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2019
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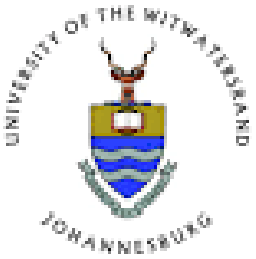



The relative impact of public and private sector investment on economic and social development

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MASTER OF MANAGEMENT IN INVESTMENT AND FINANCE

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1. Introduction

1.1. Background to topic

Economic development is a broad concept which looks at the levels of development in the economic, political and social environment of a country. Most studies will tend to focus on one or two elements of economic development to see how well a country is performing, for example by looking at the economic growth of a country measured by GDP per capita can be seen as an indicator of economic performance of the country (Romer, 1986; Barro, 1996). With particular focus on the African continent, improving the levels of economic growth has been a key focus of policy makers and governments through programmes such as the Structural Adjustment Programme (SAP, 1986), which aimed to reduce the dominance of unproductive investment in the public sector, improve the public sector's efficiency and enhance the growth potential of the private sector (Phillips, 1987). Private and public sector investment thus became a key indicator of economic growth, but the extent to which each sector contributes to economic growth for African countries has not been explored enough through literature.

Mr Njuguna Ndung'u, former Governor of the Central Bank of Kenya, highlights the role of public investment with respect to improving economic growth rates of African countries:

"Over the last 15 years, throughout the period of the Millennium Development Goals, African economies experienced stronger growth driven by improvements in institutional capacity, an environment of policy clarity, a strong move toward political accountability, and, above all, the development and implementation of long-term growth strategies or visions. Strategic country level visions have, for the most part, emphasized public investments to close the infrastructure gap, lower transaction costs, and unlock productive areas for private investments. Public investments will then encourage complementary private investments while at the same time enhance profitability of existing and future private investments through the channel of lowering transactions costs. The focus for the future then should be to sustain these trends and make sure that public investments are

protected so that they can lay the groundwork and capacity for future growth." (Foresight Africa report, 2016; pg. 19)

The above statement supports various studies on the contribution the private and public sector can play on economic growth in many developing countries. There are literature contributions on the role human capital investment plays in economic growth (Barro, 1991; Ramirez, Ranis & Stewart, 1998; Ghura & Hadjimichael, 1996) and the imapct of domestic investment by the public and private sector in economic growth (Khan & Reinhart, 1990; Tatom, 1991, 1993; Evans & Karras, 1994; Oshikoya, 1994; King & Rebelo, 1990; Khan & Kumar, 1993, 1997; Collier & Gunning, 1999). These studies highlight an important theme most policy makers and governments of developing countries require to implement programmes and policies which promote long term sustainable economic growth and improved social development in those countries (Millennium Development Goals, 2000). For example South Africa has implemented the National Development Plan (NDP, 2012) which is an action plan that focuses on eliminating poverty and reducing inequality, by accelerating economic growth.

Social (human) development is viewed as one of the determinants of economic growth (Wilson & Briscoe, 2004), with investment in health care and education having proved to have long-term positive effects on economy (Barro, 1996). Government expenditure in programmes of poverty eradication, improved healthcare and education has risen for many countries. There has been evidence of improvements in the human development index (HDI) in some of the African countries, for example South Africa ((UNDP, 2016). The African Economic Outlook (AEO) 2017 Report indicates the increasing role of the private sector and continued public sector expenditure in social development. It would therefore be of interest to investigate the relative impact that public sector investment and private sector investment would have not only on economic growth rates but also the subsequent impact on social development. The study will use existing empirical framework to investigate the role of the two sectors for the period 2005-2016 for a panel of 32 sub-Saharan African countries.

1.2 Significance of the study

Khan and Reinhart (1990) investigated if private sector investment is somewhat better than public sector investment in determining long-run growth, based on a sample of 24 developing countries (mainly South American and Asian countries) in the 1970s. Their study concluded that the private and public sector investment had different effects on economic growth, with the private sector investment having a greater impact on the economic growth of those developing countries. Khan and Kumar (1993, 1997) looked at the relative effects of public and private investment on economic growth across developing country regions and in different income groups from 1970 to 1990. The study found that private investment had a much larger impact on growth than public investment.

The contribution of this paper is to extend on empirical evidence found in the above literatures and to further investigate the relative impact of public and private sector investment on economic growth rates and social development in the sub-Saharan African region. Both above studies were based on a sample of developing countries which weren't focused on sub-Saharan countries and the period covered is not up-to-date. The outcome of this paper will mainly be in providing a panel sample of 32 sub-Saharan African countries over the period 2005-2016 specifically on the the relative impact of public and private sector investment on economic growth and social development.

1.3 Objective of the study

The proposed study's objective is to examine the relative impact of public sector and private sector investment on economic growth and social development for a panel of sub-Saharan African countries. The study aims to evaluate the relative impact of each sector to economic growth and social development for the period 2005-2016.

1.4 Research question

Does public sector investment have a greater impact than private sector investment on economic growth in sub-Saharan Africa?

Does public sector investment have a greater impact than private sector investment on social development in sub-Saharan Africa?

1.5 Hypothesis

Null hypothesis: The relative impact by public sector investment is the same as the relative impact of private sector investment on economic growth and social development.

Alternatively: The relative impact by public sector investment is not the same as the relative impact of private sector investment on economic growth and social development.

1.6 Outline of study

The paper is outlined as follows:

Section 2 discusses the literature review on the role of investment on economic growth and social development. Section 3 discusses the methodology. Section 4 examines sub-Saharan Africa data and provides empirical analysis. Lastly Section 5 provided the conclusion.

2. Literature review

2.1. The role of investment on economic growth

With a general consensus in literature that investment is essential for economic growth; debates persist on whether investment by the public sector complements private sector investment or if the investment by each sector acts as substitutes for one another. One side of the argument advocates for public sector investment in basic infrastructure; such as roads, transportation, education, communication, sanitation provision and healthcare; as the driving force of economic growth which subsequently attracts private sector investment (Blejer & Khan, 1984; Aschauer, 1989; Munnell, 1990; Easterly & Rebelo 1993; Ramirez, 1994; Pereira, 2001). Private firms operating in areas where the countries' government provides basic human needs of healthcare and education, has resulted in increased available workforce and labour productivity for the private sector.

In some cases, government may be competing with private firms in provision of goods and service which ends up crowding out the private sector and may have a negative effect on economic growth (Serven & Solimano, 1990; Khan & Reinhart, 1990; Khan & Kumar, 1993, 1997; Ghali, 1998). These studies highlight the benefits of efficiency by private sector firms, which compete amongst each other to drive economic growth. Ghura, Busa and Calamitsis (1999) investigated the effect of private investment to GDP ratio on economic growth and found it to be statistically significant and greater than the effect of an increase in government investment to GDP ratio. Collier and Gunning (1999) also found that poor public sector productivity, such as in public service delivery may have contributed to slow economic growth for African countries. Ghura and Hadjimichael (1996) concluded similar finding where growth as a result of public policies reduced the rate of inflation, maintained external competitiveness, promoted structural reforms, encouraged human capital development and slowed down population growth.

Some studies investigated the long run relationship of investment and economic growth and whether or not investment causes growth (Blomstrom, Lipsey & Zejan, 1996; Bose & Haque, 2005). Uneze (2013) investigated a relationship between capital formation and economic growth for a panel of 13 sub-Saharan Africa countries and establishes both variables Granger cause each other. Structural

programmes such as SAPs (1986) were introduced in many developing countries in the 90's with key objectives of reducing the dominance of unproductive investment in the public sector, improve the public sector's efficiency and enhance the growth potential of the private sector (Phillips, 1987).

Evidence and experience shows that country's social development relatively promotes economic growth and a higher quality of life (World Bank, 2017). When social aspects of a country show improvement, it should be expected that the country would likely to experience increased economic growth levels or vice versa. Therefore the next section of this study will investigate the relationship between social development and economic growth through public and private sector investment.

2.2. The role of investment on social development

The World Bank (2017) describes social development as a way to promote social inclusion of the poor and vulnerable by empowering people, building cohesive and resilient societies and making institutions accessible and accountable to citizens. Defined by the United Nations Development Programme (UNDP) (2017); HDI summarises the measures a country's average development in three aspects of namely health, education and standard of living. Between 2010 and 2015, African countries experienced fast progress in human development with HDI growth levels of 1.04%.

There seems to be a lack of literature on the direct role investment by the public and private sector has on social development in sub-Saharan Africa. Most studies (Nordhaus & Tobin, 1973; Sen, 1976; Sudhir & Ravallion, 1993; Mankiw, Romer & Weil, 1992; Barro & Lee, 1993; Ranis, Stewart & Ramirez, 2000; Islam & Clarke, 2002) have assumed that output growth and welfare are positively related and thus use GDP growth as a proxy for welfare (human development). Suri, Boozer, Ranis and Stewart (2011) investigated the relationship between human development and economic growth and found that human development levels are important for determining growth.

Another measure of social development is the Gini index, which measures the income inequality of a country. Africa has recorded one of the highest levels of

income inequality in the world but sub-Saharan Africa has seen slight improvement Gini coefficient between 1991 and 2011 (UNDP, 2017). Ranis, Stewart and Ramirez (2000) found that economic growth in China accelerated as a result of relatively good income distribution, policy reform and very high investment rates. Barro (2000) further found that inequality negatively influenced growth in poorer countries while it positively influenced growth in richer countries. This study will attempt to measure the relative impact that public and private sector investment on social development in sub-Saharan Africa.

3. Methodology

To measure the relative impact of investment on economic growth and social development in sub-Saharan Africa for the period 2005-2016, the study will be drawing from the empirical growth models of Arrow and Kurz (1970), Nazmi and Ramirez (1997), Khan and Kumar (1997) , Khan and Reinhart (1990) and Adams (2009). These studies evaluated the differential impact that private and public sector investment had on growth by adjusting Solow (1956) neoclassical growth model, where capital accumulation and growth of labour force are key determinants of real per capita growth. Solow's (1956) growth model hypothesised that output growth depends on capital and labour inputs as follows;

$$y = g(K, L) \tag{1}$$

Where y measures the real GDP growth, K measures the growth of capital and L measures the growth of labour. To explore the direct relationship of public and private sector investment, Nazmi and Ramirez (1997) modified the neoclaasical growth model in equation 1 for Mexico data as follows;

$$y = AF\left(L, K_p, K_g, S\right) \tag{2}$$

With A is factor productivity, K_p is private sector capital stock, K_g is government capital stock and S represent other variables. Without consistent capital stock data available in Mexico during the time of study, Nazmi and Ramirez (1997) modified their equation in line with dynamic production function using percentage growth rates of variables as follows;

$$Y_t = \beta_0 + \beta_1 \frac{\Delta \mathrm{L}}{L_{t-1}} + \beta_2 \frac{I_p}{Y_{t-1}} + \beta_3 \frac{I_g}{Y_{t-1}} + \beta_4 \frac{\Delta S}{S_{t-1}} \tag{3}$$

Where Y is the output growth rate at time t, L is the measure of labour productivity, I_p and I_g are the measure of investment by the private and government sector respectively and S measures other explanatory variables. The coefficients β_0 measures productivity growth; β_1 is the elasticity of output with respect to labour; β_2 and β_3 capture the marginal productivity of private and public capital, respectively;

and β_4 is the elasticity of output with respect to other factors such as exports, the credit provided to the private sector and other factors.

Using the above framework in equation (3), two basic regressions will be extended for this study. The first regression will be the impact of investment and other variables on economic growth (Equation 4) and the second will be the impact of investment and other variables on social development (Equation 5). This will be estimated for sub-Sahara African countries as a panel time series cross-section regression as follows;

$$Y_{i,t} = \alpha_0 + \alpha_1 \frac{I_t^G}{Y_{i,t-1}} + \alpha_2 \frac{I_t^P}{Y_{i,t-1}} + \beta_1 \frac{Credit}{Y_{i,t-1}} + \beta_2 \frac{FDI}{Y_{i,t-1}} + \beta_3 \frac{Trade}{Y_{i,t-1}} + \varepsilon_{i,t} \quad (4)$$

$$HDI_{i,t} = \alpha_0 + \alpha_1 \frac{I_t^G}{Y_{i,t-1}} + \alpha_2 \frac{I_t^P}{Y_{i,t-1}} + \partial_1 \frac{FDI}{Y_{i,t-1}} + \partial_2 \frac{Trade}{Y_{i,t-1}} + \varepsilon_{i,t} \quad (5)$$

where $Y_{i,t}$ is the annual GDP per capita growth; i is for the respective country and t is time period; α_0 is the constant term; $\frac{I_t^G}{Y_{i,t-1}}$ is the gross capital formation by the public sector as a ratio of the country's GDP and $\frac{I_t^P}{Y_{i,t-1}}$ is gross capital formation by the private sector as a ratio of a country's GDP, with α_1 and α_2 are the coefficients of the gross capital formation for each sector respectively. $HDI_{i,t}$ is the Human Development Index for country i at time$t$, $\varepsilon_{i,t}$ are the disturbance error terms for each respective country i at time period t . The other three explanatory variables, all expressed as a ratio of the country's GDP, are summarized in Table 1 below.

Table 1: Other explanatory variables

Variable	Description
Credit	Domestic credit provided by financial sector
FDI	Foreign direct investment net inflows
Trade	Net trade (Net Exports less Net Imports)

These other explanatory variables have been used in similar studies of economic growth and are therefore included in the regression to evaluate the impact they have on the sample in this paper. Suri, Boozer, Ranis and Stewart (2011) investigated

investment (foreign and domestic), technology and trade openness as important inputs of economic growth, as well as how factors such as the distribution of income and the private and public sector allocation of GDP influenced human development. They found all inputs to be positively associated with growth and that there is a link between human development and economic growth. There is a strong association between the level of financial development and GDP growth (King & Levine, 1993; Rajan & Zingales, 1998; Levine & Zervos, 1993). Gelbard and Leite (1999) found that in sub-Saharan Africa, countries with higher financial development and openness, that country experienced higher economic growth rates.

The relationship between FDI and economic growth differs for different regions and time periods, with some studies indicating a significant positive impact (Agosin & Mayer, 2000; Kumar & Pradhan, 2002; Sylwester, 2005; Blomstrom, Lipsey & Zejan, 1992) and others found a negative impact. Gui-Diby (2014) found that some African countries during the period 1980-1994, FDI negatively affected economic growth. Ssimilarly Adams (2009) found FDI to be negatively correlated to economic growth for 42 Sub-Saharan African countries under certain periods. Sharma and Gani (2004) found a positive effect of FDI on HDI for middle- and low-income countries. The rate of investment and openness in trade activities is seen to contribute positively to economic growth (Dollar & Kraay, 2004; Khan & Kumar, 1993).

Investigating the relative impact of private sector investment and public sector investment as a ratio of GDP measured by the coefficients $\alpha_1 \text{ and } \alpha_2$ respectively; is the main focus of methodology and empirical testing. The explanatory variables will add to the robustness of the estimation. The null hypothesis, $\alpha_1 = \alpha_2$ (the relative impact of public sector investment is the same as the relative impact of private sector investment on economic growth and social development) could be rejected (Oshikoya, 1994).

4. Empirical analysis and results

4.1. Data description and transformation

Annual data is used on a panel of 32 sub-Saharan African countries. For a balanced panel analysis, the time period is 2005-2016 for economic growth estimation and the social development estimations.

The two main sources used to collect the data are the African Development Bank Group and the World Bank database. Table 2 below provides a summary list of sources used to acquire data on each variable. The Sub- Saharan African countries selected for the panel analysis are; Benin, Botswana, Burkina Faso, Central African Republic, Cote d'Ivoire, Cameroon, Democratic Republic of Congo, Republic of Congo, Gabon, Ghana, Gambia, Guinea-Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Togo, Uganda, Zambia and Zimbabwe.

Data on the Human Development Index (HDI) for various countries selected for the panel of countries above is not readily available for each period used in the social development estimation making it difficult to report accurate estimations. To try keep interpolating to a minimum, two proxy variables are used to account for the lack of data. Where data is not available, linear interpolation has been used. The two proxy variables will be Schooling enrolment, primary (% gross) and Life expectancy at birth, total (years). Barro and Lee (1993) look at how the education attainment by males and females in developing countries impacts the life expectancy and economic growth of that country. Suri, Boozer, Ranis and Stewart (2011) used gross primary enrolment rate and life expectancy rate as measure of human development in their study on economic growth and its link to human development. Equation (5) will be re-estimated as follows;

$$Edu_{i,t} = \alpha_0 + \alpha_1 \frac{I_t^G}{Y_{i,t-1}} + \alpha_2 \frac{I_t^P}{Y_{i,t-1}} + \partial_1 \frac{FDI}{Y_{i,t-1}} + \partial_2 \frac{Trade}{Y_{i,t-1}} + \varepsilon_{i,t} \quad (6)$$

$$Life_{i,t} = \alpha_0 + \alpha_1 \frac{I_t^G}{Y_{i,t-1}} + \alpha_2 \frac{I_t^P}{Y_{i,t-1}} + \partial_1 \frac{FDI}{Y_{i,t-1}} + \partial_2 \frac{Trade}{Y_{i,t-1}} + \varepsilon_{i,t} \quad (7)$$

Where $Edu_{i,t}$ is gross primary school enrolment rate and $Life_{i,t}$ is Life expectancy at birth, total (years); i is for the respective country and t is time period; α_0 is the constant term; $\frac{I_t^G}{Y_{i,t-1}}$ is the gross capital formation by the public sector as a ratio of the country's GDP and $\frac{I_t^P}{Y_{i,t-1}}$ is gross capital formation by the private sector as a ratio of a country's GDP, with α_1 and α_2 are the coefficients of the gross capital formation for each sector respectively. $\frac{FDI}{Y_{i,t-1}}$ is foreign direct investment as a ratio of country's GDP; $\frac{Trade}{Y_{i,t-1}}$ is trade (net exports les net imports) as a ratio of country's GDP.

Table 2: A summary of sources and period of variables

Variable	Source	Period
Gross capital formation, Public sector	African Development Bank Group	2005-2016
Gross capital formation, Private sector	African Development Bank Group	2005-2016
GDP per capita growth (annual %)	World Bank	2004-2016
Foreign direct investment, net inflows	World Bank	2005-2016
Domestic credit provided by financial sector (% of GDP)	World Bank	2005-2016
Trade (Net Exports less Net Imports)	African Development Bank Group	2005-2016
School enrolment, primary (% gross)	World Bank	2005-2016
Life expectancy at birth, total (years)	African Development Bank Group	2005-2016

4.2. Econometric Technique

4.2.1. Economic Growth Estimation

This section will provide estimation and econometric results for equation (4) which regresses real GDP per capita growth on $\frac{I_t^G}{Y_{i,t-1}}$ is the gross capital formation by the public sector as a ratio of the country's GDP and $\frac{I_t^P}{Y_{i,t-1}}$ is gross capital formation by the private sector as a ratio of a country's GDP; . $\frac{Credit}{Y_{i,t-1}}$ is domestic credit provided by financial sector as a ratio of country's GDP; $\frac{FDI}{Y_{i,t-1}}$ is foreign direct investment as a ratio of country's GDP and $\frac{Trade}{Y_{i,t-1}}$ is trade (net exports les net imports) as a ratio of country's GDP.

Standard descriptive statistics are presented on the mean, standard deviation, variance, skewness and kurtosis which estimates the variability and normality of the series (Table 3) followed by a correlation matrix table (Table 4). Both tables present outputs for the entire sample of 32 countries over the period 2005-2016.

Table 3: Descriptive statistics

Statistic	Variables					
	LogGDP	LogPubinv	LogPvtinv	LogCredit	LogFDI	LogTrade
Mean	0.68	0.07	0.15	2.65	0.04	-0.04
Median	1.18	0.64	0.14	2.94	0.03	-0.10
Std. Dev.	1.04	0.03	0.07	1.47	0.05	0.23
Skewness	-1.30	0.78	0.67	-1.84	2.93	1.71
Kurtosis	4.70	6.60	3.61	7.29	14.05	7.29

Table 4: Correlation Matrix

	LogGDP	LogPubinv	LogPvtinv	LogCredit	LogFDI	LogTrade
LogGDP	1	0.25	0.13	0.01	-0.03	0.07
LogPubinv	0.25	1	0.013	-0.17	-0.17	0.35
LogPvtinv	0.13	0.01	1	-0.01	-0.05	0.40
LogCredit	0.01	-0.17	-0.01	1	-0.02	-0.17
LogFDI	-0.03	-0.17	-0.05	-0.02	1	-0.18
LogTrade	0.07	0.35	0.40	-0.17	-0.18	1

The variables are the transformed raw data into their log form; with LogGDP being the log of annual GDP per capita growth, LogPubinv is the log of gross capital formation, public sector to GDP ratio, LogPvtinv is the log of gross capital formation, private sector to GDP ratio, LogCredit is the log of domestic credit provided by financial sector to GDP ratio, LogFDI is the log of Foreign Direct Investment (net inflows) to GDP ratio and LogTrade is the log of trade(net exports less imports) as a ratio of GDP.

Table 4 measures the degree of association between two variables. The positive correlation between public investment and GDP growth is stronger than that of between private sector investment and GDP. Public and private investment is also positively correlated with each other, possibly explaining a complimentary relationship between the two sector investments. Credit Extension and trade are positively correlated to GDP, while FDI indicates a negative correlation. Adams (2009) found that FDI was negatively correlated with economic growth, however that the lagged FDI was positively correlated with growth. These relationships will be further analysed in the next section.

The first step taken for estimating equation 4 is testing for stationarity in the series. Using Augmented Dickey-Fuller (1981) (ADF) and the Phillips-Perron (1988) (PP) test, the null hypothesis is that all series in the panel has a unit root, against the alternative that none of the series contain a unit root. Both tests are presented at level and first differences, no trend and intercept. The log variables presented are LogGDP which is the log of annual GDP per capita growth, LogPubinv is the log of

gross capital formation, public sector to GDP ratio, LogPvtinv is the log of gross capital formation, private sector to GDP ratio, LogCredit is the log of domestic credit provided by financial sector to GDP ratio, LogFDI is the log of Foreign Direct Investment (net inflows) to GDP ratio and LogTrade is the log of trade (net exports less imports) as a ratio of GDP. Results show first difference variables are all stationary as the p-values are all less than 0.05 at level of significance and therefore the null hypothesis of unit root is rejected.

Table 5: Panel Unit Root Test Summary

	PP: Fisher Chi-square				ADF: Fisher Chi-square			
Variable	At level		At first difference		At level		At first difference	
	Statistic	Prob**	Statistic	Prob**	Statistic	Prob**	Statistic	Prob**
LogGDP	175.20	0.00	533.62	0.00	119.70	0.00	325.40	0.00
LogPubinv	62.8	0.52	475.78	0.00	58.42	0.67	293.68	0.00
LogPvtinv	53.52	0.82	439.77	0.00	56.21	0.75	296.64	0.00
LogCredit	28.67	0.99	267.23	0.00	30.89	0.97	184.17	0.00
LogFDI	104.04	0.00	484.20	0.00	73.47	0.20	337.40	0.00
LogTrade	421.21	0.00	587.26	0.00	84.10	0.05	390.58	0.00

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Using the stationary data, two empirical specifications are used to perform the estimation for equation 4 for the 32 sub-Saharan Africa (SSA) panel data. These are the panel Ordinary Least Squares (OLS) and Generalized Method of Moments (GMM) (with either fixed or random effects). There are some known limitations of using OLS regression model for panel/pooled data analysis, such as the presence of heteroscedasticity in the data, which can be corrected by using the White procedure applied for the panel data(Ghujarati & Porter, 2009, pg. 391).

The use of GMM was developed by Holtz-Eakin, Newey and Rosen (1988) and Arellano and Bond (1991) and is applied with the following specifications from the dynamic panel data wizard available in Eviews 8. The specification is one lag of the dependent variable, LogGDP; differenced cross-section effects specification for each variable in the regression (Arellano & Bond, 1991); White period (AB n-step) weighting matrices. Similar techniques have been applied in economic growth research, like Levine et al. (2000) who used GMM in their study as it addressed the

econometric problems induced by unobserved country-specific effects and joint endogeneity of the explanatory variables in lagged dependent-variable models.

The Hausman test (1978) will ensure that that the correct model is used when estimating equation 4 for the panel OLS and GMM estimation. The null hypothesis of the test is that the estimations, random-effect and fixed-effect estimation, are both consistent. The test results indicate that the null hypothesis cannot be rejected at a 5% significance level and therefore the use random effect estimator is the most efficient to use in the panel estimation.

Table 6 presented below estimates equation 4 using panel OLS and GMM estimations. For each estimation, the overall period (2005-2016) is presented in column (1) and the two sub-periods are presented in column (2) and (3), for the period 2005-2010 and 2011-2016 respectively. The standard errors are provided in brackets below each variables coefficient at various levels of significance (see note below table for levels of significance). The R-square, Durbin-Watson stat and Hausman test results are presented at the bottom the table for panel OLS estimation and the J-stat (p-value) and Hausman test results are provided for the GMM estimation for the period 2005-2016. The R-squared in the OLS estimation is fairly good, with about 31% can explain the variation in the model and with a DW stat close to 2, the model is normally estimated. The p-value of the J-stat in the GMM model is 0.91 and therefore the null hypothesis of over identifying restrictions in the model is rejected. Therefore the model for both OLS and GMM are good.

Overall the results for both panel OLS and GMM estimations is consistent with expectations, that public sector investment ratio to GDP and private sector investment ratio to GDP have positive signs and both significant. Under OLS estimation, private sector investment coefficient was lower for all periods observed. For GMM estimation, private sector investment coefficient is only higher than the public sector investment coefficient during the period 2005-2010. Khan and Kumar (1997) found that both public and private sector investment have positive signs and are statistically significant. The sub-period patterns reported in their study found that the coefficients of investment ratio are somewhat lower than those reported for the full period. The private sector investment coefficient is either greater or lower than public sector investment depending on which sub-periods is under observation.

The sub-periods in both estimations still indicate positive coefficients for both sector investment as a ratio of GDP, but the magnitude of each coefficient is slightly different for each sub-period. In the period 2005-2010 (column 1) shows that under panel OLS estimation, public sector investment has a higher coefficient than private sector investment albeit marginal. A percentage increase in public sector investment shows a 12% increase in GDP output and an increase in private sector investment indicates a 10% increase in GDP per capita. The period 2011-2016 (column 2) also shows public sector investment is higher, with a higher percentage differential. The estimated coefficient for public sector suggests that a one percent (1%) increase in investment in the sector across the sample is accompanied by an increase of 11% in real GDP per capita. Compared to the private sector investment, the percentage increase in real GDP per capita is only 3.5%. Khan (1996) finds a similar trend in developing countries, indicating that the impact of public sector investment to GDP ratio is found to be greater in low income countries than in high income countries.

Considering the sample of countries studied in this paper, most of the countries in the panel are classified as low income countries (see table 7 for list of income classification) (World Bank, 2006). This therefore supports the evidence provided by other studies on developing countries, which finds that low income countries have a greater dependency on public sector expenditure and investment to improve GDP growth (Nazmi & Ramirez, 1997; Blejer & Khan, 1984). The discussion on GMM outcomes are discussed below Table 6 along with the other explanatory variables in the estimation.

Table 6: Panel OLS and Dynamic GMM estimation of economic growth variables

	OLS estimation			Dynamic GMM estimation		
Variable	(1) 2005-2016	(2) 2005-2010	(3) 2011-2016	(1) 2005-2016	(2) 2005-2010	(3) 2011-2016
Constant	-0.04	0.01	-0.12			
	(0.08)	(0.12)	(1.09)			
DLOGGDP(-1)				-0.35*	-0.25*	-0.37*
				(0.04)	(0.05)	(0.05)
DLOGPUBINV	10.05*	11.74*	10.72*	8.97	9.50*	9.20*
	(2.61)	(3.11)	(4.26)	(7.35)	(2.19)	(3.74)
DLOGPVTINV	5.87*	9.66*	3.56*	5.12*	10.42*	3.87*
	(1.72)	(2.09)	(2.38)	(1.73)	(2.08)	(1.57)
DLOGCREDIT	-0.11	1.01	-0.02**	0.20	0.03	-0.04
	(0.10)	(1.07)	(1.01)	0.24	(0.13)	(0.19)
DLOGFDI	-2.92	-3.96	-1.37	-8.37*	-0.02	8.12*
	(2.04)	(3.86)	(2.53)	(1.51)	(2.65)	(1.46)
DLOGTRADE	-0.05	-1.07**	2.68**	-1.80	-0.27	-3.41
	(0.38)	(1.37)	(1.57)	(1.88)	(0.37)	(2.21)
R-squared	0.31					
Durbin-Watson stat	2.84					
Hausman(p-value)	0.99			0.99		
J-statistic (p-value)				0.91		

Notes:

Standard errors in brackets; * and ** denote statistically significance at 5% and 10% respectively.

The GMM results indicate that for the full period, public sector investment is significant at 10% and the coefficient is positive. The private sector investment coefficient is also positive, marginally lower than public sector investment and is significant at 1%. The lagged GDP, ($GDP_{i,t-1}$) estimator is negative, this maybe as a result of the declining GDP trends in the region over the past decade. Credit Extension is positive but found to be insignificant. The Credit Extention by financial sectors are largely dependent on financial development of a country, the World Bank (1994) indicated that low-income sub-Saharan African countries are among the world's least financially developed.

The sample of this study has a majority countries falling into the low-income catergory, which could explain the insignificance of some of the variables to economic growth. In 2015 Sierra Leone recorded a large negative growth rate of 22% (World Bank, 2016) which would have some influence on the impact of the variables estimated(See Appendix B, figure 1). FDI and trade estimators have negative signs with only FDI being significant. Yabi (2010) reported that while observing 56 developing countries, FDI is not aways positively correlated to economic growth. The investigation finds that countries with high economic growth, FDI positively impacts growth whiles the inverse is found for those countries with low growth rates. The GMM sub-period findings on investment are similar to those in OLS; with the other explantory variables coefficients and t-stats varying between the periods. The large negative growth rate of Sierra Leone in 2015 and a combination of GDP declines in low income countries may be the reason for negative relationship between GDP growth and FDI during the period 2011-2016. A robustness test will be conducted to see if excluding the low income countries from the panel yileds different results on FDI.

Table 7: List of sub-Saharan Africa countries in income

Low income	Low middle income	Upper middel income
Benin	Cameroon	Botswana
Burkina Faso	Congo, republic	Gabon
Central African Republic	Cote d'Ivoire	Mauritius
Congo, Dem. Republic	Ghana	South Africa
The Gambia,	Kenya	
Guinea-Bissau	Lesotho	
Madagascar	Nigeria	
Malawi	Sudan	
Mali	Swaziland	
Mozambique	Zambia	
Niger		
Rwanda		
Senegal		
Sierra Leone		
Togo		
Uganda		
Zimbabwe		

Source: World Bank (2016)

4.2.2. Social development estimation

To estimate the relative impact of social development by equation 6 and equation 7, will be estimated using the log form of all variables; with LogEdu being the log of School enrolment, primary (% gross), LogHealth is the log of Life expectancy at birth, total (years), LogPubinv is the log of gross capital formation, public sector to GDP ratio, LogPvtinv is the log of gross capital formation, private sector to GDP ratio, Log FDI is the log of Foreign Direct Investment (net inflows) to GDP ratio and LogTrade is the log of trade(net exports less imports) as a ratio of GDP.

The starting point is evaluating stationarity in all variables by evaluating the ADF and PP unit root test (as was tested for economic growth) and the variables are all stationary at first difference. Once all variables are stationary, equation 6 and 7 are estimated for the period 2005-2016 by panel OLS and GMM for LogHealth and only using GMM to estimate LogEdu and presented in Table 8. The specification of the

GMM model is one lag of the dependent variable, LogHealth and LogEdu; first differenced cross-section effects specification for each variable in the regression (Arellano & Bond, 1991); White period (AB n-step) weighting matrices. The R-squared of the OLS estimates of life expectancy (measured as Health) shows that 99% of variability in the dependent variable can be explained by model. The DW test result of 1.34 for the OLS estimate measured as the life expectancy in years from birth indicating normality. The OLS estimate of health measured as the life expectancy in years from birth show that both public sector investment and private sector investment have a positive relationship with health measured as the life expectancy in years from birth. The public sector investment coefficient is higher than that of private sector investment. This is in line with expectations, particularly for the sub-Saharan African region, which relies highly on public sector expenditure (WHO, 2016). OLS estimate of health measured as the life expectancy in years from birth indicate that both trade and FDI are insignificant with very small coefficients and thus nothing further needs to be discussed on the variables.

Under the GMM estimation, both public sector investment and private sector investment have positive signs and are significant at 5% when looking at education measured as gross primary school enrolment rate. The p-value of the J-stat in the GMM model is 0.53 for education estimation and 0.27 for the health estimation, therefore the null hypothesis of over identifying restrictions in the model is rejected, making this model reliable. The coefficient of public sector investment is larger than private sector investment. Trade is negatively related to education measured as gross primary school enrolment rate and is significant, while FDI is significant but positively related to education measured as gross primary school enrolment. As noted the positive effect of FDI on education can be as a result of FDI positively impacting economic growth through (Blomstrom, Lipsey & Zejan, 1992).

Looking at the GMM estimation, only public sector investment has a positive sign and is significant at 5% and private sector investment sign is positive (but almost zero) and significant for the health results measured as the life expectancy in years from birth. Barro and Lee (1994) found life expectancy to have a positive relationship with economic growth and as investment by the public and private sector are both positively related to economic growth, the public sector investment sign is justified.

However with the smaller coefficient of private sector investment, it is likely due to the low income countries which who rely heavily on public sector investment and less productivity of private sector investment in the healthcare sector of these countries. The coefficients of FDI and Trade are significant with trade being negative related to life expectancy in years from birth and FDI being positive, similar to education estimation. The lag result for both education and health are positive and significant, indicating the previous year's outcomes for both variables positively influence current year's value.

The overall outcome is that the relative impact by public sector investment is higher than the relative impact of private sector investment as seen by the high coefficient of public sector investment as ratio of GDP.

Table 8: OLS and GMM estimation of social development variables

Variable	Education	Health	
	GMM estimation	OLS estimation	GMM estimation
Constant		0.11*	
		(4.59)	
DLOGHEALTH(-1)		0.97*	0.90*
		(160.11)	(761.58)
DLOGEDU(-1)	0.23*		
	(36.50)		
DLOGPUBINV	0.19*	0.06**	0.01*
	(15.16)	(1.84)	(9.43)
DLOGPVTINV	0.04*	0.03*	0.00*
	(4.02)	(3.90)	(8.00)
DLOGTRADE	-0.01*	0.00	-0.01*
	(7.32)	(0.66)	(18.67)
DLOGFDI	0.05*	-0.01	0.00*
	(3.80)	(0.76)	(8.30)
J-stat (p-value)	0.53		0.27
Durbin-Watson stat		1.34	
R-squared		0.99	

Notes:

T-statistics in brackets; * and ** denote statistically significance at 5% and 10% respectively.

4.3. Robustness checks

The negative relationship between FDI and GDP growth is re-estimated for countries in the middle income countries. This includes Botswana, Gabon, Mauritius and South Africa for the period 2005-2016. Taking the Log of GDP, Pubinv, Pvtinv and FDI, the dynamic panel GMM estimation, with first difference specification, the results are below in Table 9. The results indicate that FDI is positively related to GDP in the middle income countries in the panel. Although not significant, the FDI coefficient is positive. The public and private scetor invesment also show a positive, significant relationship with GDP. Adams (2009) found that although FDI inflows increased for the sub-Saharan African countries studied, that increase actually lead to a negative impact of on economic growth. The only positive impact was from domestic investment and institutional infrastructure which were significantly correlated with economic growth. Thus although the results below in Table 9 indicate positive relationship between FDI and GDP growth, the relative impact of public sector investment and private sector investment is more effective at promoting GDP growth. And the relative impact of public sector invetsment on economic growth is more than that of private sector investment, therefore the null hyphothesis can not be rejected on this test.

Table 9: Public sector Investment, Private sector investment and Foreign Direct Investment estimation for middle income sub-Saharan Africa countries

Variable	Coefficient
DLOGPUBINV	15.73*
	(6.38)
DLOGPVTINV	7.39*
	(3.40)
DLOGFDI	3.84*
	(0.99)

Notes:
Standard errors in brackets; * and ** denote statistically significance at 5% and 10% respectively.

Further testing is provided below with regards to the relative impact of investment by the public and private sector on economic growth. Using the dynamic panel GMM estimation; with difference specifications; where public sector investment is the dependent variable and private sector investment and GDP are the explanatory variables. The results are summarised below in Table 10 for all 32 sub-Saharan African countries during the period 2005-2016. The results indicate that public sector investment crowds in private sector investment by the positive relationship it exhibits. These results confirm the studies of crowding in or out effect of public sector expenditure and investment (Blejer & Khan, 1984; Aschauer, 1989; Munnell, 1990). Public sector investment is also positively related to FDI, where a 10% increase in FDI will result in a 3% increase in public sector investment. Public sector investment is still positively related to GDP (as results of Table 6 also indicated).

Table 10: GMM estimation for crowding in effect of public sector investment

Variable	Dynamic Panel GMM 2005-2016
DLOGPUBINV(-1)	-0.30* (0.03)
DLOGGDP	0.02* (0.00)
DLOGPVTINV	0.08* (0.02)
DLOGFDI	0.31* (0.03)

Notes:
Standard errors in brackets; * and ** denote statistically significance at 5% and 10% respectively.

5. Conclusion

This paper attempted to empirically analyse the relative impact of public sector investment and private sector investment on output growth and social development. The examination suggests two main conclusions. First, overall the relative impact of public sector investment is positive and significant with economic growth in the 32 panel sub-Saharan African countries for the period 2005-2016. Secondly, when the evaluating the measures of social development; namely school enrolment, primary (gross %) and life expectancy from birth, years; the relative impact of investment by the public sector on both variables is positive and significant. Public sector investment impacts the social development variables by a greater margin than private sector investment. Therefore it can be concluded that public sector investment has a greater relative impact than private sector investment on economic growth and social development.

This paper also found period differences, where under the first few years (2005-2010); the impact of public investment seemed to be marginally (about 3%) more than that of private investment on economic growth. In the last 5 years (2011-2016), the impact of public sector investment is about 6-7% more than that of private sector investment. Khan and Kumar (1997) found similar outcomes for their study on developing countries, where different period exhibited different relative impact of public sector investment and private sector investment on growth. Since this study includes a large sample of low-income countries (World Bank, 2016), the outcomes favors public sector investment over private sector investment as these economies are highly reliant on government expenditure and investment. Khan (1996) found that in developing countries the impact of public sector investment to GDP ratio is greater in low income countries than in high income countries. There is also a complementary relationship between the two sector investments like Aschauer (1989) who also found public sector investment to be productive for basic needs for development and this productivity facilitated private sector investment.

6. Appendix and Reference list

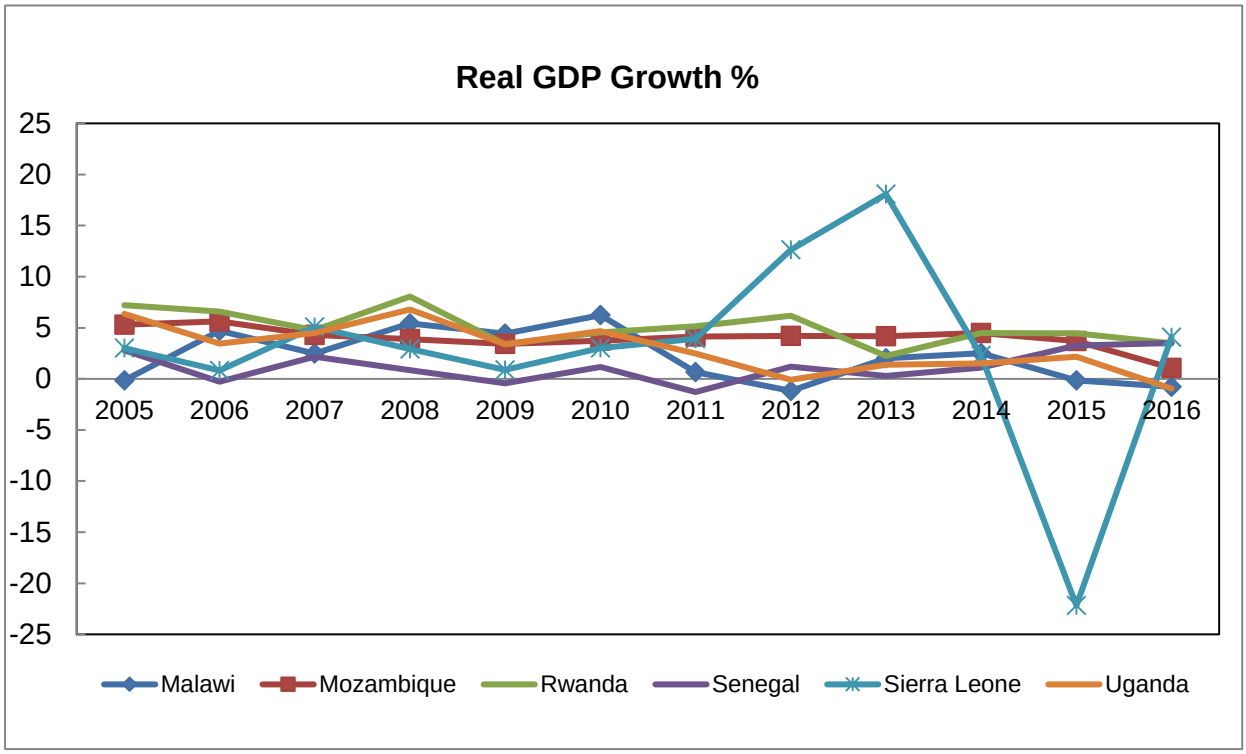
6.1. Appendix A: Definitions

Variable	Definition
Gross public investment	Public sectors' gross domestic investment is all government and non-financial public enterprises additions to the stocks of less any second-hand asset sold and scrapped fixed assets measured at constant prices.
Gross capital formation, private sector	Private sector gross domestic investment covers the gross capital outputs by the private sector (including private non-profit agencies) on additions to domestic assets. Measured at current US $ prices.
Trade	Net trade is difference between net exports and net imports of goods and services and measured as a share of gross domestic product.
GINI index	This index measures the distribution of income as it deviates from perfect equal distribution (represented by a 0) among individuals or households in an economy. Perfect inequality is measured with an index of 100.
Human Development Index (HDI)	The index measures the average human development in a country based on access to education and knowledge, health provisions for long life of citizens and the general standards of living. HDI is a geometric mean of normalized indices measuring achievements in each dimension.

(Source: World Bank, 2016 and African Development Bank Group, 2016)

6.2. Appendix B: Trends in sub-Saharan African countries

Figure 1: Real GDP grate rate (annual %) of Low Income Countries (LIC)



(Source, World Bank, 2016)

6.3. Reference list

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