INFRASTRUCTURE FACTORS OF FOREIGN DIRECT INVESTMENT ATTRACTION IN DEVELOPING COUNTRIES

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Abstract

The purpose of this paper is to analyse the effects of infrastructure on FDI in developing countries. Electricity consumption and the number of fixed telephone lines were used as proxies for infrastructure and GDP, population, inflation and openness as control variables. Based on a panel of 55 countries over the period 1990-2014, the results show that the availability of electricity infrastructure contributes to the attractiveness of FDI in developing countries. But, the availability of fixed phone does not attract foreign investors both in developing countries than in African countries. It can strongly be recommended to developing countries to promote the development of electricity infrastructures in order to make available the quantity and the quality of energy produced in a sustainable way. This production of energy will permit to attract FDI and ensure economic development.

Keywords: Infrastructure, Foreign Direct Investment, Attractiveness, Developing Countries, Panel data

INTRODUCTION

In the literature, infrastructure is presented as intermediate goods that facilitate trade and improve the productivity of other inputs in the production. Infrastructure can be defined as a result of the work of Hirschman (1958), as goods and services that support economic activity. In addition to physical infrastructure such as electricity, transport and communications, whose characteristic is to participate in the productive process, Hansen (1965) proposes a broader definition that includes social infrastructure including education and health whose function is to

maintain and develop human capital. Infrastructure is more understood as a factor in improving productive performance and private sector investment.

This analysis of the productive role of infrastructure was a major development in the 40-50's, following debates on balanced growth initiated by development theorists (Rosenstein-Rodan 1943; Nurkse 1952; Hirschman, 1958).

Infrastructure is at the heart of the concerns of developing countries. Quality infrastructure is a prerequisite and essential to attracting and successful foreign investors. An indigent infrastructure or absence of public goods increase costs for businesses. Thus, to the extent that public goods are not excludable not congestible, they reduce the cost of doing business for multinationals, seeking to maximize their profits, such as for indigenous companies. Infrastructure should create a more favourable climate for FDI, through a grant from the cost of the total investment for foreign investors, increasing the return on investment of these. Estache and Fay (1997) and Wei and al.(2000) recently put forward the idea that infrastructure endowments will influence the comparative advantage of a region, and therefore on development. Infrastructure in general, can raise the level of productivity of the incoming flow of private investment, particularly foreign direct investment.

The objective of this article is to analyse the central role of infrastructure in their ability to attract FDI. This paper aims to establish an empirical link between infrastructure and FDI using a panel of 55 developing countries for the period 1990-2014.The estimation methods for common effects, random effects and fixed effects were mobilized. In addition, in this study, African countries were extracted from the panel to better understand their behaviour in relation to developing countries.

The rest of this article is organized as follows: the second section is devoted to the review of the literature. The third section describes the data sources and methodology. The fourth section presents the empirical results and the fifth section concludes and proposes economic policy measures.

LITERATURE REVIEW

Since the pioneering work of Root and Ahmed (1979), Coughlin& al.(1991) and Wheeler and Mody (1992) and later those of Loree and Guisinger (1995), and Srinivisan Mody (1996), the literature on foreign direct investment and infrastructure is very abundant.

Theoretically, physical infrastructure has been understood as an important determinant of foreign direct investment. Using a translog model in a panel of 42 countries for the period 1982 to 1988, Wheeler and Mody (1992) argues that infrastructure has a significant and positive impact of between 1.57 and 2.54 on FDI. Shatz and Venables (2000) believe that the two main

reasons for attracting foreign direct investment are: first horizontally, infrastructure allow reducing transport costs, tariffs and access to new markets, improving business competitiveness. Secondly the vertical level, infrastructure favour the maximization of profits by reducing production costs such as capital, labour and other inputs needed for production of goods and services. Khadaroo and Seethanad (2008) argue that in reducing operational costs, infrastructure promote FDI by reducing transportation costs and transaction costs of foreign firms. Moreover, some works developed by Kinda (2008), Escibano and Guasch (2005),Canning and Pedroni (2004), Calderon and Serven (2010), straub (2001), Jan& al.(2012), Malek (2014), Calderon and Serven (2004), Garcia-Mila & al.(1996), Gramlich (1994), Aschauer (1989), Nadiri et al.(1994), Quere& al.(2007), Morrison and Schwartz (1996) have shown that the infrastructure has a significant impact on the cost structure and productivity of firms. Erenberg (1993) assume that if certain types of infrastructure do not go beyond the location of some multinational companies, they will operate below capacity, forcing them to make their own infrastructure, which can lead to waste of resources. Haughwout (2001) argues that the availability of public investment reduces costs production of private firms even if the direct role of infrastructure on productive performance and cost structure is not established. From a gravity model, Limao and Venables (2001) confirm these results by estimating the elasticity of trade flows with respect to factor costs.These analyse contrast with other studies conducted by Holtz-Eakin (1994), Holtz-Eakin& al.(1995) and Bae (2008) which recognize that public investments do not substantially affect the productive performance of private firms.

On the other hand, the unavailability or insufficient infrastructure does not promote the development of FDI in developing countries because of high transaction costs and limited access to local and global markets. Thus, these deficiencies cannot be corrected by building more infrastructure and ensuring their proper distribution in the territory.

Despite having a significant impact on FDI, the quality of infrastructure also facilitates the development of exports, FDI significant motivator in a country. Iwanow and Kirkpatrick (2006) are interested in the significant contribution of infrastructure quality on export performance.The results of theiranalyses indicate that improved 10% level of infrastructure increases of 8% export performance in developing countries. Furthermore, Suh and Khan (2003) examine the impact of infrastructure on the level of increase of exports of certain commercial developments such as CEFTA and ASEAN/AFTA.

The impact of infrastructure on FDI are different according to the countries' development level. According to Khadaroo and Seetanah (2010), and ErosoyKok (2009), Rehman and al.(2011), Li and Park (2006) and Asiedu (2006), infrastructure has a significant ability to attract FDI in developing countries. So Shekkat and Varoudakis (2007) argue that infrastructure has a

greater appeal than the opening and the business climate in developing countries. However, Addision and al. (2006) recognize that this impact is more promotional in developed countries as opposed to developing countries. Bae (2008) argues that in developed countries, the infrastructures are not a motivator, but a FDI attractiveness indicator in most emerging economies.

Empirically, several empirical studies have confirmed this significant and positive impact.Using a dynamic panel of 30 African countries between 1984 and 2002, Khadaroo and Seetanah (2010) show that a 1% increase in infrastructure leads to an increase of 17% of FDI. Kokand Erosoy (2009) found the same results with panel of 24 developing countries using cross-sectionaldata.From a cross-sectional study of the 1977 and 1982periods, Loree and Guisinger (1995) find that countries whose infrastructure (measured by an aggregate indicator of different types of infrastructures) are more developed receive more FDI from the United States. Kumar (2002), from a sample of 66 countries over the period 1982-1994 found that infrastructure development measured by a composite index has a positive and significant effect on the attractiveness of IDE. Asiedu (2002) on a sample of 34 African countries between 1980 and 2000, show that a 1% increase in the number of telephone lines per 1,000 inhabitants causes an increase of 1.12% of FDI / GDP. Ngowi (2001) on a sample of African countries, and Jenkins and Thomas (2002), on a sample of southern Africa countries, found similar results. Similarly, Tidiane Kinda (2008) shows that an increase of 10% of online subscribers to fixed or mobile phone increased 0.3% FDI inflows in 61% of developing countries over the period 1970-2003.

In the same logic, Shekkatand Varoudakis (2007) find similar results respectively for the countries of the European Centre-East and South Asia and the countries of Africa and the Middle East. Similarly, Iwanow and Kirkpatrick (2006) from panel data from 78 developing countries, Mlambo (2006) for the countries of the Development Community Countries in Southern Africa (SADC) and Obwono (2001) for Uganda. Other studies have confirmed these results.This is the case of Bae (2008) for 36 emerging economies, Li and Park (2006) for China, Asiedu (2002, 2004, 2006), Makabenta (2002) for the Philippines. From the data collected at the enterprise level through the investment climate assessment surveys by the World Bank on 7 countries, Escribano and al. (2005) say both the importance of infrastructure for productivity and for IDE.

These results were confirmed by the work of Kandiero and Chitiga (2003) for the case of 52 African countries. By cons, Quazi (2005) in the case of Asia, found that the infrastructure had no effect on the attractiveness of FDI.

METHODOLOGY

Data sources and variables description

In this study, the net foreign direct investments as a percentage of GDP were used as dependent variable. Six variables, the consumption of electricity (kWh per capita), the number of fixed telephone lines (population 100), real GDP, inflation, the total population, the opening (as% of GDP) are considered as explanatory variables. The data are from World Development Indicators 2015 of World Bank and cover the period from 1990 to 2014. We chose data for the period 1990-2014 because it is a post-crisis period during which the increase in investments, particularly in the field of electricity production infrastructures, is accompanied by an increase in foreign direct investment in developing countries as shown in the figures 1 below. Table 1 summarizes all the variables.

Table 1: Definition of variables

Variable	Meaning
ELE	Electrical consumption (kWh per capita)
TEL	Number of fixed telephone lines (population 100)
FDI	Foreign direct investment (% of GDP)
PIB	Real GDP (in US $)
INF	Inflation (annual)
POP	Total population
OUV	Opening (% of GDP)

- **Infrastructure:** This is the principal variable of our study. Infrastructures are introduced in the form of two variables. The annual consumption of electricity And the number of telephone lines. The number of fixed phone lines has been used as proxy infrastructure by authors like Sekkat and Veganzones (2004), Asiedu (2006), Nayyra Zeb and al.(2014) and Tidiane Kinda (2008), Rehman and al. (2011). A positive impact is expected on FDI.
- **Foreign direct investment:** The dependent variable is measured as corresponding to net inflows of foreign direct investment as a percentage of GDP. This variable was used by Asiedu (2002, 2006), Quazi (2005), and Khadaroo Seetanah (2010) and Kok and Ersoy (2009).
- **Opening:** The opening of trade in the country is an important element in making decisions on FDI. Measured by the sum of imports and exports as a percentage of Gross Domestic Product, Edwards (1990), Hausmann and Fernandez-Arias (2000),

Chakrabarti (2001), Asiedu (2002) (Nunnenkamp (2002) Cieślik (2005), Tidiane Kinda (2008),Nor Arzin Abu Bakar and al.(2012) and Nayyra Zeb and al. (2014), Nor Asma Ahmad (2015), Mumtaz Hussain Shah (2014) have shown a positive and significant relationship between the opening of the economy and FDI.A positive effect on FDI is expected.

- **Inflation:** This variable is used as a proxy for macroeconomic stability. Investors have a preference for stable countries where there would be less uncertainty. This indicator is used by Morrissey (2008), Tidiane Kinda (2008), Mumtaz Hussain Shah (2014).According to economic theory, this variable has a negative effect on FDI.

- **Total Population:** The literature has shown the importance of market size in the attraction of FDI. A large market creates economies of scale and contribute to the use of production factors and optimal use of imported technologies. In this study, the total population is used as a proxy for market size. This indicator has been used by authors as Feenstra (1998), Mumtaz Hussain Shah (2014). A positive effect of this variable is expected.

- **GDP:** This variable represents the index of economic development of a country. This variable has a positive impact on FDI theory. This positive effect on FDI in GDP was obtained by Loree and Guisinger (1995), Schneider and Frey (1985), Tsai (1995) and Nor Arzin Abu Bakar and al.(2012), Yol and Teng (2009) and Tidiane Kinda (2008).

ANALYSIS AND FINDINGS

Descriptive Statistics

Table 2: Descriptive statistics

	PIB	POP	OUV	ELE	IDE	INF	TEL
Mean	24.08	16.63	4.25	6.44	3.53	77.48	1.41
Median	23.68	16.68	4.27	6.56	2.09	6.33	1.64
Maximum	29.29	21.03	6.09	9.78	45.29	23773.13	6.29
Minimum	20.99	13.77	2.41	3.57	-8.59	-11.69	-5.10
Std. dev.	1.52	1.59	0.55	1.34	5.27	750.63	1.62
Skewness	0.65	0.53	0.06	0.02	3.63	24.81	-0.30
Kurtosis	3.13	3.13	3.68	2.41	22.28	748.53	3.51
Jarque-Bera	97.23	62.82	27.13	19.57	23811.33	31333000	34.87
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0
Sum	32438.11	22405.62	5723.55	8670.54	4753.39	104361.40	1904.65
Observations	1347	1347	1347	1347	1347	1347	1353

Table 2 presents descriptive statistics that describes the behaviour of each variable used in the model. The results of asymmetry tests and flattening tests respectively represented by the values of skewness and kurtosis reveal that each variable is very far from the normal distribution. This trend is confirmed by the significance of the Jarque-Bera test. In addition, all variables averages of values are positive. Figures 1 (1a, 1b and 1c) below indicates that: (i) the behaviour of African countries is similar to that of other countries in development;(ii) in the two groups of countries, there is a gradual evolution of FDI and infrastructure. This suggests a possible correlation between FDI and Infrastructure.

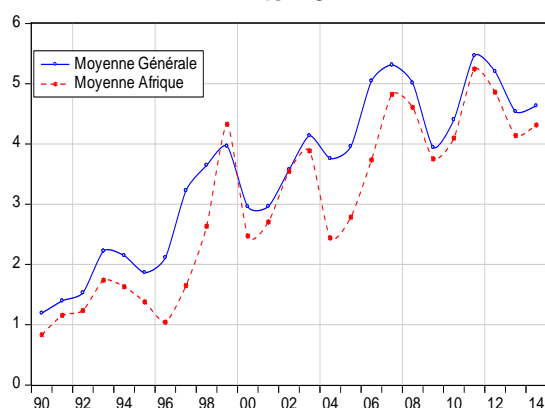Figure 1a: Mean Evolution of FDI from 1990 to 2014
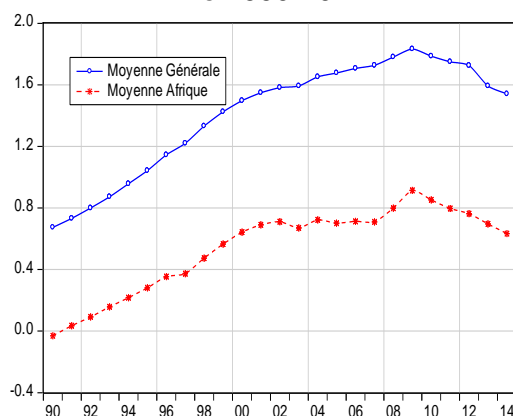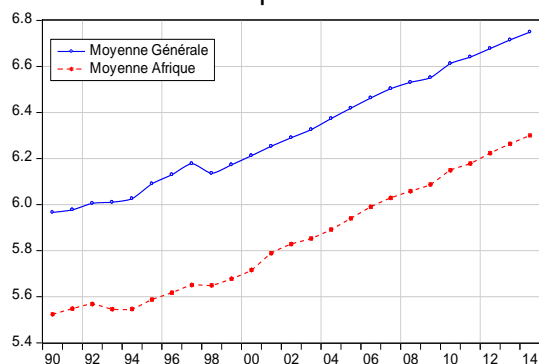

Figure 1b: Mean Evolution of Telephone Line 1990-2014

Figure 1c: Mean Evolution of the Electric Consumption 1990-2014

Econometric Model

To assess the impact of infrastructure on FDI in developing countries, we use the following econometric model:

$$FDI_{it} = \gamma_0 + \gamma_1 TEL_{it} + \gamma_2 ELEC_{it} + \gamma_3 PIB_{it} + \gamma_4 POP_{it} + \gamma_5 OUV_{it} + \gamma_6 INF_{it} + \lambda_i + \eta_{it}$$

Where, FDI is foreign direct investment, TEL, ELEC, PIB, POP, OUV and INF represent the number of fixed telephone line (in log), the annual electricity consumption (in log), the total population (in log) , trade openness (in logs) and inflation; γ the coefficient associated to each variable, λ_i individual specific effect to each country and η_{it} the rest of the disturbance. To ensure the consistency and significance of the parameters associated with the main explanatory variables, we used three (03) estimation methods: the estimate for common effects, estimating random effects and finally to estimate fixed effects. In addition, in our study, African countries were extracted from the panel to better understand their behaviour from the general panel.

INFERENTIAL STATISTICS

Tables 3 summarize the unit root tests in levels (3a) and in first differences (3b) for non-stationary variables.

Unit Root Tests

Stationarity of each variable was examined by applying 04 different tests namely: Levin, Lin and Chu test (LLC, 2002), the Im, Peasaranet Shin test (IPS, 2003), the Augmented Dickey Fuller test (ADF) of Fisher (1932) and Phillips-Perron test (PP) of Fisher (1932).The results were summarized in Tables 3a and 3b.

Table 3a: Unit Root Test

Variables	Method	LLC	IPS	ADF	PP
FDI	Statistic	-4.77	-6.17	219.27	279.00
	Probability	0.00	0.00	0.00	0.00
Openness	Statistic	-5.43	-4.18	185.32	168.66
	Probability	0.00	0.00	0.00	0.00
Electricity	Statistic	-5.44	1.50	157.42	114.42
	Probability	0.00	0.93	0.00	0.32
Real GDP	Statistic	0.52	10.89	39.61	80.23
	Probability	0.70	1.00	1.00	0.98
Population	Statistic	4.80	11.92	109.66	638.64
	Probability	1.00	1.00	0.44	0.00
Inflation	Statistic	-5.21	-4.08	182.68	166.01
	Probability	0.00	0.00	0.00	0.00
Telephone	Statistic	-10.30	-3.46	169.63	185.74
	Probability	0.00	0.00	0.00	0.00

Table 3b: Unit Root Test (difference First)

Variables	Method	LLC	IPS	ADF	PP
Electricity	Statistic	-13.09	-14.98	438.22	759.64
	Probability	0.00	0.00	0.00	0.00
Real GDP	Statistic	-12.86	-12.65	369.57	540.00
	Probability	0.00	0.00	0.00	0.00
Population	Statistic	-16.99	-21.25	787.27	225.22
	Probability	0.00	0.00	0.00	0.00

The unit root tests in panel shown in the tables above indicate that the variables Electricity, real GDP and population are I (1) that is to say, their first differences are stationary, while variable inflation, FDI Opening and are stationary or I (0).Thus, the possibility of seasonal and explosive unit roots may be excluded from the analysis (in the case of integrated variables of order I (2)).

Cointegration

To determine the presence of a long-term relationship between the direct investment abroad and Infrastructure, combined cointegration test of Fisher-Johansen was used. The study period is not extended, this test in order (delay) 1 was applied. The test results show that at all levels (order 0, 1 and 2) and depending on the technique (trace or own value), there is a cointegration between key variables. This confirms the existence of a long-term relationship between FDI and infrastructure in developing countries. The results are summarized in Table 4 below.

Table 4: Cointegration Test of Fisher-Johansen

Nber of cointeg	Trace		Eigen-value	
	Fisher Stat.	Probability	Fisher Stat.	Probability
None	481.10	0.00	420.00	0.00
At most 1	178.40	0.00	143.80	0.02
At most 2	183.30	0.00	183.30	0.00

Estimates

Tables 5 include the results of the estimation for common effects (first column), the estimate random effects (second column) and estimated fixed effects (third column).The Hausman test (43.10 ***) made calls using the fixed effects model, which is fairly predictable in terms of the temporal scope of the panel. In Table 5a, the estimation methods were applied to the entire panel while in Table 5b, the results are those of the sub-African Group of the panel.

Table 5a: Estimates throughout the Panel

Variable	Common effects		Random effects		Fixed effects	
	Coefficient	Standard Deviation	Coefficient	Standard Deviation	Coefficient	Standard Deviation
electricity	1.19 ***	0.23	1.60 ***	0.38	1.18 **	0.50
Phone	-0.36 ***	0.14	-0.31	0.22	-1.09 ***	0.28
real GDP	-1.06 ***	0.17	-1.08 ***	0.26	1.59 ***	0.55
Population	0.95 ***	0.19	1.13 ***	0.27	1.07 ***	0.29
Opening	3.29 ***	0.29	3.64 ***	0.48	3.40 ***	0.60
Inflation	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-7.69 ***	1.67	-14.33 ***	3.14	-72.03 ***	9.87
R^2	0.15		0.12		0.43	
Fisher	38.17 ***		17.15 ***		16.25 ***	

***, **, * Respectively indicate the significance of the coefficient at 1%, 5% and 10%

Table 5b: Estimate on African countries

Variables	Common effects		Random effects		Fixed effects	
	Coefficient	Standard Deviation	Coefficient	Standard Deviation	Coefficient	Standard Deviation
electricity	0.51	0.34	1.26 **	0.59	1.36	0.92
Phone	-1.08 ***	0.24	-1.39 ***	0.36	-1.72 ***	0.45
real GDP	-0.38	0.41	-0.54	0.82	-1.84	1.63
Population	0.74 *	0.38	1.49 *	0.75	8.62 ***	2.43
Opening	4.29 ***	0.52	5.39 ***	0.76	4.66 ***	0.96
Inflation	0.00	0.00	0.00	0.00	0.00	0.00
Constante	-20.77 ***	5.31	-38.28 ***	9.84	-122.57 ***	23.17
R^2	0.14		0.11		0.13	
Fisher	15.29 ***		65.75 ***		7.33 ***	

***, **, * Respectively indicate the significance of the coefficient at 1%, 5% and 10%

The analysis of the above table reveals that: (i) the index of economic development which the proxy is real GDP has a negative but insignificant effect on FDI to African countries. By cons for developing countries, this relationship is positive and significant. This means that the least

developed countries attract most of IDE. This positive effect of GDP on FDI is similar to that obtained by Schneider and Frey (1985), and Loree Guisinger (1995), Tsai (1995), Tidiane kinda (2008), Yol and Teng (2009), Nor Arzin Abu Bakar and al.(2012), Mumtaz Hussain Shah (2014).This result contrasts with that obtained by Nayyra Zeb and al.(2014). (ii) The total population is used as a proxy of market size significantly and positively impacts the level of FDI.The value of the associated coefficients indicates that FDI is very sensitive to changes in market size but with a greater positive effect on FDI in the Africans countries. This result corroborates the one of Feenstra (1998) and Mumtaz Hussain Shah (2014). (iii) Trade openness has a positive and significant effect on the level of foreign direct investment in developing countries, but with a greater effect in African countries. This result is similar to that obtained by Edwards (1990), Hausmann and Fernandez-Arias (2000), Chakrabarti (2001), Asiedu (2002), (Nunnenkamp (2002), Cieślik (2005), Tidiane Kinda (2008), Nor Arzin Abu Bakar and al. (2012) and Nayyra Zeb and al. (2014, Mumtaz Hussain Shah (2014)) and Nor Asma Ahmad (2015). Regarding the main explanatory variables, (iv) the number of fixed telephone lines has a negative and significant effect on FDI both in developing countries than in African countries. This negative result can be explained by the poor quality of the fixed telephone infrastructure in these countries. This result is close to that of Colin Kirkpatrick and al. (2006), although the effect is not significant, but in contrast to those obtained by Campos and Kinoshita (2003), and Settak Veganzones (2004), Asiedu (2006), Mumtaz Hussain Shah (2014), Nayyra Zeb, Fu Qiang and Muhammad Shabbir (2014).(v) Electricity has a significant positive effect on the attractiveness of FDI in developing countries and a positive and non-significant effect in African countries. This positive result can be explained by the fact that electricity is the main energy source for the development of a country. Overall, it appears that the infrastructure stock has positive effects on FDI in developing countries so that quality can have a negative effect.

CONCLUSION

The aim of this article was to establish a link between infrastructure and foreign direct investment by showing that the development of infrastructure in a country can attract foreign capital. Using a panel data from 55 developing countries over the period 1990-2014, the results show the key role of infrastructure in the ability to attract IDE. The results obtained from the fixed effects model shows that a 1% increase of the electricity infrastructure lead an increase of 1.18% of FDI in developing countries. An increase of 1% of the fixed telephone infrastructure causes a reduction in FDI of 1.09 and 1.72% for developing countries and African countries. Other variables such as market size, openness and GDP have a positive impact on FDI in developing countries, but with a negative and non-significant effect of GDP in the African

countries. To conclude this study, it would be important to attract foreign direct investment, promote economic growth and ensure development, to strongly recommend to developing countries: (1) to take measures related on the promotion of trade openness and do business with the rest of the world; (2) to put in place programs related on the development of electricity production infrastructures in order to make this source of energy available in a sustainable mode, in quantity and in quality.

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