International Journal of Sustainable Energy and Environmental Research
2014 Vol. 3, No. 1, pp. 16-33
ISSN(e): 2306-6253
ISSN(p): 2312-5764

ENERGY DEMAND AND FINANCIAL SECTOR PERFORMANCE IN SUB-SAHARAN AFRICAN REGION

Isola Wakeel[1] --- Ajide Kazeem Bello[2]
[1,2]*Department of Economics, University of Lagos*

ABSTRACT

This study analyzed the impact of energy demand on financial sector performance in Sub Saharan African. It adopted the production theory that was augmented with energy input. The study considered a panel unit root and co-integration test to examine the time series properties of the variables and a static panel estimation technique (pooled, fixed and random effect model) to determine the impact of production inputs on financial sector performance in SSA. The result reveals that energy demand weakens financial sector performance (showing a negative relationship), but when interacted with labour force it strengthens financial sector performance in SSA. The study, thus, attributed the negative relationship between energy demand and financial sector performance to the externalities produced from energy usage. This study therefore recommends that to support the growth of the financial sector, gross capital formation should be intensified and efficiently used and also that energy use should be effectively combined with labour force to strengthen the financial sector.

Keywords: Energy demand, Financial sector, Translog production function, Panel estimation technique.

Jel Classification: Q41, L60, CO2, C33.

1. INTRODUCTION

Financial sectors in low-income sub-Sahara Africa (SSA) are among the world's least developed (Anne-Marie and Catherine, 2006). The range of these institutions is narrow, and assets in most low-income African countries are smaller than those held by a single medium-sized bank in an advanced economy. In some African countries, most people do not have access to basic payment services or savings accounts, and the largest part of the productive sector cannot obtain credit. However, some middle-income African countries perform notably better, but the absence of a deep and efficient financial sector, constrains economies from growing. In addition, limited access to finance may reduce welfare and hinder poverty alleviation in an economy.

It has been noted that financial sector development fosters economic growth through a number of channels. Finance mobilizes and pools savings; produces information on possible investments so that resources can be channeled to their most productive use; monitors the use of funds; facilitates the trading, diversification, and management of risk; and eases the exchange of goods and services (Levine, 1997; 2004). Empirical studies confirm that countries with better-functioning financial systems grow faster, and the result does not seem to be driven by reverse causality. The link between finance and growth operates importantly through overcoming external financing constraints that otherwise hinder firm expansion. Such constraint like production inputs (capital, labour, energy use among others) in the sector may affect performance in the sector.

In Africa, over fifty percent of the population and industry in rural areas have no access to electrical energy. Africa generates 47 GW of electricity, less than 0.6% of global market share, and many countries in Sub-Saharan Africa are affected by this low supply of energy (Creamer, 2009).

Due to rising prices in commodities such as coal and oil, thermal sources of energy are proving to be too expensive for power generation. Sub-Saharan Africa is expected to build additional hydropower generation capacity of at least 20,165 MW by 2014. The region has the potential to generate 1,750 TWh of energy, of which only 7% has been explored. If this energy is generated and adequately supplied, it is expected to improve the economic performance which will transcend to enhance the financial sector in the economy (Christian and Kingombe, 2011).

The roles of financial development in an economy have been widely discussed in economic literature. Various studies have noted that a well-established and developed financial system increases the efficiency and effectiveness of financial institutions and thus boosts the innovations in the financial service delivery system. It also helps the advancement of technology, reduction of information cost and profitability of investment. Therefore, the development of the financial sector is often taken seriously by economies that seek high economic growth and development.

Many studies have shown that development in the financial sector will translate to higher economic growth (Goldsmith, 1969; Roubini and Sala-I-Martin, 1992). This is because improvement in the financial sector is expected to aid savings and capital formation and ease the external financing constraints that companies face (Levine, 2004) which consequently lead to higher growth (Greenwood and Jovanovic, 1990).

It has however been argued that for the financial sector to effectively perform the function of growing the economy, a vibrant real sector is required. In other words, higher demand for financial services and products (indication of financial development) arises when the real sector has developed and is demanding for such services or products (Patrick, 1966), (Robinson, 1952; Odhiambo, 2007).

Development in the real sector however, has been shown to be the dependent on the amount and quality of energy consumed in the sector. Therefore, if an economy's financial sector must develop, the real sector must improve and this depends on the inputs used in production activities.

Energy has been found to be indispensable in this development process. The fact that many studies have documented that the financial sector in the SSA region is grossly underdeveloped

(Anne-Marie and Catherine, 2006) can be explained by non-vibrant manufacturing sector which is limited by the consumption by energy inputs.

In line with this, the following research questions emanate; what is the impact of energy demand on the financial sector; and what is the relative importance of energy to financial sector growth when compared to the traditional factors of labour and capital? The specific objectives of the study are to: (i)to evaluate the impact of energy demand on financial sector performance in SSA (ii) to evaluate the impact of energy demand on financial sector performance relative to labour and capital. The paper contributes to the existing literature in the following ways: The study employed a translog production function that examines the relationship between energy demand and financial sector performance in SSA. The translog function has been found to be more superior compared to the traditional Cobb-Douglas function. In addition, the translog function is very flexible and allows for interaction between the regressors, thus this study considers a translog production function.

Furthermore, the importance of energy to the financial sector has been pointed out in various studies. A number of studies have investigated the causal relationship between energy consumption, economic growth and financial sector performance. Jumbe (2004) examined the causal relationship between energy demand and economic growth. In a related study, Shahbaz *et al.* (2010) examined the impact of financial sector development on energy consumption. However, there are limited studies that have empirically examined the impact of energy demand on financial sector. The aforementioned studies failed to empirically consider the impact of energy demand on financial sector development, thus this study will improve on existing studies by analyzing the impact of energy demand on financial sector performance in Sub-Saharan Africa.

1.1. Sylized Facts about Energy Demand and Financial Sector Performance in Sub-Saharan Africa (Ssa) Region

This section examines the background of the study by the use of tables, charts and trend analysis to vividly present the behavior of energy demand, capital, labour, financial development key monetary variables.

1.2. Financial Soundness Indicators in SSA

Table 1 presents the financial soundness indicator (capital to asset ratio, non performing loan to total loan, provision non-performing loan, returns to asset and return on equity) in some selected Sub-Saharan countries. From the table, all oil-exporting countries performed poorly in terms of their capital to asset ratio and provision to non-performing loans, but an improved performance is seen in their non-performing loan (except for Cameroon).

Table-1. Financial Soundness Indicators in 2011, Selected Countries in SSA *(Percent)*

Countries	**Capital to Asset Ratio**	**Non-performing loans to total loans**	**provision to non-performing loans**	**returns to asset**	**return on equity**
Oil-exporting countries					
Angola	14.8	2.4	n.a.	2.7	27.2
Cameroon	15.8	12.3	96.7	0.2	2.2
Congo, Rep.	9.9	1.2	75.3	1.4	22
Gabon	11	5.5	58.1	0.8	8.6
Nigeria	3.9	11.6	n.a.	0.2	4.5
Middle-income countries					
Ghana	13.7	14.1	76.2	3.9	27.2
Lesotho	9.5	2.4	110.3	2.8	28.9
Mauritius	7.2	2.8	41.4	1.3	17.9
Namibia	7.8	1.5	n.a.	3.7	47.1
Senegal	n.a.	16.2	54	2.2	22.6
Seychelles	9	8.1	33.8	3.7	41
South Africa	7.3	4.7	34.9	1.5	21
Swaziland	17.4	7.5	44.6	2.4	13.8
Low-income countries					
Ethiopia	7.8	2.1	n.a.	3	31.5
Kenya	13.2	4.4	n.a.	3.3	32.2
Mali	17.4	18.5	69.3	1.4	15.2
Mozambique	9	2.6	55.1	2.5	26.5
Rwanda	14.5	8	50.8	2.2	10.6
Sierra Leone	14	15.1	49.4	3.8	15.6
Tanzania	17.8	6.7	n.a.	2.7	15.1
Uganda	14.6	2.2	59.7	4	27.4
Fragile countries					
Burundi	n.a.	7.7	n.a.	3.2	23
Congo,DemocraticRepublic	15	5	n.a.	n.a.	3
São Tomé and Príncipe	n.a.	14.8	46.1	0.1	0.2
Togo	13.4	10.8	84.1	2	24.7
Mean	12	7.5	61.2	2.3	20.4
Median	13.3	6.7	55.1	2.4	22

Sources: Country authorities; and IMF African Department database.

* Green (Red) indicates improvement (worsening) relative to 2009; n.a. denotes not available.

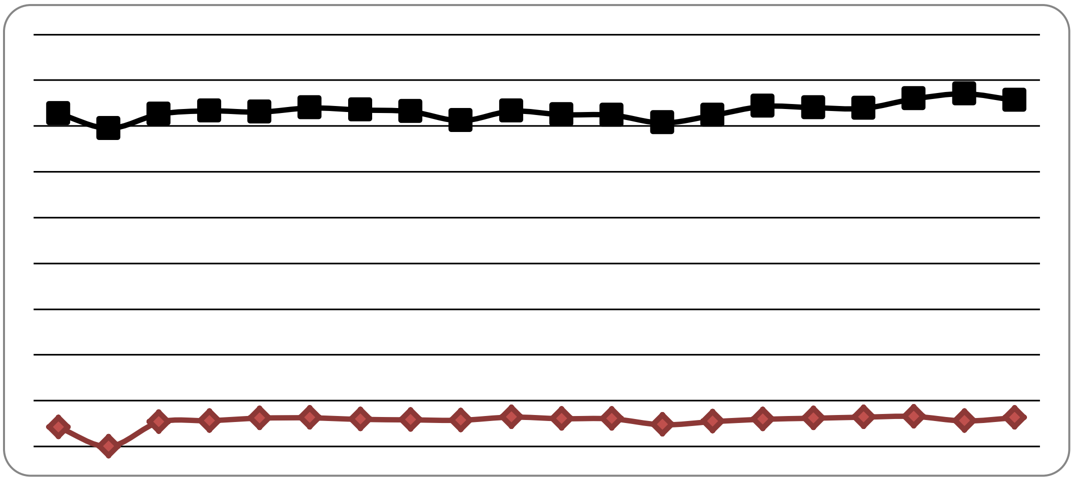
1.3. Financial Sector Performance and Selected Macroeconomic Variable in SSA.

This section centers on the relationship between financial sector, energy demand, capital and labour force and key monetary indicators.

1.4. Financial Sector Performance and Energy Demand in SSA

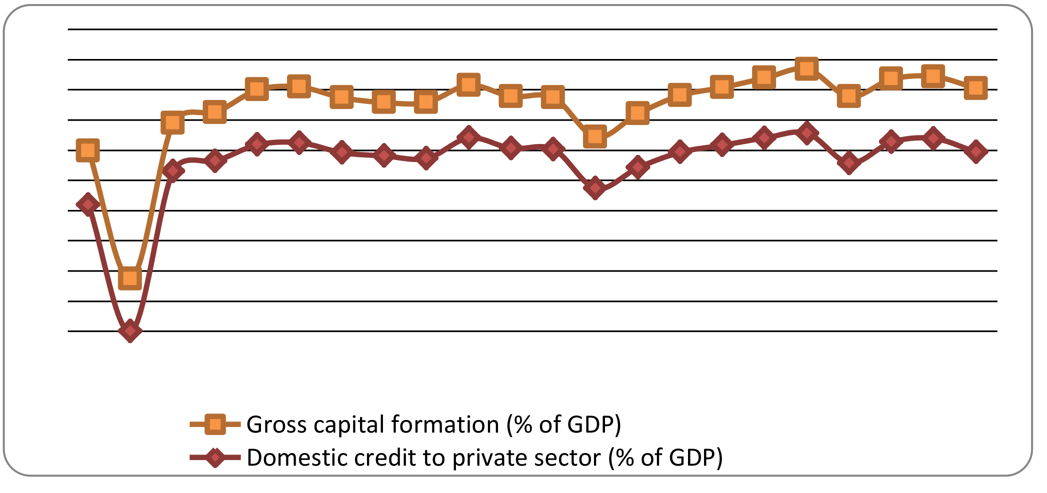
Energy inputs are essential elements in growth and development in any sector. Figure 1 shows the relationship between financial sector performance indicator and energy demand in Sub-Saharan Africa (SSA). Over the years, energy trend has witnessed a lot changes in SSA. The value of energy demand fell from 62.44kg in 1995 to 57.28kg in 1998, in the same period the domestic credit to private sector[1] also declined. The fall in the domestic credit to private sector may be as a result of the fall in energy demand. Furthermore, energy demand rose from 674.56kg in 2006 to 714.64kg in 2009, on the contrary domestic credit to private sector reduced from 64.03kg to 55.75kg in 2008. This implies that in recent years, there exist a negative relationship between energy use and financial sector performance indicator.

Figure-1. Financial Sector Performance and Energy Demand in SSA



Source: Author's Computation from The World Development Indicators (WDI) (2012)

Figure-2. Financial Sector Performance and Capital Formation in SSA



Source: Author's Computation from The World Development Indicators (WDI) (2012)

[1] Domestic credit to private sector is used to capture financial sector performance.

1.5. Financial Sector Performance and Capital Formation in SSA

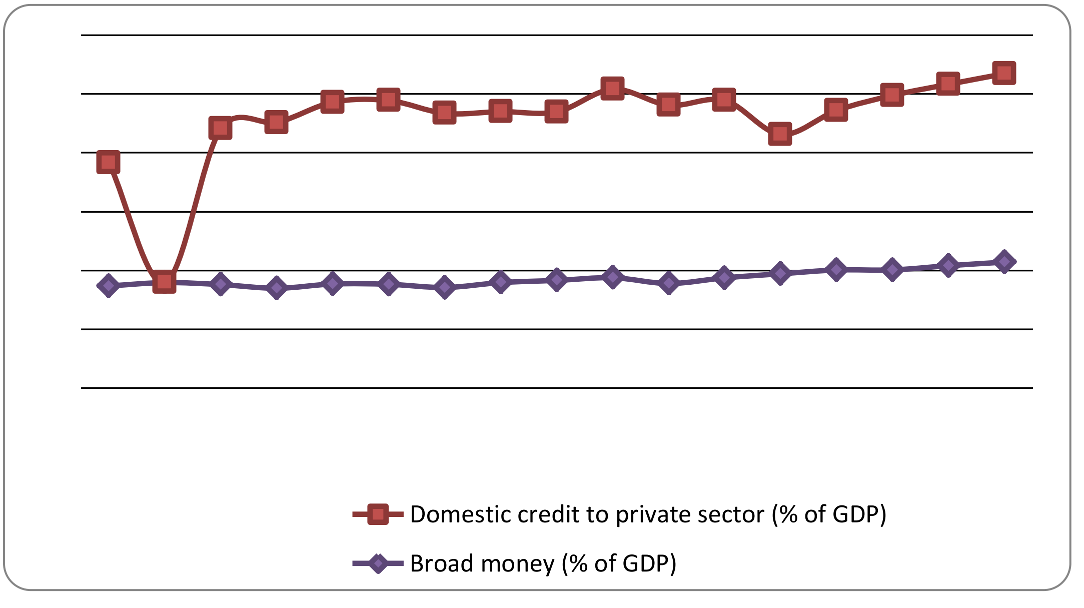
The figure below shows the trend relationship between financial performance and Gross Capital Formation. From the figure below, both gross capital formation and domestic credit to private sector fluctuated over time. A sharp decline was seen in 1991 on both gross capital formation and domestic credit to private sector. Both series peaked at 2007 while a decline in both gross capital formation and domestic credit to private sector occurred around 2008. This fall may be attributed to the global recession faced during this period. The trend movement in both series implies that capital may have a positive relationship with financial sector performance, thus capital may tend to improve financial sector performance and growth in SSA.

1.6. Financial Sector Performance and Monetary Indicator

The figures below describe the relationship between key monetary variables and financial sector performance in Sub-Saharan Africa. From table 3, broad money indicator grew steadily from 1993 to 1999, but fell suddenly at 2000. On the one hand, domestic credit to private sector fluctuated from 1992 to 2001 and fell in 2002. The trend analysis shows that money demand and domestic credit rose continuously from 2003 to 2006. The trend analysis shows that both broad money and domestic credit to private sector move in a similar direction.

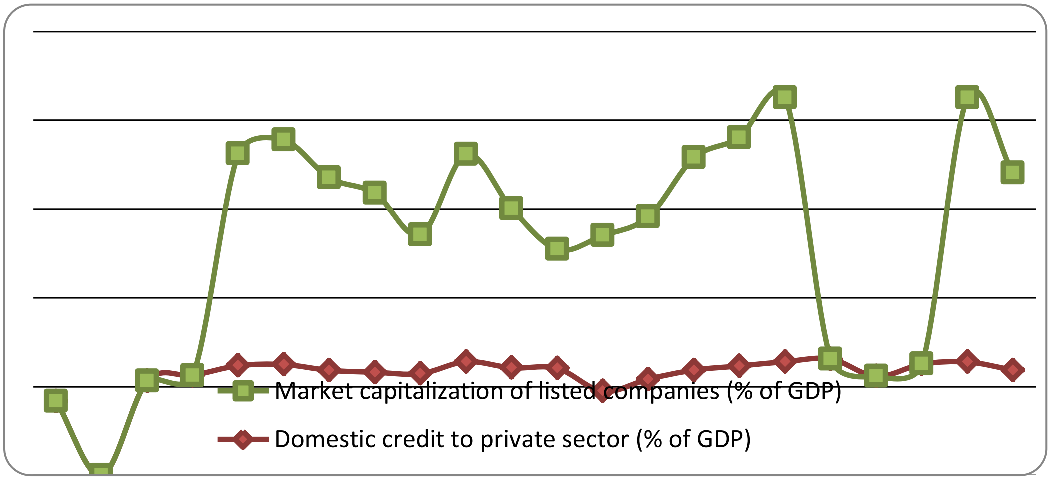
On the other hand, stock market performance (captured by market capitalization of listed companies as a percentage of GDP) and domestic credit to private sector fluctuated from 1990 to 2011. The value of capitalization rose continuously from 67.03 in 2001 to 148.75 in 2006, while domestic credit to private sector fluctuated from 60.26 in 2001 to 63.87 in 2010.

Figure-3. Financial Sector Performance and Broad Money



Source: Author's Computation from The World Development Indicators (WDI) (2012)

Figure-4. Financial Sector Performance and Market Capitalization



Source: Author's Computation from The World Development Indicators (WDI) (2012)

In summary the trend analysis only describes the behaviour of the series, but cannot empirically determine the impact of energy demand, capital and labour on financial sector performance; hence there is need to employ a more precise and robust analytical estimation technique (regression analysis).

2. LITERATURE REVIEW

This section focuses on the review of literature relevant to the study. Under the section, issues relating to theories adopted, methodologies and empirical findings are reviewed.

2.1. Financial Development and Energy Consumption

Over the years studies have been done in developed and developing economies on the linkage between energy demand and financial sector performance. Love and Zicchino (2006) studied the linkages between financial development and key monetary variables. The study employed the traditional Granger Causality test to determine the direction of relationship between financial development and energy use. They noted that financial development does not instantly impacts on energy consumption. The study found out that financial development passes through the real sector growth to increase per capita income. Increment in per capita income may increase the demand for more energy consuming durable goods such automobiles, home theatre, refrigerators, air-conditioners etc. Thus, financial development is positively related to energy demand.

Dan and Lijun (2009) empirically examined the impact of financial development on primary energy consumption in China. In order to determine the direction of relationship between financial development and energy use, they employed a Granger Causality test. The result shows that the direction of relationship is unidirectional and it runs from energy consumption to financial development. In contrast the reverse order of relationship (from financial development to energy demand) is not statistically significant.

In a study on the impact of financial development on energy consumption, Shahbaz *et al.* (2010) examined both the long-run and short run relationship between economic growth, financial development, population, capital stock and energy consumption in Pakistan over the period of 1971 to 2008. He used Auto-regressive Distributed Lag (bounds testing approach) to co-integration to explore the long run and VECM short run dynamics. His result suggest that macroeconomic variables are co-integrated (a long run relationship exist). He concluded that empirical evidence indicates a significant impact of financial development on energy consumption and economic growth is positively related to energy consumption. Also, increases in real income and population add to energy consumption in Pakistan.

In a related study, Sadorsky (2010) examined the relationship between financial development and energy demand. He considered 22 emerging countries and a time span of 1990 to 2006 (17 years). The study employed a panel analysis to empirically determine the relationship between financial development and energy use. The variables he considered are FDI, bank deposits as share of GDP, stock market capitalization as share of GDP, stock market turnover ratio and total stock market value traded over GDP.

Shahbaz and Lean (2012) studied the relationship among energy consumption, financial development, economic growth, industrialization and urbanization in Tunisia from 1971 to 2008.

The autoregressive distributed lag bounds testing approach to co-integration and Granger causality tests was employed for the analysis. The result confirms the existence of long-run relationship among energy consumption, economic growth, financial development, industrialization and urbanization in Tunisia. Long-run bi-directional causalities were found between financial development and energy consumption, financial development and industrialization and energy consumption.

In a study by Mehrara and Musai (2012) in Iran, the relationship between energy consumption and economic growth was investigated by incorporating financial development into neo-classical production function. ARDL bounds testing approach was applied to examine co-integration between the series over the period of 1970-2009. The study found a co-integrating relationship among real GDP, energy consumption, capital stock, oil revenues and financial development. They noted that the long and short run impacts of energy consumption on the economic growth are negative, small and insignificant. Indeed, the capital stock level and the financial development have been the main ingredients for economic growth. This implies that energy conservation policies such as phasing out energy subsidies or elimination of energy price distortions have little adverse or no effects on economic growth. Furthermore, the study suggested that government should promote investments on research and development to enjoy new energy-saving technology to sustain economic growth.

In a more recent study, Tang and Tan (2012) studied the relationship between financial development and energy consumption by incorporating relative prices and foreign direct investment (FDI) in the energy demand function. They also employed a Granger Causality test to determine the direction of relationship between financial development and energy demand in Malaysia. They reported a bi-directional causality between financial development and energy consumption both in short and long run.

Islam *et al.* (2011) noted that financial development, economic growth and population are major determinants of energy demand in Malaysia. The study also reported that there is a feedback between financial development and energy consumption in long run but financial development was found to Granger causes energy demand in short run. In another study Al-Mulali and Sab (2012) examined the impact of energy consumption on economic growth and financial development. Their results show that energy consumption is a major determinant that improving economic growth and financial development.

3. THEORETICAL FRAMEWORK AND METHODOLOGY

This section presents the theoretical framework for this study. This section is divided into three sub-sections (theoretical framework, model specification and methodology).

3.1. Theoretical Framework

We employed the basic production theory that models output as a function of production inputs (labour and capital). The basic production function is augmented with energy demand to capture the relationship between energy demand and financial sector performance in SSA. This is shown below;

$$Q = f(K, L) - - - - - - - - 1$$

Where Q is the output, K is the capital and L is the labour. We adopt this model to examine the relationship between financial sector performance and production inputs (capital and labour). To capture the impact of energy demand on financial sector performance, we incorporate energy input[2] into the production function. This is seen below;

$$Q = f(K, L, E) - - - - - - - - 2$$

"E" represents energy as an input into the production model. Capital and labour inputs are expected to increase production or output. Increase in energy consumption is expected to improve production output.

3.2. Model Specification

A translog specification is used to model financial sector performance. The translog function is an attractive and flexible function. The function has both linear and quadratic terms with the ability of using more than two factor inputs. It can also be approximated by second order Taylor series (Christensen *et al.*, 1973). The implicit model to be estimated is thus specified in equation (3);

$$\mathrm{DCRP} = \mathrm{f}(\mathrm{GCF}, \mathrm{LF}, \mathrm{ED}) - - - - - - - - 3$$

[2]Energy input involves work that moves or transforms matter. This includes a range of fuels based on some natural resource.

Where DRCP captures financial sector development proxied by domestic credit to the private sector, GCF is the gross capital formation, LF is the labour force and ED represents Energy demand (proxied by energy use).

The translog production function allows for interaction between variables. The explicit models (for each of the pooled, fixed and random effects models) for the three-input translog production function that captures the relationship between financial sector development, energy demand, labour force and capital can be written in terms of logarithms as follows;

Model 1 (pooled estimation)

$$lnQ = \alpha_0 + \gamma_K lnK_i + \gamma_L lnL_i + \gamma_E lnE_i + \frac{1}{2}\gamma_{KK}(lnK_i)^2 + \frac{1}{2}\gamma_{LL}(lnL_i)^2 + \frac{1}{2}\gamma_{EE}(lnE_i)^2 + \gamma_{KL} lnK_i lnL_i + \gamma_{KE} lnK_i lnE_i + \gamma_{LE} lnL_i lnE_i + +\varepsilon_1 - - - - - 4$$

Model 2 (Country fixed effect regression)

$$lnQ = \alpha_0 + \gamma_K lnK_{it} + \gamma_L lnL_{it} + \gamma_E lnE_{it} + \frac{1}{2}\gamma_{KK}(lnK_{it})^2 + \frac{1}{2}\gamma_{LL}(lnL_{it})^2 + \frac{1}{2}\gamma_{EE}(lnE_{it})^2 + \gamma_{KL} lnK_{it} lnL_{it} + \gamma_{KE} lnK_{it} lnE_{it} + \gamma_{LE} lnL_{it} lnE_{it} + \sum_{1=1}^{\rho} \gamma_\varepsilon \text{idum} + \varepsilon_{it} - - - - - 5$$

Model 3 (Country random effect regression)

$$lnQ = \alpha_0 + \gamma_K lnK_{it} + \gamma_L lnL_{it} + \gamma_E lnE_{it} + \frac{1}{2}\gamma_{KK}(lnK_{it})^2 + \frac{1}{2}\gamma_{LL}(lnL_{it})^2 + \frac{1}{2}\gamma_{EE}(lnE_{it})^2 + \gamma_{KL} lnK_{it} lnL_{it} + \gamma_{KE} lnK_{it} lnE_{it} + \gamma_{LE} lnL_{it} lnE_{it} + V_{it} - - - - - 6$$

Where $$V_{it} = \mu_{it} + \varepsilon_{it} - - - - 7$$

The gamma (γ) are the regression coefficients, ε represents the error term, ***idum*** and μ_{it} are the variables that represent control for firm specific fixed effect and random effect respectively. We expect capital, labour and energy demand to have a positive relationship with financial sector development in SSA. The a priori expectations for the parameters are shown below;

$$\gamma_K > 0, \gamma_L > 0, \gamma_E > 0, \gamma_{KK} > 0, \gamma_{LL} > 0, \gamma_{EE} > 0, \gamma_{KL} > 0, \gamma_{KE} > 0, \gamma_{LE} > 0 - - - - 8$$

3.3. Estimation Technique

In order to examine the time series properties of the series, we consider the Levin, Lin & Chu statistics for stationarity and the Johansen Fisher Panel Co-integration Test to determine if the series co-integrate. The criteria employed to select a robust model include R-Square and F-tests.

These tests are used to select between OLS classical estimation model (pooled) and panel data techniques (fixed and random effects) while the decision to adopt either of fixed or random effect is determined using the Hausman specification test.

4. ESTIMATION/ANALYSIS OF RESULTS

This section focuses on the presentation and discussions of results and is divided into three major parts. The first part comprises the descriptive analysis, while second part is the regression analysis and the discussions of the results.

4.1. Descriptive Statistics

Table 2 presents the descriptive analysis of the entire SSA countries. This reveals the mean value, standard deviation, minimum value, maximum value and sample size for the overall countries. The average value of domestic credit to the private sector is 20.74 with a standard deviation of 27.24. In the case of GCF and LF, the mean value is about 2983121279 and 9912434, with a standard deviation of 6560540320 and 10393363 respectively. The value of energy demand ranges from 216.24 to 3074.59 with a mean and standard deviation of 639.14 and 557.26 respectively.

Table-2. Description of Variables

	N	Minimum	Maximum	Mean	Std. Deviation
Dcrp	382	.68	161.98	20.74	27.24
Gcf	276	68545344	42171200000	2983121279.16	6560540320.78
Lf	399	343868	50300000	9912434.687	10393363.57
Ed	380	216.24	3074.59	639.145903	557.26

Source: Author's Computation

4.2. Correlation Analysis

From the correlation table below, most of the variables have low but significant pairwise correlation, thus can be included in the equation together.

Table-3. Correlation Table

	dcrp	gcf	lf	ed
dcrp	1			
Gcf	.940**	1		
Lf	.132**	.279**		
Ed	.820**	.845**	.036	1

Significance at the following level of significance *=10%; **=5%; ***= 1%

4.3. Presentation of Results

4.3.1. Stationarity Test

The table below presents the stationarity conditions of the series. The results show that most of the series are not stationary at levels, but are stationary at first difference, hence there is need to determine if the series have a long run relationship (if they co-integrate).

Table-4. Stationarity Test

Variable	Level	Difference	Decision
ED	-1.05714	-1.05714	I(1)
GCF	5.72460	-2.77899	I(1)
DCRP	-4.34950	-11.8894	I(0)
LF	3.95028	1.63573	I(1)

Significance at the following level of significance *=10%; **=5%; ***= 1%

4.4. Co-Integration Result

The table below presents the co-integration analysis for the series. Given that each of the series contains a panel unit root, we proceed to examine whether there is a long-run relationship between the variables using the Johansen Fisher panel cointegration test proposed by Maddala and Shaowen (1999). The Johansen Fisher panel cointegration test is a panel version of the individual Johansen (1988) cointegration test. Based on the same principles underpinning the Fisher ADF panel unit root test, the Johansen Fisher panel cointegration test aggregates the p-values of individual Johansen maximum eigenvalue and trace statistics. The co-integration result reveals that the variables under consideration have a long run relationship.

Table-5. Co-integration Result

Johansen Fisher Panel
Cointegration Test
Series: DCRP ED GCF LF
Date: 05/28/13 Time: 16:16
Sample: 1990 2010
Included observations: 399
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 1

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized	**Fisher Stat.***		**Fisher Stat.***	
No. of CE(s)	**(from trace test)**	**Prob.**	**(from max-eigen test)**	**Prob.**
None	285.8	0.0000	179.6	0.0000
At most 1	147.9	0.0000	96.66	0.0000
At most 2	83.16	0.0000	65.23	0.0000
At most 3	59.06	0.0002	59.06	0.0002

Source: Author's Computation.

5. REGRESSION RESULTS

The table below presents result of translog regression functions which are extracted and presented below (the computer outputs are also given in the appendix). The result shows that the explanatory variables jointly account for 71.6, 25.3 and 47.6 percent variation on the dependent variable in the pooled, fixed and random effect model respectively. The F- statistics reveals that the independent variables are jointly statistically significant in the model. We reject the null hypothesis and accept the alternative hypothesis that fixed effect model is better compared to random effect model, thus we accept the fixed effect model. GFC and LNLF_2 are the only production inputs that may significantly affect financial sector performance in SSA. Capital and energy demand have a negative impact on financial sector performance, while labour force is expected to increase financial sector performance. The rate of change in energy demand and capital are positively related to financial sector performance. This implies that as the value of energy demand and capital increase over time, the performance of the financial sector tends to improve.

Interestingly, the interaction of capital with labour is significant in influencing financial sector performance, while the interaction of capital and energy demand; energy demand and labour force are not significant to influence financial sector performance.

Table-6. Regression Result

Dependent Variable = lndcrp			
	Pooled	**Fixed**	**Random**
Ingcf	-5.5846***	-4.2116***	-3.5056**
Lned	-2.7529	-1.9689	-3.8313
Lnlf	1.871	2.5881	1.5547
ingcf_2	-0.1313***	0.0487	0.0434
ined_2	0.1765	0.4555	0.5605*
inlf_2	-0.3076***	-0.3317***	-0.2592***
ingcf_ined	0.4744***	-0.235	-0.2446
ingcf_inlf	0.5435***	0.2796**	0.24**
ined_inlf	-0.624***	0.0876	0.1186
_cons	54.3559***	35.2939*	39.8468**
R-squared	0.7168	0.2536	0.4767
F stat.	70.31***	10.85***	92.79***
Hausman (p-value)		21.20(0.0066)	

Significance at the following level of significance *=10%; **=5%; ***= 1%

5.1. Comparison of Results with Related Studies

Studies on the impact of energy demand on financial sector development are limited. However, our result is in tandem with the work of Shahbaz and Lean (2012). They noted that a long run relationship exist between energy demand and financial sector performance. We also found a long run relationship between financial sector development, energy demand, capital and labour in SSA. The relationship between the interaction of energy demand and labour is positive. Furthermore, our result differs from a priori expectation. We expect a positive relationship between energy demand and financial sector development, but in contrast the result indicates a negative relationship between capital, energy demand and financial sector performance in SSA.

6. CONCLUSIONS AND RECOMMENDATIONS

This study investigates the impact of production inputs (energy demand, capital and labour force) on financial sector performance in SSA. To determine the impact of production inputs when interacted, we specified a translog production function that incorporates energy demand as an input. The study also examines the time series properties and the long run relationship among the series of financial development, energy demand, capital and labour force in SSA. The results show that energy demand weaken financial sector performance, but when interacted with labour force it strengthens financial sector performance in SSA. The negative relationship between energy demand and financial sector performance can be attributed to the externalities produced from energy usage. This externality may increase cost, thus lowers productivity and economic growth which in turn affect the financial sector. In addition, capital, interaction of capital and labour force and continuous increase in labour force can influence financial sector performance.

Gross capital formation exerts a negative influence on financial sector development. This may imply that capital is not efficiently utilized in SSA region. Thus to support growth of the financial sector, gross capital formation should be intensified and efficiently used. Interestingly, our finding reveals that energy demand does not influence financial sector performance, but when interacted with the labour force it strengthens the sector. In line with this, energy use should be effectively combined with labour force to strengthen the financial sector. In addition, labour force should be intensified to improve performance in the financial sector.

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Appendix

Pooled

Source	SS	df	MS		
				Number of obs =	260
				F(9, 250) =	70.31
Model	134.614823	9	14.9572026	Prob > F =	0.0000
Residual	53.1836628	250	.212734651	R-squared =	0.7168
				Adj R-squared =	0.7066
Total	187.798486	259	.72509068	Root MSE =	.46123

```
lndcrp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ingcf |  -5.584597   1.645201    -3.39   0.001    -8.824817   -2.344377
lned |  -2.752881   2.536034    -1.09   0.279    -7.747595    2.241834
lnlf |   1.870957   2.675066     0.70   0.485    -3.397582    7.139496
ingcf_2 |   -.131319    .048763    -2.69   0.008    -.2273576   -.0352804
ined_2 |   .1765437   .1907199     0.93   0.356    -.1990788    .5521663
inlf_2 |  -.3076477   .0719727    -4.27   0.000    -.4493979   -.1658976
ingcf_ined |   .4744451   .1794687     2.64   0.009     .1209818    .8279083
ingcf_inlf |    .543468   .0626128     8.68   0.000     .4201522    .6667837
ined_inlf |  -.6239665   .2121765    -2.94   0.004    -1.041848   -.2060852
_cons |    54.3559   16.64809     3.26   0.001     21.56751    87.14428
------------------------------------------------------------------------------
```

Fixed-effects

```
Fixed-effects (within) regression               Number of obs      =       260
Group variable: _stack                          Number of groups   =        18

R-sq:  within  = 0.2953                         Obs per group: min =         1
between = 0.2433                                       avg =      14.4
overall = 0.2536                                       max =        20

F(9,233)           =     10.85
corr(u_i, Xb)  = -0.8106                        Prob > F           =    0.0000

------------------------------------------------------------------------------
lndcrp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ingcf |  -4.211612   1.570441    -2.68   0.008    -7.305692   -1.117532
lned |  -1.968932   5.401515    -0.36   0.716    -12.61098     8.67312
lnlf |   2.588142   2.406107     1.08   0.283    -2.152365    7.328648
ingcf_2 |    .048693    .052123     0.93   0.351    -.0539995    .1513856
ined_2 |   .4554697   .4062689     1.12   0.263    -.3449602      1.2559
inlf_2 |  -.3317041   .0930926    -3.56   0.000    -.5151149   -.1482933
ingcf_ined |  -.2349886    .215178    -1.09   0.276    -.6589318    .1889547
ingcf_inlf |   .2795532   .1127645     2.48   0.014     .0573849    .5017216
ined_inlf |   .0876004   .3088692     0.28   0.777     -.520933    .6961338
_cons |   35.29388   20.79165     1.70   0.091    -5.669789    76.25754
-------------+----------------------------------------------------------------
sigma_u |  1.3497022
```

```
sigma_e |  .26300271
rho |  .96341866   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(17, 233) =    31.52           Prob > F = 0.0000
```

Random-effects

```
Random-effects GLS regression                 Number of obs      =       260
Group variable: _stack                    Number of groups   =       18

R-sq:  within  = 0.2744                   Obs per group: min =        1
between = 0.3686                              avg =       14.4
overall = 0.4767                            max =       20

Random effects u_i ~ Gaussian                 Wald chi2(9)       =     92.79
corr(u_i, X)       = 0 (assumed)              Prob > chi2        =    0.0000

------------------------------------------------------------------------------
lndcrp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ingcf |  -3.505641   1.408054   -2.49   0.013    -6.265375   -.7459068
lned |  -3.831342   4.055709   -0.94   0.345    -11.78038    4.117702
lnlf |   1.554679   2.174629    0.71   0.475    -2.707515    5.816873
ingcf_2 |   .0434321    .049479    0.88   0.380    -.053545    .1404091
ined_2 |   .5605122   .3194823    1.75   0.079    -.0656616    1.186686
inlf_2 |  -.2592259   .0801105   -3.24   0.001    -.4162396   -.1022121
ingcf_ined |  -.2446244   .1923847   -1.27   0.204    -.6216914    .1324426
ingcf_inlf |   .2399821   .0996159    2.41   0.016    .0447384    .4352257
ined_inlf |   .1186021   .2541937    0.47   0.641    -.3796083    .6168126
_cons |   39.84679   17.47885    2.28   0.023    5.588876    74.1047
-------------+----------------------------------------------------------------
sigma_u |  .79875816
sigma_e |  .26300271
rho |  .90218907   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Hausman Fixed Effect

hausman fe

Note: the rank of the differenced variance matrix (8) does not equal the number of coefficients being tested (9); be sure this is what you expect, or there may be problems computing the test. Examine the output of your estimators for anything unexpected

and possibly consider scaling your variables so that the coefficients are on a similar scale.

---- Coefficients ----

	(b) fe	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
ingcf	-4.211612	-3.505641	-.705971	.6954649
lned	-1.968932	-3.831342	1.86241	3.567575
lnlf	2.588142	1.554679	1.033462	1.029729
ingcf_2	.048693	.0434321	.005261	.0163901
ined_2	.4554697	.5605122	-.1050425	.250969
inlf_2	-.3317041	-.2592259	-.0724782	.0474187
ingcf_ined	-.2349886	-.2446244	.0096358	.0963832
ingcf_inlf	.2795532	.2399821	.0395712	.0528441
ined_inlf	.0876004	.1186021	-.0310018	.1754587

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 21.20

Prob>chi2 = 0.0066

(V_b-V_B is not positive definite)