

Impact of Infrastructures and Exchange on FDI Inflows in Nigeria: An ARDL Analysis

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Abstract

This study investigated the impact of infrastructures availability proxied by electricity power consumption and exchange rate on the inflows of Foreign Direct Investment (FDI) to Nigeria. The study used annual data from 1984 to 2018. Unit root test and ARDL (bound test) and granger causality test are the econometric tools used in investigating the relationship between the variables. The unit root test indicates that FDI inflows and infrastructure, were stationary at level value 1(0) while exchange rate was stationary after first difference 1(1). Furthermore, the bound test (ARDL) results revealed that infrastructure and exchange rate have positive and statistically significant influence on the flow of FDI. The long run elasticity coefficient reveals that the 1% change in infrastructure and exchange rate will change FDI inflows by 2.42% and 0.34%. While 1% increase or decrease in the independent variables will lead to a corresponding increase or decrease of 1.24% and 0.07% in FDI inflows in the short run. The results of ECM indicate that there is both short and long run equilibrium in the system. The coefficient of one period lag of ECM is less than one, negative (-0.75) and statistically significant at 1% level. This implies that the system correct itself from the disequilibrium at the speed of 75% annually. Granger causality result show that there is an evidence of bidirectional causality between FDI inflow and infrastructure availability. Similarly, there is unidirectional causality running from exchange rate to FDI flow in Nigeria. The study therefore recommends the need for the government and the private sector to improve on power, transmission and distribution. This will reduce the cost of doing business in the economy and in turn attract more investors to the economy. Similarly, policymaker should re-design the existing exchange rate policy so as to create investors' confidence in the country's currency.

Keywords: Infrastructure • Exchange rate • FDI inflow • ARDL • Nigeria

Introduction

The contribution of Foreign Direct Investment (FDI) towards the economic growth of nations is well documented in literature. Nigeria and indeed developing economies stand to gain three basic things from the flow of FDI to their economies. These are; the flow of FDI helps in bridging the gap between low levels of savings for domestic investment. FDI flows are mostly directed to important sectors of the economy such as oil and gas the telecommunication and the manufacturing sectors. These sectors serve as stimulants to the growth and development of the economy. Lastly, when sufficient quantum of FDI is attracted to an economy, it facilitates the transfer of skills and modern technology that will enhance modern way of production. This will no doubt reduce the cost associated with production as well as increase the quality and quantity of goods produced in the economy [1].

However, the location of foreign investment into an economy is only viable if certain factors are present. These factors include availability of infrastructures and macroeconomic stability in the form of relatively stable exchange rate. Availability of infrastructures such as electricity, telecommunication, good road network, internet access and rail network in an economy reduces the cost of doing business there by increasing the amount of net return on investments. This motivates more investors to site their investments in that economy as the primary goal of any investment is increase in the net return on capital invested. Similarly, availability of critical infrastructures signals to the investors the government commitments regarding foreign investments in that economy.

Due to the collapse of Bretton woods system in the year 1973, there has been instability in exchange rate among nation including Nigeria. This has made investors skeptical as to

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where to site their investments. When an investor is in uncertain about the stability of a country's currency it makes him to choose an alternative destination where he can predict with certainty the stability of the country's currency as well the future prospects of his investments [2]. According to Froot and Stein, an increase in exchange rate in the host economy can lead to an increase in the value of an investment making the foreign investor relatively richer. This in turn creates investors' confidence resulting in the increase in the flow of FDI to that economy.

Studies of this nature were conducted by Abdul Rahamn, Ilyas, Alam and Akram in Pakistan, Prince and Victor in Ghana and Ngwen in Cameroun. However, to the best of our knowledge none of this study was carried out on the impact of infrastructure and exchange rate on FDI in Nigeria. Hence, this study intends to fill that gap.

The objective of this paper is to analyze the nexus between infrastructure, exchange rate and the inflows of FDI during the period 1981 to 2014. This will contribute to the present literature by empirically examining the interaction that subsists between the variables under review. The paper is divided into five sections. The first section been the introduction, the second section is devoted to the review of the literature. The third section spells out the methodology, data and variable and the model specification. The fourth section presents the empirical results of the data analyzed. Lastly, the fifth section is the conclusion section which proposes the economic and policy measures necessary to enhance the flow of FDI.

Materials and Methods

Due to the perceived importance of FDI to the host economies, several scholars MacDougall, Kemp, Vernon, Hymer, Hood and Young, Dunning and Richard have put forward different theories that attempt to explain why multinational corporations undertake foreign investments instead of producing in their home countries and then later export. These theories represent a significant step towards understanding the development of a systematic framework for the emergence of FDI. However, due to the complexities in various host economies, nature of FDI and the motives for undertaking foreign investment as well as the methodologies used in assessing FDI, the capacity of each theory to serve as a self-contained general theory, which could explain all types of FDI undertakings has been questioned in the works of various scholars such as Agarwal, van Parys and James and Itagaki [3]. Some of these theories are;

Location theory states that multinational corporations would choose to invest in a location, which is close to markets or raw materials so as to consolidate the investment position of the firm. Once an investment location attracts more and more FDI it becomes an agglomeration location. Concentration of production and urbanization facilitate quick spillovers of knowledge and the use of joint networks of suppliers and distributors.

According to Dunning, van Parys and James and Kuslvan of FDI and the factors that motivate the emergence of multinational

corporation at the international scene are of the view that location theory when extended across national boundaries can go along way at explaining why multinational corporation go internationally to invest rather than produce at home to be exported abroad. Location determinant can be conveniently grouped into two. Namely the "supply oriented location theory" which explains why that production takes place where the factor costs for production (including distribution) are the lowest. And the "demand oriented location theory" asserts that the location of a firm is governed by the location of its market and competitors. Converging the two theories together, four main locational factors can be deduced. This includes; availability of raw materials for their companies, low labor cost, secured market for their products and availability of infrastructures are believed to give rise to the emergence of MNEs. However, the short comings of the location theory are that although the theory provided some useful insights as to geographical distributions of MNEs, it fell short in explaining how comes that foreign owned firms could outcompete with domestic firms in supplying their own market? Neither did the theory explain the actual origin of MNEs.

Currency theory is another theory which tried to explain FDI with regards to difference in currency strength differences from the perspective of international trade. The assumption of a perfect economy and perfect competition requires the assumption that prices everywhere are adjusted to bring supply and demand into equilibrium. However, in a real situation, due to segmentation in world markets rates of return are not equalized internationally. In a state of disequilibrium flows of FDI would take place between low rate of return to higher rate of return economies until markets return to stability. Instances of disequilibrium conditions that provide incentives to invest abroad are those which apply to factor markets and foreign exchange markets Piggot and Cook.

Ragazzi, stated that currency over valuation is perhaps the most salient example of the disequilibrium hypothesis. A currency may be defined as overvalued when at the prevailing rate of exchange production costs for tradable goods in the country are on the average or higher than in other countries. Such an occurrence creates opportunities for profit-making by holding assets in undervalued currencies with the expectation that, once the equilibrium in the foreign exchange market is re-established, capital gains will be realized. In meantime, there is an incentive to locate production of internationally traded commodities in countries with undervalued currencies and to purchase income producing assets with overvalued money. The important point is that, once exchange rates return to equilibrium, the flow of FDI should stop. Even more foreign investors should sell their foreign assets, pocket the capital gains and return to domestic operations.

In the view of Aliber the theory explains why multinational companies engages in foreign investment can best be explained in terms of the relative strength of different currencies. Companies from countries having a strong-currency move out to establish themselves in host economies that have weak currencies relative to their country of origin.

In a weak-currency country, the income stream is fraught with greater exchange risk. As a result, the income of a strong-currency country firm is capitalized at a higher rate. In other words, such a firm is able to acquire a large segment of income generation in the weak-currency country corporate sector.

According to Froot and Stein, the depreciation in the real value of currency of a host country lowers the wealth of domestic residents of that economy which in turn increases the wealth of the foreign investor. As a result, it is cheaper for foreign firms to acquire assets of domestic firms.

In the view of Richard, foreign investments are influenced by exchange rates differences through a number of channels. He observed that, changes in exchange rate have significant influence on the cost and revenue stream of a firm. If the domestic currency depreciates, the import bill will inflate, diminishing in turn the net income. But, if export expands during the period of currency depreciation, income will rise. Similarly, exchange rate changes influence FDI by giving rise to capital gains. Depreciation in the value of currency, which is expected to be reversed in the near future, will lead to capital gains following appreciation. In lure of capital gains, foreign capital will flow in.

Empirical studies

Infrastructure availability in an economy has a special role to play in attracting FDI and promoting economic development through reduction of cost of doing business in an economy. According to Ogunleye, the extent of growth and development of every society largely depends on the efficient use of available natural resources in that economy to develop the basic infrastructure necessarily to support other factors of production.

Frischman view infrastructure to include such things as telecommunication, energy, transportation, governance and other public utilities. Fahmi opined that the best proxy to represent the availability of infrastructure in an economy is the use of Gross Fixed Capital Formation (GFCF). In his view infrastructure such as roads network, telephones, internet availability, pipe borne water and ports, only reflect the existing infrastructure and not the potential infrastructure as it is included in GFCF. Abdul Rehman, Ilyas, Alam and Akram carried out studies on the impact of infrastructure development on the flow of FDI, in Pakistan during the period 1975 to 2008. The results of their studies show that infrastructure has a positive impact on attracting FDI.

The studies of Asiedu, Morisset and Pirnia and Wheeler and Mody also support the fact that FDI has a significant impact on the flow of FDI. The results of their studies show that foreign investors seek to establish themselves in such place with better market opportunities and where they can achieve cost reduction and maximization of benefits which can only be made possible where infrastructures are in good and better condition and supportive to investors.

Iwanow and Kirkpatrick, says that availability of quality infrastructure has a significant impact on the flow of FDI and

improvement in export performance of the host economy. Their study reveals that an improvement in the availability and quality of infrastructure by 10% will result in an 8% improvement in export performance of the host economy [3].

Studies of Elijah and Festus, Manop, Holger and Oliver and Lee and Hsieh, have been conducted to determine whether exchange rates are significant determinants of FDI inflows to host countries. Most of these studies have established that there exists a significant positive relationship between the depreciation in the value of the local currency and the flow of FDI to the host economy. Scholars on the subject matter have put forward several suggestions as to why exchange rate have a positive relationship with currency depreciation with some suggesting that the effect of the exchange rates on FDI is due to supply-side or push factor effect on FDI. That is to say, a stronger home currency increases outward FDI and Klein and Rosengren. Others were of the opinion that the interaction of exchange rate with FDI is due to the allocation effect i.e., FDI goes to countries where the currency is weaker as a given amount of foreign currency can buy more investment.

According to Lee and Hsieh the depreciation of the host country currency is likely to attract FDI inflows due to the following reasons: Firstly, the foreign investor usually multinational corporations has an advantage over domestic investors because the foreign investor has an edge in obtaining financing from the international financial market in hard currencies when compared to his domestic counterpart. This will make them to the opportunity of undertaking profitable projects requiring huge capital outlay which the domestic investor is incapable of undertaking due to financial constraints. As a result of this, countries with weak currencies tend to be a suitable destination for FDI while countries with strong currencies tend to be sources of FDI. Secondly, when a country's currency depreciates in value, it tends to make the production cost of good lower when compared with the investor's home country, thereby making it attractive for FDI seeking production efficiency and revenues.

Ebiringa and Emeh, investigated the determinants of FDI in Nigeria. Using time series data, econometrics techniques incorporating stationarity test, cointegration, error correction mechanism and variance decomposition analysis, the study revealed that exchange rate is a statically significant determinant of FDI flow and that it exerts a long run negative effect on FDI flows in Nigeria. Tokunbo and Lloyd, empirically investigated the impact of exchange rate volatility in Nigeria on the flow of FDI. They used co-integration and error correction techniques in the analysis of their data. The results of the study confirmed a significant positive relationship between the host economy's currency depreciation [4].

Froot and Stein, explained that a depreciation of domestic currency decreases the domestic asset price in terms of other foreign currency and attracts foreign investors to invest their capital. At the same time, foreign assets become more expensive for domestic investors and impede them from investing abroad. This condition explains increasing in US' FDI inflow during the depreciation of US Dollar around 1985.

In order to understand the nexus among the variables, this study applied Autoregressive Distributed Lag (ARDL) model for estimation. Moreover, prior to model estimation, the properties of the variables under study were tested in order to know the stationarity levels. The econometrics techniques used was the Augmented Dickey-Fuller (ADF) test. The model used in this study was adopted from the work of Hodge with little modification in order to estimate the relationship among the series. The variables incorporated in the model are Foreign Direct Investment (FDI), infrastructure which is proxied by Electricity Power Consumption (EPC) and Exchange Rate (EXR).

Description of data and variables

The study made used of secondary time series data sourced from the Central Bank of Nigeria (CBN) statistical bulletin and World Development Indicators (WDI), a publication of world bank 1984 to 2018. FDI is the dependent variable in millions of US dollars while infrastructures and exchange rate are the independent variables.

The dependent variable in this study is the aggregate flow of FDI from 1984 to 2018. In other words, it is the summed aggregate inflow of foreign direct investment into the Nigerian economy during the period under review. The proxy has been used by scholars such as Babatunde and Adepoju and Olalaye [5].

Availability of sound physical infrastructures such as stable electricity supply, good road network, internet access, air and seaport can create a more favorable investment climate that will enhance the inflows of FDI. Infrastructures reduce the transaction cost of doing business in an economy there by increasing the return on capital invested. Infrastructure in this study is proxied by Electricity Consumption (EC). This proxy has been used by Wheeler and Mody and Asiedu.

Exchange rate measures the price of one currency in terms of another currency. In this study, the exchange rate of Nigeria (Naira) to USA (Dollar) is adopted. A weak exchange rate makes import expensive and export cheap and hence may likely impact positively on FDI inflow. All the data for the variables were converted into natural logarithm form to make them into the same base for easy analysis and interpretation. Therefore, the econometric model is given as follows:

$$\ln(FDI_t) = \beta_0 + \beta_1 \ln(EPC_t) + \beta_2 \ln(EXR_t) + \varepsilon_t$$

Unit root test

Despite the fact that ARDL approach does not necessitate pre-testing of series variables, however the series cannot go outside integrate order of I (1) for the results of the study to be valid. Therefore unit roots testing will be necessary in order to ensure that none of the variables is integrated to the order of two I(2) test, since the data generating process of the variables is not known. If the time series data is found to be non-stationary, it will be difficult to represent the time series in an equation with fixed coefficients [6].

Therefore, if variables are non-stationary at level value as expected for most macroeconomic variables, the data will then be differenced. In testing for unit root, the study made use of Augmented Dickey-Fuller (ADF). The model is given as:

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \sum_{j=1}^p \alpha_j \Delta y_{t-j} + \mu_t$$

Where Δy_t is the change in y at period t , α_0 represents constant, y_{t-1} is the lag value of y , α_1 is the estimated lag coefficients and μ_t is the error terms.

Model specification

This study makes used of ARDL approach developed by Pesaran et al. To estimate the nexus among the variables. The rationales behind the choice of this approach are: First ARDL can be applied irrespective of whether the variables are stationary at level value I(0) or at first difference I(1) or combination of both. Second, it can generate robust and reliable results even if the number of observations is small or large [7]. Finally, ARDL is valuable because it permits us to describe the presence of an equilibrium relationship in terms of long-run and short-run dynamics without missing long-run information. Aligned with Pesaran, Shin and Smith the ARDL model is given as:

$$\Delta LFDI_t = \beta_0 + \sum_{i=1}^m \beta_1 \Delta LFDI_{t-i} + \sum_{i=1}^m \beta_2 \Delta LEPC_{t-i} + \sum_{i=1}^m \beta_3 \Delta LEXR_{t-i} + \alpha_1 LFDI_{t-1} + \alpha_2 LEPC_{t-1} + \alpha_3 LEXR_{t-1} + \mu_t$$

Note that β_0 , to β_3 and α_1 to α_3 are the parameters of the explanatory variables. Additionally, the error correction model of the ARDL approach is specified as:

$$\Delta LFDI_t = \beta_0 + \sum_{i=1}^m \beta_1 \Delta LFDI_{t-i} + \sum_{i=1}^m \beta_2 \Delta LEPC_{t-i} + \sum_{i=1}^m \beta_3 \Delta LEXR_{t-i} + \beta_4 ECM_{t-1} + \mu_t$$

The ARDL model is structured into two; the first part of the equation with β_0 to β_4 represents the short-run dynamics of the model, while the coefficients α_1 to α_4 represents the long-run relationship. The null hypothesis of the above model is defined as $H_0: \alpha_1 = \alpha_2 = \alpha_3 = 0$ which tell us that there is no co integration among the variables under measurement. Furthermore, the study began the analysis by conducting co integration test of the ARDL in order to find out the evidence of long-run relationship. The calculated F-statistics is compared with the critical value as tabulated by Pesaran et al. If F-statistics is greater than the upper critical value, then the decision rule will be to reject the null hypothesis of no long-run relationship, whereas if it falls below a lower critical value, then the null hypothesis cannot be rejected and if it falls within these two critical bounds, then the result is inconclusive [8].

Results and Discussion

From Table 1, the results of the unit root test show that LNFDI and LNEPC were stationary at level value while LNEXR became stationary after the first difference. From the forgoing, it is found that the variables were stationary at

different order of integrations with some at level value $I(0)$ and other at first difference $I(1)$. Therefore, the best method to handle the result of this nature is ARDL. We then go ahead to

conduct bound test of ARDL and the result is presented in Table 2.

Dependent variable: LNFDI		
Variables	Level 1 (0)	1 st Difference I (1)
LNFDI	-3.9661**	-10.7104***
LNEPC	-3.3896*	-7.7574***
LNEXR	-1.2176	-5.3622***

Note: ***, ** and * indicates significance at 1%, 5% and 10% respectively

Table 1. Unit root test using ADF.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-69.28351	NA	0.018392	4.517719	4.655132	4.563268
1	6.587357	132.7740*	0.000283*	0.338290*	0.887941*	0.520484*
2	11.61421	7.854463	0.000369	0.586612	1.548501	0.905451

Note: *Indicates lag order selected by the criterion

Table 2. LAG selection criteria.

Optimal lag-length selection test was carried out to know the optimal lag to be included in the model. This because lag included in the model can have an impact on the long run relationship of the variables in the system equation [9]. Hence using Akaike Information Criterion (AIC) and Schwarz Bayesian Information Criterion (SBC) to select optimal lag length,

the results reported that the best lag to be included in the model is lag one. The results from Table 3 indicate that there is an evidence of long run relationship among the variables in the model. This is because the F statistics value (4.78) is greater than the lower and upper critical bounds at all significant levels.

Test statistics	Value
F- Statistics	4.78

Critical value bounds		
Significance	Lower bound I(0)	Upper bound I(1)
10%	2.63	3.35
5%	3.1	3.87
1%	4.13	5

Table 3. Bound test for ARDL.

Table 4 shows the results of long run relationship among the variables in the system equation. According to the results, infrastructure has positive and statistically significant influence on FDI inflows in Nigeria. This implies that 1% change in infrastructure will lead to 2.42% change in FDI inflows. Additionally, exchange rate has positive and

statistically significant effect on the inflows of FDI to Nigeria [10]. A unit increase or decrease in exchange rate will lead to 0.34 increase or decrease in FDI inflows in Nigeria. The result also reveals that irrespective of infrastructure and exchange rate, FDI inflows to Nigeria will remain at 9.0061 and is statistically significant at 1%.

Dependent variable: LNFDI				
Independent variables	Coefficient	Std. error	t-Statistics	Prob
LNEPC	2.4193	0.5975	4.0489	0.0004
LNEXR	0.3397	0.0815	4.1692	0.0003

C	9.0061	2.5779	3.4936	0.0017
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Note: $R^2=0.90$, Adj. $R^2=0.89$, F-statistics= 62.3088 (0.000), DW-Stat.=2.0137

Table 4. Long run coefficient of ARDL.

The estimated short run results show that there is positive and statistically significant relationship between infrastructure and the inflows of FDI to Nigeria. In the same vein exchange rate is reported to have positive but statistically insignificant effect on the

inflows of FDI during the period under review. The ECM results has the correct sign *i.e.*, negative, less than one (-0.7456) and statistically significant at 1%. This means that in the event of any disequilibrium, the system will correct itself annually at the speed of 75% (Table 5).

Dependent variable: D (LNFDI)				
Independent variables	Coefficient	Std. error	t-Stat.	Prob.
D (LNEPC (-1))	1.2409	0.5303	2.3399	0.0269
D (LNEXR(-1))	0.0731	0.1812	0.4036	0.6897
ECM (-1)	-0.7456	0.1687	-4.4194	0.0001

Table 5. Short run coefficient of the ARDL model.

The results of the Table 6 show that the model is free from serial correlation. This is as indicated by the insignificant p values of 0.8548. The test for heteroscedasticity reveals that there is no evidence of variation in mean and variance of the model.

This is as shown by the p-value of 0.5559. The results of the normality test indicate that the data are normally distributed as shown by the p-value of 0.8211 [11].

Tests	F-Statistics	p-value
Auto-correlation	0.1578	0.8548
Heteroscedasticity	0.7672	0.5559
Normality	0.3941	0.8211

Table 6. Diagnostic test results.

The results of the Table 6 show that the model is free from serial correlation. This is as indicated by the insignificant p values of 0.8548. The test for heteroscedasticity reveals that there is no evidence of variation in mean and variance of the model. This is as shown by the p-value of 0.5559. The results of the normality test indicate that the data are normally distributed as shown by the p-value of 0.8211 [11].

Moreover, the study conducted stability test in order to determine the adequacy of the model and parameters. In the process, the study makes the use of Cumulative Sum of Recursive Residual (CUSUM) and Cumulative Sum of Square of Recursive Residual (CUSUMQ). The result presented in Figures 1 and 2, shows that the model and parameter under estimation are stable. This is due to the fact that the recursive errors lines fall within the two critical lines of the CUSUM and CUSUMQ (Figures 1 and 2).

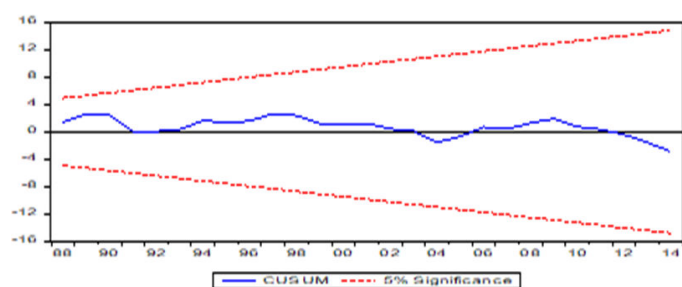


Figure 1. Stability test for Cumulative Sum of Recursive Residual (CUSUM).

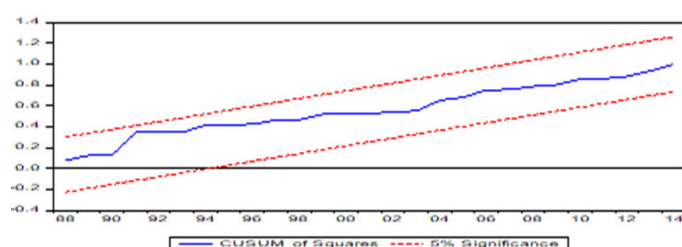


Figure 2. Stability test for Cumulative Sum of Square of Recursive Residual (CUSUMQ).

Granger causality test

As indicated in Table 7 the granger causality shows that there is an evidence of bidirectional causality between infrastructure and FDI in flows during the period under review. This

is as a result of the significant p values of F-statistics (0.0741 and 0.0791). Similarly, it is evident that there is unidirectional causality running from exchange rate to FDI inflows as shown by the significant p value of 0.0020 [12].

Null hypothesis	Obs	F-Statistic	Prob.
LFDI does not granger cause LEPC	34	3.42351	0.0741
LEPC does not granger cause LFDI		3.30409	0.0791
LEXR does not granger cause LFDI	34	11.3288	0.002
LFDI does not granger cause LEXR		2.31482	0.1383

Table 7. Granger causality test results.

Conclusion

From the analysis of the results, we have established that that infrastructure and exchange rate have positive and statistically significant influence on the flow of FDI to Nigeria during the period under review. This implies that availability of stable electricity supply in the country can raise the level of productivity of companies, reduce the cost of production since they do not have to fuel their alternate source of power to make production. This will translate to increase in the return on investments there by motivating the increase in the flow of investment, particularly foreign direct investment.

In conclusion, this study recommends that in order to enhance the increase in the flow of FDI so as to benefit from the positives externalities attached the government should do the following: The government should ensure the provision of stable electricity. This can be done through increased in private sector participation as well as looking at the possibility of having an alternate source of power such as nuclear and solar source. This will pave ways for the country to join the league of twenty most industrious nations by the year 2020. Similarly, most investors will be unwilling to invest in an economy where the cost of production due to instability of power is high. The government should consider the possibility of replacing the ageing thermal power stations as well as the hydro plant currently producing below the installed capacity generation to feed the 40% of the population that are connected to the national grid. Transmission companies currently owned by the Nigerian government should be fully privatized. This will ensure enhance electricity supply and as means of attracting investors into the economy.

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