The Role of Transport Infrastructure in Attracting FDI in Africa

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Abstract

This research analyses infrastructure availability as an ingredient of Foreign Direct Investment (FDI) inflows in sampled 25 African economies. It particularly studies transportation. Using dynamic panel data approach, transport infrastructure availability is seen to have been contributing to the relative attractiveness of the countries in the sample. Foreign direct investors are also sensitive to the other measures of infrastructure, though to a lesser extent as compared to transportation. FDI flows to African economies are further confirmed to be resource seeking as well as market seeking. Interestingly, the study also establishes the presence of dynamism in FDI modelling.

Keywords: Transport infrastructure, FDI, Dynamic Panel Data, Africa.

JEL: F23, O55

1. Introduction

A number of scholars have acknowledged the importance of infrastructure in stimulating FDI. They include Wheeler and Mody (1992), Loree and Guisinger (1995), Richaud et al. (1999), and Asiedu (2002, 2006). These authors have argued that good infrastructure is necessary for foreign investors to operate successfully. Poor infrastructure or unavailable public inputs increase costs for firms. Thus, to the extent that the public input is non-excludable and non-congestible, it will lower the costs of doing business for

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profit maximising multinational and indigenous firms alike. A good infrastructure should therefore improve the investment climate for FDI. Indeed, Estache and Fay (1997) and Wei et al. (2000) share the view that relative infrastructure endowments will affect a region’s comparative advantage.

The primary benefits of transport infrastructure development are increased accessibility and reduced transport costs. Firms can benefit from these without contributing directly to the project. Ample supply of transport infrastructure at no or low costs to users is conjectured to have a positive impact on costs and productivity of firms. Indeed, the usefulness of privately owned and operated cars and trucks depends on a network of roads and bridges. For instance, good road designs, materials, and maintenance can reduce the wear and tear on vehicles, thus reducing transportation costs. The same is true for aircraft, which require good airports, and for private ships and barges, which need ports and navigable waterways. A freeway is faster than a washed out dirt road, email is faster than the post office, and time is money. One can therefore argue that transport and public capital may in general enhance the productivity of private inward and foreign direct capital, and thus their level. Erenburg (1993) noted that if these types of infrastructure were not publicly provided, the domestic private sector and multinational enterprises (MNEs) would operate less efficiently, and attempts by them to provide their own networks would result in duplication and a waste of resources. Thus, if moving to a developing economy to take advantage of lower labour costs means higher transport costs due to inadequate transportation infrastructure, then MNEs will not choose to do business there.

While most studies have concentrated on developed countries, research based exclusively on developing countries has been generally neglected. Hence the dearth of literature with regard to research on the determinants of FDI to Africa. Among the existing few feature Schoeman et al. (2000) and Asiedu (2002, 2006).

The aim of this paper is therefore to investigate the empirical link between transport infrastructure and FDI for the case of 25 African countries (selected as per data availability), for the 1985-2004 period using panel data regression techniques.

Although there are some previous studies that analysed the role of general infrastructure in attracting FDI (see Asiedu 2002, 2006 and Kandiero and Chitiga 2003), our paper is different in the sense that we attempt to supplement the literature on the determinants of FDI by laying special focus on one type of infrastructure, namely transportation infrastructure. So far, transportation infrastructure has not received any particular attention in existing literature. It is important to assess its role, given that investment in such type of projects has been quite erratic and not prioritised. We innovatively address the hypothesised link in a dynamic panel data framework using the GMM (Generalised Method of Moments) methodology and crucially testing for panel unit root.
The paper is organised as follows: Section 2 deals with the theoretical and empirical literature review. Section 3 describes the econometric modelling and discusses the empirical approach and the data used. It also presents the econometric results and analyses the findings. The last section concludes the study.

2. Related literature

The role of infrastructure in attracting FDI has lately received increasing interest from academic scholars. Pioneering works are available from Root and Ahmed (1979) and Wheeler and Mody (1992), who reported the crucial importance of infrastructure for FDI inflows. Among more recent works acknowledging the value of infrastructure are those of Loree and Guisinger (1995) for the case of US, Kinoshita (1998) for the Asian region, and Kumar (2001) for a sample of 66 countries. Escribano et al. (2005), in their study of seven countries using firm level data from World Bank’s Investment Climate Assessment surveys, also reported the significance of infrastructure for productivity and FDI.

Similar studies on African countries are not many, but present the same arguments. Using panel data estimates, Asiedu (2002), for instance, observed that countries with improved infrastructure were “rewarded” with more investments. Subsequent studies by the author (Asiedu 2006, and Asiedu and Gyimah-Brempong 2007) confirmed the positive impact of infrastructure in FDI. Kandiero and Chitiga (2003), and Sekkat and Veganzones-Varoudakis (2004) also validated the correlation for 52 African states, and Middle East and North African (MENA) countries respectively. While most studies established the importance of infrastructure for FDI, there are a few that failed to support the hypothesis. Quazi (2005), for instance, could not find positive and significant relationship between infrastructure and FDI in a study on Asian countries.

3. Methodology

To examine the hypothesis that well-developed regions with superior transportation infrastructures are more attractive to foreign firms, we extend a reduced form specification for demand for inward direct investment with the above transportation infrastructure proxy. Such an economic model has been extensively used in literature (Wheeler and Mody 1992; Chen and Kwan 2000; Asiedu 2002, and Quazi 2005), and has generally included various explanatory variables as determinants of FDI, such as domestic market size, economic openness, human capital, tax incentives, labour costs, and quality of infrastructure among others.
The following economic model\(^1\) is specified, and has been guided by the empirical literature. It should be pointed out that the selection of explanatory variables was constrained by data availability for countries in Africa.

\[
F_{Di} = f(RES_{it}, SIZE_{it}, WAGE_{it}, XMGP_{it}, SER_{it}, POL_{it}, TRAN_{it}, COM_{it})
\]  

(1)

We use \(i\) to index the countries and \(t\) to denote time. The rationale for including these variables is explained within the text that follows. Extrapolation was kept to a minimum.

**Natural Resource Intensity (RES):** As posited by the eclectic theory, all else equal countries that are endowed with natural resources would receive more FDI. Very few studies on the determinants of FDI control for natural resource availability (except Gastanaga et al. 1998; Warner and Sachs 1995; Asiedu and Esfahani 2001, and Noorbakhsh et al. 2001). The omission of a measure of natural resources from the estimation, especially for African countries, may cause the estimates to be biased (Asiedu 2002). We therefore include the share of minerals and oil in total exports to capture the availability of natural resource endowments. This measure of natural resources was available from World Development Indicators 2003.

**Market Size:** For foreign investors, the size of the host market, which also represents the host country’s economic conditions and the potential demand for their output, is an important element in their FDI decision-makings. Moreover, Scaperlanda and Mauer (1969) argued that FDI responds positively to the market size “once it reaches a threshold level that is large enough to allow economies of scale and efficient utilisation of resources”. The importance of the market size has been confirmed in many previous empirical studies (Kravis and Lipsey 1982; Schneider and Frey 1985; Tsai 1994; Loree and Guisinger 1995; Wei 2000). To proxy for market size (SIZE), we follow the literature and use real GDP per capita. The figures are drawn from *Penn World Table 6*. Since this variable is used as an indicator of the market potential for the products of foreign investors, the expected sign is positive. Per capita GDP may also proxy for capital abundance (Edwards 1990) and investment climate (Wei 2000 and Asiedu 2002).

**Labour cost:** Labour cost is a major component of total production cost and of the productivity of firms. Wage variables have thus been often included in the empirical literature, and this is particularly true for labour-intensive production activities, where a higher wage would deter FDI. However, wages may also be high because of high local inflows of FDI. We use the nominal wage rate (WAGE) as used by Wheeler and Mody (1992), and Tsai

\(^1\) The model has been extensively used in literature and has generally included various subsets of explanatory variables of determinants of FDI, such as domestic market size, economic openness, human capital, tax incentives, labour costs, and quality of infrastructure, among others (see Wheeler and Mody 1992; Chen and Kwan 2000; Adeisu 2002, and Quazi 2005).
(1994) to proxy for labour cost. We would generally expect a negative sign on the coefficient (i.e., countries with lower labour costs would attract more FDI). Our source of data is the International Labour Organisation (ILO) and their yearly compilation of labour statistics\(^2\), and the World Development Indicators.

**Human Capital (SER):** Foreign direct investors should be concerned not only with the cost of labour, but also with its quality. In fact, the cost advantages accrued by lower wages in developing nations can well be mitigated by lowly skilled workers. A more educated labour force can learn and adopt new technology faster, and is generally more productive. Higher level of human capital is a good indicator of the availability of skilled workers, which can significantly boost the locational advantage of a country. Root and Ahmed (1979), Schneider and Frey (1985), Borensztein et al. (1998), 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 key role in attracting FDI. We control and test for the impact of labour quality, using the general secondary education enrolment rate (SER) (as used by Hanson 1996 and Noorbakhsh et al. 2001). The source of the data on SER was from World Development Indicators and individual countries CSO web sites.

We also added political instability (POL) following works from Schneider and Frey (1985), Edwards (1990), Loree and Guisinger (1995), Hanson (1996), Jaspersen et al. (2000) and Aseidu (2002). Political stability is a significant factor in the location decision of multinational corporations (MNCs). Frequent occurrences of political disorder “create an unfavourable business climate, which seriously erodes the risk-averse foreign investors’ confidence in the local investment climate, and thereby repels FDI” (Schneider and Frey 1985). We use a political risk rating\(^3\) as provided by the International Country Risk Guide (2004) as a proxy. The rating awards the highest value to the lowest risk and the lowest value to the highest risk, and provides a means of assessing the political and institutional framework of the countries (ICRG 1999).

**Openness:** It is a standard hypothesis that openness promotes FDI (Hufbauer et al. 1994). In literature, the ratio of trade to GDP is often used as a measure of openness of a country. It is also often interpreted as a measure of trade restrictions. Rodrik (1998) finds an inverse and robust relationship between several measures of trade policy (particularly trade restrictions) and trade/GDP. This proxy is also important for foreign direct investors who are motivated by the export market. Empirical evidences (Jun and Singh 1996; Aseidu 2002 among others) exist to back up the hypothesis that higher levels

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\(^2\) ILO collects data on over 200 countries in the areas of employment, unemployment, labour costs, wages, hours of work, consumer price indices, and several other factors.

\(^3\) The political risk index is composed of 12 indicators: Government stability, socioeconomic conditions, investment profile, internal and external conflicts, corruption, military in politics, religion in politics, law and order, ethnic tensions, democratic accountability, and bureaucratic quality.
of exports lead to higher FDI inflows. We therefore include trade/GDP in the regression to examine the impact of openness on FDI.

**Transport Infrastructure:** This is the variable that is central to our study. To assess the level and quality of transport infrastructure, the only consistent and reliable measure available for our sample is the length of paved roads per square kilometre of area \((\text{TRANS})\). This measure has been used by a number of authors, especially in the assessment of the economic importance of the general level of transport infrastructure (Canning 1999; Canning and Bennathan 2000). The data was available and constructed from Canning (1999) database, the International Road Federation (IRF), and also from the central statistical offices in various countries.

To control for other types of infrastructure in the recipient countries and to better model the role of infrastructure in FDI, a proxy for communication infrastructure, namely the number of telephones available per 1,000 people \((\text{COM})\), was added. Availability of main telephone lines is necessary to facilitate communication between the home and host countries. This measure has been extensively employed in the determinants of foreign direct investment literature, for instance by Loree and Guisinger 1995, and by Asiedu (2002, 2006).

The dependent variable, \(\text{FDI}\), is measured as the net foreign direct investment inflow as a percentage of GDP, and is a widely used measure (Asiedu 2002, 2006, and Quazi 2005). The main sources of data series are from the International Monetary Fund’s International Financial Statistics (IFS) (various issues), World Development Indicators (various issues) and from the African Development Bank’s Selected Statistics on African Countries (2000). The study covers the 1985-2004 period for a sample of 25 African states.

### The Econometric Model and Preliminary Tests

Applying logs on both sides of the equation 1 (for elasticities) and denoting the lowercase variables as the natural log of the respective uppercase variable and \(t\) for time results in the following:

\[
\text{fdi}_{it} = \alpha + \beta_1 \text{res}_{it} + \beta_2 \text{size}_{it} + \beta_3 \text{wage}_{it} + \beta_4 \text{xmgdp}_{it} + \beta_5 \text{ser}_{it} + \beta_6 \text{pol}_{it} + \\
\beta_7 \text{tran}_{it} + \beta_8 \text{com}_{it} + e_{it}
\]

The Im, Pesaran, and Shin (1995) panel unit root tests were applied on the dependent and independent variables. Im, Pesaran, and Shin (1995) developed a panel unit root test for the joint null hypothesis that every time series in the panel is non-stationary. This approach is based on the average of individual series ADF (Augmented Dickey-Fuller) test, and has a standard normal distribution once adjusted in a particular manner. Results of this test

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4. The countries included in the study are Angola, Benin, Botswana, Cameroon, DRC, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Senegal, South Africa, Uganda, Zambia, and Zimbabwe.
applied on our time series in levels reject a unit root in favour of stationarity. The results were also confirmed by the Fisher-ADF and Fisher-PP panel unit root tests at the five percent significance level for each variable. It was judged safe to continue with the panel data estimates of the above econometric specification.

Dynamic Panel Data Regression.

There is still the possibility of endogeneity of the explanatory variables and the loss of dynamic information even in a panel data framework. For instance, Quazi (2005) argued that foreign investors were typically risk averse and would favour familiar territories, thus implying endogeneity and dynamism in FDI modelling. The author explained that it appeared very important for countries to “establish a track record of FDI inflow, which could help dispel the foreign investors’ fear of investing in an unknown location”. Cheng and Kwan (2000) further argued that FDI was one of the least volatile forms of foreign capital flows. It has a relatively higher sunk cost of physical investment and becomes more irreversible once it is undertaken. It is thus likely to be persistent over time. Noorbakhsh et al. (2001) also brought evidence that many multinational corporations test their new markets by staggering their investments, which gradually reach the desired levels after some time adjustments. It is expected that incremental lagged changes in FDI should therefore contribute positively toward the current level of FDI. In the words of Kinoshita (1998), “it takes time for the stock of FDI to reach the optimal level”.

The incorporation of dynamics into our model necessitates the equation above to be rewritten as an AR (1) model in the following:

\[ \text{fdi}_{it} - \text{fdi}_{it-1} = \alpha_t + v \text{fdi}_{it-1} + \beta x_{it} + \mu_{it} \] (3)

The left hand side is the log difference in foreign direct investment over a period. \( \text{fdi}_t \) stands for the log of FDI at the start of that period, and \( x_{it} \) is the vector of explanatory variables, i.e., \( x = [\text{res}, \text{size}, \text{wage}, \text{xmgdp}, \text{pol}, \text{trans}, \text{com}, \text{ser}] \). \( \alpha_t \) represents the period specific intercept terms to capture changes common to all sectors, while \( \mu_{it} \) denotes the time variant idiosyncratic error term.

Equivalently, the above equation can be written as:

\[ \text{fdi}_{it} = \alpha_t + (v+1) \text{fdi}_{it-1} + \beta x_{it} + \mu_{it} \] (4)

We can also write the above in first differences:

\[ \Delta \text{fdi}_{it} = \alpha_t + (v+1) \Delta \text{fdi}_{it-1} + \beta \Delta x_{it} + \Delta \mu_{it} \] (5)

A problem of endogeneity might exist if \( \text{fdi}_{it-1} \) is endogeneous to the error terms through \( u_{it-1} \). It will therefore be inappropriate to estimate the above specification by OLS. To overcome this problem of endogeneity, an instru-
mental variable need to be used for $Afdi_{it-1}$. Two approaches, namely Instrumental Variable (IV, Anderson and Hsiao 1982) and two GMM estimators (Arellano and Bond’s 1991), first and second step respectively, can be used in this regard. We used the latter technique because the IV approach leads to consistent but not necessary efficient estimates of the parameters (see Baltagi 1995). Moreover, the first step GMM estimator will be used. It has been shown to result in more reliable inferences. The asymptotic standards errors from the two step GMM estimator have been found to have a downward bias (Blundell and Bond 1998). The results from estimating equation (5), extended with a lagged term using the Arellano-Bond (1991) first step GMM estimator, are contained in Table 1.

The consistency of the estimation depends on whether lagged values of the endogenous and exogenous variables are valid instruments in our regression. Also, this methodology assumes that there is no second-order autocorrelation in the errors. Therefore, a test for the previous hypotheses is needed. We have accordingly conducted a test for autocorrelation and the Sargan test for over-identifying restrictions as derived by Arellano and Bond (1991).

## Table 1. Dynamic Panel Data Estimation (First Step GMM estimator)

<table>
<thead>
<tr>
<th>Variable</th>
<th>GMM estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.004 (0.29)</td>
</tr>
<tr>
<td>$fdi_{it-1}$</td>
<td>0.53 (4.64)** ***</td>
</tr>
<tr>
<td>$dres$</td>
<td>0.022 (2.22)**</td>
</tr>
<tr>
<td>$dsize$</td>
<td>0.13 (3.69)** ***</td>
</tr>
<tr>
<td>$dwage$</td>
<td>–0.07 (-3.44)** ***</td>
</tr>
<tr>
<td>$dmgdp$</td>
<td>0.14 (8.04)** ***</td>
</tr>
<tr>
<td>$dpol$</td>
<td>-0.2 (-0.33)</td>
</tr>
<tr>
<td>$dtrans$</td>
<td>0.07 (1.80)*</td>
</tr>
<tr>
<td>$dcom$</td>
<td>0.04 (3.17)** ***</td>
</tr>
<tr>
<td>$dser$</td>
<td>0.16 (4.55)** ***</td>
</tr>
</tbody>
</table>

### Diagnosis tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sargan Test of Over-identifying restrictions</td>
<td>prob&gt;chi2=0.94</td>
</tr>
<tr>
<td>Arellano-Bond test of 1st order autocorrelation</td>
<td>prob&gt;chi2=0.12</td>
</tr>
<tr>
<td>Arellano-Bond test of 2nd order autocorrelation</td>
<td>prob&gt;chi2=0.18</td>
</tr>
<tr>
<td>Wald Test</td>
<td>Prob&gt; chi2=0.00</td>
</tr>
</tbody>
</table>

*significant at 10 percent, ** significant at 5 percent, ***significant at 1 percent

The small letters denote variables in natural logarithmic. d denotes variables in first difference and the heteroskedastic-robust z-values are in parentheses.
Failure to reject the null hypothesis related to Sargan Test (confirmed by the Hansen J Statistic) of over-identifying restrictions (suggesting no invalid over-identifying restrictions) and the Arellano-Bond test of 2nd order autocorrelation (validating the use of the suitably lagged endogenous variable as instrument) support a correct model specification. To note that first differencing of the variables naturally generates first order autocorrelation, we test for second order autocorrelation in the error term.

The model also passes the Wald test. A Hausman test was further used to test for the strict exogeneity of all regressors in the model, hence the appropriateness of our model.

From Table 1, it is observed that the robust coefficient of transport capital is positive and significant, implying that foreign direct investors are sensitive to transport capital. This is in line with the theoretical underpinnings discussed earlier. Communication infrastructure is also judged to be important by these investors, though to a slightly lesser extent than transport.

These findings are particularly true for the case of Africa, where much of FDI have originally flown to the extractive industries, which are usually located in remote areas, and thus requires access to basic amenities such as roads, communication facilities, electricity, and water among others. Aseidu (2002) argued that “physical infrastructure is more relevant for non-natural resource (non extractive industries) based investments. As a consequence, host countries need to provide infrastructure of much better quality than the infrastructure available in previous years, in order to attract the ‘new’ types of FDI”. Provision of infrastructure could explain to some extent, the change in sectoral composition of FDI (towards investments in non-extractive industries) to Africa. Our results are particularly consistent (although observed to be comparatively lower) with the findings of Aseidu (2002, 2006), and more recently, Asiedu and Gyimah-Brempong (2007) for the African context. Thus, the result indicates that countries that improved their transport and other types of infrastructures have attracted significant amounts of investment from foreigners.

As far as the other explanatory variables are concerned, they are seen to behave according to theoretical predictions, and are in line with recent empirical evidences. For instance, the abundance of natural resources, as measured by RES, is seen to be positive and significant, confirming the results of Aseidu (2002) and Asiedu and Gyimah-Brempong (2007) for the African case. This means the presence of resource-seeking FDI, though the elasticity cannot be readily interpreted, since it is a qualitative variable.

Openness had a positive impact on FDI as well, suggesting that an efficient environment that comes with more openness to trade is likely to attract foreign firms (as supported by Asiedu 2002; Edwards 1990), and that those countries in Africa that embarked on trade liberalisation were rewarded with more FDI. The significance of xmgdp, even after controlling for natural resource availability, suggests that FDI is not only resource seeking, and that governments can play major roles as well in the FDI equation. FDI is there-
fore believed to flow to non-extractive industries (non-natural resource based) as well. This is particularly important to Africa because investments in areas like manufacturing and in technologically intensive industries enhance technological spill-overs and foster employment.

The size of the domestic market and stock of human capital, though to a large extent as witnessed by the size of their respective coefficients, play a positive role in attracting FDI. Political instability and labour cost contribute negatively to FDI. The results are consistent with empirical works in the field.

Interestingly, the positive and significant coefficient of $\text{fdi}_{-1}$ from the table shows that lagged FDI has been contributed positively towards the current level of FDI, which means that there is a self-reinforcing effect of FDI. This suggests that foreign investors’ incremental knowledge about investment opportunities in host countries are also important.

Indeed, the value of the robust-heteroskedastic coefficient of the lagged FDI is 0.53 for the aggregate sector sample case, implying a coefficient of partial adjustment $\alpha$ of 0.47. Kinoshita and Campos, 2004, found similar adjustment pace for Central and Eastern European, and former Soviet Union countries. This means that net investment in one year is 47 percent of the difference between the optimal and the current level of $\text{fdi}$. The fact that a lower $\alpha$ means a slower speed of adjustment implies a larger role for persistence in the pattern of FDI in these economies. This confirms the existence of dynamism and endogeneity in FDI modelling. It is consistent with Cheng and Kwan (2000), Kinoshita and Campos (2004), and Quazi (2005). The openness of the country, labour cost, and host country’s literacy level are also reported to be important ingredients in the inflow of FDI in Africa countries.

4. Conclusions

This paper investigated the role of transport infrastructure in enhancing the attractiveness of FDI recipient countries. It is based on a sample of 25 African countries over the 1985-2004 period. Using dynamic panel data framework, results from the analysis shows that transportation capital has been an important ingredient in making the countries attractive to foreign direct investors in both the short and long run. The same is observed for the case of non-transport infrastructure. The results are consistent with those obtained recently by scholars, particularly for developing country cases. The positive and significant lagged value of the dependent variable from the dynamic panel data estimates also confirms the existence of dynamism and endogeneity in FDI modelling. This suggests that there is a self-reinforcing effect of FDI on itself and that foreign investors’ incremental knowledge about investment opportunities in host countries are also important. The other classical variables included in the model yielded the expected results in general, with education, openness, and size, being among the main drivers of FDI.
These findings imply that transportation and other infrastructure development are integral elements of the strategy to attract FDI inflows. This is particularly true for Africa counties, where there is much to be done in that respect. The results should be meaningful to governments in formulating policies.

References

AFD (2004), "Developing Countries: Leveraging the Role of Multinationals", Workshop organized jointly by AFD and IFRI in Paris on June 10, 2004


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Quazi R (2005), “Economic Freedom and Foreign Direct Investment in East Asia”. International Academy of Business and Public Administration Disciplines (IABPAD) meetings


WDI (2002), World Development Indicators, World Bank, Washington, D.C.

World Bank (2005), World Development Indicators on CD-Rom.