
Foreign Direct Investment an Engine for Development: Factors Determining Its Inflow to the Sudan

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To cite this article:

Emmanuel Pitia Zacharia Lado. Foreign Direct Investment an Engine for Development: Factors Determining Its Inflow to the Sudan. *Economics*. Vol. 4, No. 5, 2015, pp. 81-89. doi: 10.11648/j.econ.20150405.12

Abstract: The study was carried out to establish the possible factors that determine the inflow of Foreign Direct Investment into the Sudan. Using OLS and annual time series data for the period 1980 to 2011, the study established that variables that determine inflow of FDI both in the long-run and short-run for the Sudan are the market size and the level of development. While infrastructure development and financial sector development have been the determining factors for the FDI flow to the country in the long-run, they do not possess any effect on the FDI flow into the country in the short-run. Additionally, inflation as a proxy for macroeconomic instability and openness of the economy to the outside world have been effective in determining the inflow of the FDI to the Sudan in the short-run but do not have any impact on the FDI flow to the country in the long run. The ECM term in the short-run dynamics shows that FDI was above its equilibrium value and has been moving downwards towards its equilibrium value, however, with low speed of adjustment towards its equilibrium value. As much as the study succeeded in attaining its objectives, the study suffers from lack of data for some variables and this has reduced the findings of the study. Additionally, with the break away of southern part of the country (now South Sudan), coupled with the civil war in the country, Sudan is likely to lose out foreign investors.

Keywords: FDI, Sudan, Determinants, Unit Root, ECM

1. Overview

Foreign Direct Investment (FDI) also known as Direct Foreign Investment (DFI) entails the ownership of productive assets by a corporation in another nation (Cypher & Dietz, 2004). Such ownership should be distinguished from the purchase of foreign stock or the lending of funds to foreign companies and governments which are known as portfolio investments. Foreign direct investment (FDI) of a recent has dominated the literature pertaining to Economic growth and development in the developing and underdeveloped countries. The benefits to a host country associated with the inflow of FDI are enormous: FDI inflow is a means of transferring technology and advanced forms of organizations to a host country, helps in human capital formation, creating a more competitive business environment, filling the gap between domestic savings and domestic investment (Todaro & Smith, 2003), and helps the host country in breaking the vicious cycle of underdevelopment (Hayani, 2001). However, the impacts of FDI on poverty depend on many factors including the host country's institutions and policies, the quality of the

labour market, the economic environment, and investment itself (Mayne, 1997).

1.1. Problem Statement

Contribution of foreign direct investment to domestic investment and therefore development in the host countries especially in the developing world where the level of domestic savings is low cannot be downplayed. In addition to its relatively higher resilience as a source of capital flow to developing countries, FDI is regarded as a potential catalyst for raising productivity in developing host countries through the transfer of technology and managerial know-how, and for facilitating access to international markets (Ocampo et al, 2007). The case of development that was thought to be supported by foreign aid has now shifted to depend on FDI. Every country in the developing world in which African countries with Sudan being a subset are no exceptions, have taken concern to host FDI as a means to foster development. Despite this interest to have FDI, most countries have never been able to create an environment conducive enough to attract FDI to those countries probably due to lack of

knowledge. In the Sudan, no study has ever been taken to determine the possible determinants of FDI flow to the country. This study is intended to discover the possible factors that determine the inflow of FDI to the country both in the long-run and in the short-run.

1.2. The Objectives of the Study

Generally, the study is intended to identify the different determinants of FDI flow into the Sudan. In particular, the study is carried out to:

- i. Establish the possible determinants of FDI inflow into the Sudan for the period covered in the study.
- ii. Identify whether there exists long-run relationships between the dependent variable and each of the determinants.

1.3. Hypotheses Tested

To achieve the objectives stated above, the following hypotheses were tested.

- i. Market size does not determine the inflow of FDI into a country.
- ii. The level of development in terms of per capita GDP does not affect the amount of FDI into a country.
- iii. The level of infrastructure does not impact the inflow of FDI into a host country.
- iv. Macroeconomic instability has no impact on FDI inflow.
- v. Host country's openness to the outside world in terms of trade relations does not determine the level of FDI inflow into a concerned country.
- vi. The level of financial sector development does not determine the FDI inflow to a country.

2. Literature Review

This section presents both the theoretical framework and the empirical literature review. Each of the two is presented briefly below.

2.1. Theoretical Literature

Literature on foreign direct investment as a wheel for development is so wide and diverse.

In sum, FDI can be of great value to less developed countries. Most foreign investment projects do generate substantial positive economic benefits for the third world. An investment climate that rewards the investors sufficiently to compensate them for their risk is necessary to attract foreign corporations.

A good investment climate provides opportunities and incentives for firms to invest productively, create jobs, and expand, therefore promoting economic growth and poverty reduction. Investment climate can be grouped into:

Economic, social, and political instabilities deter investment by making future rewards more uncertain and undermining the value of assets. For example, high inflation and volatile real exchange rates can weaken the position of creditors, making access to credit more difficult. Moreover,

the impact of instability is more likely to be felt by medium and small firms rather than large firms, because the latter are more likely to have tools at their disposal to cope with these risks, including better access to dollar accounts, financial instruments, and credit from overseas (Fiestas & Sinha, 2011).

Crime and corruption undermines the investment climate as it not only discourages firms from investing but also increases the costs of business, whether through the payment of bribes, the direct loss of goods or the costs of taking precautions such as hiring security guards or installing alarm systems (Fiestas & Sinha, 2011; UNCTAD, 1998; Gadkarim, 2012).

Institutional constraints (Business regulations and licensing): Regulations impose necessary costs on firms such as the need to adapt the business to meet regulatory requirements or to pay licensing fees, but too often these costs are unnecessarily high because of rent-seeking behaviour, inefficient administration, or poor institutional fit (World Bank, 2005a, Fiestas & Sinha, 2011), thereby reducing business entry and firm growth.

Institutions and the legal system: A reliable institutional and legal system is essential for firms to invest as it reduces the risks and uncertainties that they face when entering into commercial agreements. For example, delays or uncertainties in the enforcement of contracts governing exchange diminishes the opportunities and incentives to invest as firms cannot commit to long term and complex commercial contracts (Fiestas & Sinha, 2011). That is, important is the level of legal infrastructure strong enough to impose anti-corruption laws such that no bribes are paid by the investors in addition to economic and political stability (UNCTAD, 1995; UNCTAD, 1998).

Taxation: Whilst taxation is necessary to finance public goods and re-distribute income, the process through which a government collects tax can entail substantial costs in terms of growth. The most obvious cost is that higher tax rates on businesses can reduce incentives of investment and risk-taking because post-tax profits would be lower. In addition, the cost of compliance with the administration of taxes can be high (Fiestas & Sinha, 2011; UNCTAD, 1998; Salvadori et al, 2009; Gadkarim, 2012).

Financial constraints (access to and cost of finance): Firms need to be able to access those financial instruments that they needed in order to operate efficiently (e.g. payment services) and invest (e.g. loans, quasi debt). Moreover, the cost of capital needs to be reasonable because, if it is too high, the expected rate of return to investment after the payment of the cost of capital will be too low (or even negative) and firms will have no incentive to invest (Fiestas & Sinha, 2011, Ocampo et al, 2007).

Infrastructure: Firms need access to a reliable electricity supply, efficient transport links and modern telecommunications services to have the incentives to invest more. Good access to infrastructure allows firms to become more productive, reduce costs and expand their businesses (Fiestas & Sinha, 2011, UNCTAD 1998, Ocampo et al, 2007).

Micro-level constraints: Besides the investment climate constraints examined so far, there are also firm level factors that can have a very significant impact on the birth and development of firms (Dicken, 1992; Ocampo, 2007). In order to grow, firms need to make productive investments - increases in productivity will then make firms more competitive and this will increase the returns to the investment. However, improving a firm's productivity (which is determined by the available technology or know-how for converting resources into outputs and the way in which resources are organized in firms to produce goods and services) is limited (Fiestas & Sinha, 2011) coupled with continuing civil conflicts, political crises and natural disasters, especially drought, in a country (UNCTAD, 1995). The list of those countries is long but at least countries like Somalia, Sudan, are still suffering from civil wars. Another group of countries that include Rwanda, Liberia, Eritrea, Ethiopia, Mozambique, Uganda, and similar others have emerged from civil wars. Another group of African countries that have been affected one time or the other include Algeria, Libya, Morocco, Tunisia and Zimbabwe (UNCTAD, 1995).

Development as measured by GDP per capita (UNCTAD, 1995; UNCTAD 1998; Salvadori et al, 2009; Dicken, 1992), market size in terms of total GDP or size of population (UNCTAD, 1995; UNCTAD 1998, Salvadori et al, 2009; Dicken, 1992), and market growth as measured by GDP growth rates in constant prices (UNCTAD, 1995, UNCTAD 1998) are, as a rule the most important determinants for the vocational decisions of transnational corporations (TNCs).

Openness (Salvadori et al, 2009) is a factor that accounts for FDI inflows to the liberalized economies.

There are a number of other factors that determine FDI flows such as availability of natural resources (UNCTAD, 1995; Dicken, 1992; Salvadori et al, 2009), and the cost and productivity of labour (UNCTAD, 1995; UNCTAD, 1998, Dicken, 1992; Salvadori et al, 2009; Ocampo et al, 2007).

2.2. Empirical Literature Review

Different studies have been conducted to establish the potential factors that would determine the inflow of FDI into a host developing country both in Africa and elsewhere in the developing worlds of Asia and South America.

Haile & Assefa (2006) did a study on the determinants of FDI in Ethiopia using time series data for the period 1974 - 2001. The independent variables considered in the study were market size represented by real per capita GDP, market growth potential proxied for by growth rate of real GDP, export orientation (openness) which is represented by the relative size of the export sector in GDP, macroeconomic instability proxied for by inflation rates and exchange rates, infrastructure (measured by gross fixed capital formation as a percentage of GDP), human capital (measured by adult illiteracy rate as a percent of people age 15 years and above), and liberalization of the economy by employing a dummy variable in a discrete form. The results indicate that growth rate in real GDP, export orientation, liberalization, have positive impact on FDI. On the other hand, macroeconomic

instability and poor infrastructure have negative impact on FDI.

Nonnemberg & Mendonca (n.d) carried out a study on 'The determinants of Foreign Direct Investment in Developing Countries using panel data approach'. The data used in the study covered a period as from 1975 to 2000 for 33 developing countries including countries in the continent of Africa, Asia, and South America. The variables used include GDP, average rate of GDP growth, level of schooling of the labour force, the degree of trade openness, the rate of inflation, the risk rating, per capita energy consumption, the Dow Jones index, and the average rate of growth of the largest OECD exporters of FDI to developing countries. The results were that the levels of schooling, openness of the economy, risk, inflation, and economic growth, have effects on FDI. Stock market performance also affects FDI.

Quazi (2007) did a study on 'Investment Climate and Foreign Direct Investment: A study of selected countries in Latin America', using a panel data approach covering nine Latin American countries for the period 1995 - 2004. In the study, a host of regressors comprising lagged changes in FDI, economic freedom measured by the index of economic freedom, domestic market size measured by per capita real GDP, human capital measured in terms of adult literacy rate, infrastructure measured in terms of mobile phone connections per capita, returns on investment proxied with inverse of per capita real GDP, and trade openness measured in terms of the share of total volume of trade (exports and imports) in GDP were employed. The results indicate that the lag FDI, infrastructure, returns on investment, and trade openness, significantly and positively affect FDI inflow while the lack of economic freedom significantly depresses the inflow.

Hussain & Kimuli (2012) conducted a study on the Determinants of Foreign Direct Investment flows to Developing Countries employing a panel data for 57 low and lower middle income countries for the period 2000 - 2009. The regressors used in the study were the GDP per capita on purchasing power parity a proxy for market size, inflation rate, tariff rate on imports, higher secondary enrollment rate, broad money supply to GDP ratio, and country and time specific dummies. The findings suggest that the market size, tariff, availability of skilled labour, have enhancing effect on the FDI while inflation affects FDI flow to developing countries negatively. However, financial sector development has insignificant effect on FDI flow.

Asiedu (2002) carried out a study on the Determinants of Foreign Direct Investment to Developing Countries: Is Africa Different? using panel data approach for three subperiods: 1988 to 1990, 1991 to 1993, 1994 to 1997. The independent variables in the study were return on investment in the host country, infrastructure development (telephones per 1,000 population as a proxy for infrastructure development), openness of the host country (ratio of imports + exports) to GDP, Political risk, the ratio of liquid liabilities to GDP as a measure of financial depth, the ratio of government consumption to GDP as a measure of the size of government,

the inflation rate as a measure of the overall economic stability of the country and the growth rate of GDP as a measure of the attractiveness of the host country market. The results show that openness, infrastructure development and the return on investment cause changes in FDI inflow. The results equally show that the ratio of FDI to GDP increases with the degree of openness to international trade, infrastructure development and the return on investment. However, all the other economic variables and political risk were insignificant.

Sichei & Kinyondo (2012) using a sample of 45 African countries for the period 1980 to 2009 did a study on 'Determinants of Foreign Direct Investment in Africa: A Panel Data Analysis'. The model contains a set of independent variables namely Real GDP growth, openness (ratio of exports to GDP), national international policy coded as 1 and 0, natural resources using dummy variable coded 1 and 0, political governance measured by the years of current president in power, and regional trade agreement block variables. The results of the study indicate that agglomeration effects were highly significant on FDI, the real GDP growth, trade openness natural resources availability; all have positive significant effect on the FDI. Additionally, bilateral investment treaties, and double taxation treaties, have significant and positive effect on FDI inflow. However, political governance has no strong effect on the choice of location for FDI inflow including whether the president is a military officer or not.

Anyanwu (2012) carried out a study on 'Why Does Foreign Direct Investment Go Where It Goes? New Evidence From African Countries', employing annual panel data for 53 African countries, covering the period 1996 to 2008. The independent variables in the model consist of urban population as a percentage of total population, GDP per capita (in US\$), openness index –total trade (% of GDP), financial development (domestic credit to the private sector as % of GDP), annual inflation rate, annual average official exchange rate to US\$, infrastructure (in fixed and mobile subscribers per 1000 people), human capital (gross secondary school enrollment), foreign aid (% of GDP), real GDP growth, lag 1 of FDI, corruption (control of corruption percentile rank 0 – 100), regulatory quality (percentile rank 0 – 100), rule of law (percentile rank 0-100), and net oil exports. The results show that market size (urban population share of total population), openness, foreign aid, natural resource endowment, all have significant effects on FDI inflows to Africa, while the real GDP per capita does not have significant effect on FDI, and financial development has negative effects on FDI flows to African countries.

In conducting a study on the 'Foreign direct investment, does it matter? A case of Zimbabwe, Sikwila (2015) employed annual time series data for the period 1980 to 2012 by the means of OLS estimation method. The variables employed in the study were output (real GDP), trade openness (as a ratio of exports plus imports to GDP), political stability, domestic investment measured in terms of fixed capital formation, inflation (a proxy for macroeconomic

stability), property rights, and indigenization, using dummy variables (1980 to 2000 = 0 when the policies did not exist and 2001 to 2012 = 1 when the policies exist). The results indicated that output, trade openness, political stability, domestic investment and inflation were significant and as such were exerting influences on FDI flows into Zimbabwe while property rights and indigenization were insignificant.

Brima (2015) carried out a study on the 'Macroeconomic Determinants of Foreign Direct Investment in Sierra Leone: An Empirical Analysis' using OLS estimation method for time series data covering the period 1990 to 2013. The variables used for the study were market size (proxied by host country's GDP), openness (the host country's ratio of imports + exports to GDP), exchange rate, inflation, money supply, government expenditure, natural resource availability (measured as a share of minerals, natural gas, forest, and oil in total exports), and political stability expressed as a dummy variable to capture the period of war (1991 to 2001 = 1 and 0 otherwise). The results show that the market size, openness, exchange rate, natural resource availability exert positive effects on FDI while inflation and money supply have negative influences on the FDI in Sierra Leone.

3. The Methodology of the Study

3.1. The Data

In this study annual time series data collected from two different sources covering the period 1980 to 2011 were used. The data for GDP (proxy for market size), GDP per capita (a measure of demand or level of development), fixed capital formation (a proxy for infrastructure), inflation (to proxy for macroeconomic instability), openness (measured by ratio of exports to GDP), and financial sector development (measured in terms of broad money supply as a percentage of the GDP), were collected from the World Bank database. The data for FDI were collected from the United Nations Conference on Trade and Development (UNCTAD) database.

3.2. The Model

In this study, Ordinary Least Squares (OLS) estimation method was employed. As in the literature, different variables (factors) have been identified being the determinants of FDI inflows into different countries of which the Sudan would not be an exception. However, because of lack of data for some of the variables, the model was formulated to include only those variables whose data were able to be obtained for the Sudan. Therefore, the functional form of the model became:

$$FDI = f(GDP, PCGDP, INFRAS, INF, Open, FSD) \quad (3.1)$$

Given the above functional form, the model estimated became:

$$FDI_t = \beta_0 + \beta_1 GDP_t + \beta_2 PCGDP_t + \beta_3 INFRAS_t + \beta_4 INF_t + \beta_5 Open_t + \beta_6 FSD_t + \varepsilon_t \quad (3.2)$$

Where:

FDI = Foreign direct investment

GDP = Total GDP as a measure of market size in the country

PCGDP = Gross Domestic Product per capita (a proxy for level of development)

IFRAS = Infrastructure (measured in terms fixed capital formation as a share of GDP)

INF = Inflation rate a proxy for macroeconomic instability

Open = Openness of the economy to the external trade links (to measure the degree of country's openness to the rest of the world)

FSD = Financial sector development in the concerned economy

ε = error term

t = Represents the time series dimension in the data

Based on the results of the model in equation(3.2) above, a battery of diagnostic tests were conducted and it was established that the model suffered from lack of normality of the errors based on the Jarque-Bera (JB) test statistic. With skewness coefficient being different from 0 and its kurtosis being different from 3 (i.e. 6 greater than 3), the model became not appropriate (Gujarati, 2011). To solve the problem of the lack of the normality of the errors of the concerned variables in the model, the linear model in (3.2) above was abandoned in favour of the logarithmic transformed model in (3.3) below.

$$LFDI_t = \beta_0 + \beta_1 LGDP_t + \beta_2 LPCGDP_t + \beta_3 LIFRAS_t + \beta_4 LINFR_t + \beta_5 LOPEN_t + \beta_6 LFSD_t + \varepsilon_t \quad (3.3)$$

3.3. Unit Root Test

Time series data for most developing countries such as the Sudan are non-stationary. Estimation within such an environment not only violates most classical econometric assumptions, but also renders policy making from such econometric results less accurate. In cases where the data series exhibit unit roots, the short-run dynamic properties of the model can only be captured in an error correction model, when the existence of cointegration has been established (Engle & Granger, 1987). That is, to avoid spurious regression, variables that are at the same level of integration were to enter the regression equation. Therefore, in this study a test for a unit root was conducted.

To carry out the test of unit root, the study applied the test method developed by Dickey and Fuller (1979) popularly known as Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) test. To illustrate the use of DF test, consider first a general form of an AR (1) process:

$$y_t = \mu + \rho y_{t-1} + \varepsilon_t \quad (3.4)$$

where μ and ρ are parameters and ε_t is assumed to be white noise. y is stationary if $-1 < \rho < 1$. If $\rho = 1$, y is a nonstationary series (i.e. a random walk with drift). If the

absolute value of ρ is greater than 1, the series is explosive. Therefore, the hypothesis of nonstationary series can be evaluated by testing whether the absolute value of ρ is strictly less than 1. The DF test method takes the unit root as the null hypothesis $H_0 : \rho = 1$. Since explosive series do not make much economic sense, this null hypothesis is tested against the one-sided alternative $H_1 : \rho < 1$. The test is carried out by estimating an equation with y_{t-1} subtracted from both sides of the equation:

$$\Delta y_t = \mu + \delta y_{t-1} + \varepsilon_t \quad (3.5)$$

where $\delta = \rho - 1$ and the null and alternative hypotheses are:

$H_0 : \delta = 0, H_1 : \delta < 0$. The test is based on the critical values simulated by Mackinnon (1991). The simple unit root test described above is valid only if the series AR (1) process is uncorrelated. If the series is correlated at higher order lags, the assumption is violated. The ADF test use different method to control for higher order serial correlation in the series. The ADF test makes a parametric correction for higher order correlation by assuming that the y series follows an AR (p) process and adjusting the test methodology. The approach controls for higher order correlation by adding lagged differenced terms of the dependent variable y to the right hand side of the regression:

$$\Delta y_t = \mu + \lambda y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \dots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \quad (3.6)$$

This augmented specification is then used to test $H_0 : \lambda = 0$ against the alternative $H_0 : \lambda < 0$ in the test regression. In carrying out the above test, one has to specify the number of lagged first difference terms to add to the test regression (selecting zero lag yields the DF test; choosing lags greater than zero generate ADF tests).

The decision to whether to include a constant, a constant and a linear trend, or neither in the test regression, was taken on the basis of the following: each of the series was graphed and observed, if the series did not exhibit any trend and has a nonzero mean, a constant was included in the test regression, if the series exhibit a trend and a constant, then a constant and a trend was included, while if the series seems to be fluctuating around a zero mean, neither a constant nor a trend was included into the regression test.

In this study, the lag length (i.e. p) was chosen as follows:

Firstly, a DF test was carried out on a given variable and secondly, each of the variables - $LFDI_t$, $LGDP_t$, $LPCGDP_t$, $LINFRAS_t$, $LINF_t$, $LOPEN_t$, $LFSD_t$ - was regressed on its first lag. Thirdly, statistics (i.e. the coefficients, the t-statistic, the standard errors, and the p-values) of the first lag in the DF and estimated equation results were compared to ensure that indeed the variable was regressed on its own first lag (which normally indicated by the equality of the statistics). Then a test of autocorrelation

conducted by the Breach-Godfrey method with lags zero up to the lag where there were no serial correlations. This procedure was carried out on each of the variables in levels and first differences. In levels, the variable $LGDP_t$ was found to have serially correlated errors from lag zero to lag four and as such ADF test was employed in unit root test for this variable. The variables, $LFDI_t$, $LPCGDP_t$, $LINFRAS_t$, $LINF_t$, $LOPEN_t$, $LFSD_t$, were having no serially correlated errors and as such DF was used to test for stationarity.

In first differences, the same procedure was followed as above to establish the lag length in testing for a unit root. It was found that the first differences were not serially correlated and as such DF was used in every case. The result of the unit root test showed that all the variables in the regression were nonstationary in levels. That is, in levels, every variable in the regression model was $I(1)$. In first differences, all the variables were found to be stationary. This means that in first differences, all the variables were $I(0)$. The results of unit root tests in levels and in first differences are presented in tables (3.1) and (3.2) below, respectively.

Table 3.1. The results of unit root tests in levels.

Variable	DF/ADF	T-Statistic	Order of integration
LFDI	DF	-1.178109**	$I(1)$
LGDP	ADF	-1.307220**	$I(1)$
LPCGDP	DF	-0.739396**	$I(1)$
LINFRAS	DF	-2.397375**	$I(1)$
LINF	DF	-1.649091**	$I(1)$
LOPEN	DF	-2.243292**	$I(1)$
LFSD	DF	-0.693300**	$I(1)$

** All values insignificant at 1%, 5%, and 10%.

Table 3.2. The results of unit root tests in first differences.

Variable	DF/ADF	T-Statistic	Order of integration
Δ LFDI	DF	-3.076404*	$I(0)$
Δ LGDP	ADF	-10.02448*	$I(0)$
Δ LPCGDP	DF	-4.718622*	$I(0)$
Δ LINFRAS	DF	-7.045065*	$I(0)$
Δ LINF	DF	-5.443147*	$I(0)$
Δ LOPEN	DF	-7.701059*	$I(0)$
Δ LFSD	DF	-4.472340*	$I(0)$

* All values significant at 1% level

3.4. The Cointegration Test

A number of methods to test for cointegration have been analyzed in the econometric literature among which is the Engle-Granger two-stage procedure (EG) or the Augmented Engle-Granger two stage procedure (AEG). The test for cointegration in this study was carried out by the EG/AEG test procedure. The EG test procedure goes as follows:

Let us suppose a general case where y_t is regressed on x_t both being time series. Subjecting each of these time series to

unit root test, it is found that these variables are $I(1)$; that is, they contain unit roots. Supposed then that $y_t\sqrt{2}$ is regressed on x_t as follows.

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t \quad (3.7)$$

The above equation can be written as:

$$\varepsilon_t = y_t - \beta_0 - \beta_1 x_t \quad (3.8)$$

where the dependent variable is regressed on several explanatory variables. If the linear combination of two or more series is stationary, that is; $I(0)$, it can be said that the variables are cointegrated. Economically speaking, two or more variables are said to be cointegrated if they have a long term, or equilibrium, relationship between or among them. A test Supposed ε_t is subjected to a unit root test and is found that it is stationary; that is, it is $I(0)$. This means that, although y_t and x_t are individually $I(1)$, that is, they have stochastic trend, their linear combination in (3.7) above is $I(0)$. That means the linear combination cancels out the stochastic trends in the two series. This concept can be extended to a regression of cointegration as Granger noted can be thought of as a pre-test to avoid 'spurious regression' situation. In this case, a regression such as (3.7) above is known as a cointegrating regression and the slope parameter β_1 is known as the cointegrating parameter. In the case of regression model containing k regressors, we are to have k cointegrating parameters. This procedure subjects the errors from the cointegrating equation, say in (3.7) to a unit root test by DF or ADF test depending on whether there are no lagged terms of the AR (1) process or there are lagged terms of the AR(p) process. However, the critical values from DF or ADF are not valid in this case. The value of the test statistic from the DF or ADF is to be compared with the critical values simulated by Engle and Granger that are found in the EG critical values table(s) on which basis a judgment can be carried out whether given variables are indeed cointegrated or not.

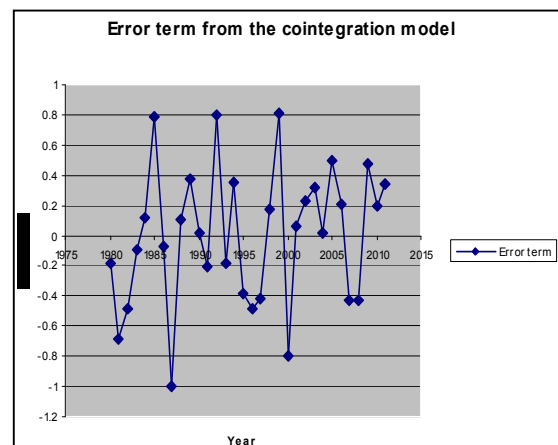


Fig. 3.1. Errors from the long run equation.

In this study, the errors from equation (3.3) estimated were subjected to a unit root test. The procedure of conducting the unit root test was the same as outlined in the section on the ‘unit root test’ above. The result of the test indicates that the variables are cointegrated given the rejection of the null hypothesis of a unit root.

3.5. The Error Correction Mechanism (ECM)

Having established the existence of cointegration in the series of nonstationary variables, there was a need to proceed to estimate an error correction model. The error term in the long run equation could be treated as the “equilibrium error”. That is, the error term was used to tie the short run behaviour of FDI in this study to its long run value. The error correction mechanism (ECM) first used by Sargan and later popularized by Engle and Granger (1987) corrects for disequilibrium. Granger representation theorem states that if two variables Y and X are cointegrated, the relationship between the two can be expressed as ECM which can be expressed as:

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta x_t + \alpha_2 u_{t-1} + \varepsilon_t \quad (3.9)$$

where Δ denotes the first difference operator, ε_t is a random error term, x_t represents every independent variable in the model, and

$$u_{t-1} = y_{t-1} - \beta_1 - \beta_2 x_{t-1} \quad (3.10)$$

That is, the one-period lagged value of the error term was from the cointegrating equation (i.e. the original equation). The ECM equation (3.9) states that Δy_t depends on Δx_t and also on the equilibrium error term. If the error term is nonzero, then the model is out of equilibrium. Supposed Δx_t is zero and u_{t-1} is positive. This means that y_{t-1} is too high to be in equilibrium, that is, y_{t-1} is above its equilibrium value of $(\alpha_0 + \alpha_1 x_{t-1})$. Since α_2 is expected to be negative, the term $\alpha_2 u_{t-1}$ is negative and therefore, Δy_t will be negative to restore the equilibrium. That is, if y_t is above its equilibrium value, it will start falling in the next period to correct the equilibrium error, hence the name ECM. By the same token, if u_{t-1} is negative (y is below its equilibrium value), $\alpha_2 u_{t-1}$ will be positive, which causes Δy_t to be positive, leading y_t to rise in period t. Thus the absolute value of α_2 decides how quickly the equilibrium is restored. The results of the ECM for FDI in the Sudan are availed in chapter four. The ECM model was estimated with variables in their first differences since every one of them was differenced stationary with the cointegrating error term entered in its first lag (as usual) as shown in the model below.

$$\begin{aligned} \Delta LFDI_t = & \alpha_0 + \alpha_1 \Delta LGDP_t + \alpha_2 \Delta LPCGDP_t \\ & + \alpha_3 \Delta LINFRAS_t + \alpha_4 \Delta LINFR_t + \alpha_5 \Delta LOPEN_t \\ & + \alpha_6 \Delta LFSD_t + \alpha_7 U_{t-1} + \varepsilon_t \end{aligned} \quad (3.11)$$

4. Results and Discussion

The preceding section was on the methodology of the study. The present section is meant for the results of the study both for the long run model and the short run model presented in Tables (4.1) and (4.2) below, respectively:

Table 4.1. Results of the long-run model.

Variable	Coefficient	T-statistic	P-value
C	-10.35142	-5.504268	0.0000
LGDP	0.553589	2.463882	0.0210
LPCGDP	2.023872	5.581071	0.0000
LINFRAS	2.314216	4.514046	0.0001
LINF	-0.205419	-1.245518	0.2245
LOPEN	0.623497	1.619519	0.1179
LFSD	-2.849667	-10.67103	0.0000
$R^2 = 96\%$, DW 1.96, F-Statistic 100.7194 Prob (F-statistic) 0.000000			

The market size (proxied by GDP) has been significant at 5% level of confidence and possesses the expected (correct) sign in the long run model. However, the response of FDI to percentage change in GDP has been by a smaller amount. This means that a 1 percent increase in GDP causes an increase in FDI by 0.6 percent per annum, with everything else remaining constant. In short run, the variable GDP carries unexpected sign and significant at 10% per annum, *ceteris paribus*. The negative sign may mean that in the short run, the smallness of the host country’s market is likely to discourage foreign investors from investing in the country. The result of the long run equation is consistent with the studies carried out by Hussain & Kimuli (2012), Anyanwu (2011), Sichei & Kinyondo (2012), Sikwila (2015) and Brima (2015).

Per capita GDP (PCGDP) has been highly significant at 1% level of confidence in the long run and carries the correct sign. Given the coefficient, it can be readily understood that FDI is highly elastic to any changes in PCGDP by a percent. This means that any increase in PCGDP by one percent increases FDI by 2% per annum in the long run, *ceteris paribus*. In the short run, PCGDP is equally significant at 1% level and the coefficient carries the expected sign. This means that in short run, any increase in PCGDP by one percent increases FDI by 0.9 % per annum, everything else remaining constant. Meaning that in the short run, FDI is inelastic to any changes in per capita GDP in the country. The results are consistent with the findings of Haile & Assefa (2006).

Infrastructure development (INFRAS) in the long run regression carries the expected sign and highly significant at 1% and highly elastic. This means that any increase in the level of infrastructure development by one percent increases the flow of FDI inflow into the country by 2.3% per annum, *ceteris paribus*. This result is consistent with

the results of other studies by Aseidu (2001) and Quazi (2007). In the short run, however, infrastructure has been insignificant possibly because it takes time for capital formation to take place and would cause the FDI not to flow into the Sudan in the short run. Sudan being one of the developing countries lacks proper infrastructure (Gadkarim, 2012). As the current study reveals, any slight improvement in the level of infrastructure acts as a gimmick for foreign investors.

Inflation (Inf) a proxy for macroeconomic instability has been insignificant in the long run although it carries the correct sign. However, in the short run, inflation has been having a negative significant effect on FDI inflow at 5% level. This means that in the short run, an increase in the level of inflation by one percent reduces FDI inflows into the country by 0.2 percent per annum, everything else remaining constant. This means that, although inflation has a negative effect on FDI in the short run, the response of the FDI to changes in inflation has been relatively low. In other words, FDI has been inelastic to any changes in the inflation rate. The result in the long-run regression model has been consistent with the findings established by Aseidu (2001) in her panel data study. However, the results of the short-run model are consistent with studies conducted by Hussain & Kimuli (2012), Haile & Assefa (2006), Sikwila (2015), and Brima (2015).

Openness has been found insignificant although it carries the correct sign in the long run. In the short run, however, openness has been significant at 1% although inelastic. This means that in the short run, any openness of the economy by 1 percent induces an FDI inflow by approximately 0.5% to the country per annum with everything else remaining constant. The insignificance of trade openness to FDI in the long run model has been in disagreement with studies conducted by Sichei & Kinyondo (2012), Anyanwu (2011), & Aseidu (2001), Quazi (2007), Sikwila (2015), and Brima (2015). However, the results obtained in the short run model are consistent with the studies cited above.

Financial sector development (FSD) has been significant at 1% level and its coefficient has been negative both in the long and short runs. In the long run, FDI inflow into the country has been elastic to any changes in financial sector development in a negative manner. In other words, in the long run, any increase in the level of financial sector development by 1% reduces FDI flows into the Sudan by 2.8%. However, in the short run, financial sector development has been having no effect on the FDI flow into the country. This means in the long run, the availability of financial facilities in the country may provide local investors with the required capital necessary for investment and may deter foreign investors from carrying out investment in the country. This finding is consistent with the studies carried out by Anyanwu (2011, 2012), Anyanwu & Erhijakpor (2004), Nasser & Gomez (2009), and Walsh & Yu (2010). However, the result has been inconsistent with the results established by Hussain & Kimuli (2012).

Table 4.2. Results of the Short-run model.

Variable	Coefficient	T-statistic	P-value
C	0.174477	4.079434	0.0005
Δ LGDP	-0.137744	-2.554412	0.0177
Δ LPCGDP	0.855501	3.821035	0.0009
Δ LINFRAS	-0.039338	-0.208833	0.8364
Δ LINF	-0.189730	-2.464733	0.0216
Δ LOPEN	0.480300	4.540511	0.0001
Δ LFSD	-0.126059	-0.508966	0.6156
U_{t-1}	-0.353603	-5.061864	0.0000
$R^2 = 61\%$, DW 1.49, F-Statistic 100.7194 Prob(F-statistic) 0.000000			

The error correction mechanism (ECM) which ties the dependent variable to its equilibrium value has been highly significant at 1% level of confidence. The coefficient of the ECM term carries a negative sign meaning that the dependent variable (FDI) has been temporarily above its equilibrium value and has been falling towards its equilibrium value. However, the speed of adjustment of FDI to its equilibrium value has been very slow.

5. Conclusions

The aim of the study was to find out the possible determinants of the FDI flows into the Sudan. The results indicate that the market size and the level of development (demand) have been the significant determinants of FDI inflows into the country both in the long run and in the short run. The level of infrastructure development and financial sector development, have been the important determinants in the long run but not in the short run. The level of inflation and the openness of the economy to the outside world on their part have been the determining factors for the FDI flow into the country in the short run but not in the long run. Given the above, it can be concluded that foreign investors are affected by inflation in the short run only and after sometimes they become used to the situation and getting adjusted to it. For the Sudan to gain from FDI being the engine of growth and development in the developing countries, it is essential for the Sudanese authorities to enhance growth in terms of GDP, increase the level of per capita GDP, try to enhance the level of infrastructure in terms of roads, airports, railways, seaports and similar others as a basis for long term FDI flow into the country. As much as the study succeeded in achieving its objectives, there have been limitations from which the study suffers. The main challenge to the study was lack of data for some of the important determinants of FDI inflows. As much as effort was exerted to get data for literacy level in the Sudan (in terms of enrollment rate in secondary schools), the records of telephone lines per 1000 people, data on raw materials as a proportion of total exports, data on taxes (tax revenue), have been absent, and this reduces the number of the independent variables in the estimated model.

It cannot go without saying that the break away of the southern part of the Sudan (now South Sudan) might have changed the circumstances of FDI inflows into the Sudan. With the major oil fields now located in South Sudan, FDI inflows to the country that were targeting investments in the oil

sector are likely to diminish. At the same time, the reduction in the size of the country with wars in Darfur, Blue Nile, and the Nuba mountains, Sudan is likely to be affected negatively unless solution is found to settle the current political instability the country faces (Gadkarim, 2012).

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