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The Role of International Trade and Agricultural Production on Economic Growth in Somalia: Johansson Cointegration Approach

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Astract

This paper investigated the role of international trade and agricultural production on economic growth in Somalia by utilising annual time series data stretching from 1989 to 2019. Gross domestic product (GDP) was the dependent variable, while exports, imports and agricultural production were the explanatory variables of this study. Augmented Dickey-Fuller test (ADF) and Phillips-Perron (PP) test were used to examine the unit root of the data, and all the variables were stationary both at the first difference I(1). Moreover, the study used the Johansen co-integration method and the Granger-Causality test to analyse the long-run cointegration and direction causality of the interested variables respectively. According to the result of the analysis, Johansson and Julius method revealed that there is long-run cointegration between international trade, agricultural production and economic growth in Somalia. The results also showed that there is more than one co-integrating vector as provided by both trace and max statistics which is less than the critical value at the 5% significance level. All explanatory variables such as exports, imports and agricultural production are positively related to GDP with coefficients of 0.332%, 0.2601% and 1.0685% respectively. Interpretively, a one percent change in exports, imports and agricultural production will increase GDP by about 0.332%, 0.2601 and 1.0685% respectively. Furthermore, the consistency of this result has been confirmed by an autoregressive distributed lag model (ARDL) robustly. In contrast, we found that there is strong evidence of unidirectional causality from agricultural production to economic growth and also from agricultural production to exports. Based on the empirical findings, the study recommended to policymakers to enact policies that enhance agricultural production and trade openness, since they are essential to economic growth.

Keywords: *Agricultural production, ARDL model, causality, cointegration, economic growth.*

1. Introduction

Economic growth is currently one of the main goals that all countries seek to achieve. Whether developed or developing, the gross domestic product (GDP) of an economy is a measure of total production. More precisely, it is an increase in the capacity of an economy to produce goods and services which can be measured in nominal or real terms; the latter is adjusted for inflation. It is one of the prime long-run concerns of macroeconomists and policymakers (Chokri, Anis, & Ali, 2018). For a society to achieve an increasing standard of living, the total output must grow. Some economists have focused exclusively on the foreign sector, particularly on the relationship between international trade (exports and imports) and GDP growth. Furthermore, the majority of the population in Africa live in rural areas, where the sources of their livelihood immensely depend on farming and livestock keeping. For many years, agriculture has been the most important sector in most developing countries and in almost all African countries. Further, agriculture is considered a key sector in overcoming poverty. In Somalia, agriculture is

an important economic activity not only in terms of meeting the food needs of the population but also in terms of generating income through crop sales and agricultural labour opportunities.
However, according to the World Bank (2018), the agriculture's share of gross domestic product (GDP) is nearly 75% and denotes 93% of total exports. It is mostly associated with robust livestock exports in the recent pre-drought years.

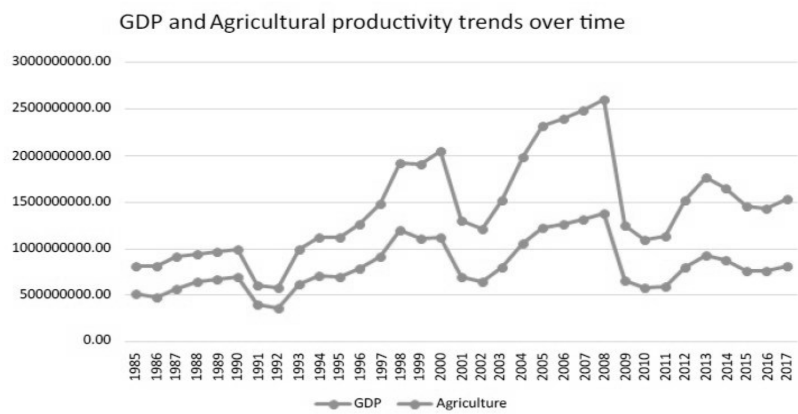


Fig 1.1: Somalia's GDP and agriculture from 1985 to 2017
Source: Sheikdon (2019)*

Figure 1.1 illustrates Somalia's GDP and agriculture from 1985 to 2017. It shows that GDP and agricultural production began together to decline after 1990 when Somalia's central government collapsed for a lack of political stability and civil war, and began to rise after 1993. Moreover, this makes sense that Somalia's agricultural production depends on rainfall. Crop production went down and reached the lowest since 1991 and 1992 for the severe drought between 2010 and 2012 as well as gross domestic production. Previous studies include Michelis and Zestos (2004), Awokuse (2007, 2008), Andersen and Babula (2009), Cetintas and Barisik (2008), Bakari and Mabrouki (2017), and Bakari et al. (2019a, 2019b). While these studies are suggestive, their evidence is based on the classical linear regression and simple correlation which cannot be a firm indication of both the long run and short run. The study used the vector error correction model to determine both the long-run and short-run relationships between international trade and agricultural production in economic growth. The VECM methodology has the strength to avoid the biases inherent in the structural models.

Somalia has fertile and arable land that has reliable rainfall. Similarly, most of the Somali regions are suitable for agriculture. Somali is an import-dependent nation. Her most important export commodities are livestock and crop production. During the war, Somalia was significantly isolated from international trade, and this limited its access to foreign exchange (Warsame, 2014). Moreover, Somalia's trade balance was structurally deficient in 2018. It is not a member of any regional economic bloc and it has few formal trade deals with other nations. The US and the European Union currently have no trade agreements with Somalia. This compounds the difficulties local firms face when competing regionally and internationally due to an absence of effective government, lack of banks and financial institutions with international standards, poor infrastructure, and lack of quality standards and controls to check exported products. Hence, Somalia cannot participate in certification or provide authenticity documentation that would enable businesses to sell goods globally.

The purpose of this study is to measure the role of international trade and agricultural productivity on economic growth in Somalia. The objectives of this study are to examine how export, import and agricultural production are related to economic growth in Somalia.

This study is a country-level analysis of the impact of exports, imports and agricultural production on economic growth in Somalia. The study uses annual data covering 1985 to 2018 taken from the World Bank development indicators and the website of the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC). The dependent variable is economic growth, measured as the log of the gross domestic product (GDP) and independent variables are international trade measured by export and import, and agricultural production measured by agricultural value added.

This study analyses the relationship between growth rate, export, import and agricultural production in Somalia. Therefore, it will significantly help Somali policymakers in deciding whether or not the country should persist with the trade-led economic growth agenda or pursue a completely different economic development.

2. Literature Review

In the empirical literature, several studies investigated the effects of export on economic growth, called the export-led growth hypothesis (ELGH), in the case of individual countries and groups of countries. However, conflicting results due to variations in the era studied, country or groups of countries focused on the methods used, which still make this topic current and a focus of attention.

Ahmad (2017) studied the impact of exports on economic growth, focusing on empirical evidence of Pakistan. The study is based on how exports influence economic growth in Pakistan consisting of 43 years of annual data from 1972 to 2014. Gross domestic product (GDP) is employed as the dependent variable while exports and other factors are used as independent variables such as imports, consumer price index, and terms of trade as independent variables in the study. The autoregressive distribution lag model (ARDL) and error correction model (ECM-ARDL) were employed for the long-run and short-run relationships in the study. ECM empirical estimations found out that equilibrium is fairly fast and restored. The findings of the study undertaken by Ahmad (2017) show the positive impact of exports as the country's exports increase the economic growth of the country, assuming other factors are equal. So, the findings show that export growth is an important factor that enhances growth in Pakistan. The study shows a greater and more suitable effect on the growth of GDP and confirms the ELG hypothesis in Pakistan. The findings are relevant to the study undertaken by Uğur, (2008).

Mishra (2014) studied the dynamic relationship between exports and economic growth in India. The objective of the paper was to investigate the dynamics of the relationship between exports and economic growth in India, using the annual data for the period 1970 to 2009. The Johansson's cointegration test method was used in the study to reveal whether exports and economic growth are long-run cointegrated. The results of the cointegration test, based on Johansen's procedure, indicate the existence of the cointegration between exports and real GDP. The Granger causality test indicates that there is a causal relationship running from GDP to exports in the long run, but not in the short run. The results of the empirical analysis led to the conclusion that exports and economic growth are related. Furthermore, different studies were done by academics and policymakers for imports and economic growth. Bakari and Mabrouki (2017) studied the impact of exports and imports on economic growth. The study used time series data measured for the period 1980-2015. Particularly, their study aimed at empirically discovering an answer to the query of whether imports lead to economic growth or economic growth leads to exports and imports. The cointegration test, VAR model and Granger causality tests were used to look into the relationship between these three variables. The results of the Johansson's test indicated the absence of a cointegration relation between the variables studied. Therefore, the investigators used an estimate based on the VAR model and the Granger causality test. The purpose of the model was to identify and see the short-run effects between the independent variables. The VAR results estimate to show that the variable that designates exports has a positive effect on GDP, but it does not have a significant probability. Beyond productivity and agriculture's role as a productive sector, there are other reasons to focus on African agriculture as a sector that affects growth and poverty.The findings are relevant to the studies undertaken by Abou-Stait, (2005) and Mohammad Ashraf, S. R. (2011).

Oyakhilomen, O., & Zibah, R. G. (2014). studied agricultural production and economic growth in Nigeria. Zibah used time series data on the index of agricultural production, real gross domestic product, interest rate, exchange rate and inflation rate extending from 1970 to 2011 in Nigeria. The study used the autoregressive distributed lag (ARDL) bound testing procedure to examine the cointegration (long run) relationship between economic growth and its determinants (agricultural production, interest rate, exchange rate and inflation rate) as well as the short-run dynamics'ARDL model. The result of ARDL implies that there is cointegration (long-run relationship) between economic growth and agricultural production. Sheikdon (2019) examined the contribution of agriculture sector to the Somali economy from 1985 to 2017. The study found a positive relationship between the dependent variable GDP and the independent variable 'agriculture' with a 5% significant level.

Moreover, there is the impact of agricultural sector on economic growth in Nigeria (Sertoğlu1, Ugural, & Bekun, 2017). Sertoğlu1, Ugural and Bekun (2017) used time series framework data sourced from the World Bank Development database for over 30 years. Johansen's cointegration approach methodology was used to investigate the existence of a long-run relationship between the agricultural sector and economic growth, and found two cointegrating vector models. This implies the existence of long-run causality relationships between agricultural output and RGDP per capita. VECM establishes and confirms the existence of the cointegration with significant and negative ECT and they concluded that agricultural production and economic growth are positively related in the long run.

3. Theoretical Framework and Methodology

The first section provides a general theoretical framework for analysing the impact of international trade and agricultural output on economic growth by starting with the definition of the constructs of the study. In the second section, the neoclassical economic growth model is discussed. After analysing its relationship with international trade (exports and imports) and agriculture, an analytical model will be generated. The third section presents the description of the data and finally, the last section will provide the specification of the model.

3.1 Theoretical Framework

Economic growth is an increase in the capacity of an economy to produce goods and services, compared from one period of time to another. It can be measured in nominal or real terms, the latter of which is adjusted for inflation. Traditionally, aggregate economic growth is measured in terms of gross national product (GNP) or gross domestic product (GDP) (Romer, 2007).

International trade is an exchange involving a good or service conducted between at least two different countries. The exchanges can be imports or exports and exports. Imports are the goods and services purchased or bought from the rest of the world by a country's residents, rather than buying domestically produced items (Hobson, 1904). Exports are goods and services produced domestically but then sold to customers residing in other countries.

Agricultural production is a measure of the amount of agricultural output produced for a given amount of inputs. It is the production of any grass or crop attached to the surface of the land, whether or not the grass or crop is to be sold commercially, and the production of any farm animals, whether or not the animals are to be sold commercially (Dewett & Singh, 1966).

3.2. Cobb-Douglas Production Function

Early empirical formulations tried to capture the long-run link between exports, imports and economic growth by incorporating them into the aggregate production function (Balassa, 1978; Onalan & Basegmez, 2018; AfafAbdull J. Saaed, 2015; Dritsaki & Stamatiou, 2018). Cobb-Douglas production function is a specific form of the production function. In 1928, Charles Cobb and Paul Douglas published a paper where they considered that production is determined by labour and capital. The function that was used is the following:

$$(\boldsymbol{L}, \boldsymbol{K}) = \boldsymbol{A L^{\beta} K^{\alpha}} \quad 3.1$$

where

Y total production (the real value of all goods produced in a year).
L labour input (the total number of person-hours worked in a year).
K capital input (the real value of all machinery, equipment and buildings).
A total factor productivity.

$\boldsymbol{\beta}$ and $\boldsymbol{\alpha}$ are the output elasticities of labour and capital respectively. The coefficient $\boldsymbol{\beta}$ measures the rate of increase in the variation of production for a percentage increase of labour, keeping capital stable. Respectively, coefficient $\boldsymbol{\alpha}$ measures the rate of increase in the variation of production for a percentage increase of capital, keeping labour stable.

The partial derivatives of a Cobb-Douglas production function are:

$$\frac{\partial Y}{\partial L} = \beta A L^{\beta-1} K^{\alpha} \quad 3.2$$

$$\frac{\partial Y}{\partial K} = \alpha A L^{\beta} K^{\alpha-1} \quad 3.3$$

The absolute value of the slope of an isoquant is the technical rate of substitution or TRS.

$$TRS = \frac{\frac{\partial Y}{\partial L}}{\frac{\partial K}{\partial L}} = \frac{\beta A L^{\beta-1} K^{\alpha}}{\alpha A L^{\beta} K^{\alpha-1}} = \frac{\beta L}{\alpha K} \quad 3.4$$

Equations 3.1 and 3.2 imply that the Cobb-Douglas technology is monotonic since both partial derivatives are positive. Equation 3.3 demonstrates that the technology is convex since the absolute value of the TRS falls as L increases and K decreases.
Suppose that all inputs are scaled up by some factor t, the new level of output is

$$(\boldsymbol{tL}, \boldsymbol{tK}) = (\boldsymbol{tL})^{\boldsymbol{\beta}}(\boldsymbol{tK})^{\boldsymbol{\alpha}} = \boldsymbol{t}^{\boldsymbol{\beta}+\boldsymbol{\alpha}}\boldsymbol{A}\boldsymbol{L}^{\boldsymbol{\beta}}\boldsymbol{K}^{\boldsymbol{\alpha}} = \boldsymbol{t}^{\boldsymbol{\beta}+\boldsymbol{\alpha}}\boldsymbol{f}(\boldsymbol{L}, \boldsymbol{K}) \qquad 3.5$$

The sum of both coefficients $\beta + \alpha$ measures the return to scale and can be expressed as a typical response of output in a proportionate change in the two inputs.
If $\boldsymbol{\beta} + \boldsymbol{\alpha} = \mathbf{1}$ is an indication that the return to scale is stable. In other words, we would say that if we double capital and labour, we will double the production.
If $\boldsymbol{\beta} + \boldsymbol{\alpha} > \mathbf{1}$ is an indication that return to scale increases, meaning that if we double capital and labour, we will more than double the production.
If $\boldsymbol{\beta} + \boldsymbol{\alpha} < \mathbf{1}$ is an indication that returns to scale decreases.
That means that if we double capital and labour, we will have less than double the production. Following the studies of Mankiw et al. (1992) and Shahbaz (2012), we use the Cobb-Douglas production function for period *t* as follows:

$$(\boldsymbol{t}) = (\boldsymbol{t})\boldsymbol{k}(\boldsymbol{t})^{\boldsymbol{\beta}}\boldsymbol{L}(\boldsymbol{t})^{\mathbf{1}-\boldsymbol{\beta}} \ \mathbf{0} < \boldsymbol{\beta} < \mathbf{1} \qquad 3.6$$

Y is domestic output, **A** is technological progress, **K** is capital stock, and labour.
On the above function, we assume that technology can be determined by international trade and skilled human capital.

$$(\boldsymbol{t}) = \boldsymbol{\mu TR}(\boldsymbol{t})^{\boldsymbol{\gamma}} \qquad 3.7$$

where **TRD** is the indicator of international trade, $\boldsymbol{\mu}$ is a constant.
Replacing Eq. 3.6 on Eq. 3.7, we get:

$$(\boldsymbol{t}) = \boldsymbol{\mu TR}(\boldsymbol{t})^{\boldsymbol{\gamma}} \ \boldsymbol{k}(\boldsymbol{t})^{\boldsymbol{\beta}}\boldsymbol{L}(\boldsymbol{t})^{\mathbf{1}-\boldsymbol{\beta}} \ \boldsymbol{u}^{\boldsymbol{e}} \qquad 3.8$$

Equation 3.8 taking the logarithms, we have the following equation:

$$(\boldsymbol{Y_t}) = \boldsymbol{\mu} + \boldsymbol{\gamma}\ \boldsymbol{lnTRD_t} + \boldsymbol{\beta}\ \boldsymbol{lnK_t} + (\mathbf{1} - \boldsymbol{\beta})\ \boldsymbol{lnL_t} + \boldsymbol{u_t} \qquad 3.9$$

If we include only the term 'TRD' (international trade) in the model and take export and import as a measurement of international trade, equation 3.9 appears as the following:

$$(\boldsymbol{Y_t}) = \boldsymbol{\mu} + \boldsymbol{\gamma_1}\,\mathbf{ln}(\mathbf{EXP}) + \boldsymbol{\gamma_2}\,\mathbf{ln}(\boldsymbol{IMP}) \qquad 3.10$$

$$(\boldsymbol{Y_t}) = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\mathbf{ln}(\mathbf{EXP}) + \boldsymbol{\beta_2}\,\mathbf{ln}(\boldsymbol{IMP}) \qquad 3.11$$

This equation is added to agricultural production (AGRO) to determine whether agriculture contributes to economic growth:

3.3 Data Description

This study used annual data covering 1989 to 2019. The data were extracted from the SESRIC website. The choice of the period of study is related to the availability of data on interest variables such as trade and economic growth in Somalia. The dependent variable is economic growth, measured as the log of the gross domestic product (GDP). The independent variables are export measured by real export, import (real import) and agricultural production measured (agricultural value added).

3.4 Model Specification

Model was specified by using equation 3.11, so the relationship between international trade, agricultural productivity and economic growth was modelled as

$$(\mathbf{GDP}_t) = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\mathbf{ln}(\mathbf{EXP}_t) + \boldsymbol{\beta_2}\,\mathbf{ln}(\boldsymbol{IMP_t}) + \boldsymbol{\beta}_3\mathbf{ln}(\boldsymbol{AGRO_t}) + \boldsymbol{\varepsilon_t}\ \textit{where}$$

$\boldsymbol{GDP}$ *real gross domestic product*
$\boldsymbol{EXP}$ *real export*
$\boldsymbol{IMP}$ *real import*
$\boldsymbol{AGRO}$ *agricultural production*
$\boldsymbol{\varepsilon}$ *random error term assumed to be normally, identically and independently distributed.*
$\boldsymbol{\beta_0}$ *is a constant whare* $\boldsymbol{\beta}$, $\boldsymbol{\beta}$, $\boldsymbol{\beta}$ $_3$ *are coeficient elasticity of the variables* and
$\boldsymbol{t}$ *is time varianty*

4. Results and Discussion

This section gives the results of the empirical analysis. It contains more subsections: descriptive statistics, unit root test, cointegration test, vector error correction model (VECM), Granger causality test and other tests. Finally, the study uses the ARDL model as a robust analysis of the cointegration test. The details and explanation of these methods are in the tables below.

4.1 Descriptive Statistics

Descriptive statistics of the variables show the main preliminary features of the data. These include mean, standard deviation, maximum and minimum values of the variables as shown in Table 4.1.

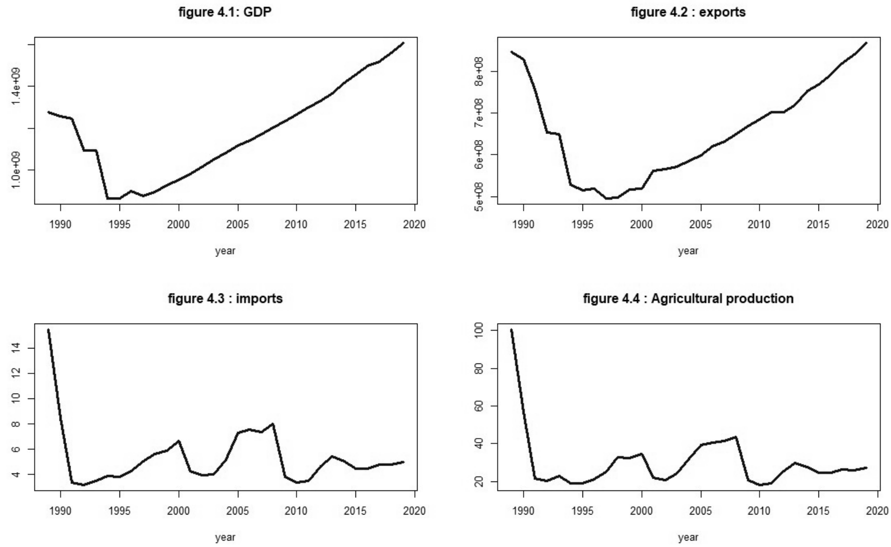
Table 4.1: Descriptive statistics

Variables	GDP ($billion)	AGR ($million)	Exports($million)	Imports($million)
Mean	4.5348	659.17	30.310	5.3348
Median	4.7500	649.97	25.490	4.7500
Maximum	5.218	867.75	18.320	15.460
Minimum	3.1700	495.94	100.35	3.1700
Standard deviation	0.93788	117.17	15.739	2.3788

Table 4.1 shows descriptive statistics results of the variables. The average gross domestic product was $4.5348 billion each year and the highest value of GDP in Somalia reached $5.218 billion and the lowest value was $3.1700 billion. The mean of exports in the country in the selected periods of the study was $30.310 million where its highest amount reached $100.35 million and its lowest amount stretched to $18.32 million. Also, imports of the country averaged $5.3348 million per year, its highest value reached $15.56 million and its lowest was $3.1700. Agricultural production was measured on agricultural value added that has an average of $659.17 million per year; its maximum value was

$867.75 and its minimum value was $495.94. Furthermore, apart from the mean, agricultural production has a standard deviation of 117.17, meaning that the range between the highest and the lowest values is larger than other variables in the model. So, its dispersion spread more than the dispersion of the other variables.

Figures 4.2 to 4.4 show the trend analysis of the variables.



The figures above show the trend of the variables from 1989 to 2019, starting from the GDP in Figure 4.1 which tells the overall growth or output of the country declining from 1990 to 1995. This can be attributed to the subsequent civil wars which ravaged the country and destroyed all the local industries, thereby lowering the country's productivity. Consequently, it had been increasing progressively yearly until it reached up to $7 billion between 1997 and 2019 due to some impermanent governments that had been working in the country and maintaining the overall economic stability.

Exports were declining from 1889 up to 1997 from almost 800 million to 200 million due to the breaking up of industries and a decrease in local production. This resulted in the collapse of the central government of Somalia in 1991, but it started growing up after 1997 after the restoration of some sources including trading and exporting livestock and some agricultural produce.

Imports were larger before the 1990s, especially in the mid-1980s, but were unstable in that period. The fluctuations seen in Figure 4.3 show the ups and downs. Imports slowed down after the collapse of the central government in 1991. Political instability, pirates, weak purchasing power and lack of government consumption were the key factors that led to decreased Somali imports.

Agricultural production also declined after 1889 as other variables from 846 million to 459 million. In 1995 the lowest point that agricultural produce of Somalia ever reached. From 1998 to 2010, it was unstable. Further, it went down in 2011 since there was severe drought in Somalia. From 2015, it was almost stable and there were slight positive shifts.

4.2 Unit Root and Cointegration

The unit root test is important because it allows examining of whether or not a time series is stationary. Knowing the existence of a time series' stationarity is essential because stationarity in regression model is assumed in the derivation of standard inference procedure. The nonstationary of regression model invalidates the standard results. This study used two most popular tests for stationarity. First, the ADF test was used, based on the Schwarz Information Criterion, while the bandwidth was based on Newey-West. **Table 4.2** shows the results of unit root tests for level and first difference of ADF and PP test. It was found that all variables were stationary at I(0) and also stationary after first difference; this indicates that variables were integrated of order one I (1).

The study selected the optimal lag length by using the general-to-specific approach developed by Hendry. Since the study's sample was limited to 31 observations, we selected three as maximum lag order which was then reduced to two and one, until the optimal lag length was free from diagnostic errors such as autocorrelation problems and model stability.

Table 4.2: Unit root tests

	Augmented Dickey-Fuller (ADF)		Phillips-Perron (PP)	
Variable	Constant Without Trend	Constant with Trend	Constant Without Trend	Constant with Trend
	At Level			
LGDP	-0.934346	-4.690564**	-0503442	-2.601743
LM	-5.151251***	-5.061416***	-4.407582***	-4.183665***
LX	-3.527431***	-3.418161*	-4.265917***	-4.129941***
LAGR	0.947413(7)	-3.029295(0)	-1.375909(4)	-3.202987*
	First Difference			
$\Delta LGDP$	-4.432117**	-5.458370***	-4.597757***	-5.507652***
ΔLM	-3.947719***	-3.885115**	-4.272483***	-3.984383**
ΔLX	-3.995102***	-3.892433**	-4.933152***	-4.275515***
$\Delta LAGR$	-3.582331**	-5.106681***	-3.788827***	-5.344855***

Note: *** and ** denotes significant at 1%, and 5% significance level, respectively. The figure in parentheses (…) represents the optimum lag length selected based on Schwarz Info Criterion.

4.3 Cointegration Test

After establishing the stationarity test and having found that all series are integrated of I (1), the next step is to test the existence of a long-run relationship among the variables by using Johansen. Cointegration implies that the series do not drift far apart from each other but maintain an equilibrium relationship over time.

Table 4.3: Cointegration test

Hypothesised	*Trace Statistic*		*Max-Eigen Statistic*	
No. of CE(s)	***Trace statistic***	***Prob.*****	***Eigenvalue***	***Prob.*****
r≤0	***65.38293***	***0.0005*****	***32.41700***	***0.0110****
r≤1	***32.96592***	***0.0209****	***21.29244***	***0.0475****
r≤2	***11.67348***	***0.1733***	***11.00259***	***0.1541***
r≤3	***0.670886***	***0.4127***	***0.670886***	***0.4127***

*** denotes rejection of the hypothesis at the 0.05 level.*

From the above, we fail to reject the null hypothesis of no cointegration between GDP, exports, imports and agricultural production. The results of Johansson's test show that there is more than one co-integrating equation as provided by both trace and max statistics which is less than critical value at 5% level. The results thus imply that there is a long-run relationship between the series.

4.4 Long-run Coefficients

Once the co-integration is confirmed to exist between variables, then the third step requires the construction of the error correction mechanism to model a dynamic relationship. The purpose of the error correction model is to indicate the speed of adjustment from the short-run equilibrium to the long-run equilibrium state. The vector error correction model is specified as follows:

$$\Delta \mathrm{GDP}_t = \alpha_1 + \lambda_{gdp} e_{t-1} + \sum_{i=1}^{n} \alpha_{11}(i)\Delta\,\mathrm{GDP}_{t-i} + \sum_{i=1}^{n} \alpha_{12}(i)\Delta\, EXP_{t-i} + \sum_{i=1}^{n} \alpha_{13}\,(i)\Delta \mathrm{IMP}_{t-i} + \sum_{i=1}^{n} \alpha_{14}(i)\Delta \mathrm{AGRO}_{t-i} + u_{1t} \qquad 3.12$$

$$\Delta EXP_t = \alpha_1 + \lambda_{\exp e_{t-1}} + \sum_{i=1}^{n} \alpha_{21}(i)\Delta\,\mathrm{EXP}_{t-i} + \sum_{i=1}^{n} \alpha_{22}(i)\Delta\,\mathrm{GDP}_{t-i} + \sum_{i=1}^{n} \alpha_{23}\,(i)\Delta\mathrm{IMP}_{t-i} + \sum_{i=1}^{n} \alpha_{24}(i)\Delta\mathrm{AGRO}_{t-i} + u_{2t} \quad 3.13$$

$$\Delta IMP_t = \alpha_1 + \lambda_{imp} e_{t-1} \sum_{i=1}^{n} \alpha_{32}(i)\Delta IMP_{t-i} + \sum_{i=1}^{n} \alpha_{32}(i)\Delta\, GDP_{t-i} + \sum_{i=1}^{n} \alpha_{33}(i)\Delta\, EXP_{t-i} + \sum_{i=1}^{n} \alpha_{34}(i)\Delta AGRO_{t-i} + u_{3t} \quad 3.14$$

$$\Delta\mathrm{AGRO}_t = \alpha_1 + \lambda_{agro} e_{t-1} \sum_{i=1}^{n} \alpha_{41}(i)\Delta\mathrm{AGRO}_{t-i} + \sum_{i=1}^{n} \alpha_{42}(i)\Delta\,\mathrm{GDP}_{t-i} + \sum_{i=1}^{n} \alpha_{43}(i)\Delta\, EXP_{t-i} + \sum_{i=1}^{n} \alpha_{44}(i)\Delta\mathrm{IMP}_{t-i} + u_{4t} \quad 3.15$$

where Δ denotes the first difference operator; *n* is the number of lags; $\boldsymbol{u}_1$, $\boldsymbol{u}_2$, $\boldsymbol{u}_3$ *and* $\boldsymbol{u}_4$ are random error terms; $\boldsymbol{e_{t-1}(GDP_{t-1} - \beta_0 - \beta_1 EXP_{t-i} - \beta_3 IMP_{t-i} - \beta_4 AGRO_{t-i})}$ is the one period lagged of the **ECT**, which is derived from the long-run cointegration relationship. The α terms are all short-run dynamics parameters and $\boldsymbol{\lambda}$**GDP**, $\boldsymbol{\lambda}$**EXP**, $\boldsymbol{\lambda}$**IMP** and $\boldsymbol{\lambda AGRO}$ are known as the speed of adjustment parameters and represent the deviation of dependent variables from the long-run equilibrium relationship. The results in **Table 4.4** shows that all explanatory variables are related positively to economic growth since the signs of the coefficients obtained from VECM are reversed.

4.5 Vector Error Correction Model (VECM)

Table 4.4: Long-run coefficient elasticities

	LGDP	LX	LM	LAGR
Cointegration coefficients	1.00	-0.331948**	-0.2603832**	- 1.068476****
Standard Error		(0.10066)	(0.09148)	(0.02989)
t-statistic		[-3.29777]	[-2.84630]	[-35.7522]

Once the cointegration is confirmed to exist between variables, then the next step entails the construction of the error correction mechanism to model a dynamic relationship. The purpose of the error correction model is to indicate the speed of adjustment from the short-run equilibrium to the long-run equilibrium state. In this study, the general form of the VECM is as follows:

Table 4.5: Analysis of the short run dynamics

		Coefficient	t-Statistic
Constant		0.002813*	0.399796
	$\Delta lgdp_{t-1}$	-0.025989	-0.136569
	Δlgd_{t-2}	0.188657	1.256909
	$\Delta lgdp_{t-3}$	-0.064132	-0.375086
	Δlx_{t-1}	0.456327	** 2.153904
	Δlx_{t-2}	0.125719	0.757424
	Δlx_{t-3}	0.315568*	1.708269
	Δlm_{t-1}	-0.409951*	-1.998435
	Δlm_{t-2}	-0.073484	-0.460534
	Δlm_{t-3}	-0.261852	-1.372323
	$\Delta lagr_{t-1}$	-0.237810	-1.030098
	$\Delta lagr_{t-2}$	-0.214530	-1.058879
	$\Delta lagr_{t-3}$	-0.154622	-0.516546
	ect_{t-1}	-0.6983***	-4.706074

In Table 4.5, the error correction term represents the long-run relationship. A negative and significant coefficient of the error correction term indicates the presence of a long-run causal relationship. This means that any deviation that occurs in economic growth in the short run will be adjusted by these explanatory variables in the long run 69% yearly. The lagged terms of Δlx_t, Δlm_t and $\Delta lagr_t$ appeared as explanatory variables, indicating a short-run causality relationship between the variables. Therefore, this validates our earlier results from Johansson's cointegration that economic growth and selected explanatory variables have a long-run relationship.

Table 4.6: Analysis of the Granger causality test

Null Hypothesis:	Prob.	Decision
lgdp→ lx	0.5215	reject
lgdp→ lm	0.4938	reject
lgdp→ lagr	0.4872	reject
lagr→ lx	0.0392	do not reject
lagr→ lm	0.1000	reject
lagr→ lgdp	0.0987	do not reject
lm→ lx	0.4598	reject
lx→ lm	0.4938	reject

The results of Granger causality show that there exists unidirectional causality between agricultural production exports and economic growth.

4.6 Robust Analysis

To further verify the existence of long-run cointegration between the trade and agricultural production with economic growth, we apply autoregressive distributed lag (ARDL) bound testing procedure to see whether it confirms the results of Johansen and Juselius (J&J) cointegration test in Table 4.3, and ARDL results are presented in Table 4.7. The results indicate that exports, imports and agricultural production have a long-run cointegration with economic growth. Hence, we reject the null hypothesis (no cointegration), and we fail to discard the alternative hypothesis (cointegration). Since our Wald F-statistics of 27.6 is greater than the critical value of 6.465 at a significance level of 1%, we validate the existence of cointegration between the dependent variable and explanatory variables. Therefore, this complies with the findings of the J&J long-run cointegration.

Table 4.7: F-bounds cointegration tests

Model	F-statistic	Significance	Bounds test critical value	
			K(3)	
			I(0)	I(1)
Lgdp=f (lx, lm ,lagr)	27.59155	1%	4.614	6.465
		5%	3.272	4.428
		10%	2.627	3.695

The critical values are based on Narayan (2004). K represents the number of parameters.

The Breusch-Pagan-Godfrey Test was applied to check the heteroscedasticity in the model. The regression analysis of the residual diagnostic test result incorporated in Table 4.8 shows that the model is free from the problem of heteroscedasticity, meaning that, among the variables, residuals have a constant variance.

Table 4.8: Diagnostic tests

Test	**Null hypoth ($H0$)**	**P-Value**	**Decision**
Normality Jarque-Bera	Normally distributed	0.962377	Fail to reject $H0$
serial correlation LM test	No serial correlation	0.3853	Fail to reject $H0$
$\chi 2 Heteros$ Breusch-Pagan-Godfrey	homoscedasticity	0.5617	Fail to reject $H0$

The critical values are based on Narayan (2004). K represents the number of parameters.

Table 4.9: Long-run coefficient

Explanatory variable	Coefficient
Constant	0.415802 (1.267313)
Lx	0.252475 (2.085528*)
Lm	0.274997** (2.481873)
Largo	0.553808*** (11.81152)

The result of the estimated coefficients of the long-run relationship in Table 4.9 indicates that imports, exports and agricultural production has a positive and significant influence on economic growth at 5% probability level. The estimated coefficient of agricultural production (0.5538) implies that 1% increase in agricultural production will increase economic growth by approximately 55%, all things being equal. Export's coefficient is 0.25, meaning that 1% increase in exports leads to increased GDP by 0.25%. Also 1% increase in import leads to increased output by 2.08%. All this validates Johansson cointegration estimations in the previous sections.

4.7 Diagnostic and Stability Analysis of Model

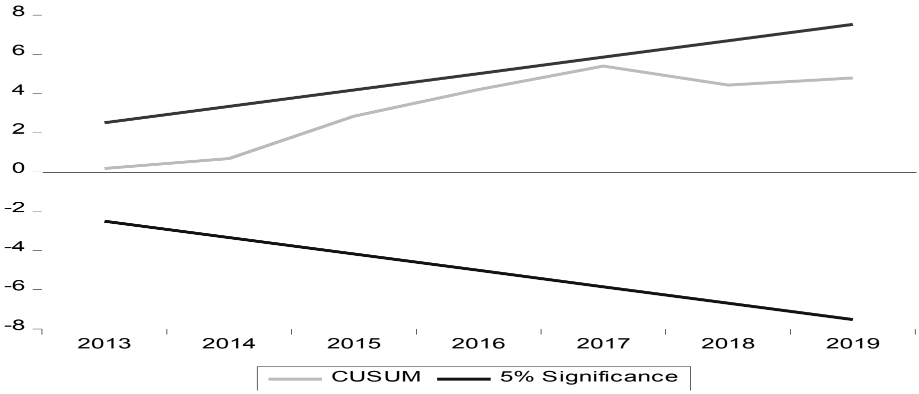
Stability and diagnostic test has been applied to ensure the reliability, righteousness and sensitivity of the model. Furthermore, different analytical techniques were also applied for detecting auto-correlation and heteroscedasticity, stability analysis of the model, long-run relation and co-integration vector among the variables.

To check the stability and normality of the model, Ramsey RESET test was applied. The stability diagnostic test was regressed, applying Ramsey RESET test and the results obtained authenticate the stability. As indicated in Figure 4.5, both CUSUM and CUSUM square plots were employed to test the parameter constancy. Both tests show that the model is stable.

Other diagnostics were checked as represented in Table 4.8 The Breusch-Godfrey LM Test was applied for serial correlation and the results obtained from the residual diagnostic correlation test does not show any sign of auto-correlation as well as of serial correlation nor any spurious relation. Further, it could also be concluded from the results that the error term is independent from each other of the corresponding year.

Diagnostic and Stability Analysis of Model

a. CUSUM test



b. CUSUM square test

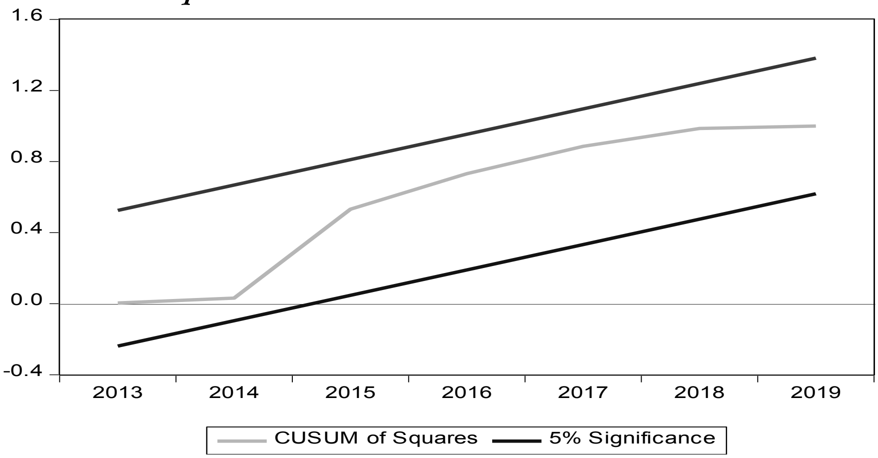


Fig. 4.5: Parameter constancy: a CUSUM Test. b CUSUM squared test

All these tests are showing the desirable results that indicate that this model is free from diagnostic problems. All tests – Jarque-Bera for normality, serial correlation LM test and Breusch-Pagan-Godfrey test – have been found greater than the critical level (5%). This means no autocorrelation, homogeneous variability of the residuals and normally distributed error terms.

5. Conclusion

This paper studied the role of international trade and agricultural production on economic growth in Somalia. Data were extracted from the websites of the SESRIC and the Food and Agriculture Organisation Corporate Statistical Database (FAOSTAT), focusing on the period between 1989 and 2019. Gross domestic product (GDP) was the dependent variable, while exports, imports and agricultural production were the explanatory variables of this study.

The study employed several tests. The study used the augmented Dickey-Fuller test (ADF) and Phillips-Perron (PP) test to test for stationarity. It utilised the Johansson's cointegration technique to determine the co-integrating equation and to test for long-run association. Also, the study employed VECM derived from the unrestricted vector autoregressive (VAR) model to examine the short-term adjustment between the selected variables and economic growth. Granger causality test was used to determine the causal relationship between the variables of the study.

The study found that all variables are stationary after first difference. The Johansson's cointegration technique was also checked to determine the co-integrating equation and the long-run relationship. The results of the study reveal that there is more than one co-integrating equation as provided in both trace and max statistics. Granger causality test has been employed to reveal the causality relationship between variables and the results show that there exists only a unidirectional causality between agricultural production and exports and also from agricultural production to economic growth. Regarding all other variables, we failed to reject the null hypothesis that there is no causality between exports and exports, imports and agricultural product imports and economic growth. Furthermore to Improve the precision and the reliability of the results of J&J cointegration, this study employed the ARDL cointegration model as a robust analysis and the model confirms the result of the previous model since the F-test was greater than Narayan upper bounds F critical with 5% of the significance level, that is, there is cointegration.

6. Policy Implications/Recommendations

Based on its findings, this study recommends the following:

a. Considering the magnitude of the sector's contribution to the economy, the government should give substantial assistance to farmers. Given the low use of fertiliser by Somali farmers, there is a need for fertiliser components to increase agricultural production while also allowing farmers to market their goods at reasonably good prices.
b. The government should work in collaboration with international organisations such as FAO. It should make efforts to assist farmers in diversifying their crops so that they can become more resilient to shocks such as floods or droughts.
c. The government of Somalia should have the capacity to participate in certification schemes and provide authority documentation to sell goods globally.
d. Provision of an adequate information system by the government will help bridge the gap that exists between the local farmers and research institutions for the dissemination of innovation.

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