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FINDING LINK BETWEEN FINANCIAL DEVELOPMENT AND ENERGY DEMAND IN AFRICA

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Abstract

In most regions the production and consumption of energy is considered as a benchmark for shifting toward development of economy. The aim of this study is to determine the relationship of different growth indicators (FDI, GDPPC, RPRICES) and energy consumption and different financial development indicators (domestic credit by banking sector, liquid liability, M2, Domestic credit to private sector) in a selected panel of Sub Saharan countries that are Egypt, Sudan and Nigeria for a period of 39 years from 1977 to 2014. Panel cointegration test found cointegration among the variables and have long term relationship among them. The pooled OLS test suggests that there is significant relationship among the variables and the results concluded that there is a high impact of GDPPC and relative prices of energy on Energy consumption in the region.

Keywords: *Fdi, Gdppc, Rprices, Domestic Credit, Banking Sector.*

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INTRODUCTION

Energy has a crucial part to play in the economic, social and human life and helps to enhance financial development especially in the third-world countries. An estimated 16% of all the population around the globe, live without electricity (WEO2016), reduced by 15 million than last year [8], most of them living in rural areas and 95% of them living in sub Saharan Africa. International energy agency estimates that in 2030 almost 1.4 billion people have not access to electricity in Africa and Asia. [4]

According to the IEO there has been a huge surge in the demand of energy over the 28-year period between 2012 and 2040. The total consumption is projected to increase from 549 quadrillion BTUs in 2012 to 629 quadrillion BTUs in 2020 and 815 quadrillion BTU in 2040 – an increase of 48% in 2040 compared to 2012.Demographic references generally reflect to affect the current policies. The Middle East is the largest oil producing region and producing more than a third of the world oil in 2035. Natural gas accounts for more than 50% of the growth in the region energy usage. The percentage of non-fossil fuels in the regional mix is predicted to rise from 1% today to only 5% in 2035. [2]

Electricity is the most commonly and widely form of energy. The high growth of renewable energy in many countries makes their high share in the power generation. [8]

According to one report 1.6 billion people have not access to electricity in the world. They live in darkness and the most of them living in rural areas of the developing countries. They totally depend on handmade lightning tools. In the result the rates of these tool and other things as well high day by day and increase in Inflation. Use of solar energy is a comparatively cheaper alternate solution to being electric power to masses. [8]

The prosperity that economic development brings changes in provides energy and stimulates the demand of energy. Developing countries increase their economic growth rate day by day and energy, helping it. The current situation tells us that the energy demand increases day by day and current energy policies make 1.4% growth of energy every year till 2035. But alarmingly the high fossil oil prices and climate change problems that are harmful for our Earth (global warming) makes it difficult to increase it. The fossil fuels have an adverse effect on human being and other living organisms. The demand of energy is rising continuously. These massive changes in demands have resulted in the Global community to think about exploring alternate, less harmful energy sources (UNEP 2011). Renewable energy means that energy comes from wind, solar, bio-fuel, hydro-power and geothermal. It is also known as clean energy and protects the environment and creates the income and job as well. [3]

Many studies have focused on making relation between energy usage, renewable sources and financial growth as this is an important indicator of correct policy. [3]

Egypt is the largest oil producing country and second in terms of natural gas production in Africa. Egypt is also a major transit route for oil between the Persian

Gulf and the United States. [1]

Egyptian power usage has increased tremendously in the previous decade. However, providing energy to everyone is a massive challenge. The energy sector can play an important role in decreasing the poverty level in Egypt. [8]

Egypt plays an important part in the international energy market because of the Suez and the Suez-Mediterranean repines. The Suez Canal plays a critical role in transporting LNG to North America. Egyptian government charges a fee of these two operations as revenue. Egypt has faced a decline in FDI and tourism after the 2011 revolution. Egyptian GDP growth dropped from 5.1% to 1.8% in 2012 and now it stands at 4.3%. [1]

Today Egypt faces problems such as rising population, lack of farming land, tourism, foreign investment and such others. After the revolution 2011, Hosni Mubarak was forced to resign and a new chapter of Egyptian history began with a new constitution in 2014 with a population of about 96 million with an annual population growth of 2% [1]. The poverty level in Egypt is increasing each year.

Egypt's electricity use has been growing swiftly because of economic growth in the closing decade. However, Egypt has massive numbers of its populace residing in rural areas where access to energy is still a challenge. The power sector is key to Egypt's monetary development and poverty decrease goals. [3] "Table 1" shows the energy consumption.

Egypt is a developing country and heavily dependent on oil. Egypt faces a massive swell in energy usage due to economic growth and industrialization. The rapid growth in energy consumption has increased from 72 billion kilowatt/hr to 140 kilowatt/hr in 2016 (EIA 2017) and the Egyptian citizens mainly depend on LPG, with 70% of electricity being produced by it and the other 30% by oil and hydro-electricity. So, it is evident that the decline of energy production in Egypt is because of shortage of crude oil, Egypt need to find cheap and sustainable alternative sources of energy. [3]

Effective use of energy has become a huge priority in Egypt. Due to the expensive supply of oil and gas combined with a tight budget, the government has started pursuing energy efficiency aggressively. Egypt makes a necessary strategy which helps them into makes 20% of renewable energy for its power generation in 2022 and expected that 12% of it making by wind and the other 8% by solar and hydro-power which reduce the fossil fuels and pollution.

Egypt faces a lot of electricity shortage due to increasing consumption, shortage of LNG and inadequate generation capacity. The growing political and social instability have also halted the government's plans to increase the power in the national grid by 30 GWs.

Sudan is the largest country in the African continent, with an area of approximately one million square miles (2.5 million square kilometers). Sudan is viewed as one of the potentially richest nations especially in livestock beside water and land with 30 million head of cattle, 70 million head of sheep and goats, and 3 million head of camels [21]. Besides that, Sudan has a great wealth of the wild life, birds, reptiles, and fish wealth, which are estimated to give 200,000 tons of food

annually. Sudan has a total population of about 30 million people, which is growing at an annual rate of about 2.8%. About 70% of the population live in rural areas. About 62% of the population are employed in agriculture [22]. Agriculture contributes about 33% of the gross national product (GNP), and 95% of all earnings. Energy is an essential factor in development since it stimulates and supports economic growth and development. Fossil fuels, especially oil and natural gas, are finite in extent, and should be regarded as depleting assets, and efforts are oriented to search for new sources of energy. The clamor all over the world for the need to conserve energy and the environment has intensified as traditional energy resources continue to dwindle whilst the environment becomes increasingly degraded. Biomass energy supply in Sudan has contributed 87% of the total energy supply since the 1980s [23]. The basic form of biomass comes mainly from firewood, charcoal and crop residues. Out of total fuel wood and charcoal supplies 92% was consumed in the household sector with most of the firewood consumption in the rural areas.

Nigeria is blessed with an array of conventional energy-resources, prominent among which are crude oil, tar sands, natural gas and coal. In addition, there are substantive potentials for renewable energy-resources such as hydro, solar, wind, biomass, wave and tidal, and some geothermal.

Despite these resources, the country is still unable to generate enough electricity to meet its demand. As at 2005, the name-plate capacity for electricity generation in Nigeria is about 6500 MW. Of this, only 3959 MW is available, due to the ageing of power plants, poor maintenance and paucity of funds [24]. Because of the poor infrastructure, load shedding and frequent power-outages are common occurrences, and the average per capita electricity annual consumption in 2003 was as low as 99 kWh per person [25].

Evidence of the impact of the poor quality, unreliability and limited availability of power supplies on Nigeria's economic development are its debilitating effects on the industrial sector. Poor power-supply is probably the most important constraint upon industrial production in the country [26]. Many manufacturers now rely on self-generated electricity for their entire production process. Also, as a result of the inadequate power supply and poor infrastructure, less than 45% of the Nigerian population had access to electric power in 2003.

The objectives of this research are:

- *To observationally scrutinize the influence of relative prices, foreign direct investment, financial increase and indicators of economic development on the consumption of energy, by using panel co integration framework in Egypt.*

LITERATURE REVIEW:

Ucan, Aricioglu, and Yuce analyzed the correlation between energy consumption (non-renewable, renewable) and economic development of the 15 EU countries from 1990-2011 by using co-integration mechanism. The study found unidirectional causality between economic development and non-renewable energy consumption. [20]

H1: Growth Indicators (GDP, relative prices, FDI) stimulates energy consumption in Egypt, Sudan and Nigeria

Shu-Chen Chang [9] There is a strong relation between economic growth and FDI. There are two opinions about that the one argues that financial development effects on energy consumption. The financial development increasing investment in the country and the factories uses energy that pollutes air as well as water.

The other argues that financial development in a country makes jobs for the peoples of the country. If the peoples of the country that have no job then the NNP of the country is decreases. It's true that the investment which comes through financial development increases the usage of energy, but it makes some sense for the country. [9]

The issue of electricity consumption is mainly focus on the income of a person. There are three points of views regarding this issue. The first states that power usage results in financial development. The next holds that this relationship moves in the opposite direction i.e. financial development causes an increase in power usage. The last one states that this relationship in bi directional in nature. [9]

H2: Financial indicators (broad money, domestic credit available to both the banking and private sector, liquid liabilities) stimulates energy consumption in Egypt, Sudan and Nigeria

K.D Pattizianas [10] says that till today some factors are blocking the development of solar energy in Egypt. Egypt has enough sunlight annually to produce more than 20% of the total energy in 2020. Egypt can be used as a case study and a pioneer in the field of solar power usage in the Middle East. There are some barriers like economical barriers, social barriers, political barriers and technical barriers are still needs to be removed. [10]

Arash Farnoosh and Fredric Lantz [11] states that Egypt produces the most oil in Non-OPEC countries and is second in production of NG in Africa. In the last decade it has decreased oil production and an increase in consumption. They analyzed the current and the forecasted power generation capacity of the country. They also suggested cost effective ways of power generation. They find the alternatives to generate the energy without the fossil oil. [11]

Ahmad Shata Ahmad [12] studied the methods of making electricity through wind. He is going to search enough windy areas. He studied Ras-ul-Ghareb to investigate and predict the destiny of electricity generation. He finds the wind nearly 900kw/m² p/y at 100 m of altitude of the region. [12]

Sami Kamal and Carol Dahl [13] studied the possibility and utility of using solar and wind power farms to produce energy in the Egyptian desert, hence boosting the agriculture in these areas and combating the food shortages in the whole country. This will also replace the conventional diesel used as fuel, hence reducing the pollution. [13]

Horn, M., Führing, H., & Rheinländer, J. [14] studied the use of "parabolic trough collector field and volumetric air receiver tower" as a source of energy generation in Egypt. This is an environmentally and economically better alternative to produce energy in Egypt. [14]

Egypt is well energized, with 99 percent of families associated with the power framework. Power request has developed fundamentally as of late because of the nation's financial improvement. Pinnacle power request expanded more than 200%, up from 6,902 to 22,500 MWs in 2010. The private part represents 47 percent of the aggregate power utilization. The mechanical area represents 20%, while Government, open lighting, agribusiness and business represent 12%, 9%, 4% and 3%, individually. There are possibilities and strategies to move forward energy proficiency and to direct the development of power utilization. Additionally, the request development relaxed to some degree due to the 2008-2009 worldwide monetary downturns. By and by, power request is predicted to proceed developing at a fairly rapid yearly rate of 6.5% between 2010 and 2020. [15]

Egypt is blessed with multiple options for production of renewable energy. Egypt plans to use 20% of its electricity, created from renewable sources in 2022, with wind providing 12%, Hydro power 5.8%, and Solar 2.2%. There are plans to add a further 51.3 GW to the current installed capacity. NREA is responsible to execute the government's plans regarding renewable energy. [16]

DATA SOURCE & METHODOLOGY:

In this we study data for different variables in Egypt, Sudan and Nigeria from 1977 till 2014 from "World Development Indicators" or WDI, published by World Bank. The variables for which data is being used are:

1. *Energy consumption (i.e., kg of oil equivalent per capita)*
2. *GDP per capita (current US$)*
3. *Relative price of energy to non-energy goods (measured by the ratio of the price index to the GDP deflator, annual %)*
4. *Foreign direct investment FDI*
5. *Net inflows (% of GDP)*
6. *Money and quasi money as % of GDP*
7. *Liquid liabilities (M3) as % of GDP*
8. *Domestic credit provided by banking sector as % of GDP and domestic credit to private sector as % of GDP has been taken for analysis.*

The variables being used in this study with the classification as dependent and independent are listed in the table 1. Considering the scope of this study and the methodology being applied, Energy consumption has been selected as the dependent variable while per capita GDP, FDI, energy prices(relative), supply of broad money, liquid liabilities and domestic credit provided by banking sector to private sector as independent variables.

Table 1:

List of dependent and independent variables:

Variables	*Measurement*	*Symbol*	*Expected sign*	*Data source*
Dependent variable				
Energy consumption	*kg of oil equivalent per capita*	*EC*	*After Test*	*World Bank*
Independent			*After Test*	*World*

variables				Bank
GDP Per Capital	Current US $	GDPPC	After Test	World Bank
Foreign Direct Investment, inflows	% of GDP	FDI	After Test	World Bank
Relative Energy Price Money	The ratio of the price index to the GDP deflator, annual %	RPRICES	After Test	World Bank
Liquid Liability (M3)	% of GDP	LL	After Test	World Bank
Domestic credit provided by banking sector	% of GDP	DBC	After Test	World Bank
Domestic credit to private sector	% of GDP	DPC	After Test	World Bank
Money and Quasai	% of GDP	M2	After Test	World Bank

Zaren and koc[17] said that the financial development help to bring positive changes and decrease the cost of energy consumption per capita. Chtioui [18] rejected that statement and said that the energy has no or little impact on the on the economic growth and it does not decrease the energy consumption per capital.

Energy have not such an impact on the financial development of the country. [17] "FDI involve in the expansion of the industrialization, commercialization manufacturing of the country, while the energy help the manufacturing process, both are equally important for any country".

It is essential to know that the energy efficiency for too many reasons. Firstly, energy plays foundation role in the production process and the crises of energy is not favorable for any country. Secondly, the economy of the country is totally depended on the energy. [19]

This study adopted the following techniques:

- *Firstly, the study adopted Levin, Lin and Chu (LLC), Fisher-ADF, and Fisher-PP unit root test to check the unit root problem in the data set of each variable.*
- *After examining the unit root problem, the study employed Pedroni residual co-integration test to check the long-run relationship between the variables. For this purpose, four cointegration test has been performed i.e., Panel v-statistic, Panel rho-statistic, Panel PP-statistic and Panel ADF-statistic.*
- *Next, the study takes on the panel least square test to evaluate the significance between the variables.*

In this study, we employed the method of Pooled Least Squares method, general representation of the equation is as follows:

$$ln(EC)_t = f\ ln\ (GDPPC, RPRICES, FDI, M2, LL, BDC, DPC)$$

The general representation of the equation mentioned above is as follows:

$$Log(Y_t) = C + \beta_{1t}\, log(X_{1t}) + \beta_{2t}\, log(X_{2t}) + \beta_{3t}\, log(X_{3t}) + \beta_{4t}\, log(\lambda *_{4t}) + \varepsilon_t$$

*where Yt is the dependent variable; C is the intercept; βt is the slope of the independent variables; Xt is the growth measures (i.e., GDPPC, RPRICES and FDI); λt is the financial development indicators (i.e., M2, LL, DBC and DPC); T=1, 2…39 periods; i=1, 2…3 countries; εt is the error term; β1 is the coefficient of economic growth; β2 is the coefficient of relative prices; β3 is the coefficient of FDI; β4 is the coefficient of financial development(FD) indicators; *, asterisk represents FD indicators separately regress on energy consumption and εt is the error term.*

EMPIRICAL FINDINGS

To test whether each of the variables in a study containing a panel unit root, the panel unit root tests proposed by Levin, Lin and Chu(LLC), Fisher-ADF, and Fisher-PP tests have been applied on the data set. Table 2 reports these results. The results show that FDI, RPRICES, M2, LL and DBC have a unit root at level while EC, GDPPC and DPC have a non-stationary at level, however, after taking first difference, these variables have become stationary. The results indicate mixture of order of integration; therefore, we applied the test of cointegration given by Pedroni.

Table 2

Panel unit root tests.

Variables	*Level*			*First difference*		
	LLC	*Fisher-ADF*	*Fisher-PP*	*LLC*	*Fisher-ADF*	*Fisher-PP*
Log(EC)	*-2.83099**	*10.1508*	*8.36775*	*6.84597****	*59.8807****	*75.2406****
Log(GDPPC)	*-1.99462*	*0.19718*	*0.25296*	*7.82891****	*55.1664****	*55.8763****
Log(FDI)	*-1.90311*	*10.0673***	*13.8561***	*8.16364****	*63.2247****	*113.920****
Log(RPRICES)	*1.96433***	*7.28803*	*6.39867*	*-9.99022**	*75.0518****	*96.5044****
Log(M2)	*-1.55498*	*23.3184****	*12.5427*	*-6.10728**	*41.1841****	*46.8090****
Log(LL)	*-0.52039*	*13.8913***	*15.6424***	*-5.82764**	*50.2093****	*54.1553****
Log(DBC)	*-0.38760*	*8.25003*	*13.0097***	*-1.03770*	*35.2133****	*92.7445****
Log(DPC)	*0.26631*	*6.84876*	*7.63473*	*-7.81846**	*52.7911****	*73.3881****

**** 1% Level of significance.*

*** 5% Level of significance.*

** 10% Level of significance.*

Pedroni cointegration Results are given in Table 3. The result shows that in all four columns, first panel statistics positive (i.e., v=0.27, 0.75, 0.93 & 0.87) and rest

of three panel statistics also have negative values (i.e., rho= -0.033, -0.194, -0.103, & 0.101; pp= -1.008, -1.359, -0.743, & -0.515; ADF= 0.090, -0.238, 0.169, & 0.179). Based on Pedroni test we can conclude that series are cointegrated and have a long-run relationship.

TABLE 3

Pedroni residual cointegration test.

Pedroni (Engle-Granger based)	*Log(EC), Log(GDPPC), Log(RPRICES), Log(FDI), Log(M2)*	*Log(EC), Log(GDPPCLog(RPRICES),Log(FDI), Log(LL)*	*Log(EC), Log(GDPPC), Log(RPRICES), Log(FDI), Log(DBC)*	*Log(EC), Log(GDPPC),Log(RPRICES),Log(FDI), Log(DPC)*
nel v-statistic	*0.272314*	*0.747704*	*0.926724*	*0.856174*
anel rho-statistic	*-0.032869*	*-0.193791*	*-0.102552*	*0.101071*
anel PP-statistic	*-1.008033*	*-1.359568*	*-0.743046*	*-0.515171*
anel ADF-statistic	*0.090498*	*-0.238020*	*0.169140*	*0.179267*

Table 4

Pooled least square regression test dependent variable: ln(EC)t.

Variables	*Pooled OLS (1)*	*Pooled OLS (2)*	*Pooled OLS (3)*	*Pooled OLS (4)*
Constant	*5.880862****	*5.876378****	*5.844252****	*5.708391****
log (GDPPC)t	*0.148853****	*0.143628****	*0.133411****	*0.133307****
log (FDI)t	*0.271983****	*0.272438****	*0.263469***	*0.258574****
log (RPRICES)t	*-0.028723****	*-0.033968****	*-0.026901****	*-0.022229***
log (M2)t	*-0.125784****	_	_	_
log (LL)t	_	*-0.116303****	_	_
log (DBC)t	_	_	*-0.088050****	_
log (DPC)t	_	_	_	*-0.064566***

R-square	*0.708843*	*0.699881*	*0.701336*	*0.668878*
Adjusted R-square	*0.698158*	*0.688868*	*0.690376*	*0.656727*
F-statistics	*66.34203****	*63.54745****	*63.98964****	*55.04601****

**** Significance at 1% level.*

*** Significance at 5% level.*

** Significance at 10% level.*

Then we used Pooled estimation of least square. The results of pooled least square are presented in Table 4. The results of Table 4, column1 show that GDP per capita and foreign direct investment have a positive and significant impact on energy consumption in selected countries, however, the intensity of their magnitude is different, as if there is one percent increase in GDP per capita and foreign direct investment, energy consumption increases by 0.148 percent and 0.271 percent respectively. In Table 4, column 2, same results have been appeared on energy consumption, as this time another financial determinant i.e., liquid liability (LL) has a significant negative impact on energy consumption. In Table 4, column 3, shows that both FDI and GDP per capita has a significant impact on energy consumption, similarly, DBC (another proxy for financial development) has a negative impact on energy consumption. The result suggests that an escalation in energy consumption lead to more economic and investment activities. This increases the demand for financial services that further hints to financial development. In Table 4, column 4, shows that there is a positive and significant impact of FDI & GDP per capita in these countries, however, this time also DPC (proxy for financial development) exerts negative impact on energy consumption. The analysis shows that energy prices increase with FDI in the host countries where as FDI increases with better growth chances. In terms of the usual diagnostic statistics, the value of adjusted R-square for pooled OLS lies in between minimum 65.6 percent to maximum 69.8 percent variation of independent variables explained to the dependent variable. F-value is higher than its critical value in all four columns, suggesting an overall good significance of the estimated model. Therefore, fitness of the model is acceptable empirically.

CONCLUSION

The objective of the study is to analyze the impact of GDP per capita, relative prices, FDI and different proxies of financial development (FD) i.e., M2, LL, DBC and DPC (each FD proxy separately regressed on dependent variable) on energy consumption (EC) in selected countries over a period of 1977–2014. This study uses different panel data techniques i.e., panel cointegration and pooled OLS to examine the energy – growth nexus including FDI, relative prices and financial development indicators in Egypt, Sudan and Nigeria. The results of Pedroni cointegration test indicate that variables are cointegrated and have a long-run relationship. Pooled OLS results on average indicate that only GDP per capita and FDI have significant and positive impact on energy consumption in Egypt, Sudan and Nigeria. The results confirm the prevalence of energy led growth, energy led FDI, and energy led FD hypothesis in the region. This implies that financial depth

and growth catalyst each other. The growth of the real sector significantly impacts development of the financial sector. Our results confirm impact of FDI on energy demand in Egypt, Sudan and Nigeria indicating inflow of advanced technologies as con- sequences of FDI and there by escalation of economic growth and energy consumption..

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