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Infrastructure and Foreign Direct Investment Inflows: Evidence from Ghana

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Introduction

In the literature, there has been the tendency for studies to focus on the relationship between economic infrastructure and foreign direct investment (FDI) inflows alone without taking into account the effects of social infrastructure on FDI. The main objective of the study therefore was to examine the relationship between economic infrastructure and FDI on one hand, and social infrastructure and FDI on the other. The study employed Two Stage Least Squares (2SLS) estimation technique and quarterly time series data from 1975 to 2012 to examine the effects of both economic and social infrastructure on net FDI inflows. The Two Stage Least Squares (2SLS) results find a positive and statistically significant effects of both economic and social infrastructure on net FDI inflows. While market size, trade openness and agglomeration exerted a positive and statistically significant effect on FDI inflows, inflation and external debt stocks on the other hand, revealed a negative effect on FDI inflows. In order to attract more FDI inflows, the study recommends that both the Ministry of Energy/Power and the Ministry of Education should increase investment in electricity generation and educational facilities respectively so as to enhance economic and social infrastructure.

Keywords*: Economic Infrastructure, Social Infrastructure, Foreign Direct Investments, Market Size, Trade Openness, External Debts, Ghana*

INTRODUCTION

The connection between infrastructure and foreign direct investments (FDI) inflows is well known in the development literature (Anyawu, 2012; Aseidu, 2002; Cheng & Kwan, 2000; Coughlin, Terza & Arromdee, 1991; Globerman & Shapiro, 2003; Kang & Lee , 2007; Khadaroo & Seetanah, 2007; LICHAO, 2011; Wheeler & Mody, 1992). FDI inflows bridges the gap between the desired and the actual level of capital stock, especially when domestic savings and investment are not sufficient to push the actual capital stock up to the desired level. The role of FDI as a source of private external finance to developing countries has become increasingly important. **It helps among other things to transfer knowledge and technology and to invest in infrastructure development in host countries.** Empirical evidence on developing countries tends to suggest that the availability and quality of both economic and social infrastructure may attract FDI inflows into these countries. As indicated by Jordaan (2008) and Wheeler and Mody (1992), countries with good and well-developed infrastructure tend to increase the productivity of investments and therefore stimulates FDI flows towards the country. Both economic and social infrastructure contribute to firms cost structures and hence should be included in a model that explains the multinationals as well as the host government's decision for investment. Infrastructure should thus improve the business investment environment for FDI by subsidising the cost associated with total investment by foreign investors and thus raising the rate of return from the investment. Availability of infrastructure, such as electricity and human capital resources directly influence the productivity and thereby attract higher levels of FDI. Although over

the years, Africa has succeeded in attracting some percentage of total world FDI flows, the continent's share still lags behind that of other developing economies (see Figure 1 in Appendix A).

Similarly, FDI trends over the past years for Ghana have not been sustained and perhaps one plausible reason for such a decline in FDI inflows has been due to inadequate and poor economic and social infrastructure development. Ghana has not been able to realise the benefits that a more stable inflows of investments could bring (UNCTAD, 2006). Also, the latest Global investment trends monitored by the UNCTAD indicated that net FDI inflows to Ghana has declined by 11 percent in 2013. Meanwhile, FDI flows to Africa decreased by 5 percent in the first half of 2013, compared to the same period in 2012. FDI flows to Ghana can at best be described as erratic and at worst insignificant to stimulate and sustain economic growth. Also FDI inflows as a percentage of gross fixed capital formation (GFCF) to Ghana stood at 56.6 percent in 2009, declining to 36.0 percent in year 2010. It decreased further to 31.7 percent in 2011 and then to 30.9 percent in 2012 (UNCTAD, 2013).

In terms of infrastructure development, although the country is endowed with natural resources and has gone far in terms of economic and political stability she is considered as infrastructure deficient in almost all sectors of the economy. The country currently ranks far behind the best performing countries in Africa in terms of the quality of infrastructure (African Development Bank report, 2012). In addition, according to the Ghana Statistical Service (2014), although the country recorded Gross domestic product (GDP) growth rate averaging 6.9 percent in 2014, this seemingly impressive growth has however not translated into the provision of needed economic and social infrastructure that will play the crucial role of attracting FDI inflows. Furthermore, a recent study carried out by the Ministry of Finance (2014) to address Ghana's infrastructure deficit shows the country requires sustained spending of at least US$1.5 billion per annum over the decade to plug economic and social infrastructure gap that exit in the country. For example, poor road networks, schools under trees, improper waste disposal, intermittent and unreliable power supply and water crisis emerge as some of the most limiting factors negatively weighing foreign investment. Thus, both economic and social infrastructure constraint in Ghana presents a major threat to foreign investment and international competitiveness given the close link between the availability of these infrastructure components and net FDI inflows.

A lot of empirical studies have put much emphasise on the role of infrastructure in attracting FDI to Sub-Saharan African (SSA), emerging and developed economies. Furthermore, most of these studies have shown the clear evidence supporting that highly developed infrastructure would play a crucial role in attracting FDI inflows (Cheng & Kwan; 2000, LICHAO; 2011, Wheeler & Mody; 1992, Asiedu; 2002, Khadaroo & Seetanah; 2007). Almost all these studies seem to focus much on the contribution of transport, road and communication infrastructure in attracting FDI. All these measurements focus on the economic aspect of infrastructure but very little is known about the contribution of social infrastructure in driving FDI inflows. Furthermore, given the fact that recently net FDI inflows to Ghana is declining coupled with huge economic and social infrastructure deficit that existed in the country therefore calls for the need to conduct a research by not only looking at the role of economic infrastructure in attracting FDI but also incorporate the social component of infrastructure into the model and examine their impact on FDI in Ghana. The rest of the paper is organised as follows: section 2 deals with the methodology including the theoretical and empirical model specifications. Section 3 presents the results and discussions. Conclusions and recommendations are given in section 4.

METHODOLOGY

1.1 Theoretical model specification

The choice of location for investment depends on the stream of returns in the long-run which is

largely determined by location specific potential to convert the investment into returns. This means that, in order to derive the theoretical model on the determinants of FDI inflows, it is important to define an appropriate functional form of conversion of investment into returns. Following Griffiths and Webster (2004), let us define the expected return from investment (R_t) as,

$$R_t = \varphi_t\,[\tau_t\, ln\,(FDI_t) + \gamma] \quad (1)$$

Here, FDI_t is the amount of FDI inflows into Ghana, φ_t is the return per unit of realised output from FDI in Ghana and τ_t represents the Ghana's potential to convert FDI into output, t represent years, given γ as the threshold output which is constant across all the regions in Ghana. Therefore, the present value of expected return from investment PVR_t will be;

$$PVR_t = \frac{\varphi_t\,[\tau_t\ ln\,(FDI_t)+\gamma]}{(X_t+r)} \quad (2)$$

Here, X_t stands for the risks of investing in Ghana and r for the rate of discount constant for all the states. Similarly, the present value of the recurring expenses of investment will be:

$$C_t = \frac{\mu FDI_t}{(X_t+r)} \quad (3)$$

Here, μ stands for the proportional factor and it is assumed to be constant across all regions in Ghana. If the investors decide to make investment to the maximum amount of FDI_0 in Ghana, then the actual investment will be FDI_t will be either less than or equal to FDI_0, i.e.

$$FDI_0 \geq FDI_t \; or \; FDI_0 - FDI_t \geq 0$$

Therefore, the objective of the investors is to decide FDI_t so that the net expected return (NER) at time t becomes:

$$NER_t = \frac{\varphi_t\,[\tau_t\ ln\,(FDI_t) + \gamma]}{(X_t + r)} - \frac{\mu FDI_t}{(X_t + r)}$$

The objective of the investor is to maximise NER_t subject to $FDI_0 - FDI_t \geq 0$, Hence, the problem of the potential investor can be written in Lagrange expression as follows:

$$L = \frac{\varphi_t\,[\tau_t\ ln\,(FDI_t)+\gamma]}{(X_t+r)} - \frac{\mu FDI_t}{(X_t+r)} + \lambda(\,FDI_0 - FDI_t) \quad (4)$$

By applying Kuhn-Tucker conditions the constrained optimisation becomes,

$$FDI_t = \frac{\varphi_t \tau_t}{[\mu + \lambda(x_t+r)]} \quad (5)$$

Assuming that the rate of discount 'r' is uniform across all regions, (5) can be expressed as the following functional relationship,

$$FDI_t = f(\tau_t, \varphi_t, x_t) \quad (6)$$

$$\frac{\partial FDI_t}{\partial \tau_t} > 0, \frac{\partial FDI_t}{\partial \varphi_t} > 0, \; and \; \frac{\partial FDI_t}{\partial x_t} < 0$$

This means that the optimum investment in Ghana varies directly with the country's potential to convert FDI into output, return per unit of realised output, but inversely with the risks of investment in Ghana. Ghana's ability to convert FDI into returns is likely to depend on availability of economic and social infrastructure, the scope for investment therein and the technology frontier. Economic and social infrastructure in this paper are captured in the τ_t since well-developed infrastructure in Ghana will not only serve as catalyst for attracting FDI but will also ensure increases in output of the investor. Again, a well-developed market size and trade openness are expected to impact positively on FDI therefore these variables are also captured in τ_t.

1.2 Empirical model specification

Therefore, from equation (6) τ_t becomes;

$$\tau_t = \emptyset(\,Econinfra_t, Socinfra_t, Size_t, Opn_t)$$

$$= \emptyset\,(Econinfra_t^{\beta_1}\, Socinfra_t^{\beta_2}\, Size_t^{\beta_3}\; OPN_t^{\beta_4}\,) \quad (7)$$

To further augment the model, we assume that inflation (Inf_t) and external debt stocks (Ex_debt_t) are considered as risk to the investing environment and hence were captured in x_t. Therefore, by adding Inf_t and Ex_debt_t to those

variables contained in τ_t and also by adapting equation (6), a new expression is obtained for FDI in equation (8)

$$FDI_t = f(Econinfra_t^{\beta_1}\ Socinfra_t^{\beta_2}\ Size_t^{\beta_3}\ \ Opn_t^{\beta_4}\ Inf_t^{\beta_5}\ Ex\_debt_t^{\beta_6}) \quad (8)$$

By taking logs of FDI, $Econinfra$, $Socinfra$, $Size$ and Ex_debt and including both first and second lags of FDI inflows equation (9) is obtained. Again, if we further assume that there exists linearity in the relationships, the above functional relationship can be rewritten as;

$$ln\ FDI_t = \beta_0 + \beta_1 lnEcoinfra_t + \beta_2 lnSocinfra_t + \beta_3 lnSize_t + \beta_4 Opn_t + \beta_5 Inf_t + \beta_6 lnEx\_debt_t + \beta_7 lnFDI_{t-1} + \beta_8 lnFDI_{t-2} + \varepsilon_t \quad (9)$$

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1.5 DATA DESCRIPTION AND ESTIMATION

Type and sources of data

The study used quarterly data for all the variables from the period 1975 to 2012. All variables are expressed as natural logarithms, except inflation, trade openness and fertility rate per woman which are already in a preferred measure. Data was obtained from World Bank, International Financial Statistics and British Petroleum Statistical Review. Inflation and world natural gas production were obtained from international financial services and BP-Statistical Review respectively.

1.6 Definition, measurement and justification of variables

1.7

1.8 Economic infrastructure *(Ecoinfra)*

Economic infrastructure is defined as internal facilities of a country that promote economic or business activity such as electricity production, roads network, ports, communication and financial institutions. Economic infrastructure is one of the variable central to this study. The study used electricity production (kWh) to capture for economic infrastructure because electricity production (kWh) is vital to nearly all long-term capital development projects (Amaro & Miles, 2006; Wheeler & Mody, 1992). Also this measure of economic infrastructure used for the study is an aggregate of all-source electricity production (includes hydro, nuclear, coal, crude oil and fossil fuel) measured in kilowatt-hours. Access to sufficient and consistent electricity supply, intuitively, are of importance to foreign investors, particularly when considering plant and factory demands (Wheeler & Mody, 1992). The coefficient of economic infrastructure is expected to be positively related to FDI inflows.

1.9 Social infrastructure *(Socinfra)*

Social infrastructure are facilities in the community such as schools, libraries, health facilities, cultural and religious facilities, open spaces and recreation areas. It is also another variable that is central to this study. This study used the secondary school enrolment in terms of the number of pupil as a proxy for measuring social infrastructure(Feenstra & Hanson, 1997; Noorbakhsh, Paloni & Youssef, 2001). The reason for using secondary school enrolment is that a more educated labour force can learn and adopt to new technology faster, conduct research and is also generally considered to be more productive which tends to boost the locational specific advantages of a country in terms of attracting FDI. The empirical studies by Moos(2009), Noorbakhsh et al. (2001). and Aseidu (2002) found that the level of human capital is a significant determinant of the locational advantage of a host country and plays a crucial role in attracting FDI. That is, high levels of social infrastructure development all other things held constant, will lead to attraction of FDI inflows. Therefore the study expect a positive relationship between social infrastructure and FDI inflows.

Market size *(Size)*

The size of the host country's market, which also indicates the host country's economic conditions and the potential demand for output, play a significant role in FDI decision-makings. The importance of the market size in driving FDI inflows has also been confirmed in many previous empirical studies(Kravis & Lipsey, 1992; Lipsey, 2004; Loree & Guisinger, 1995;Schneider & Frey, 1985; Wei, 2003; Wheeler & Mody, 1992). To get a good proxy for market size, the study reviewed the empirical literature and use real GDP per capita. The study also expect a positive relationship market size and FDI inflows.

1.10

1.11 Inflation (Inf)

Inflation basically is defined as the continuous and persistence rise in the general price levels. High inflation represents greater instability in many countries (Buckley et al., 2007). That is, a volatile and unpredictable inflation rate in the host market creates uncertainty and discourages FDI activities. On the other hand, a stable inflation is a measure of stable macroeconomic environment which also promotes FDI by showing less investment risk. As a results, the effect of inflation on FDI can either positive or negative. While Udoh & Egwaikhide (2008) found a statistically significant positive relationship between inflation and FDI, Djokoto (2012) also found a negative relationship among inflation and FDI to the agricultural sector but a positive relationship among inflation and total FDI inflows. The study used consumer price index as a measure for inflation. The coefficient of inflation in this study is expected to be positive or negative.

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1.14 Trade openness (Opn)

Trade openness in this study followed the traditional definition that is, the ratio of the sum of exports and imports of goods and services measured to gross domestic product. Multinational companies prefer to locate in a country with more open investment environment (Chakrabarti, 2001). High level of trade openness also leads to more economic relations of the host countries with other foreign countries. Openness makes domestic countries have access to international markets and also prepares suitable conditions for multiple countries to invest in those countries. For instance, whiles Chakrabarti (2001) and Morisset (2000) found a positive relationship between trade openness and FDI flows, De and Ghosh (2005) found an inverse relationship between trade openness and FDI. Trade openness attracts export-oriented FDI, whiles trade restriction on the other hand attracts tariff-jumping FDI whose primary interest is to take advantage of the domestic market(Onyeiwu, 2003). Trade openness in this study is expected to be either positively or negatively related to FDI.

External debts (Ex_debt)

From economic point of view, external debt is defined as the portion of a country's debt that was borrowed from foreign lenders including commercial banks, governments or international financial institutions. These loans, including interest, must usually be paid in the currency in which the loan was made. A lot researchers have argued that too much dependence on external debt can negatively affect with FDI inflows (Banga, 2003; Udo & Obiora, 2006). Therefore, the coefficients of external debt is expected to carry negative sign. To capture for external debt the study used total external debts stock, concessional (DOD, Current US$).

***1.15* Agglomeration effects (fdi_1, fdi_2)**

Agglomeration economies may exist given that foreign investors may be attracted to countries with more existing foreign investment. In order to test for agglomeration effects, it is believed that the country which has FDI inflows is better in attracting new FDI inflow (Gichamo, 2012). For example, Head et al. (1995) find that industry level agglomeration benefits play a significant role in the location choice of Japanese manufacturing plants in the US. More recently, Chen and Kwang (2000) in the study of the determinants of FDI in Chinese regions also report the positive feedback effect of

FDI. If there is a positive feedback effect, once the initial flow of FDI sets in, it should perpetuate itself and attract further FDI. To capture for agglomeration effect, the study relate current FDI inflows to past FDI inflows. This is proxied by the first and second lagged values of FDI. The study expects the coefficient of both first and second lagged FDI variables to be positive.

1.16 Estimation technique

Empirical research have shown that both economic and social infrastructure act as prerequisite for the establishment of FDI projects (Asiedu 2002; Cheng & Kwan 2000; Khaderro & Setenaah, 2007). That is, a good and available infrastructure have positive effect on attracting FDI inflows. Other researchers (Kirkpatrick, Parker & Zhang, 2006; World Bank, 2006) have shown that FDI inflows can also have significant effect in developing country's infrastructure. Therefore one can conclude that there exist bi-causal relationship between infrastructure and FDI inflows. This leads to an endogeneity problem in the structural equation (9). Hence, if equation (9) is estimated by the traditional Ordinary Least Squares (OLS) approach, a biased and inconsistent estimates will be obtained due to the likely correlation between the stochastic explanatory variables $Ecoinfra_t$ and $Socinfra_t$ and the stochastic disturbance term ε_t.

Because OLS estimation of equation (9) cannot resolve the possible endogeneity problem, the study employs a more appropriate estimation technique the Two Stage Least Squares (2SLS), developed independently by Theil (1953) and Basmann (1957) which yields a consistent estimates than the OLS does. Therefore from the structural equation (9), both economic and social infrastructure are considered as an endogenous explanatory variables in the FDI regression and external instruments are therefore needed to correct for this endogeneity problem using two-stage estimation procedure.

1.17

1.18 The First stage of 2SLS

In the first stage of 2SLS, both economic and social infrastructure are regressed on a set of exogenous and predetermined variables including the external instrumental variables that affect infrastructure, but do not directly affect FDI. With regards to the choice of instruments, the study observed the conditions underlying the choice an instrument (i.e. instrument validity and relevance) from Wooldridge (2005) and came out with appropriate instruments for both economic and social infrastructure. Since the study proxied economic infrastructure by electricity production (kWh), therefore study followed the literature such as Jaramillo, Griffin and Matthews (2007) and use world natural gas production as an instrument for electricity production in the first stage equation. The use natural gas is seen as a good source of electricity supply for a number of economic, operational and environmental reasons: it is low-risk (technically and financially) and lower-carbon relative to other fossil fuels. Electric power generation remains the main driver behind global natural gas demand growth and the growth in natural gas is expected to occur in every region and is most concentrated in developing countries, where demand increases more than twice as fast as in developed countries. Furthermore, natural gas is expected to be the world's fastest growing fossil fuel, with consumption increasing at an average rate of 1.5 percent per year to 2040. In view of the above, using world natural gas production to measure electricity generation is justified (International Energy Agency, 2013).

Also with regards to social infrastructure, the study used secondary school enrolment (number of pupil) to measure social infrastructure since. Hence to get a good instruments for social infrastructure, the study reviewed the work by Ahiakpor, Nunoo and Alnaa (2014) and used fertility rate per woman to measure social infrastructure. Whiles increase in fertility is expected to have positive effect on enrolment, it can also have negative effect on schooling. That is, increase in the number of children in each household is expected to lead to an increase in household expenditure which makes it difficult for households to have excess to money to spend on children's education and therefore leading

to low school enrolment (Ahiakpor et al.,2014). Similarly, as indicated by Child Trends Databank (2015) sustained high fertility rates lead to disproportionately large populations of young dependents, driving demand for supports for young families and for an adequate number of schools. As a result, the use of fertility rate to measure schooling in this study is also justified in the literature. Based on the structural equation (9), the first stage equation (or the reduced form equation) for both economic and social infrastructure in the 2SLS are specified below:

$$lnEcoinfra_t = \alpha_0 + \alpha_1 lnSize_t + \alpha_2 Inf_t + \alpha_3 lnEx\_debt_t + \alpha_4 Opn_t + \alpha_5 lnfdi_{t-1} + \alpha_6 lnfdi_{t-2} + \alpha_7 lnWNGP_t + \alpha_8 fert_t + v_t \quad (10)$$

$$lnSocinfra_t = \eta_0 + \eta_1 lnSize_t + \eta_2 Inf_t + \eta_3 lnEx\_debt_t + \eta_4 Opn_t + \eta_5 lnfdi_{t-1} + \alpha_6 lnfdi_{t-2} + \eta_6 lnWNGP_t + \eta_9 fert_t + \upsilon_t \quad (11)$$

Where $WNGP$ indicates world natural gas production which act as external instrument for economic infrastructure, $fert$ indicate fertility rate per woman respectively which also act as external instruments for social infrastructure.

1.19 The second-stage equation

In the second stage, the predicted values of both economic and social infrastructure enter equation (9) as one of the regressors (exogenous) variables of the FDI inflows.

$$ln\,FDI_t = \pi_0 + \pi_1 ln\widehat{Econinfra}_t + \pi_2 ln\widehat{Socinfra}_t + \pi_3 lnSize_t + \pi_4 Inf_t + \pi_5 lnEx\_debt_t + \pi_6 Opn_t + \pi_7 lnFDI_{t-1} + \pi_8 lnFDI_{t-2} + \varepsilon_t \quad (12)$$

Where $\widehat{Econinfra}_t$ and $\widehat{Socinfra}_t$ are the predicted values for economic and social infrastructure respectively at time t from the first stage OLS estimation.

RESULTS AND DISCUSSIONS

1.20 Unit roots tests

Before the study employed both the ordinary least squares (OLS) and the two-stage least squares (2SLS) approach, unit root test was conducted in order to investigate the stationarity properties of the data. As a result, the Augmented Dickey- Fuller (ADF) Test was applied to all variables in levels and in first difference in order to check for the order of integration of these variables. In addition, the Schwartz-Bayesian Criterion (SBC) and Akaike Information Criterion (AIC) were employed to determine the selection of the optimal lag length included in the test. The results of the unit root tests for all the variables at their levels with intercept and their first difference are presented in the Table 1. The result indicate that apart from inflation and market size which were stationary at their levels all the other variables were integrated of order one. In order to eliminate the possibility of spurious regression results, the first difference of the variables were employed in the estimation process.

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1.22 Table 1: Test for the Order of integration (ADF): Levels and first difference with intercept only

Levels(Intercept)				First Difference(Intercept)				
Var	ADF- Statistic	P-Value	Lag	Var	ADF-Statistic	P-Value	Lag	OI
lnFDI	-2.033	0.272	1	DlnFDI	-5.224	0.000	0	I(1)
lnEconinfra	-2.265	0.185	7	DlnEconinfra	-4.612	0.000	7	I(1)
lnSocinfra	3.657	1.000	12	DlnSocinfra	-3.405	0.012	6	I(1)
lnSize	-3.128	0.027	7	DlnSize	-4.893	0.000	6	I(0)
Inf	-1.709	0.004	13	DInf	-5.142	0.000	12	I(0)
lnEx_debt	-1.595	0.483	8	DlnEx_debt	-5.19	0.000	7	I(1)
Opn	-1.638	0.461	1	Dopn	-5.865	0.000	0	I(1)
lnWNGP	0.061	0.962	6	DlnWNGP	-12.691	0.000	5	I(1)
fert	-1.924	0.321	13	Dfert	-0.933	0.083	11	I(1)

Note: D denotes first difference, *OI* represents the order of intergration

Source: Authors construct

The study presents the results of the OLS and IV (2SLS) estimation of the relationship between infrastructure and FDI in Ghana in Table 2. Since the OLS results are fraught with the problem of endogeneity bias and hence generates biased and inconsistent estimates, the student failed to interpretes this results but rather presents a vivid discussions of the results from the IV (2SLS) estimation that is assumed to account for the problem of endogeneity and therefore generates more robust estimates than the OLS.

Table 2: Results of OLS and IV (2SLS) estimation of the relationship between Infrastructure and FDI inflows *(Dependent variable: lnFDI*)

Explanatory Variables	OLS	IV (2SLS)
lnEconinfra	0.066	0.823***
	(0.076)	(0.295)
lnSocinfra	0.014	0.241***
	(0.056)	(0.069)
lnSize	0.134***	0.264***
	(0.037)	(0.057)
Inf	-0.002**	-0.003***
	(0.001)	(0.001)
lnEx_debt	-0.221**	-0.418***
	(0.086)	(0.157)
Opn	-0.114	0.324*
	0.191	(0.182)
$lnfdi_{t-1}$	1.471***	1.408***
	(0.115)	(0.120)
$lnfdi_{t-2}$	-0.625***	-0.570***
	(0.121)	(0.122)
Constant	1.244**	1.357***
	(0.537)	(0.556)
Observations	150	150
Diagnostic Tests (OLS)		
Autocorrelation:		
Durbin Watson d-stat (9,150)	1.875	
Heteroskedasticity:		
Breusch-Paap/Cook-Weinberg- test	49.85	0.0000***
Diagnostic Tests (2SLS)		
Underidentification test:		
Kleibergen-Paap rk LM stat	21.718	0.0000***
Weak identification test:		
Crag-Donald Wald F stat	15.721	
Kleibergen-Paap Wald rk F stat	13.089	
Overidentification test		
Hansen J Statistic		0.0000***
Equation exactly identified		
Endogeneity test	11.432	

Robust standard errors in bracket, * significant at 10%; ** significant at 5%; *** significant at 1%. Notes: Statistics robust to heteroskedasticity and autocorrelation

Source: Authors construct

Table 2, presents both OLS and IV (2SLS) regressions results. It is clear from the OLS results that Economic infrastructure ($Econinfra$) has a positive effect with FDI inflows but the effect of economic infrastructure in attracting FDI with the 2SLS regression is higher than that of the OLS estimation. The results from the 2SLS regression indicate that at 1 percent level of significance, a percentage increase in economic infrastructure in Ghana will lead to 0.823 percent increase in FDI inflows. The positive sign implies that economic infrastructure plays a crucial role in attracting FDI inflows into Ghana. This result is consistent with Anyanwu (2012) who found that infrastructure has positive and statistically significant effect in attracting FDI for East and Southern Africa sub regions using 53 African Countries. Similarly it confirms the result by Asiedu (2002) who also suggested that infrastructure development is vital for attracting FDI inflows in SSA. The results does not only support empirical literature but also confirms the location factor theory that emphasises the positive link between infrastructure development and FDI inflows.

The results from both OLS and 2SLS regressions also show that social infrastructure ($Socinfra$) has a positive effect with FDI inflows. However, the effect of social infrastructure in attracting FDI is statistically insignificant with the OLS but shows 1 percent significant in the 2SLS estimation at 1 percent level. In addition, the results of the 2SLS indicate that a 1 percentage point increase in social infrastructure leads to 0.241 percent increase in FDI inflows. The positive sign implies that when all other factors are held constant, social infrastructure plays a critical role in attracting FDI inflows into Ghana. This is consistent with studies (Broadman & Sun, 1997; Feenstra & Hanson, 1997; Noorbakhsh, et al., 2001). The result confirm the theoretical literature that a country with well-developed social infrastructure attract more FDI.

As anticipated, the 2SLS revealed a positive relationship between market size and FDI inflows. A 1 percent increase in market size results in 0.264 increase in FDI inflows. This implies that increase in market size attract more market seeking FDI into the country. Again, the result indicates that inflation has a negative effect on FDI inflows in Ghana. FDI decreases by 0.003 percent for every one cedi rise in the general price level in Ghana. The negative sign of inflation decreases real purchasing power and increases the cost of living in Ghana. High cost of living therefore discourages private investment. In addition, external debts stock negatively impacted significantly on FDI inflows. It was revealed that, FDI inflows decreases by 0.418 percent for every one percent increase in Ghana's external debts stock. This is an indication that too much accumulation of external debts hinders both potential and existing multinational firms in Ghana. Expectedly, the 2SLS results revealed a positive and ten percent statistically significant level relationship between trade openness and FDI. Thus, FDI inflows in Ghana increases by 0.324 percent for any extra attempt the country make in relating to the rest of the world in terms of international trade. Furthermore, agglomeration effects exerted a positive statistically significant effect on FDI. The results therefore suggest that foreign investors' incremental knowledge about investment opportunities in host countries are important as well. The diagnostic tests reported for both estimate (OLS and 2SLS) are significant at one percent alpha value and therefore, there is nothing to suggest that the models are mis-specified.

Results of test of differences in coefficients for economic and social infrastructure

The study presents results of the test of differences in coefficients of both economic and social infrastructure. The rationale for conducting this test was to determine which infrastructure components have higher differential effect on FDI inflows in Ghana (i.e. is it economic or social infrastructure?). Because from the 2SLS regression results presented

in Table 2, it came out that economic infrastructure have higher marginal effect on FDI inflows than social infrastructure in Ghana. This could be deceiving because it may happen that differences in coefficients between these infrastructure components might be zero. In that case one can conclude that both economic and social infrastructure have the same marginal effect or impact on FDI inflows. The result that emanated from the test was presented below:

H_0: lnEconinfra-lnSocinfra=0

H_A: lnEconinfra-lnSocinfra≠0

Chi2(1)=10.35

Prob> Chi2=0.0013

The test basically tested the null hypothesis (H_0) that difference in coefficients of the infrastructure components is zero against the alternative hypothesis (H_A) that difference in coefficients of the infrastructure components is not equal to zero. Since the Chi2 (1) value (10.35) generated from the test was statistically significant it gives enough evidence to reject the claim that difference in coefficients is zero hence accepting the alternative hypothesis at one percent significance level that difference in coefficients is not zero but positive. The result also confirms that the coefficient of economic infrastructure from the 2SLS is larger than the coefficient of social infrastructure. This implies that economic infrastructure in this study drives more FDI inflows than social infrastructure in Ghana.

1.24

1.25 Conclusion and Recommendation

The results from this study show that both economic and social infrastructure play crucial role in attracting FDI inflows in Ghana. This is because available economic and social infrastructure reduces cost of production and therefore raising profits by private investors. However, despite the significant contribution of economic and social infrastructure components in attracting FDI as this study has indicated, there is still wide gaps in terms of the investment, maintenance and development of economic and social infrastructure in Ghana. To be able to bridge the economic and social infrastructure gap and hence attract more FDI inflows into the country, the study recommends that the Ministry of Power and the Ministry of Energy should consider increasing investment in electricity generation so as to enhance the economic infrastructure of the country. Again, the study recommends that the Ministry of Education should increase investment in educational facilities so as to encourage a lot of people to enroll in schools in order to boost social infrastructure of the country. Government should also focus on economic infrastructure (electricity generation) more than social infrastructure (schooling) since economic infrastructure drives more FDI inflows than social infrastructure in Ghana. It would be interesting to see how far an examination of infrastructure would relate to a decomposed foreign and domestic investments in order to establish an incentive structure that is conducive to raising profits of private investors. This issue will be taken up in subsequent study.

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APPENDIX A

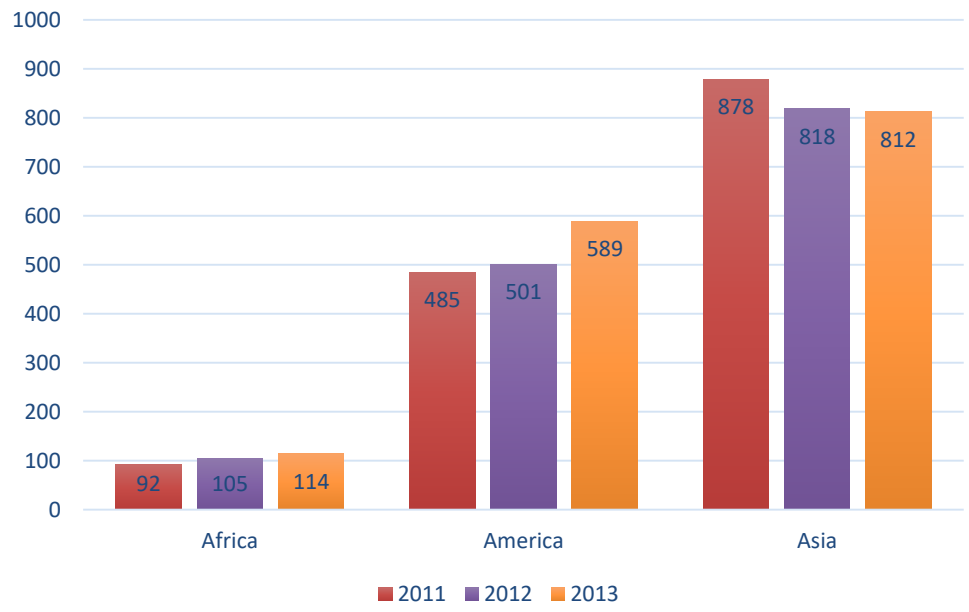

Figure 1: FDI inflows to developing economies, by major regions, 2011–2013 (Billions of US dollars)

Source: UNCTAD (2014)

APPENDIX B

1.26 Summary of variables source, measurement and their a priori signs

Variable	Measurement	Source	Sign
$lnFDI$	Log of Foreign direct investment, net inflows(BOP, Current US$)	WDI	
$lnEconinf$	Log of Economic infrastructure measured by electricity production(kWh)	WDI	+
$lnSocinfr$	Log of Social infrastructure measured by secondary school enrolment (number of pupil)	WDI	+
$lnSize$	Log of Market size measured by GDP, (current US$)	WDI	+
Inf	Inflation measured by consumer price index (2010=100)	IFS	+/-
Opn	Trade openness measured by the ratio of import plus export to GDP. All values in current US$	WDI	+/-
$lnEx\_debt$	Log of external debt measured by external debt stocks, concessional(DOD, Current US$)	WDI	+/-
$lnfdi_{t-1}$	Log of first lagged values of FDI	Author	+
$lnfdi_{t-2}$	Log of second lagged values of FDI	Author	+
$lnWNGP$	Log of World natural gas production (Billion Cubic Metres) used as instrument for economic infrastructure (electricity production).	BP-Statistical Review	+
$fert$	Fertility rate per woman used as instrument for social infrastructure (secondary school enrolment)	WDI	-/+

Source: Author's construct