Volume: 4, Issue: 7
Page:26-45
2020

ISSN 2520-4750 (Online) & ISSN 2521-3040 (Print)

International Journal of Science and Business

The Location Determinants of FDI in Sudan. Time Series – Empirical Analysis From 1980-2018

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Abstract:
This paper study the location determinants of FDI inflow in Sudan, the study applied multivariate time series, Vector auto-regression using time-series data of 1980-2018. Variable include; market size, infrastructure, inflation rate, Debt, Dummy of investment incentive, and Terms of Trade openness. The empirical results revealed that there is a short-run causality relationship running from independents variable to FDI as specified in the study. Also, GDP, External debt, investment incentive, and inflation are important location determinants of FDI inflows to Sudan. The Granger Causality shows Uni-directional causality running from GDP, Inflation, TOP, inflation, and Dummy investment incentives to FDI. These results were consistent with the short-run vector autoregression results. Therefore for a country to be declared as attractive by MNC, it means that the above factors have to be significant, since the variable for infrastructure and terms of trade openness are insignificant, investors would choose to neglect Sudan. The outcome shows that GDP is a very important variable in determining the location choice of FDI. This suggests that authorities need to take into account factors that hamper the growth of the economy given its importance in attracting FDI inflows. Finally, Sudan should implements policies to encourage a fast-growing economy by improving its debt service payment, infrastructure, and its terms of trade openness and international cooperation.

IJSB
Accepted 21 June 2020
Published 22 June 2020
DOI: 10.5281/zenodo.3903279

Keywords: Location determinants of FDI, Unit root, Cointegration, VAR Model, and Granger Causality.

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1.0 Introduction.

With an increase in Globalization, FDI is acknowledge as a vital incentive for productivity, economic growth, and the general welfare in both LDC and DC economies, many scholars have vigorously argued that the benefits of FDI far outweigh its adverse effects. According to Jadhav (2012), Empirical reveal that 1980 debts crisis, countries were compelled to adjust investment policies to bridge the gap in national saving by an attempt to attract more FDI became the most suitable mode replacing capital loans, the major source of capital and an empowering mechanism to accelerate economic growth free from risks, associated with debt compare to past(Agiomirgianakis et al, 2003, Prasanna, 2010, UNCTAD). According to the World Investment Report 2018, it showed that the world inward FDI inflow starting from the pre-crisis period of 2005 to 2007 to 2018 respectively as in the table below.

Table 1 World Investment Report

Inward FDI Inflow (In Millions)	Pre-crisis period (2005 to 2007)	2015	2016	2017	2018
World	1,414,425		2,033,803	1,918,679	1,497,371
Developing economies	419126	728,814	656,290	690,576	706,043
Sudan	1,654	1725	1064	1065	1136

Source: WIR (2018)

The above data shows that as the world inwards FDI inflow steadily decline from 2015 to 2018, the percentage decrease in 2017 and 2018 was -22% and -13.4 % respectively while developing economies experience an increase of 5.2% and 2.2% respectively in 2017 and 2018. Besides, the Sudan economy recorded a positive trend in FDI inflow by 0.1 % in 2017 and 6.6% in 2018. Despite the FDI's surge in both developing countries and Sudan in the years 2017 and 2018, there appeared to be hugely significant differences in terms of research and development, availability of professional skilled workers, and institutional development. Some of the poorest regions continue to see stagnant FDI inflows. Interestingly, developing economies recorded high inwards FDI rates of returns than developed economies at a six years average of 9% from 2012 to 2017 while developed economies registered an average of 6.2 % in the same period. South, East, and Southeast Asia remarkably picked up thus outperforming other developing regions, it recorded an inwards FDI rates of returns by 9.5 % in 2016 and 9.1% in 2017(World Investment Report 2018, UNCTAD). Sudan despite its richness in Natural endowment, the country experience an inverse trend of FDI inflows. The country experiences fragile economic characterized by Debt, embargo, dwindling oil revenue, massive depreciation in the foreign exchange rate, and deficit in the balance of payment. Acknowledging the aforementioned factors, FDI is an important source of external financing for the country to supplement foreign exchange and reduce the current account deficit.

1.1 Statement of Problem

Post debt crisis (1980), nations were constraint to adjust their investment policies to bridge the gap in national saving through attempts to attract more FDI. Sudan, despite a surge in FDI inflow by 6.6% in 2018, it was not among attractive economies by FDI inflow in Africa. By understanding factors that are considered to declare the country attractive by MNC, thus will enhance our knowledge of the future pattern of total inward FDI. An investment survey conducted by GICS(2018) and MIGA (2002), stressed the importance of country knowledge

in the location decision of MNEs, inadequate knowledge can cause investors to underestimate opportunities and overestimate risk.

Identifying location determinants of FDI and estimating their efficiency in Sudan is a precondition to know the factors responsible for such lagging performance behind FDI inflow.

1.2 The objective of the study

I. To identify possible significant location determinants of FDI inflows to Sudan for the period covered in our study.
II. To identify whether there exists a long-run or short-run relationship between the dependent and independent variables.
III. To investigate the influence of external debt to FDI inflows resulting in the replacement of capital loans by FDI as a new economic growth empowering mechanism.
IV. Lastly to Find out if Investor objectives on Location choice, for instants improve to market access and reduce operating costs are applicable in the context of Sudan.

2.0 Literature review.

FDI is a form of an inter-firm joint operation that involves a substantial equity intake in, or effective management control of foreign enterprises (Mello, 1997). FDI boosts production, employment, income, economic growth, the balance of trade payments, prices, exports, imports, and general welfare of the recipient country.FDI literature is based on three approaches this includes micro-oriented econometric studies, survey data analysis, and aggregate economic analysis (Jun & Singh, 1996). Contra to market seeking investors' view, a small market that is well-linked and opens up to the international market through international trade offer scale of economies similar to a large domestic market. Openness to the domestic market might significantly determine the flow of FDI. E.g. Hongkong & Singapore (UNCTAD, 2009)

2.1 Theory in International trade.

Micro-theory of international production (Stephen Hymer, 1960 published in 1976). It focuses on two dimensions; variable aligns to the company's dimension and ownership and Variable resulting from the existence of a market of market failure. Hymer showed that FDI becomes effective when the benefits of exploiting firm-specific advantage (FSAS) across the borders surpass the cost of doing business. Moreover, Hymer noticed that MNEs move in either direction across boundaries in industrialized countries, therefore countries received and engage in outward FDI.

2.2 Motives behind FDI.

Micro-level, not only does it view FDI movement through profit-making through cheap labor cost but also with the help of ownership specific advantage through internationalization. E.g. Bulgaria FDI falls under market hunters, factor hunters, and location hunters subsequently (Bitzenis, 2004). Shartz and Venable (2000), Argue that firms go global due to horizontal or market seeking, vertical or product cost-minimizing'', reason relevant for developing countries.

2.3 Location choice of FDI

The theory of FDI tries to examine criterion use by foreign companies when deciding to invest abroad. Up to date, no theory had precise rules explaining international investment's location choice. As suggested by Gilmore, O's Donnel, Carson, and Cummins (2003) eight factors are influencing the choice of the host market. They are as follows: Availability of resources, Economic Policy, Size and growth of the domestic market, Knowledge, and experience of the domestic market, Government emphasis on FDI and financial incentives, Transportation

material and labor cost, Technology, and Political Stability. Foreign companies often choose countries base on cost minimization by appropriately selecting countries that foster a minimum total operational cost.

Table 2. 1 Business-Friendly Legal and Regulatory Environment Is Important for Investors. Shares of the respondent (percentage).

Indicators	Critical important.	Important.	Somewhat important	Not important	Don't know
Political stability and security	50	37	9	2	
Legal and regulatory environment	40	46	12	2	
Large Domestic market size	42	38	14	4	2
Macroeconomic stability and favorable exchange rate	34	44	16	5	1
Available talent and skill of labor	28	45	22	5	0
Good physical infrastructure.	25	46	24	5	0
Low tax rates.	19	39	31	9	2
Access to land or real estate.	14	31	32	22	0
Financing in the domestic market.	16	28	31	24	1

Source: What matters to investors in developing countries: Findings from the Global Investment Competitiveness Survey (GICS) 2017/2018, doi 10.1596/978 – 1-3. by Peter Kusek and Andrea Silva.

Note: the respondents answered the question "How important are the following characteristic to your company's decision to invest in the developing countries? ". Factors were asked randomly, they are listed in the descending order, base on the joint analysis of critically important and important. Important means it is a deal-breaker, the factor itself can change the company's decision to invest or not in a country.

2.4 Empirical literature review.

The size of the Domestic market (GDP), (Root & Aham, 1979), matters most to market seeking investors but not Export-oriented foreign Firms.

Inflations, Birhan(1998), long terms investment consider the low and predictable rate of inflations, it also affects the cost of inputs and price of output, hence reducing real returns investment.

Foreign Debts, (Serven, L, Solimano, 1992), Immoderate foreign debt may signal imminent fiscal crises and portrait future situations in the country.

Political Stability, (Birhanu, and Kibre, 2003)

political instabilities can delay FDI and could cause diversion of potential investors for good.

Legal and Regulatory framework. Emphasize on a stable, transparent, reliable, legal, and regulatory framework to encourage both domestic and foreign investors. (Birhanu & Kibre, 2003), however, UNCTAD (1999) report that an efficient and transparent legal system, and in particular LDCs, does not make a country more attractive for FDI.

Investment promotion strategy & incentive structure

Investment incentives are used as motivational policy structure to influence foreign incentives (low-interest on loans), special tax allowance, subsidies as well as grants. Investment guarantee for repatriate of capital and transfer of profit. Bilateral and

Multilateral investment treaties motivate investors by providing a reliable investment climate, boost direct foreign investors' confidence (Birhanu & kibre, 2003). Some Economies recommended that "if a country gets its investment policy right, investors would evaluate all worthwhile investment opportunities ", (IFC & FIAC, 1997:49)

Level of Infrastructure. The country should implement efficient and adequate infrastructure policy enable better access to potential market and natural resource (Birhanu, 1999), i.e adequate and reliable telecommunication service, improved roads and air transport services, adequate water and reliable electricity supply facilities are fundamental factors in boosting the profitability of foreign companies and attracting more inflow of FDI.

3.0 *AN OVERVIEW OF FOREIGN DIRECT INVESTMENT IN SUDAN.*

Foreign Direct Investment (FDI) is referred to as investment made to acquire a lasting interest in or effective control over an enterprise operating outside of the economy of the investor (WB), it has been considered as a means of reducing short-coming in saving. Many researchers have acknowledged that the national savings level of most African countries is quite low. Hence, foreign direct investment is an alternative source of capital to bridge the gap between savings and the required investment level (Solomon, 2008). In the 1960s, Sudan had foreign companies operating in the country for an instant, the shell was offered preferential allowance in 1960s, in 1990s some Asian oil giant companies first entered into Sudan as first-mover (Kobrin, 2005). Moreover, foreign capital inflows were projected toward; secure cheap food (Arab States) (O'Neill, 2007) or seeking natural resources in the case of Chevron (USA oil company), and company Seeking cheap raw materials for manufacturers (British colonialism).

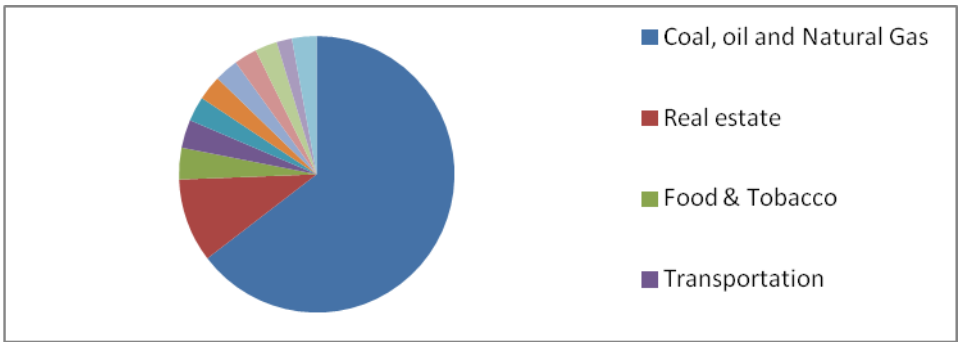
Table 3. 1 Sudan Trade balance during the period of 2007-2018

Year	Trade balance	imports	Exports	Non-petroleum export	Petroleum export	Percentage Increase in Petroleum export.
2007	1 03,793	8,775,457	8,879,250	4 60,722	8,418,528	94.81%
2008	2 ,318,964	9,351,540	11,670,504	5 76,393	11,094,111	95.1%
2009	(1,433,813)	9,690,918	8,257,105	1 ,020,318	7,236,787	87.6%
2010	1 ,359,510	10,044,770	11,404,280	1 ,709,085	9,695,195	85.0%
2011	9 57,424	9,236,008	10,193,432	2 ,294,239	7,899,193	77.5%
2012	(5,163,819)	9,230,318	4,066,499	3 ,111,511	954,988	23.48%
2013	(5,128,336)	9,918,068	4,789,732	3 ,073,187	1,716,545	35.5%
2014	(4,757,577)	9,211,300	4,453,723	3 ,096,140	1,357,583	30.5%
2015	(6,340,104)	9,509,115	3,169,011	2 ,541,829	627,182	19.8%
2016	(5,216,968)	8,310,607	3,093,639	2 ,757,926	335,713	10.9%
2017	(5,033,287)	9,133,668	4,100,381	3 ,683,175	417,205	10.2%
2018	(4,365,399)	7,850,081	3,484,682	2 ,965,104	519,578	14.9%

Source: Bank of Sudan, (Author calculation of percentage change).

In conclusion, according to the above statistical records of country exports, we can confidently assert that Sudan's economy has been the oil-based economy; this is depicted in the years where oil exports recorded high at an average of 88% for five consecutive years. However, the year 2009 experience trade deficit despite a high record of 87.6% of petroleum exports, this deficit was caused by a decline in exports of Non-petroleum export, therefore emphasis is based on measures to improve exports in all sectors to prevent trades deficits.

Figure 3. 1 Pie Chart representation of FDI in Sectoral distribution.



Source: FDI Intelligence from Financial Times. (2015).

In summary, sectoral investment and sector export are important in analyzing the impacts of FDI inflow on export per sector, considering thirteen year FDI inflow average of 64.6% in Coil, Oil, and Gas sector, the corresponding nine years average of petroleum exports from 2007-2015 rated at 61%(see table 3.1), this is an indication that Foreign Direct Investment and export exhibit positive correlation, this assumption commensurate with the finding of a relationship between the ratio of investment and ratio of export shares, the results support that fact that there is a positive relation between ration of investment and ratio of exports (Akcan, Ahmet & Azam, Faith & Akyiiriik, Hasm & Buldas, Mahnut & Kara, Erkan,(2015). Many authors stressed that markets seeking foreign investors would prefer to exports portion of their products to other countries hence this concept of openness to global markets might significantly determine the inflow of FDI, for instance, Hong Kong and Singapore. The three years (2016-2018) average of exports in petroleum sectors have significantly dropped to 12% per annum (see table 3.2), thus this explained how the investment in petroleum sectors decline, this view is supported by (Mohamed, I ssam A.W,2010) which asserted that the secession of South Sudan reduces the country oil sector by 80%.

3.2 Sudan Business Environment.

World Bank ranked economies on their ease of doing business, therefore higher ease of business ranking implied that the regulatory environments are conducive to the starting and operation of a local firm. Despite a central role placed at FDI to achieve the desire economic transformation in Sudan's economy, numerous obstacles hinder the country's performance in terms of FDI's reception and utilization. In the context of the global business environment, Sudan emerged among the most costly registered at 44.8 by doing business scores. According to the World Bank Doing Business reports, Sudan ranks 171th Measure by the ease of doing business and 171th out of 190 ranks within the group of economies covered in the survey in terms of ease of doing business for the years 2019, respectively.

Table 3. 2 Sudan Doing Business Indicator

Indicator	The rank of Sudan out of 190 Countries
Ease of doing business	171
Rank within the group	171
Starting a business	157
Dealing with the construction permit	124
Getting electricity	162
Registering property	95
Getting credit	176
Protecting Minority investors	153
Paying Taxes	164
Trading Across borders	185
Enforcing contracts	148
Resolving Insolvency	152

Source: World Bank, Doing Business measuring business regulation. (2018/2019)

As display in Table 3.2, Sudan was amongst the weakest performers using indicators such as starting a business at 157. Also, Sudan ranks of 185 out of 190 economies on the ease of trading across borders for the years 2019. Considering global ranking for enforcing contracts, Sudan stands 148 for the year 2019. Furthermore, it was noticed that on the protection of Minority investors, Sudan ranked 153 which place great cost for minor investor due to weak protection. The country's most efficient ranking was in the registering property indicator rank of 91. On Contrast, research by Mohammed Elhaj Mustafa Ali, 2016, indicate that in 2011 and 2012, the country's ease of doing business score was 154 and 135 respectively, but the current data on world bank indicate lagging performance as the country score 171st which is a worst-case scenario from past years in 2019 report.

This chapter attempts to provide an overview of the impacts of both major macroeconomic and political facts influencing the pattern of FDI inflow from the period of 1980 to 2018. Political and economic environment factors are the major reason for the deteriorating performance of FDI inflow. Nonetheless, the chapter attempts to explain the considerable scope of macroeconomic indicators such as economic growth and trade. The emphasis was to interpret the link between such variables and lagging performance of FDI given with prevailing socio-economic and political factors. Base on business environment analysis, it's suggested that to expand market function and investment in Sudan economy, strong emphasis is placed on a balance between state and private sector right. Moreover, to achieve such a goal, the state needs to provide an essential public good, sound regulation, and market-supporting laws. Lastly, the stylized facts presented in the study support the following suggested. Firstly, Sudan experience poor economic performance which was inconsistent with its endowments from natural and human resources. Secondly, the period starting from 1990 to 2010 stood to have a bit of improvement compared to other years, FDI flow doesn't explain much of economics improvement in sectoral level. The sectoral distribution of FDI depicts the strong correlation between FDI and the oil boom witnessed by the country in the last two decades. Nonetheless, the central importance attached to FDI highlighted possible location determinants of FDI that are considered by foreign investors to Sudan economy under question.

The hypothesis of the study

I. Market size does not explain a location determinant of FDI inflow to Sudan.

II. The level of infrastructure does not explain the location choice of FDI inflow into the host country.
III. Inflation does not explain a location determinant of FDI inflows.
IV. The host country's openness to external economies in terms of trade relations does not explain the location choice of FDI inflow into the country.
V. Investment policies implemented by the government do not explain the location choice of FDI inflow into Sudan.

4.0 Research methodology.

4.1Theoretical Framework.

The theoretical concept adopted Location Choice of FDI in line with objective consider when investing outside the country, *Direct Investment Survey*, a study conducted by Global Investment Competitiveness Survey (GICS) 2017/2018. The theory of FDI tries to explained measures considered by foreign companies when deciding to invest abroad. Up to date, there is no single theory with precise rule explaining international investment's location choice. As suggested by Gilmore, O's Donnel, Carson, and Cummins (2003), 8 factors are influencing the choice of the host market. Therefore the theory analyzed location determinants of FDI as a function of the below factors.

FDI = f (Availability of resource, Economic policy, size and growth of Economic, Knowledge, and experience of the domestic market, Government emphasis on FDI and Financial incentive, Transportation material and labor costs, Political Stability).

Where: FDI represents Dependent factor,

Independent Factors are:

I. Availability of resource is Proxy by (Natural Resource Rent or Total reserve)
II. Economic policy is proxy by Trade Openness.
III. The size and growth of the domestic market is proxy by (GDP).
IV. Knowledge and experience of the domestic market lead to a reduction in operating cost which is proxy by Infrastructures (GFCF).
V. External Debt (Macroeconomic stability)
VI. Inflation (Macroeconomic stability).
VII. Investment Incentive (Government emphasis on FDI).

With the aid of location determinants of FDI, therefore, we based our analysis of both Independents and dependent variables explicitly; this removes the biases of the researcher's inclusion of variable of interest that does not possess economics and theoretical link to the model use. In line with finding from the Global investment Competitiveness Survey (GICS) 2017/2018, a study conducted by GICS assigned a specific number to different indicators based on their relevance in explaining the underlying relationship between independent variables and dependents variables. few factors are considered to possess high explanatory power within the model of FDI such as an Improve to market access valued at 42%, Reduce operating Cost valued at 25%, Macroeconomic stability, and favorable exchange rate 34%. Thus the above analysis laid the foundation of our inference if the results fall within the aforementioned criterion.

4.2 Empirical Model Specification.

The study used time-series data for the period 1980-2018, it applied the Ordinary Least Squares (OLS) multiple regression analysis method with HAC standard error to estimate the equation. The reason for using this technique is due to its unbiased, efficiency, simplicity, minimum variance and it has been used by many researchers in their previous studies and results were meaningful. The ordinary least square technique is considered as the simplest

technique of linear regression to use and easy to understand. The aim of the ordinary least square technique (OLS) is to fit the function with the data and minimization of the sum squared errors from the data. The correlation matrix is also employed in this study to test if the selected variables are correlated. As in the literature, different variables (factors) have been identified as location determinants of FDI inflows into different SSA countries of which Sudan would not be an exception. However, because of the 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 Sudan. Therefore, the functional form of the model became:

FDI = f (X), ……. (3.1)

Where X includes GDP, External debt, gross fixed capital formation, Inflation Rate, trade openness, Dicent)

Given the above functional form, the model estimated

Became:

FDI= f (GDP, INFLA, DEBT, TOP, GFCF, Dicent) ……. (3.2)

$FDI_t = \alpha + \beta_1 (GDP_t) + \beta_2 (Debt_t) + \beta_3 (Infla_t) + \beta_4 (TOP_t) + \beta_5 (GFCF_t) + \beta_6 (Dicent_t) + \mu_\tau$……(3.3) (model)

Where:

FDI = Foreign direct investment.

GDP = Growth Domestic Product

IFRAS = Infrastructure

INF = Inflation rate

TOT = Terms of Trade Openness

Debt = External Debt.

Dincent= Dummy of investment incentive (1980 to 2002= 0, 1 otherwise)

μ_τ = error term

t = Represents the time-series dimension in the data.

4.2.1 Estimation Technique.

OLS regression model was generated with HAC standard errors to solve for heteroskedasticity, Based on the results of the model in equation (3.2) above, variables were rescaled and assign with different numbers, such as GDP *0.0001, GFCF*0.01, FDI*0.0001, and Debt*0.0001. A battery of diagnostic tests was conducted and it was established that the model does not suffer from the normality of the errors based on the Jarque-Bera (JB) test statistic. With its overall Jarque-Bera normality test: .1495 Chi (2) .928, this means that the residual is 92.8% normal and the VIF was less than 5 for all five variable but the inclusion of investment dummy will reduce normality percentage to 30.6% which is desirable, the model exhibit expected sign if the GDP is converted to logarithmic form (Gujarati, 2011). Hence the new model becomes:

$FDI_t = \alpha + \beta_1 (LogGDP_t) + \beta_2 (Debt_t) - \beta_3 (Infla_t) + \beta_4 (TOP_t) + \beta_5 (GFCF_t) + \beta_6 (Dicent_t) + \mu_\tau$……(3.3) (model).

4.3 Unit Root Test.

Sudan being among LDC, their time-series data are inherently non-stationary. When two data series exhibit a common trend this does not necessarily imply the existence of a meaningful economic relationship between them. If the series are not stationary (for instance their means, variance, and auto-covariance are not independent of time), such regressions could wrongly poster the existence of a relationship, Situation known as spurious regression by Granger and Newbold (1974). By not taking into consideration such fact and estimating a regression model containing non-stationary variables might lead to unreliable results.

Besides, such a regression ignores important information about the underlying statistical and economic processes generating the data. Therefore, it is important to test the presence of unit roots and if they are present, use appropriate modeling.

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.). The study will employ the Augmented Dickey-Fuller (ADF) Test and the Phillips-Peron Test to check for the stationary of the variables, as well as to determine the order of integration of the variables.

4.3.1 The Augmented Dickey-Fuller Test.

An improved version of the ADF test gives a better result than the Dickey-Fuller Test (DF) (1979, 1981). Since it includes extra lagged terms of the dependent variable to eliminate autocorrelation. The ADF is given by the following equation:

$$\Delta y_t = \mu + \lambda y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \delta p_{-1} \Delta y_{t-p+1} + \varepsilon t$$

Thus this equation could be interpreted as ΔYt= Yt – Yt-1; ΔYt-1 = Yt-1 – Yt-2, and the number of lags to be included is empirically determined by mean of lag-order selection statistics. Therefore, test the significance of the coefficient of Yt-1. The method of augmenting ensures the removal of possible autocorrelation among error terms. Among all three models of ADF test (intercepts only, trend and intercept and no trend, no intercept), the Null hypothesis Ho: variable is not stationary and H1: stationary, all the three models must comply with our variable Y having unit root or not, so if the outcome of the test appears that have values greater than the critical values, we reject the null and state that the variable is stationary. The test suggests that the more negative it is, the stronger the rejection of the hypothesis that there is a unit root at some level (Brooks, 2008). However, Chinhamu and Chikobvu (2010), assert that if ADF Test has could not determine whether to include exogenous variables in the test regression or to include more than one lag. Moreover, the ADF Test often accepts the null unit root more frequently than is acceptable, implying that the test may find a unit root even when none exists. Another disadvantage of the ADF Test is that it does not consider the cases of heteroscedasticity and non-normality frequently revealed in raw data of economic time-series variables (Asteriou, 2011).

4.3.2 Phillips-Perron Test.

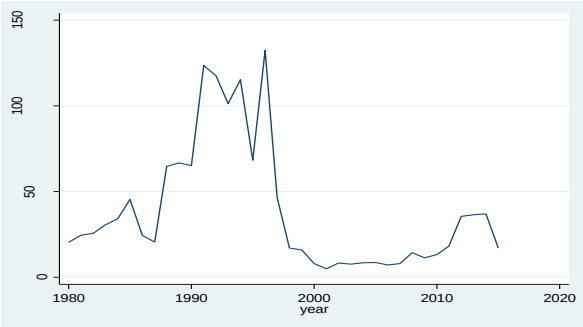
The Phillips-Perron Test (PP Test) will be conducted as a complement test to verify the consistency of ADF Test results, having similarity to ADF Test, but most it incorporates an automatic correction to the DF procedure to allow for autocorrelated residuals (Brooks 2008). Meaning that the PP Test applied nonparametric methods to tackle the serial correlation in the error terms without adding lagged difference terms. Thus the test is needed as it allows that error disturbances are heterogeneously distributed and weak dependent (Gujarati, 2004). PP Test is the AR (1) process given as:

$$\Delta y t - 1 = \alpha 0 + yy t - 1 + e t - 1$$

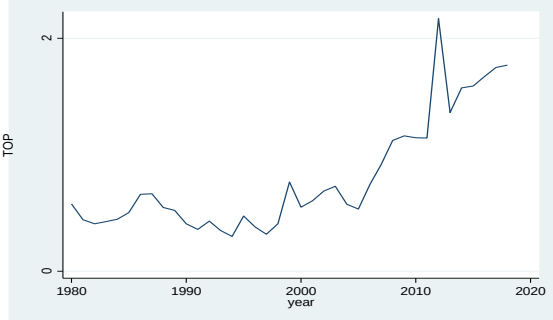
Chinhamu et al. (2010) assert that the PP Test has an advantage over the ADF Test when the time series concerned has a structural break, especially that the time series externs over a longer period. Brooks (2008) suggests that unit root tests between ADF and PP Tests have to display the same outcome to confirm robust results, either to reject or accept the null hypothesis, hence the fact that both tests (ADF and PP) suffer from the same limitation.

Figure 4. 1 Graphical plots of a variable at the level.

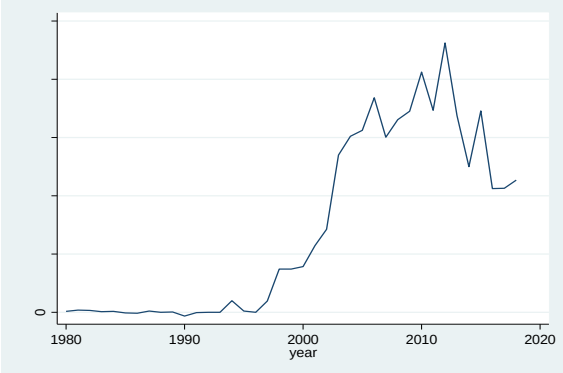
The graphical representation of the variable in the research study depicts some evidence of non-stationarity in the trend. The variables were also examined at the first difference.



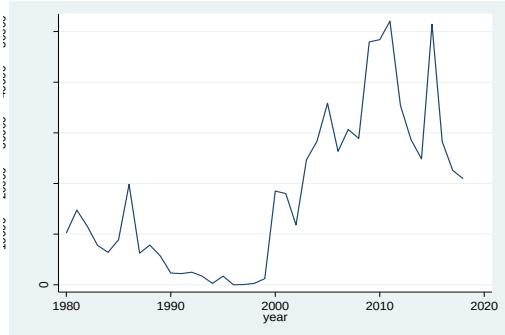
INFLATION



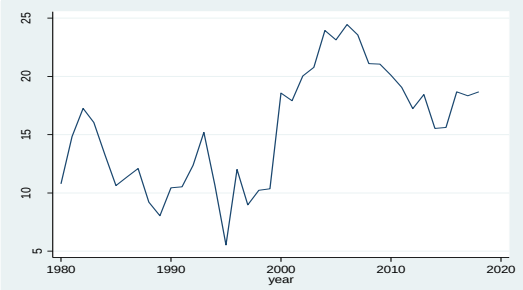
TERM OF TRADE OPENNESS



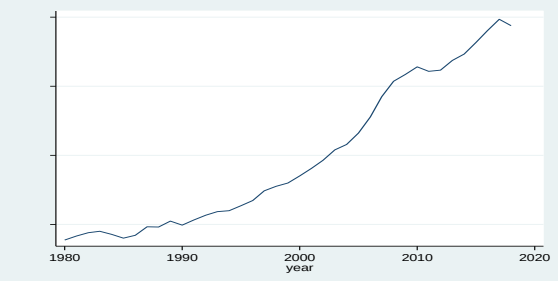
FDI



FOREIGN DEBT



GFCF

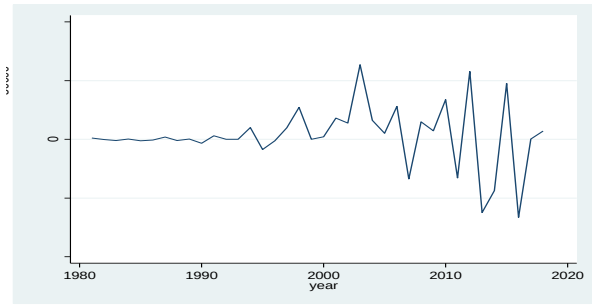


GDP

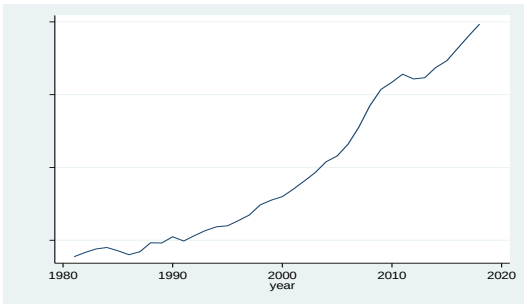
Source: Drawing from Author's Stata 13, an estimation of Sudan's Location determinants FDI data 1980-2018, World Bank Data (2018)

Figure 4. *2* **Graphical plots of a variable at first difference.**

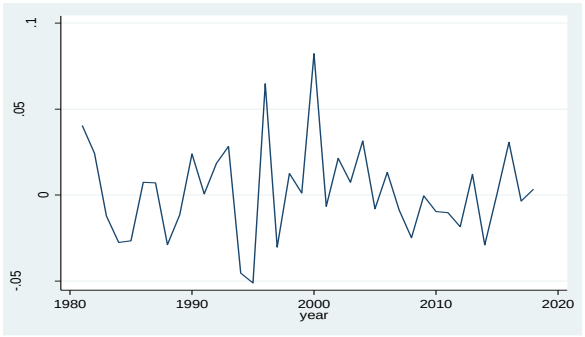
The below figures depicts differenced variables fluctuate around the mean; thus the variables are integrated at first difference. All variable is stationary at first difference. However, it's impossible to draw precise conclusions from the graphical analysis because graphical plots are considered informal tests; therefore we should conduct a formal test for unit roots.



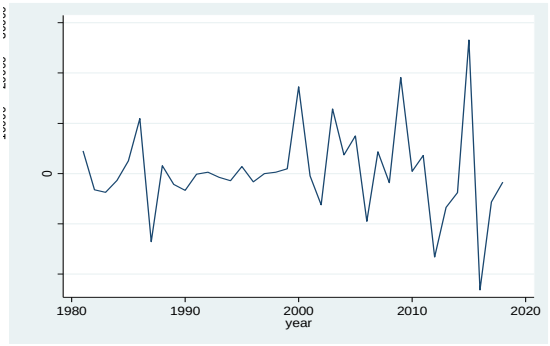
DFDI



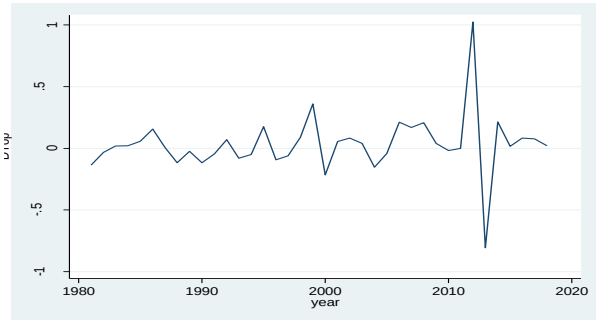
DGDP



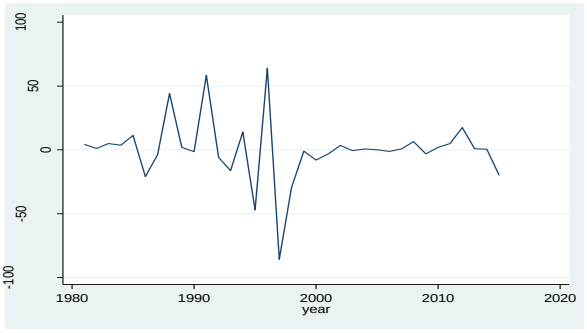
DGFCF



DDEBT



DINFLATION



DTOP

Source: Drawing from Author's Stata 13, an estimation of Sudan's Location determinants FDI data 1980-2018, World Bank Data (2018)

Table 4. 1 Unit Root test: level Series.

	Augmented Dickey-Fuller Test Trends. (Critical Values).					Phillips-Perron Test. Trends (Critical Values).				
Variable	*1%*	*5%*	*10%*	*t-value*	*Prob*	*1%*	*5%*	*10%*	*t-value*	*Prob*
FDI	-4.26	-3.55	-3.21	-1.75	0.729	-4.26	-3.55	-3.21	-1.8	0.703
LnGDP	-4.26	-3.55	-3.21	-1.81	0.698	-4.26	-3.55	-3.21	-1.91	0.651
GFCF	-4.26	-3.55	-3.21	-2.12	0.536	-4.26	-3.55	-3.21	-2.17	0.506
INFLA	-4.29	-3.56	-3.22	-2.34	0.412	-4.29	-3.56	-3.22	-2.34	0.412
TOP	-4.26	-3.55	-3.21	-2.86	0.177	-4.26	-3.55	-3.21	-2.69	0.239
DEBT	-4.26	-3.55	-3.21	-2.52	0.316	-4.26	-3.55	-3.21	-2.35	0.412

Note: ***denotes significance at 1%; ** significance at 5% and * significance at 10%
Source: Calculation from Author's Stata 13, Sudan's FDI data 1980-2018, World Bank Data(2018)

Table 4.2 Unit Root Test: First Difference Series.

	Augmented Dickey-Fuller Test Trend. (Critical Values).					Phillips-Perron Test. Trends (Critical Values)				
	1%	5%	10%	t-value	Prob	1%	5%	10%	t-value	Prob
DFDI	-4.28	-3.56	-3.21	-4.52	0.001	-4.27	-3.55	-3.21	-8.05	0.000
DLnGDP	-4.28	-3.56	-3.21	-3.62	0.03	-4.27	-3.55	-3.21	-4.79	0.001
DGFCF	-4.28	-3.56	-3.21	-4.83	0.000	-4.27	-3.55	-3.21	-6.82	0.000
DINFLA	-4.31	-3.57	-3.22	-4.47	0.002	-4.30	-3.56	-3.22	-7.88	0.000
DTOP	-4.28	-3.56	-3.21	-6.62	0.000	-4.27	-3.55	-3.21	-10.41	0.000
DDEBT	-4.31	-3.56	-3.21	-4.91	0.000	-4.27	-3.55	-3.21	-7.61	0.000

Note: ***denotes significance at 1%; ** significance at 5% and * significance at 10%
Source: Calculation from Author's Stata 13, Sudan's FDI data 1980-2018, World Bank Data (2018).Table 4.1. Illustrated the unit root test at level series; it is clear evidence that all variables are non-stationary at level with both tests confirming similar results. In the following table 4.2. Shows the unit-roots test of the first difference of our variable in the research question hence all variables become stationary at first difference.

4.4 Cointegration.

In line with the ADF test and PP test results in Table 4.1, all variables are integrated of the same order and the cointegration test is performed. With the aids of Cointegration, we will, therefore, establish if there is either long-run or short-run causality between FDI or its determinants and this will also help on the choice of appropriate model either ECM or VAR Model. If two-time series variables are non-stationary but cointegrated, at any point in time the variables may drift apart, but there will always be a tendency for them to retain reasonable proximity to each other. Table 4.3 indicates that Lag 2 is the optimum selection according to VAR lag order selection criteria using LR and AIC criteria. Table 4.4 provides the results from the application of the Johansen cointegration test among the data set. The result, starting from the first row and compares Trace Statistic value with the 5% critical value. The result indicates that the Trace statistic value does not exceed the critical value and therefore no cointegration at zero levels.

Table 4. 3 VAR Lag order selection criteria.

Sample: 1982-2015 Number of obs =34

Lag	LL	LR	Df	P	FPE	AIC	HQIC	SBIC
0	-2466.13				5.8e+55	145.42	145.512	145.689
1	-2324.17	283.94	36	0.000	1.2e+53*	139.186	139.829*	141.072*
2	-2287.98	72.371*	36	0.000	1.4e+53	139.175*	140.369	142.677

LR: Sequential modified LR test statistic (each test at a 5% level).
AIC: Akaike Information Criterion.
FPE: Final Prediction error.
SBIC: Schwarz information criterion.
HQIC: Hannah-Quinn information criterion. (Source Arthur estimation).
Source: Calculation from Author's Stata 13, Sudan's Location determinants FDI data 1980-2018

Table 4.4 Johansen Test for Cointegration.

Trend: Constant.

Sample: 1982-2015. the number of obs = Lag = 2.

Maximum

Rank	*Parms*	*LL*	*Eigenvalue*	*Trace Statistic*	*5% critical value.*
0	42	-2344.2722		79.2745*	94.15
1	53	-2328.5754	0.60281	45.8808	68.52
2	62	-2316.8444	0.49845	24.4188	47.21
3	69	-2308.7655	0.37826	8.2609	29.68
4	74	-2305.2922	0.37826	1.3144	15.41

Source: Calculation from Author's Stata 13, Sudan's Location determinants FDI data 1980-2018, World Bank Data (2018).

5.1 EMPIRICAL ANALYSIS AND DISCUSSION.

5.1 Descriptive Statistics.

Table 5.1 shows summary statistics for FDI inflow and location determinants of FDI in Sudan. The below points were drawn from the data. Base on Skewness: FDI, GDP, DEBT, and GFCF exhibit positive skewness, therefore data are normal with a right-handed tail longer than left-handed tail thus moderately skewed, while inflation and trade openness had a value greater than 1, hence highly skewed. Since all variable is positively skewed to right we expect the mean to be greater than a median value which is correct in our case study. Base on Kurtosis, same variable on FDI, GDP, DEBT a GFCF are platykurtic, this mean their values are less than 3 thus consider to be light-tail data (it has much data in each tail as it does in the peak) while variable on inflation and Trade openness have values of more than 3, hence considered as leptokurtic with heavy tail data. Since data on FDI, GDP, DEBT, and GFCF are moderately skewed, therefore considering standard deviation and mean for inference is valid. In case of FDI inflow, the mean of 71,421 and high standard deviation valued at 77,584 showings spread out of data over a large range of data which corresponded with a high positive maximum value of FDI and negative minimum FDI inflow, this tells us that high years of FDI inflow responded to high years of GDP growth, low DEBT and high record of gross fixed

capital formation and vice versa leading to a high value of standard deviation among this variable. Though the skewed value of the dummy variable for investment incentive shows a low number of 0.3 which is moderately normally, in really interpretation dummy data is not normally distributed however we can still draw positive conclusions from the data. The mean value of 0.44 implied positive relationship between FDI and investment incentive while the median value of 0 explained that the years of unfavorable investment policies are more than 50% of the total years in the scope of our research and lastly the STD.DEV 0.5 higher than mean value shows the difference between the dummy value of 1 and 0. Finally, descriptive statistics show clearly that Sudan's FDI inflows are different, it also points to the fact that other factors may be at play in explaining the low FDI inflows. This issue is covered in the empirical analysis and these results are inconclusive at this stage to indicate the determinants of FDI inflows.

Table 5. 1 Summary of descriptive statistics.

	FDI	*GDP*	*INFLATION*	*TRADE –OPENNESS*	*DEBT*	*GFCF*	*Dummy of Investment incentive*
OBS	39	39	36	39	39	39	39
MEAN	71421.53	3960656	39.02	0.8	17819.25	15.54	0.44
MEDIAN	37080	3202110	15.99	0.77	1237.34	10.34	0
MAXIMUM	231146.1	7941102	132.36	2.17	52010.63	24.46	1
MINIMUM	-3113	1550543	4.87	0.3	25.99	5.54	0
STD.DEV	77584.7	2147654	37.07	0.49	15560.25	5.0	0.5
SKEWNESS	0.5	0.51	1.31	1.17	0.7	0.02	0.26
KURTOSIS	1.67	1.75	3.5	3.26	2.53	1.95	1.07

Source: Calculation from Author's Stata 13, Sudan's FDI data 1980-2018, World Bank Data (2018)

Table 5. 2 Vector Autoregression results. (Short-run Causality Test).

Variable	D(FDI)	D(LnGDP)	D(Infla)	D(GFCF)	D(TOP)	D(DEBT)	D(DICEN)	C
Var(L1)	-0.439	3472.61	-130.36	42680.22	-1909.2	1.70	78458.34	-1637763
	(0.000)	(0.92)	(0.034)	(0.524)	(0.81)	(0.000)	(0.00)	(0.00)
	[-3.87]	[0.11]	[-2.12]	[-2.12]	[-0.24]	[7.03]	[8.26]	[-9.80]
Var(L2)	-0.136	112523.2	-68.61	46223.5	-39208.2	0.405	22379.8	
	(0.16)	(0.001)	(0.31)	(0.48)	(0.000)	(0.19)	(0.089)	
	[-1.40]	[3.25]	[-1.01]	[-0.71]	[-4.91]	[1.31]	[1.70]	

Source: Calculation from Author's Stata 13, Sudan's Location determinants FDI data 1980-2018, World Bank Data (2018)

5.3 Granger Causality Test.

Granger Causality tests were used to examine causality in the VAR system. Granger Causality tests provide the direction of causality. The results from the Granger Causality Test are reported in Table. 5.3 Below.

Table 5.3 Granger Causality Test

Granger Causality				
Excluded	Chi-sq	Df	Prob	Remarks
D(LnGDP)	92.56	2	0.000	Unidirectional
D(Infla)	12.42	2	0.002	Unidirectional
D(GFCF)	0.65	2	0.727	No Causality
D(TOP)	30.22	2	0.000	Unidirectional
D(Debt)	69.44	2	0.000	Unidirectional
D(Dicent)	90.01	2	0.000	Unidirectional
ALL	316.39	12	0.000	

Source: Calculation from Author's Stata 13, An estimation of Sudan's Location determinants FDI data 1980-2018, World Bank Data (2018).

Following the above outcome of our study, there is evidence of a causal relationship between the variables of interest. Our entire variables with an exception of Gross Fixed Capital Formation show a causal relationship with FDI. The results reflect that there is evidence of unidirectional causality from GDP, Infla, TOP, Debt, and Dicent to FDI. These results are consistent with Omer Ali and Ibrahim (2013; Emmanuel Pitia(2015), Gadkarim(2012), and Anyawu who concluded that there is a causality relationship between FDI and GDP, investment incentive policy, inflation and terms of trade openness. These results are in line with the short-run causality test due to a lack of cointegration among variables in the long-run.

5.4 Discussion of the results

Gross Domestic Product (GDP). Measurement of market size shows a positive relationship with FDI at a 5% level. 1% change in logGDP while holding other factors constant lead to 1125.23 increases in FDI inflow.

Gross fixed capital formation: It shows a positive relationship but insignificant. Sudan being among Sub-Saharan developing countries faces a huge cost of operation to investors.

Inflation. Proxy for macro-economic stability. It shows a negative relationship and significant at 5% level. Value of 0.013 is very low to discourage FDI inflow, Most LDC experience high inflation but still receive FDI inflow.

Trade openness: Shows negative and insignificant results, though granger causality depicts unidirectional causality, Sudan ranked 185 out of 190 countries measures by the ease of trading across borders.

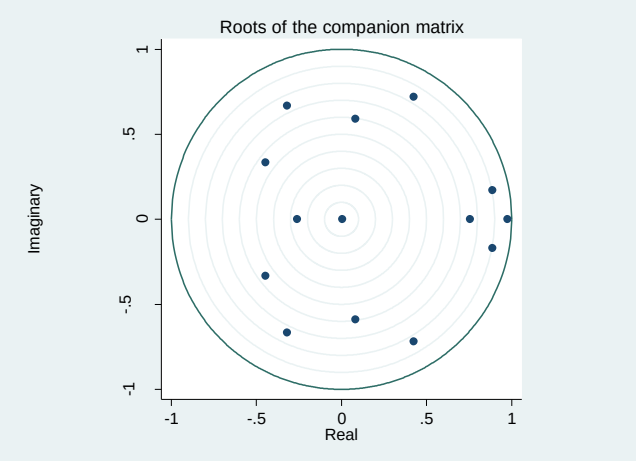
External debt: Coefficients show a positive relationship which is significant at a 5% level. A unit increase in external debt will increase FDI by 1.7, therefore Sudan used a small portion of FDI to cater for debt repayment

Dummy for investment incentives: Show a positive relationship and significant at the 5% level. A unit increase in investment policy leads to a 7.85 change in FDI inflow holding other constant. Investment incentives limit cumbersome procedures that hinder the easy flow of FDI.

5.5 Diagnostic Test

Diagnostic tests of the VAR test are presented below to examine the validity of the fitted model.

Figure 5.1: Eigenvalue stability condition.



Source: Drawing from Author's Stata 13, An estimation of Sudan's Location determinants FDI data 1980-2018, World Bank Data (2018)

Check for stability condition of VAR estimates reveal that all the Eigenvalues lay inside the unit circle hence VAR satisfied stability condition. The estimated VAR is stable, that is, stationary if all roots have modulus less than one and lie inside the unit circle. In this case, as illustrated in Figure 4.2.3

5.6 Normality, Autocorrelation, and Wald lag-Exclusion test.

The residuals were also examined for the normality, autocorrelation and Wald lag-Exclusion test

Table 5. 4 Normality, Autocorrelation, and Waldlag-Exclusion test.

Test	H_o	Ch2	Df	P-value	Conclusion.
Jarque-Bera (ALL)	Residuals are normally distributed.	10.18	14	0.748	Residuals are normally distributed at 74.8%
VAR residual serial correlation LM Test	No autocorrelation at lag order	L1. 45.34	49	0.62	There is no serial correlation at both lag order.
		L2. 53.53	49	0.31	
Wald lag-Exclusion statistics. (ALL)	Both lags are jointly significant to influence the dependent variable.	L1. 394.96	49	0.000	Accept Ho. Both lags are jointly significant.
		L2. 255.91	49	0.000	

Source: Calculation from Author's Stata 13, An estimation of Sudan's Location determinants FDI data 1980-2018 World Bank Data (2018).

As presented in Table 5.4 in Appendix 1, the joint Jarque-Bera chi2 is 10.18 at 14 degrees of freedom (df) with a probability of 0.75, this means that residuals are highly normal at 75%, thus the null hypothesis of normality in the residuals is accepted at 10% significance level as

reflected in Appendix 1. Results from Appendix 1 test the presence of autocorrelation. At lag both lag1 and lag 2 respectively. The Chi-2 45.3 and 53.5 with a probability of 0.62 and 0.31 respectively. Thus the model is significant at all levels of significance; hence the null hypothesis which states that the error terms are independent is accepted. The results of the Wald Lag Exclusion Test, considering both lags, the prob of 0.000, therefore, the Ho that both lags are jointly significant is accepted at 5% significant level.

6.0 CONCLUSION AND RECOMMENDATIONS.

This study attempts to identify the location determinants of FDI inflows into Sudan. The empirical results derived using the Vector Autocorrelation model and Granger Causality test lead to a conclusion and set out recommendations for future policy formulation. With the current emphasis on importantly of FDI inflow by economists and other stakeholders, the finding can provide substantial suggestions for dealing with the adverse market conditions that Sudan is currently facing. Our study also included diverse perspectives from the theoretical literature, emphasis on international trade theories such as the Absolute Advantage Theory, the Comparative Advantage Theory, the Heckscher-Ohlin Model, and the Product Life-Cycle Theory. The latest developed theories were also drawn on, including the Eclectic Paradigm and the Market-Size Hypothesis. In accordance to the view of the host country location motive for FDI inflow, a finding from the Global investment competitiveness survey 2017/2018, and a suggestion from Gilmore, O's Donnel, Carson, and Cummins (2003) eight factors which influence the choice of the host market, the Portfolio Theory and Hymer FDI Theory were relevant. Empirical evidence strongly reveals a positive relationship between FDI and GDP, Indicate that economies with large –market size (GDP), attract a large amount of FDI. Sudan is less open to international trade and cooperation despite its vast natural resources.

Policy implication and recommendation

It was found that the recent surge of FDI into African countries was based on efficiency seeking (UNCTAD, 2018) to exploit the benefit of economies of scale. GDP is an important variable in determining FDI inflow into Sudan. Hence Sudan should implement policies that encourage a fast-growing economy that can attract a greater share of FDI.

Recommendation.

Sudan should pay it debt service obligation and further keep the supplementary account that will cater for long-term debt payment, Sudan should continue to expand it investment laws, to provide a substantial fiscal and non-fiscal incentives to foreign investors, and Sudan should formulate it relevant borrowing policies and laws to establish some regulating, monitoring, and guaranteeing procedures and skills in the borrowing of foreign loans.

Limitation and area of further study

None inclusion of quantitative data, (variable such as political-legal and regulatory environment, natural resource rents, and human capital but it could not render our results susceptible. Further research has to investigate the effect of both political stability which is attached to a 50% level of importance by GICS report, legal and environment policy that valued at a 40% level of importance. Finally, it should assess which sector is more effective and efficient for FDI investors.

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Cite this article:

PETER KUOT MADIT CHOL (2020). The Location Determinants of FDI in Sudan. Time Series – Empirical Analysis From 1980-2018. *International Journal of Science and Business, 4*(7), 26-45. doi: https://doi.org/ 10.5281/zenodo.3903279

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