the language barrier in the cause of the financial integration will disappear over time.

Similarly, in another study by Narayan (2005), using an ordinary least square method to establish S-I correlation for China, and ARDL to test for unit-roots property and long-run relationships of the said variables of concern respectively. It found that the two variables were correlated for China (Narayan, 2005). The study asserts that the result is a valid outcome for the country since the country had fairly restricted capital mobility over the period of 1952-1994 as indicated by the country's relatively low foreign direct investment (Narayan, 2005). The study concluded that its finding gave more credence to Feldstein and Horioka (FH) puzzle. A similar study was carried using Japan's data over a period of 40 years starting from 1960, with the ARDL approach (Narayan, 2004). The study found 0.68 (68 per cent) degree of association for S-I relationship and bidirectional causality. It thereby concluded that there is no puzzle for Japan as the saving-retention coefficient is moderately high at 68 per cent.

3. Methodology

Sample[i]

The study used secondary data extracted from the World Development Indicators (WDI) covering a period of thirty-five (35) years starting from 1980. Thirty African countries were

selected on the basis that the country must have reasonable consistent data. The data were cleaned and stored in the public domain[4].

Method of Data Analysis

Panel regression using the Pooled Mean Group (PMG) approach is used in investigating the link between saving and investment in the selected African countries. The approach gives the opportunity of estimating individual short-run coefficients in addition to the average long-run coefficient for all the pooled countries. Based on previous studies such as Feldstein and Horioka (1980), Feldstein and Bacchetta, (1991), Schmidt (2001), Anoruo (2001), Onafowara *et al*., (2011), and Bangake and Eggoh (2012) the following model was employed in line with the PMG specification (Pesaran, Shin & Smith, 1999) in an attempt to investigate the link between saving and investment in Africa using some selected countries data. The PMG approach supported the estimation that allows the short-run parameters to differ across the group, while equality of the parameter is maintained for the long-run estimation (Pesaran, Shin & Smith, 1999). Table 1 shows the variable definition as applicable in this paper.

Table 1: Variable Definition

S/N	Variable	Proxy	Definition
	GDI	Gross Domestic Investment	Gross capital formation.
	GDS	Gross Domestic Saving	Gross national income in addition to net transfers and minus total consumption.

NB: All variables in monetary value are in US$.
Source: World Bank (2015).

Equation 1: investment and saving model

$$\left(GDI/GDP\right)_{i,t} = \delta_i + \delta_{0i}\left(GDS/GDP\right)_{i,t} + \delta_{1i}\left(GDS/GDP\right)_{i,t-1} + \gamma_i\left(GDI/GDP\right)_{i,t-1} + \vartheta_{i,t}$$

Where:

$GDI = Gross\ Domestic\ Investment$
$GDS = Gross\ Domestic\ Savings$
$GDP = Gross\ Domestic\ Products$
$\vartheta = Error\ term.$
$t = time\ trend\ identifier\ (= 1, 2, \ldots, 35).$

[4] http://dx.doi.org/10.17632/2xff2dj86j.1

$$i = cross\ sectional\ dimension\ identifier\ (= 1, 2, \ldots, 30).$$

Economic growth was proxy by real gross domestic products while investment was taking to be gross fixed capital formation, and saving to be gross domestic saving. The postulation in the model gained researchers' support considering a perusal of it.

4. Results and Discussion

Descriptive statistics

The statistics show the average ratio of investment to output, which 0.1850 is and the ratio of saving to income, which is 0.1346, is very close but that of investment is greater than saving. Likewise, the middle value of 0.1874 and 0.9079, which is measured by the median shows that the middle value for both variables is very close to the average value for each of the variables. The standard deviation statistics of 0.089838 and 0.123441 showed that there is less variability in the ratio of investment to income compared to the ratio of saving to income. Above all, non-normality indicated by the Jarque-Bera statistics of 22.6129 and 854.6759, with the probability less 5 per cent, as depicted by the statistics in Table 2, are given less attention based on large observation far beyond what the central limit theorem set as minima for such action.

Unit-root tests

The specified model in equation 1 provides evidence on the relationship between saving and investment in the selected African countries. The stationary test was carried out on all the variables in the model. Table 3 shows the results of the unit-root tests as concerns the model's variables. The test involved two processes; one assumes the common unit root test while the three other tests assume individual unit root tests. The Levin, Lin & Chu t* reveals that $\left({}^{GDI}/_{GDP}\right)_{i,t}$ is stationary at level [that is I (0)] at 1 per cent statistical significance level with -2.4237 statistical value. The other statistics such as Im, Pesaran and Shin W-stat, ADF-Fisher Chi-square, and PP-Fisher Chi-square confirmed the individual stationary of the variable at level (see Table 3, which contains the output of unit root tests for investment and saving model). Also, $\left({}^{GDS}/_{GDP}\right)_{i,t}$ is stationary at the level as indicated by the Levin, Lin & Chu t* statistical value of -6.4502, which is statistically significant at 1 per cent significance level. Other statistic confirmed the individual stationary at the level as well. Both variables had a finite variance that is time-invariant and integrated at the same order. Since, both the variables are integrated at level, there is no need to conduct cointegration test but progress to regression analysis.

Panel Regression Estimation: Pooled Mean Group (PMG)

Table 4 shows the results of panel estimation using PMG. The table contains the results for the long-run, short-run and adjustment coefficients estimation. The cointegration (COINTEQ01) coefficient (-0.25) under the short-run equation is an indication that the model converges from

the short-run to the long-run in an instance of homogeneity S-I coefficient across the countries captured. Furthermore, the convergence of deviation in the S-I relationship takes three months period and this is statistically relevant at the 1 per cent significance level. There is a convergence from the short-run to the long-run in capital across African countries and this adjustment takes three months. Bangake and Eggoh (2012) show that the adjustment coefficient is -0.24 on average for 37 African countries. On average the speed of adjustment has increased slightly, that is, the time taken for convergence from short-run to long-run has reduced slightly. Saving-retention coefficient (0.11) shows relatively capital mobility in the short-run. This indicates slower capital mobility compared to the short-run coefficient (0.057) in Bangake and Eggoh (2012).

Saving retention coefficient (0.38) at long-run, which is statistically significant at the 1 per cent significance level, it is an indication of capital mobility in the continent of Africa. This finding is consistent with some earlier studies on the African countries. However, it seems the free capital movement has been slowed down slightly compared to the estimation of Bangake and Eggoh (2012), which happened to be 0.36, as well as, Gidigbi and Akanegbu (2017) who estimated 0.34 for the ECOWAS member-countries. With a slight decline in the degree of capital mobility in the Africa continent, there is need to consider some factors that have been considered as possible inhibitors of the capital mobility in the continent, such as savings and exchange rate regime as rightly noted in Seka (2011) and Özmen (2007) respectively.

In the global sample, Nigeria and Malawi have the highest speed of adjustment (-0.57 both at par), while Cape Verde has the least (-0.02). Furthermore, Gambia is the country with the highest capital mobility (saving-retention coefficient 0.02), with Ghana as the country with the least capital mobility (0.53) among the countries in the global sample, both at the short-run (See Table 5).

Fourteen (14) Western-African countries make up the global sample for this study. Among these countries, Nigeria happened to be the country with the highest speed of adjustment coefficient (-0.57) and Burkina Faso is the country with the least coefficient (-0.03), both countries' adjustment coefficients are statistically relevant at 1 per cent. In the eastern-African countries, six (6) are in the global sample used for this study. Malawi has the highest speed of adjustment coefficient (-0.57), surprisingly, the country enjoys better convergence in deviation when compare to Kenya (-0.12), which has the least coefficient. The coefficients for both countries are statistically significant at 1 per cent. In addition, in the Central-African Countries, Congo, Rep. has the highest speed of adjustment coefficient (-0.37) and Guinea has the least adjustment coefficient (-0.18), both coefficients are statistically significant at 1 per cent. In the Northern-Africa Countries, Sudan has

Table 2: Descriptive Statistics for Investment and Saving Model

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.	Sum	Sum Sq. Dev.	Obs.
$\left(GDI/GDP\right)_{it}$	0.1850	0.1874	0.5973	-0.0242	0.0898	0.2013	3.5956	22.6129	0.0000	194.3445	8.4664	1050
$\left(GDS/GDP\right)_{it}$	0.1346	0.1248	0.9079	-0.2210	0.1234	1.2818	6.6004	854.6759	0.0000	141.3784	15.9843	1050

Source: Authors' Computation using EViews 8.

Table 3: Unit-Root Tests for Investment and Saving Model

Variable	Cross-Sections	Observation	Common unit root process		Individual unit root process						Decision-based on common unit root process	Level of Integration
			Levin, Lin & Chu t*		Im, Pesaran and Shin W-stat		ADF-Fisher Chi-square		PP-Fisher Chi-square			
			Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.		
$\left(GDI/GDP\right)_{it}$	29	970- 986	-2.4237	0.0077	-3.3788	0.0004	107.353	0.0001	107.058	0.0001	Stationary at level	I(0)
$\left(GDS/GDP\right)_{it}$	29	979-986	-6.4502	0.0000	-	-	124.817	0.0000	126.511	0.0000	Stationary at level	I(0)

Source: Author's Computation using EViews 8.

Table 4: Panel Regression Output for Investment and Saving Model

	Method: Pooled Mean Group (PMG) Dependent Variable: $\left(GDI/GDP\right)_{it}$		
	Long Run Equation		
Variable	Coefficient	Std. Error	t-Statistic
$\left(GDS/GDP\right)_{it}$	0.3805***	0.0450	8.4493
	Short Run Equation		
COINTEQ01	-0.2552***	0.0272	-9.3629
$D\left(GDS/GDP\right)_{it}$	0.1154**	0.0531	2.1736
C	0.0345***	0.0037	9.3241

*Source: Authors' Computation using EViews 10. *** Indicates that the p-value is statistically significant at the 1 per cent significance level. ** Indicates that the p-value is statistically significant at the 5 per cent significance level. * Indicates that the p-value is statistically significant at 10 per cent significance level.*

the highest and Cape Verde has the least adjustment coefficients (-0.32 and -0.02 respectively). Only two countries are included in the Southern-Africa countries, Botswana with the higher coefficient (-0.25) and South-Africa with -0.16, which is the least. Both coefficients are statistically significant at the 1 per cent significance level (See Table 5).

On average, overall saving-retention coefficient is greater than zero but not closer to one (1). Saving influence investment positively, that an increase in saving implies an increase in investment. It was found that a dollar increase in saving would increase investment by 38.05 cents. Cross-border flow of capital was faced with minimum reluctance, and investment did not necessarily crowded-in. Since saving and investment correlation is one of the suggested means of investigating capital mobility, then, one could opine that capital mobility in the selected African countries was not hindered but still low in the continent in the face of the needed investible fund. This finding tallied with that of Gidigbi and Akanegbu (2017) in ECOWAS, Hassan et al., (2014) on non-OECD, Schmidt (2001) in the USA, UK, Canada, France and Japan, but against the findings of Johnson and Lamdin (2014), Nasiru and Usman (2013) in Nigeria, Narayan (2005) in China, Anoruo (2001) in ASEAN countries and Schmidt-Hebbel et al., (1996).

5. Conclusion and Recommendations

This study explores the link between saving and investment in Africa, using a Pooled Mean Group (PMG) panel estimation – to take care of heterogeneity problems –, with a global sample of 30 African countries, based on the availability of consistent data across thirty-five (35) years period, and starting from 1980. The result suggested relative capital mobility in the continent, though, slightly decline compared to an (almost a decade) estimated value. However, this result reinforces the existing studies that backed the existence of capital mobility in the continent. Countries in the Western-Africa (Nigeria and Malawi) has the highest speed of adjustment, that is, convergence from the short-run to long-run when there is a divergence in capital mobility. In the short-run, Gambia has the highest capital mobility. Western-Africa countries of Nigeria, Malawi and Gambia has some lessons to offer, which could benefit other countries in the continent. Lessons should be drawn from these countries and others with relatively high capital mobility about the management of their economic structures, with focus on savings and exchange rate, because both have been identified as part of possible variables, which could inhibit free capital movement. Further studies, on each territorial region classification by the United Nations (UN), Regional Economic Community (REC) and the continent as a whole should be continuously considered for timely interventions towards more capital mobility in the continent of Africa as one of means of meeting the investment demand in the continent.

Table 5: Regional Classification of Cross-Section Short-Run Coefficients

Country	COINTEQ01	$D\left(GDS/GDP\right)_{it}$	C	Country	COINTEQ01	$D\left(GDS/GDP\right)_{it}$	C
Western-Africa Countries				Eastern-Africa Countries			
Benin	-0.4148***	0.3846***	0.0589***	Ethiopia	-0.1530***	0.3086***	0.0360***
Burkina Faso	-0.0310***	0.1249***	0.0107***	Kenya	-0.1222***	-0 .0202***	0.0159***
Cote D'Ivoire	-0.1994***	0.0576***	0.0173***	Madagascar	-0.1669***	0.1561**	0.0191***
Gambia	-0.4244***	0.0253***	0.0518***	Malawi	-0.5738***	0.0286	0.0692***
Ghana	-0.2411***	0.5363***	0.0308***	Mozambique	-0.3586***	0.3038***	0.0566***
Guinea Bissau	-0.1459***	0.0339	0.0199***	Rwanda	-0.1282***	-0.1608***	0.0173***
Liberia	-0.2987***	-0.1243***	0.0127***	Central-Africa Countries			
Mali	-0.3145***	0.2546***	0.0474***	Cameroon	-0.2213***	-0.1192***	0.0270***
Mauritius	-0.4258***	-0.1814***	0.0646***	Congo, Rep.	-0.3708***	-0.0001	0.0784***
Niger	0.0450***	0.1644***	-0.0011***	Gabon	-0.3094***	-0.1938***	0.0553***
Nigeria	-0.5760***	-0.0019	0.0340***	Guinea	-0.1872***	0.2210***	0.0254***
Senegal	-0.3066***	-0.0837***	0.0564***				
Sierra Leone	-0.3788***	0.2517***	0.0359***	Northern-Africa Countries			
Togo	-0.2241***	0.2938***	0.0309***	Algeria	-0.1994***	-0.0878***	0.0381***
Southern-Africa Countries				Cape Verde	0.0202***	1.2942***	-0.0009***
Botswana	-0.2578***	-0.0755***	0.0367***	Morocco	-0.2085***	-0.1127***	0.0347***
South Africa	-0.1631***	-0.0975***	0.0178***	Sudan	-0.3208***	0.1043***	0.0389***

*** Indicates that the p-value is statistically significant at the 1 per cent significance level. ** Indicates that the p-value is statistically significant at the 5 per cent significance level. * Indicates that the p-value is statistically significant at 10 per cent significance level.

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[i] Algeria, Benin, Botswana, Burkina Faso, Cameroon, Cape Verde, Congo Rep., Cote d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea-Bissau, Guinea, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritius, Morocco, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Togo.