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10 June 2017

Online at <https://mpra.ub.uni-muenchen.de/79788/>

MPRA Paper No. 79788, posted 19 Jun 2017 14:48 UTC

# **Appraisal of Trade Potency on Economic Growth in Sudan: New Empirical and Policy Analysis**

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## ***Abstract:***

This paper investigates the relationship between domestic investment, exports, imports, and economic growth in Sudan. In order to achieve this purpose, annual data were collected from the reports of World Bank for the periods between 1976 and 2015, was tested by using Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) stationary test, co integration analysis of Vector Error Correction Model and the Granger-Causality tests. According to the result of the analysis, unit root tests show that economic growth, domestic investment, exports and imports series become stationary when first difference is considered. Also, it was determined by using co integration analysis that there is relationship between the four variables in Sudan. Also, and according to the Vector Error Correction Model, there is no relationship between variables in the long run term. On the other hand, and according to the Granger-Causality tests, we defined that in the short run term, only economic growth cause domestic investment. These results provide evidence that Reforms and measures in economic strategies are still insufficient to make trade and domestic investment able to boost the Sudan's economy.

**Key words:** Exports, Imports, Economic Growth, Sudan, Cointegration, Vector Error Correction Model and Causality.

**JEL Classification :** F1, F10, F14

## I. Introduction

Today, the openness of national economies is largely achieved and trade theories dominate the economic literature. The classical theorists, relayed by neoclassical theory, have defended the idea that trade improves the collective well-being. The increase in international trade leads to a specialization of production and, in so doing, increases the levels of productivity in the sectors that trade, which ultimately benefits growth. Noncompetitive sectors are disappearing and there is a reallocation of resources to competitive sectors. In addition, international trade makes it possible to increase the range of products consumed by economic agents at a lower price. While it is clear that the opening of economies in [Smith](#) is closely related to economic growth because open borders increase the size of markets, the introduction of economic growth into international trade years. [Findlay \(1984\)](#) offers a broad review of economic literature using the neo-classical [Solow](#) model to show the positive effects of trade on economic growth. Empirically, studies such as [Maddison's \(1995\)](#) emphasize that opening up economies is a significant factor in the growth, along with technical progress, the accumulation of physical capital, or the improvement of capital human. Thus, for [Maddison](#), whose study spans the nineteenth and twentieth century's, "It is clear that rapid economic growth is closely linked to the opening of economies." The development of international trade has produced an international specialization, and has made possible the diffusion of new technologies. International trade has also helped to break the [Malthusian](#) logic of the decline in the amount of natural resources per inhabitant. Other well-known studies, such as [Dollar \(1992\)](#), [Edwards \(1993\)](#), [Sachs and Warner \(1995\)](#), or [Harrisson \(1993\)](#) confirmed the idea that free trade policies lead to stronger economic growth. [Barro and Sala-I-Martin \(1995\)](#), show that growth is lower, when foreign trade is protected. Finally, [Vamvakadis \(1999\)](#) shows that economic growth is stronger when openness is widespread. Sudan has many natural resources such as oil and natural gas, as well as large agricultural land, which has been called the world's food basket. Also, Sudan is the world's first producer of gum Arabic (80% of the world's production) and a small stock of iron ore, copper, chromium ore, zinc, tungsten, mica, Silver, gold and uranium. In addition, Sudan is a vast country rich in natural resources represented in agricultural lands, livestock and mineral resources, forests and fisheries. Sudan relies heavily on agriculture, accounting for 80% of population activity in addition to industry, especially those that depend on agriculture. The Sudanese exports depend heavily on oil production, which reached 500 thousand barrels per day before falling by up to 75% after the secession of the south, and seeks to compensate this important source of the state treasury by

intensifying oil exploration in the regions, especially in the center and southeast and increase exploration for Gold and the development of the agricultural and livestock sector through the introduction of new technologies to raise productivity and improve quality. Cotton has been given special attention due to the increasing demand in the world markets. The gum Arabic is considered the first country of production in the world and exported to European countries and the USA. Sugar occupies an important place in the list of Sudanese exports. Sudan has achieved self-sufficiency in sugar and is currently exporting its surplus. In addition, Sudan exports oilseeds, cotton seed, vegetables, fruits, cattle and meat. The total export revenue in 2010 was about US \$ 10.29 billion. According to 2010 estimates, China is one of the largest importers of Sudanese commodities exported (68.3%), followed by Japan (12.6%) and India (5.8%). To 2010, the volume of Sudanese imports amounted to about US \$ 9,176 billion. Imported goods consist of foodstuffs, manufactured goods, equipment, petroleum appliances, medicines, chemicals, clothing and wheat. China is the leading trading partner in the import sector (22% in 2010)), Saudi Arabia (6.5%), India (5.8%), the United Arab Emirates (5%), Korea (3.2%) and Australia (2.7%). In particular, this work tries to empirically find an answer for the question of whether exports lead economic growth or imports lead economic growth or economic growth leads exports and imports in Sudan, to achieve this objective the paper is structured as follows. In section 2, we present the review literature concerning the nexus between trade and economic growth. Secondly, we discuss the Methodology Model Specification and data used in this study in Section 3. Thirdly, Section 4 presents the empirical results as well as the analysis of the findings. Finally, Section 5 is dedicated to our conclusion.

## **II. Review literature**

Different studies and researches were done by academics and policy makers for exports, imports and economic growth. A variety of studies shows different results about the relationship of these three variables. [Asafu-Adjaye et al \(1999\)](#) consider three variables: exports, real output and imports (for the period 1960- 1994). They do not find any evidence of the existence of a causal relationship between these variables for the case of India and no support for the ELG hypothesis, which is not too surprising given India's economic history and trade policies. [Francisco \(2000\)](#) investigated the Granger-causality between exports, imports, and economic growth in Portugal over the period 1865 - 1998. Findings revealed that, more interestingly, there is no kind of significant causality between import- export

growths. Further, researcher concluded that the growth of output for the Portuguese economy during that period revealed a shape associated with a small dual economy in which the intra-industry transactions were very limited. [Hossain and al \(2009\)](#) found the unidirectional causality relationship from export to income. They also found, long run relationship for export, import and income. However, they found no causality relationship between import and income. [Akbay O.S \(2011\)](#) investigated the role of international trade on the economic growth of Turkish economy for the period of 1998-2010. By using the Granger Causality tests, the results suggest that imports led to economic growth and growth led to exports. [Barbara Pistoresi and Alberto Rinaldi \(2011\)](#) the nexus between trade and economic growth in Italy has been widely debated by historiography. The outcome suggests that three variables, GDP, import, export commove in the long run but the direction of causality varies across time. [Kogid, Mulok, Ching, Lily, Ghazali and Loganathan \(2011\)](#) analyzed the relationship between the economic growth and the import in Malaysia from 1970 to 2007. Results show that there is no co integration exists between economic growth and import, but there exists bilateral causality between economic growth and import. Results also show that import could indirectly contribute to economic growth, and economic growth could also directly contribute to import. These findings may be vital for future economic growth policy. [Khan, Umar, Zaman, Ahmad and Shoukat \(2012\)](#) have approached the study on exports, imports and economic growth nexus. The study uses the Granger Causality and Co – integration tests to examine the long run correlation among economic growth, exports, and imports of Pakistan taking time serious data for the period 1972- 2009. Results indicated that, both exports and imports are considered an essential part for economic growth of Pakistan. Moreover, economic growth has an important impact on exports and impact. Further, a successful and sustained economic growth requires growth of both exports and imports. [Taghavi, Goudarzi, Masoudi, and Gashti \(2012\)](#) investigated the import, export and economic growth in Iran over the period 1962- 2011. The role of the import and export variables in the investigation of economic growth output co integration analysis is emphasized, enabling one to test for the cases direct long run relationship, indirect long run relationship, and impulse, response function between export and import and economic growth. [G.Jayachandran \(2013\)](#) investigates the impact of exchange rate volatility on the real exports and Imports in India using annual time series data for the period 1970 to 2011. He found that GDP has a positive and significant impact on India s real exports in the long-run, but the impact turns out to be insignificant in the short-run. [Hussain M and Saaed A.\(2014\)](#) examined the nexus of Exports, Imports and Economic growth in Saudi Arabia, using annual data for the period 1990- 2011.

Granger Causality and Cointegration test were employed in the empirical analysis. Both Trace and Maximum Eigenvalue indicated cointegration at 5% level of significance pointing to the fact that the variables have a long-run relationship. Also, economic growth was found to Granger Cause import. There was a unidirectional causality existing between export and import. But the result of the causation between Exports and economic growth and imports and economic growth was statistically insignificant. [Sachin N. Mehta \(2015\)](#) tested the relationship between exports, imports and economic growth in India by using annual data for the period 1976-2014. Engle Granger Cointegration analysis, VECM and Granger causality tests were employed in the empirical analysis. The results show that there is a long run co-integrating relationship between Gross Domestic Products (GDP), Export, and Import in India. In long term the results of Granger causality tests show that GDP leads to Exports but Exports does not lead to GDP, also GDP does not lead to Import and Import do not lead to GDP. Finally Export lead to Imports but Imports do not lead to Exports. [Sani Hassan Hussaini, Bashir Ado Abdullahi, Musa Abba Mahmud \(2015\)](#) examined the relationship between exports, imports and economic growth in India. They found that exports, imports and economic growth are cointegrated and there exist bidirectional relationship between GDP and Export. [Bader S.S. HAMDAN \(2016\)](#) analyzed the effect of exports and imports on economic growth in the Arab countries during the period 1995 to 2013. The study used panel data approach in 17 countries: (Jordan, United Arab Emirates, Bahrain, Tunisia, Algeria, Saudi Arabia, Sudan, Oman, Qatar, Kuwait, Lebanon, Egypt, Djibouti, Mauritania, Morocco, Yemen and Palestine). The outcome indicates that exports and imports have positive effect of economic growth. [Masoud Albiman Md and Suleiman NN \(2016\)](#) investigated the nexus between exports, imports and economic growth in Malaysia, using annual data for the period 1967- 2010. Cointegration analysis, VAR and Granger causality tests were employed in the empirical analysis. The results show that there is a causal relationship from exports to economic growth and from exports to imports. [Bakari Sayef and Mohamed Mabrouki \(2017\)](#) investigate the relationship between exports, imports, and economic growth in Panama. In order to achieve this purpose, annual data for the periods between 1980 and 2015 were tested using the Johansen co-integration analysis of the Vector Auto Regression Model and the Granger-Causality tests. According to the result of the analysis, it was determined that there is a strong evidence of bidirectional causality from imports to economic growth and from exports to economic growth. [Bakari Sayef and Makram Krit \(2017\)](#) look into the acquaintance between exports, imports, and economic growth in Mauritania, by using co integration analysis of Vector Error Correction Model and the Granger-Causality tests. According to the

Vector Error Correction Model, exports have a positive effect on economic growth. However, imports have a negative effect on economic growth. On the other hand, and according to the Granger-Causality tests, they defined that there is uni-directional causality between imports and economic growth. In addition, the result of the Granger Causality Tests shows that there is no relation of causality between exports and GDP. The nexus between import, export and economic growth, has been a subject matter for a substantial body of empirical work. With regard to methods haven used to determine the importance of exports and imports to economic growth, there are two main methods. The first one employs simple or multiple regressions, while the second method employs the causality technique. Recently, most of studies have attended to focus on VAR and VEC models and cointegration approach.

### **III. Data, methodology and model specification:**

#### **1. The Data:**

The analysis used in this study cover annual time series of 1976 to 2015 or 55 observations which should be sufficient to capture the short run and long run correlation between Export, Import and economic growth in the model. The data set consists of observation for GDP, exports of goods and services (constant US\$), imports of goods and services (constant US\$), and Fixed Formation Capital (constant US\$). All data set are taken from World Development Indicators 2016.

#### **2. Methodology**

We will use the most appropriate method which consists firstly of determining the degree of integration of each variable. If the variables are all integrated in level, we apply an estimate based on a linear regression. On the other hand, if the variables are all integrated into the first difference, our estimates are based on an estimate of the VAR model. When the variables are integrated in the first difference we will examine and determine the cointegration between the variables, if the cointegration test indicates the absence of cointegration relation, we will use the model VAR. If the cointegration test indicates the presence of a cointegration relation between the different variables studied, the model VECM will be used.

#### **3. Model specification:**

Early empirical formulations tried to capture the causal link between domestic investment, exports, imports and economic growth by incorporating trade into the aggregate production function (Balassa, 1978; Sheehey, 1992; Güngör Turan, 2014; Rummana Zaheer, 2014; Afaf Abdull J. Saaed, 2015). The augmented production function including both exports and imports is expressed as:

$$GDP_t = f(Investment, Exports, Imports) \quad (1)$$

The function can also be represented in a log-linear econometric format thus:

$$\log(GDP)_t = \beta_0 + \beta_1 \log(exports)_t + \beta_2 \log(imports)_t + \beta_3 \log(Investment)_t + \varepsilon_t \quad (2)$$

Where:

- $\beta_0$  : The constant term.
- $\beta_1$ : coefficient of variable (Exports)
- $\beta_2$ : coefficient of variables (Imports)
- $\beta_3$ : coefficient of variables (Domestic investment)
- $t$ : The time trend.
- $\varepsilon$ : The random error term assumed to be normally, identically and independently distributed.

#### IV. Empirical analysis:

##### 1. Tests for integration

This involves testing the order of integration of the individual series under consideration. Several procedures for the test of order of integration have been developed. The most popular ones are Augmented Dickey-Fuller (ADF) test due to Dickey and Fuller (1979, 1981), and the Phillip-Perron (PP) due to Phillips (1987) and Phillips and Perron (1988).

The general form of ADF test is estimated by the following regression:

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \sum_{i=1}^n \beta_i \Delta Y_i + \varepsilon_t \quad (3)$$

The general form of PP test is estimated by the following regression

$$\Delta y_t = \alpha + \beta \Delta y_{t-1} + \varepsilon_t \quad (4)$$

- $\Delta$ : is the first difference operator
- $Y$  : is a time series
- $t$  : is a linear time trend
- $\alpha$ : is a constant
- $n$ : is the optimum number of lags in the dependent variable
- $\varepsilon$ : is the random error term.



**Table 1: Tests for Unit Root**

<b>Log (GDP)</b>	Stationary in first difference, at thresholds of 1%, 5% and 10% with constant
<b>Log (Domestic Investment)</b>	Stationary in first difference, at thresholds of 1%, 5% and 10% with constant
<b>Log (Exports)</b>	Stationary in first difference, at thresholds of 1%, 5% and 10% with constant
<b>Log (Imports)</b>	Stationary in first difference, at thresholds of 1%, 5% and 10% with constant

The result in table 1 shows that all the variables were not stationary in level form and for different level (1%, 5% and 10%). This result provides strong evidence of non stationary in both Augmented Dickey Fuller test and Philips-Peron test. However, variable become stationary after first difference and second difference in both ADF and PP tests and in all levels (1%, 5% and 10%).

## 2. Lag order Selection Criteria

Most VAR models are estimated using symmetric lags, the same lag length is used for all variables in all equations of the model. This lag length is frequently selected using an explicit statistical criterion such as the AIC or SIC.

$$AIC = 2k - 2\ln(L) \quad (5)$$

$$SIC = -2 \ln(L) + k \cdot \ln(n) \quad (6)$$

- L: The maximum values of the likelihood function for the model.
- K: the number of estimated parameters in the model.
- n: the number of observation.

**Table 2: Lag order Selection Criteria**

VAR Lag Order Selection Criteria						
Lag	Log L	LR	FPE	AIC	SC	HQ
0	-33.26655	NA	8.81e-05	2.014408	2.188561	2.075805
1	114.5207	255.6321*	7.15e-08*	-5.109229*	-4.238463*	-4.802243*
2	123.3978	13.43557	1.09e-07	-4.724206	-3.156827	-4.171631
3	133.5210	13.13274	1.62e-07	-4.406539	-2.142546	-3.608375

\* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

It is clear from Table 3 that LR, FPE, AIC, SC, HQ and HQ statistics are chosen lag 1 for each endogenous variable in their autoregressive and distributed lag structures in the estimable VAR model. Therefore, lag of 1 is used for estimation purpose.

### 3. Cointegration analysis and VECM :

The superior test for cointegration is Johansen's test. This is a test which has all desirable statistical properties. Johansen's methodology takes its starting point in the vector autoregression (VAR) of order  $p$  given by:

$$\mathbf{y}_t = \boldsymbol{\mu} + \mathbf{A}_1 \mathbf{y}_{t-1} + \dots + \mathbf{A}_p \mathbf{y}_{t-p} + \boldsymbol{\varepsilon}_t \quad (7)$$

Where  $\mathbf{y}_t$  a vector of variables that are integrated of order one, and  $\boldsymbol{\varepsilon}_t$  is a vector of innovations. This VAR can be re-written as

$$\Delta \mathbf{y}_t = \boldsymbol{\mu} + \boldsymbol{\Pi} \mathbf{y}_{t-1} + \sum_{i=1}^{p-1} \boldsymbol{\Gamma}_i \Delta \mathbf{y}_{t-i} + \boldsymbol{\varepsilon}_t \quad (8)$$

Where:  $\boldsymbol{\Pi} = \sum_{i=1}^p \mathbf{A}_i - \mathbf{I}$  and  $\boldsymbol{\Gamma}_i = -\sum_{j=i+1}^p \mathbf{A}_j$

If the coefficient matrix  $\boldsymbol{\Pi}$  has reduced rank  $r < n$ , there exist matrices  $\mathbf{a}$  and  $\boldsymbol{\beta}$  each with rank  $r$  such that  $\boldsymbol{\Pi} = \mathbf{a}\boldsymbol{\beta}'$  and  $\boldsymbol{\beta}'\mathbf{y}_t$  is stationary.  $r$  is the number of cointegrating relationships the elements of  $\mathbf{a}$  are known as the adjustment parameters in the vector error correction model and each column of  $\boldsymbol{\beta}$  is a cointegrating vector. It can be shown that for a given  $r$ , the

maximum likelihood estimator of  $\beta$  defines the combination of  $y_{t-1}$  that yields the  $r$  largest canonical correlations of  $\Delta y_t$  with  $y_{t-1}$  after correcting for lagged differences and deterministic variables when present. Johansen proposes two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of the matrix  $\Pi$ : the trace test and maximum Eigenvalue test, shown in equations (9) and (10) respectively.

$$J_{trace} = -T \sum_{i=r+1}^n \ln(1 - \lambda_i) \quad (9)$$

$$J_{max} = -T \ln(1 - \lambda_{r+1}) \quad (10)$$

Where  $\lambda_i$  denotes the estimated values of the characteristic roots obtained from the estimated  $\pi$ , and  $T$  is the number of observations.

**Table 3: Cointegration Test**

<b>Unrestricted Cointegration Rank Test (Trace)</b>				
<b>Hypothesized No. of CE(s)</b>	<b>Eigenvalue</b>	<b>Trace Statistic</b>	<b>0.05 Critical Value</b>	<b>Prob.**</b>
<b>None *</b>	0.575626	77.44143	47.85613	0.0000
<b>At most 1 *</b>	0.450382	45.72724	29.79707	0.0004
<b>At most 2 *</b>	0.275167	23.58158	15.49471	0.0024
<b>At most 3 *</b>	0.270595	11.67446	3.841466	0.0006
<b>Trace test indicates 4 cointegrating eqn(s) at the 0.05 level</b>				
<b>* denotes rejection of the hypothesis at the 0.05 level</b>				
<b>**MacKinnon-Haug-Michelis (1999) p-values</b>				

The results of the cointegration test indicates 4 cointegrating equations at the 0.05 level, and provide the existence of long run equation between GDP, exports and imports, which can be written as:

$$\log(GDP) = 0.503421 \log(exports) - 0.429936 \log(imports) + 0.072572 \log(Investment) \quad (11)$$

According to this equation a 1% increase in exports leads to an increase of 0.503421% of GDP. On the other hand, a 1% increase in imports leads to a decrease of 0.429936% of GDP. Also, we can see that a 1% increase in domestic investment leads directly to an increase of 0.072572. Otherwise, the four variables are cointegrated, which obliges us to use the VECM model to test the significance of this model.

As, GDP, domestic investment, exports and imports are cointegrated, a VECM (vector error correction model) representation would have the following form, in equation

$$\Delta \text{GDP}_t = \sum_{i=1}^k \alpha_0 \Delta \text{GDP}_{t-i} + \sum_{i=1}^k \alpha_1 \Delta \text{exports}_{t-i} + \sum_{i=1}^k \alpha_2 \Delta \text{Imports}_{t-i} + \sum_{i=1}^k \alpha_2 \Delta \text{Investment}_{t-i} + Z_1 EC1_{t-1} + \varepsilon_{1t} \quad (12)$$

Where:

- $\Delta$ : The difference operator.
- $k$  : The number of lags
- $\alpha_0, \alpha_1$  and  $\alpha_2$  : Short run coefficients to be estimated.
- $EC1_{t-1}$  : The error correction term derived from the long-run co integration relationship.
- $Z_1$  : The error correction coefficients of  $EC1_{t-1}$ .
- $\varepsilon_{1t}$ : The serially uncorrelated error terms in equation

**a- Long run term**

**Table 5: Long run equation estimate**

<b>Dependent Variable: D(DLOG(GDP))</b>				
<b>Method: Least Squares (Gauss-Newton / Marquardt steps)</b>				
$\text{D(DLOG(GDP))} = \text{C(1)} * (\text{DLOG(GDP(-1))} - 0.0725718248482 * \text{DLOG(INVESTMENT(-1))} - 0.503421278987 * \text{DLOG(EXPORTS(-1))} + 0.429936182723 * \text{DLOG(IMPORTS(-1))} - 0.0216070310325) + \text{C(2)} * \text{D(DLOG(GDP(-1)))} + \text{C(3)} * \text{D(DLOG(INVESTMENT(-1)))} + \text{C(4)} * \text{D(DLOG(EXPORTS(-1)))} + \text{C(5)} * \text{D(DLOG(IMPORTS(-1)))} + \text{C(6)}$				
	<b>Coefficient</b>	<b>Std. Error</b>	<b>t-Statistic</b>	<b>Prob.</b>
<b>C(1)</b>	-0.188885	0.125907	-1.500194	0.1437
<b>C(2)</b>	-0.270166	0.166534	-1.622288	0.1149
<b>C(3)</b>	0.002021	0.040823	0.049495	0.9608
<b>C(4)</b>	-0.040683	0.051720	-0.786590	0.4375
<b>C(5)</b>	0.034342	0.039093	0.878465	0.3864
<b>C(6)</b>	0.002977	0.009261	0.321433	0.7500

C (1) must be significant, and the coefficient of C (1) should be negative for the VECM model to be significant. C (1) = -0.188885= correction error term or adjustable velocity to equilibrium = adjustment speed any imbalance to long equilibrium state, with an adjustable speed of 18.88%. But, it does not significant because it has a probability value more than 5%. Therefore in our case, we can say that the long equilibrium equation is not able to study and to explain the nexus between exports, imports, domestic investment and economic growth in the long run term.

**b- Short run term**

**Table 6: VEC Granger Causality**

VEC Granger Causality/Block Exogeneity Wald Tests			
Dependent variable: D(DLOG(GDP))			
Excluded	Chi-sq	df	Prob.
D(DLOG(INVESTMENT))	0.002450	1	0.9605
D(DLOG(EXPORTS))	0.618723	1	0.4315
D(DLOG(IMPORTS))	0.771701	1	0.3797
Dependent variable: D(DLOG(INVESTMENT))			
Excluded	Chi-sq	df	Prob.
D(DLOG(GDP))	9.593189	1	0.0020
D(DLOG(EXPORTS))	0.299118	1	0.5844
D(DLOG(IMPORTS))	0.020538	1	0.8860
Dependent variable: D(DLOG(EXPORTS))			
Excluded	Chi-sq	df	Prob.
D(DLOG(GDP))	0.430353	1	0.5118
D(DLOG(INVESTMENT))	0.034141	1	0.8534
D(DLOG(IMPORTS))	5.866717	1	0.0154
Dependent variable: D(DLOG(IMPORTS))			
Excluded	Chi-sq	df	Prob.
D(DLOG(GDP))	2.737360	1	0.0980
D(DLOG(INVESTMENT))	0.648490	1	0.4207
D(DLOG(EXPORTS))	1.241993	1	0.2651

In the short run term, the results of the Granger Causality test show that exports and imports have no effect on economic growth. Also, GDP has no effect on trade.

#### 4. Checking the quality of the model

##### a- Diagnostic tests

**Table 6: Diagnostics Tests**

<i>Heteroskedasticity Test: Breusch-Pagan-Godfrey</i>			
F-statistic	1.336441	Prob. F(12,24)	0.2624
Obs*R-squared	14.82067	Prob. Chi-Square(12)	0.2514
Scaled explained SS	7.690477	Prob. Chi-Square(12)	0.8088
<i>Heteroskedasticity Test: Harvey</i>			
F-statistic	1.728178	Prob. F(12,24)	0.1228
Obs*R-squared	17.15116	Prob. Chi-Square(12)	0.1440
Scaled explained SS	19.97315	Prob. Chi-Square(12)	0.0676
<i>Heteroskedasticity Test: Glejser</i>			
F-statistic	1.832240	Prob. F(12,24)	0.0999
Obs*R-squared	17.69015	Prob. Chi-Square(12)	0.1254
Scaled explained SS	13.80861	Prob. Chi-Square(12)	0.3131
<i>Breusch-Godfrey Serial Correlation LM Test:</i>			
F-statistic	1.188381	Prob. F(1,30)	0.2843
Obs*R-squared	1.409823	Prob. Chi-Square(1)	0.2351

Diagnostic tests indicate that the overall specification adopted is satisfactory. The tests performed to detect the presence of Breusch-Pagan-Godfrey in the estimated equation did not reveal any problem of heteroskedasticity at the 5% threshold.

##### b- VAR stability:

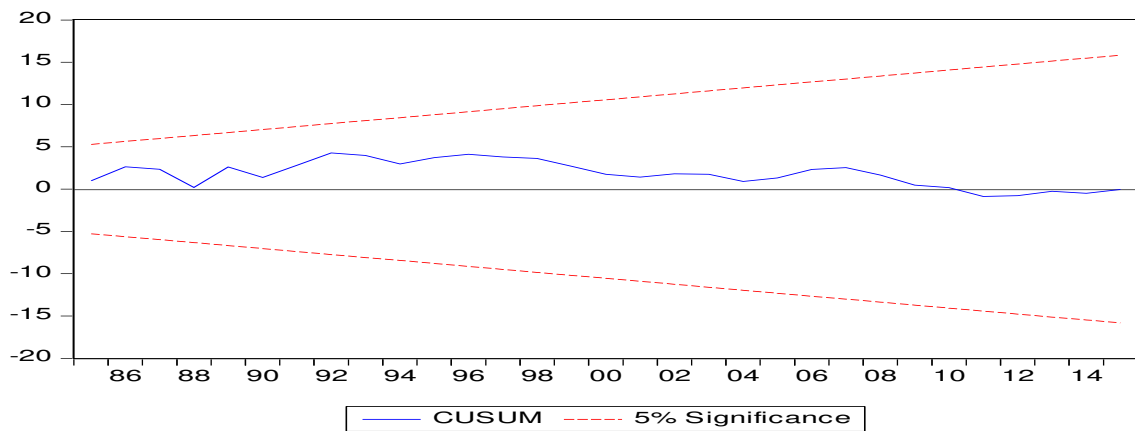
Finally we will apply to use the test CUSUM, this test makes it possible to study the stability of the model estimated over time. There are two versions of this test: the CUSUM “ $S_t$ ” based on the cumulative sum of the recursive residues and the CUSUM SQ “ $S'_t$ ” based on the cumulative sum of the square of the recursive residues.

- “ $k$ ” the number of parameters to be estimated from the model.
- “ $\epsilon_j$ ” the residue normalized by its standard deviation.

$$S_t = (T - k) \frac{\sum_{j=k+1}^t \varepsilon_j}{\sum_{j=k+1}^t \varepsilon_j^2} \quad t = k + 1, \dots, T \quad (12)$$

$$S'_t = \frac{\sum_{j=k+1}^t \varepsilon_j^2}{\sum_{j=k+1}^T \varepsilon_j^2} \quad t = k + 1, \dots, T \quad (13)$$

The tests results of the stability VAR (CUSUM Test) show that the Modulus of all roots is less than unity and lie within the unit circle. Accordingly we can conclude that our model the estimated VAR is stable or stationary.



## V. Conclusion

In this work we have attempted to address the relationship between economic growth, exports and imports in Sudan. The annual data were compiled from the World Bank reports for the periods 1976 to 2015 and were examined using the Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) stationary test, the co-integration analysis of Vector error correction model and the Granger-Causality tests. According to the result of the analysis, unit root tests show that economic growth, domestic investment, exports and series imports become stationary when the first difference is considered. In addition, it was determined by applying the co-integration analysis that there is a relationship between the four variables in Sudan. Moreover, and according to the vector error correction model, there is no relationship between the variables in the long term. On the other hand, and according to the Granger-Causality tests, we have defined that in the short term, only economic growth leads to domestic investment. Nineteen years ago, the United States imposed severe economic sanctions on Sudan, which included a long list of exports and imports and restricted financial transfers to

and from it. The United States has long said that its sanctions target the Government of Sudan, not its people, but our findings indicate that it was the Sudanese who paid the price of these sanctions, not their government. On the other hand, US sanctions include banning all kinds of commercial and financial dealings with Sudan. The Sudanese banking sector has also emerged from the global financial system because of the sanctions, which also include banning the export of technology and the seizure of Sudanese assets. In addition, Sudan Airways was one of the most affected by these sanctions, as it was denied access to spare parts and periodic maintenance of its aircraft, which led to the survival of most of its fleet of aircraft landing in the airport. Also, More than a thousand factories have been directly affected by sanctions for failing to obtain US spare parts or software. The sanctions imposed by the United States on banks and banks have violated these sanctions 1.5 billion dollars. Among researchers, students and university professors, US sanctions have had a major impact, depriving them of fellowships and participating in research, scientific journals and more. Other, these sanctions have deprived Sudan of medical devices, drugs and US preparations, and have also affected the functions of medical analysis laboratories, and have adversely affected patients with certain diseases, including cancer. US sanctions exempted gum Arabic from the sanctions list, making it the only commodity exported from Sudan to the United States, due to its being the largest user of the commodity. If oil is the main cause of the economic blockade, Sudan has lost more than 15 years of its exploitation of more than 15 years, amounting to about \$ 100 billion. This siege culminated in the secession of the south in July 2011, with oil revenues exceeding \$ 7 billion a year. Instead of lifting the economic blockade after the break-up, the country has been fueling conflict in South Kordofan and Blue Nile as well as the Darfur region. Thus, it seems clear that Sudan's economic problems, starting with US sanctions, the accumulation of foreign debts, the deterioration of the value of the pound, the bankruptcy of institutions, the flight of investments, the secession of the south, the continuation of the conflict in some areas and the decline in growth are in essence political problems and economic programs are not solved. In the structure of government lead to the cessation of war and armed conflicts, and allow for the real peaceful transfer of power, and the achievement of external relations that restore Sudan to interact with regional and international economic development, and to benefit from foreign investments.

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