Addis Ababa University, Ethiopian Journal of Business and Economics, EJBE Vol.8, No. 1
Doi: http://dx.doi.org/10.4314/ejbe.v8i1.2 P-**ISSN**: **2311-9772 eISSN: 2410-2393**
Available online: https://ejol.aau.edu.et/index.php/ejbe and https://www.ajol.info/index.php/ejbe

The Impact of Export Volatility on the Growth of Ethiopia: A GARCH Model Approach

Nurhussen Ahmed[1], Zerayehu Sime Eshete [2]

Abstract

Export volatility is a hot issue in any developing country's economic growth. This study examines export volatility and its long-term impact on Ethiopia's economic growth. Employing quarterly data from 1991 to 2014, the study uses the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model and Extended Cobb-Douglas Production Growth Models. According to the estimation result of the GARCH (1, 1) model, the volatility index negatively affects Ethiopia's economic growth. Moreover, the previous day's volatility of export price and volume can influence the current day's volatility of both export price and volume. The results from the extended Cobb-Douglas production model show that both the export price and volume volatility indexes negatively impact long-run economic growth. As a solution, the study suggested that the country should switch from making low-quality goods to making high-quality goods and exporting a more comprehensive range of goods with a competitive edge. Moreover, there should be price-based stabilization through price-oriented diversification and replacing primary products with industrial exports is fundamental to the realization of sustained economic growth in Ethiopia.

Keywords: *Export volatility, economic growth, GARCH, Cobb-Douglas, Ethiopia*

[1] PhD Candidate at Sakarya University, Department of Economics: E-mail: nurek2006@gmail.com

[2]Associate Professor, Department of Economics, Addis Ababa University: E-mail: zerayehu.sime@aau.edu.et

Introduction

Economic development is a structural transformation process in which nations shift from producing low-quality goods to producing high-quality goods. The aim of any developing country is to achieve sustainable economic development which demands achieving continuous economic growth. One of the preconditions for economic growth is export stability. Because many developing countries have low domestic demand for their goods, export earnings are the primary source of their significant economic growth (Farhat etal., 2012). As a result, it is a critical source for LDCs to recover their balance of payment gap through foreign exchange earnings.

Ethiopia has a shortage of foreign currency because its exports, mainly, primary commodities, fluctuate considerably. LDCs, including Ethiopia, are known for exporting a few primary products. The volatility issue, especially for primary exports and international prices, has played a significant role in the analysis of the problems faced by developing countries (Gebru, 2004). Ethiopia's economy heavily depends on agriculture, which accounts for 46.3 percent of the nation’s GDP, 83.9 percent of exports, and 80 percent of its labor force. Agriculture is the foundation of the country's economy and plays a central role in its growth (UNDP, 2015).

Ethiopia remains reliant on a small number of primary products to generate export revenues, and coffee continues to dominate the country's exports when compared to other commodities (NBE, 2013/14). Even though export volume has improved from time to time, there is still a trade deficit between export revenue and import bill (NBE, 2013/14).

Our focus is on export volatility instead of export performance because export volatility can be an important indicator of a country's economic health and stability. It can also be an important consideration for businesses that are involved in international trade. In contrast, export performance, or the overall level of a country's exports, may not provide as much insight into these factors.

In Ethiopia, the volatility in export prices and export volume is a source of national macroeconomic disturbance and creates serious problems in national income and investment. Generally, export volatility may be derived from country specific factors as well as from

negative influences emanating from the global marketplace. Ethiopia is importing the industrial commodity that helps for her development while, she depends on exporting very few primary products.

Most of Least Developed Countries have a deficit on their current account balance due to their import payments are above their export earnings. In Ethiopia during the past thirty years from the year 1981-2011 earnings from export covered more 9.0 percent of import bill. Even though export volume showed improvement from time to time, still, there is a trade deficit among the export proceeds and import bill.

Concerning to whether export volatility has considerable impact on economic growth or not, the area of the study is still debatable among researchers. There is several empirical researches that was done by many research. The outcome of the scholars was varied. For example, Gezahegn (2012); Kwabena (1991) and Lim (1991) have found a negative association among export volatility and economic growth. But Dipendra (1999) studied export volatility and economic growth in Asian Countries using neoclassical production function and found positive relationship between the two variables on three developing countries, from nine countries he studied the case. But, Sule & James (1988) stated that there are two views about the impact of export earnings volatility on economic growth. The first view is the negative impact of the export volatility of growth because of a lack of perfect insurance markets, especially in the absence of ability to smooth out fluctuations of export recites. The second view is that export volatility may encourage growth with risk averse individuals in uncertainty about the future income will have a positive impact on saving by increasing precautionary demand for saving. This in turn will ultimately lead to higher investment and growth.

In Ethiopia most research on this subject mainly focused on the performance of the export sector and its significance on a country's economic growth. For instance, Kagnew (2007) studied Export Performance and Economic Growth in Ethiopia using a multivariate co-integration and error correction procedure with GDP as a function of aggregate exports, imports, capital, labor force, and exchange rate and found that export, exchange rate, labor, and capital positively affect output growth while the import is negatively related with output. Thus, it could be right to say that the outcome of this study would fill the gap in the existing knowledge through examining

the volatility of export and identifying the volatility for both export price and volume by investigating the causes of volatility and its impact on economic growth over the period from 1991 to 2014 using the GARCH model and extended Cobb-Douglas production.

The broad objective of the study is to examine the volatility of export and its impact on economic growth over the period 199 to 2014 with the following specific objectives are: to examine whether there is volatility in export price and export volume; to examine the causes of volatility; and to investigate the long-run impact of volatility of export price and export volume on growth. This research work has answered the following research questions: Does the Ethiopian export are volatile or not? To what extent export volatility affects growth? What is the long-run impact of the export volatility on economic growth?

Literature Review

Theoretical Literature Review

There are different arguments made by researchers regarding the relationship between export volatility and economic growth. The first group advocates the negative relationship. An increase in export volatility is associated with a decrease in the country's foreign currency reserve. A decrease in foreign exchange reserve would have a negative impact on that country's import of capital goods. This will contribute to the reduction of investment in that country. The decline in investment will bring about a decrease in the national income of the country (Mcbean, 1966).

The second group of economic researchers argued that there is a positive relationship between export volatility and economic growth. They argue that an increase in export earnings volatility of a country will increase uncertainty about the future income of the investors. When investors are uncertain about the future due to export volatility, they will increase their savings. The saving amount will have a positive impact on growth (Gezahegn, 2012).

The third group of economic researchers examined the link between export earning instability and economic growth in two ways. For instance, Sule & James (1988), stated that there are two views about the impact of export earnings volatility on economic growth. The first view is the negative impact of export earnings volatility on growth. Developing economies would face intermittent difficulties in importing intermediate and capital goods that are highly needed for

production. In such economies risk-averse private investors are likely to reduce their investment or the actual efficiency of the existing investment is likely to be reduced. The second view is that export volatility may encourage growth with risk averse individuals are uncertain about the future income will have a positive impact on saving by increasing precautionary demand for saving. This in turn will ultimately lead to higher investment and growth.

An important dimension of the volatility problem is the generation of uncertainty, and this had to exert adverse effects in two ways. First, uncertainty about the availability of government revenues is thought to complicate further the already difficult task of development planning. Secondly, uncertainty is taken to affect private sector investment. Short-run export-induced instability in domestic demand suggests to private investors the prospect of underutilization of productive capacity. This in turn reduces the overall level of efficiency of a country because the formation of capital is distorted by bad investment planning (Shewangizaw, 2003).

The mercantilists maintained that the way for a nation to become rich and powerful was to export more than it imported. The resulting export surplus would then be settled by an inflow of precious metals, primarily gold and silver. The more gold and silver a nation had the richer and more powerful it was. Adam Smith wrote that trade between nations is based on absolute advantage or disadvantage. When one nation has an absolute advantage over another in the production of one commodity and the other a disadvantage with respect to the other, then both nations can gain from specialization in production. Resources are utilized in the most efficient way and the output of both commodities will rise (Dominick, 2016, 32). In 1817, Ricardo published his Principles of Political Economy and Taxation, in which he presented the law of comparative advantage which reflects the idea that even if one nation has an absolute disadvantage with respect to the other nation in the production of both commodities, there is still a basis for mutually beneficial trade. Two neoclassical Swedish economists, Heckscher (1919) and Ohlin (1933) focused on factor endowments[3] variability as the source of international trade (Dominick, 2016).

[3] *Φαχτορ ενδοωμεντσ αρε ρελατιϖε αμουντσ οφ διφφερεντ φαχτορσ οφ προδυχτιον ωιτηιν τωο χουντριεσ (Θοην, 2004, 507)*

Theories of International Trade Export Volatility

The mercantilists maintained that the way for a nation to become rich and powerful was to export more than it imported. The resulting export surplus would then be settled by an inflow of precious metals, primarily gold and silver. The more gold and silver a nation had the richer and more powerful it was.

According to Adam Smith, when one nation has an absolute advantage over another in the production of one commodity or has an absolute disadvantage with respect to the other nation in producing a second commodity, then both nations can gain from each specializing in the production of the commodity of its absolute advantage (Dominick, 2016, 32).

In 1817, Ricardo published his Principles of Political Economy and Taxation, in which he presented the law of comparative advantage which reflects the idea that even if one nation has an absolute disadvantage with respect to the other nation in the production of both commodities, there is still a basis for mutually beneficial trade. The first nation should specialize in the production and export of the commodity in which its absolute disadvantage is smaller and import the commodity in which its absolute disadvantage is greater.

Two neoclassical Swedish economists, Heckscher (1919) and Ohlin (1933) focused on factor endowments variability as the source of international trade (Dominick, 2016)

The Heckscher – Ohlin theory is based on the following assumptions: Perfect Competition, Constant returns to scale, Two goods and two factors of production, Homothetic preferences, Full employment, No transportation costs, No government intervention (Dominick, 2016).

Empirical Literature Review

Export volatility is a major basis of concern for most exporting nations, whereas it is a relatively minor concern for most importing nations (UNCTAD, 2015).

Declining international prices are the main cause of the recent poor performance of goods exports. A decomposition of export value growth into its price and quantity effects illustrates this point. Export prices dropped by a staggering 15 percent in 2012/13, much more than what was

observed in 2008/09. The price drop was so severe that even a healthy export volume growth of 15 percent in 2012/13 could not prevent export values from declining (WB, 2014).

Empirical research on the relationship between growth and export has shown mixed results. After splitting the actual export earnings in to stable and unstable components using a five-year moving average, the instability of export earnings is found to have a negative effect on economic growth, while the stable components have a positive effect. Violent and sudden fluctuations in prices, varieties, and total amounts of exports, have a serious adverse impact on the overall growth of the less developed countries (Aggarwal, 1982).

Firoz (2014) tried to investigate the impact of export earning instability on economic growth based on log linear econometric model by including export variable. Using annual data which covers 34 years from 1974/75-2007/08, he found negative sign of the export earning instability index both in the short run and long run. The stock of capital has positive and significant relationship with the growth rate of GDP both in the long run and in the short run. In his study, capital was the only variable that explained the variation in the growth of the economy. He recommended diversification of export to achieve progress in the sector.

Gezahegn (2012) investigated the long-run effect of the export volatility on GDP growth in Ethiopia. The key question of the study was to investigate whether export volatility has a significant negative effect or not on Ethiopian GDP. To answer this question, he used time series data from the year 1981 to 2011 using extended Cobb-Douglas production growth model, of which GDP as a function of export of good and service, stock of capital, GDP and export volatility index and labor. The volatility index was calculated using a five-year based moving average. Finally, he found that the long run effect of export volatility has a negative effect on output growth in Ethiopia.

Mulugeta (2007) studied the effect of export earnings fluctuation on economic growth in Ethiopia using the general production function in which exports were taken as one of the inputs in the production process. He concluded that the instability of export earnings is found to have a negative effect on economic growth.

Kiros (2012) studied the determinants of export growth rate in Ethiopia from 1980 up to 2010 using Co integration and Error Correction Model Analysis. The finding of his study shows that the effect of GDP on the export growth rate is positive and significant but not statistically strong due to the size of the economy that is small and poor countries tend to have highly homogeneous export structures. He recommended maintaining a high and sustainable economic growth rate as evidence has shown that sustainable growth patterns promote exports.

Yishak (2009) analyzed determinants of export performance of Ethiopia using gravity model with panel data using 30 Ethiopia 's trading partners from 1995–2007. The model was estimated using the Generalized Two Stages Least Squares (G2SLS) method. He found that good institutional quality and internal transport infrastructure appear to be major determinants, whereas the real exchange rate and FDI have no statistically significant effect on Ethiopia's export performance. In addition, the growth of domestic national income affects Ethiopian exports positively.

3. Method of the Study

The ARCH (q) regression model is a linear function of past squared disturbances:

$$\delta^2{}_t = \omega + \sum_{1}^{q} \alpha_i \varepsilon^2{}_{t-1} \qquad (1)$$

Where $\omega \geq 0$ and $\alpha_i \geq 0$ for all i= 1, 2.... q. To assure a positive conditional variance, the parameters have to satisfy the constraints that $\Phi > 0$ and $\alpha i \geq 0$ for all i= 1, 2...q.

The main problem with an ARCH model is that it requires many lags to catch the nature of the volatility; this can be a problem, as it is difficult to decide how many lags to include, as a result it produces a non-parsimonious model where the non-negativity constraint(s) could be failed. The GARCH model is usually much more parsimonious and often a GARCH (1, 1) model is sufficient, this is because the GARCH model incorporates much of the information that a much larger ARCH model with large numbers of lags would contain. GARCH models are intended to model and forecast conditional variances.

The dependent variable's variance is modeled as a function of past values of the dependent variable and independent variables.

Since GARCH model is a generalized form of ARCH model, the underlying regression is the usual one as in the case of equation (1) above. Conditioned on information set at time t-1 GARCH (p, q) process is defined as follow:

$$\delta^2{}_t = \omega + \sum_1^Q \alpha_i \delta^2{}_{t-1} + \sum_1^Q \beta_i \varepsilon^2{}_{t-1} \quad (2)$$ Where, ω > 0 and αi > 0 for all i= 1,2, ... q and βj > 0 for all j= 1,2.....q.

Based on equation (2), the GARCH (1, 1) model can be specified as:

$$\delta^2 t = \alpha_0 + \alpha_1 \varepsilon^2{}_{t-1} + \beta_1 \delta^2{}_{t-1} \quad (3)$$ Where, $\delta^2 t$ is the conditional variance of the error term.

Cobb-Douglas Model

$$Y(L,K) = AL^{\alpha} K^{1-\alpha} \quad (4)$$

Where, 0 <α < 1**,** L is the labor force, K is gross capital formation (investment), A is imported capital good,$\alpha$is the output elasticity of labor, and 1-α is the output elasticity of capital.

The extend of the Cobb-Douglas production model is specified as follows:

$$\ln Y = \beta_0 + \beta_1 \ln L + \beta_2 \ln K + \beta_3 \ln EV + \beta_4 \ln EP + \beta_5 \ln IM + \beta_6 \ln EVX + \beta_7 \ln EP + \varepsilon_t \quad (5)$$

Where, β_0 is the constant term, β's are the coefficient of the variables, lnY is the natural logarithm of the real GDP, lnL is the natural logarithm of the labor force, lnK is the logarithm Investment, lnEV is the logarithm of the export volume, lnEP is the logarithm of the export price, lnEVX is the logarithm of the volume volatility index, lnEPX is the natural logarithm of the export price volatility index, lnM is the logarithm of the imported capital good and ε_t is the error term In economic research involving time series data, before any kind of statistical

estimation takes place the data of all variable in the model have to be tested for their stationarity (Gujarati, 2004).

Stationarity

There are various statistical tests for the detection of non-stationarity or unit root problem. These include Dickey-Fuller (DF) test, Augmented Dickey Fuller (ADF) test, Phillip-Perron (PP) test etc.

The ADF test modifies the DF test to account for possible serial correlation in the error terms by including the dependent variables lagged difference terms. The ADF test avoids the DF problem by correcting for serial correlation with lagged difference terms (Greene, 2003).

The ADF test can be represented as;

$$\Delta y_t = \beta_1 + \beta_{2t} + \delta y_{t-1} + \sum^{m}{}_{h=1} \alpha \Delta y_{t-h} + \varepsilon_t) \qquad (6)$$

Where ε_t is a pure white noise error term and $\Delta Y_{t-1} = (Y_{t-1}-Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2}- Y_{t-3})$, etc. The ADF test uses the same null hypothesis and the same asymptotic critical value as that of DF test (Gujarati, 2004).

Nature of Data

The data set consists of quarterly time series data on Real Gross Domestic Product (RGDP),[4] export price, export volume, labor force, gross capital formation, and imported capital good from quarter1 of 1991 up to quarter4 of 2014. We chose 1991 as a starting year because it marked a significant political change in Ethiopia and the establishment of a new government. This change could have had a significant impact on the country's economy and trade relations. Additionally, there is a change in the country's economic policy or data availability that changed after that year.

The data is obtained from the Ethiopian Customs Authority, MoFED (Ministry of Finance and Economic Development), CSA (Central Statistical Authority), NBE (National Bank of Ethiopia),

[4] *ΡΓΔΠ ισ τηε ϖαλυε οφ αλλ γοοδσ ανδ σερϖιχεσ προδυχεδ ιν τηε νατιον (Μανκιω, 2002, π. 505)*

and UNCTAD (United Nations Conference on Trade and Development). Annual GDP data will be decomposed based on the country specific interpolation method to generate quarterly GDP data.

GDP interpolation method: In the case of Ethiopia there is no quarterly GDP data available officially. However, there are different interpolation methods to get quarterly data. Chow & Lin (1971) developed a method for the decomposition of annual GDP data using related variable series.

The approach used in this paper is the one by (Haile, 2001). He tried to study the behavior of the seasonality function of each sector in its contribution to annual GDP based on seasonality adjustment coefficients.

Volatility Index: - According to Love (1986) export earning instability is defined in terms of deviations from trend and several indices have been developed which typically have been sample estimates of the variance of such deviations.

For calculating export volatility index, we can use different index measurement, the most popular measurements are, international monetary fund (IMF) index, semi long standard error (SSE) index, normalized standard error index (NSE) index, and five-year moving average (FMA) index. This paper prefers to use the five-year moving average (Ramey & Ramey, 1995).

Generating Quarterly Data: For variables such as GDP and export, the quarterly data is collected from the National Bank of Ethiopia. However, the quarterly data for variables such as labor force and export volatility are generated using the EViews 9 software.

Estimation Technique

Ordinary Least Square (OLS) assumes heteroskedasticity as a problem to be corrected whereas; ARCH/GARCH models treat heteroskedasticity as a variance to be modeled. As a result, ARCH/GARCH model helps us to compute prediction for the variances of the error terms (Engle, 1982).

Conditional variances are specifically modeled and forecasted using Autoregressive Conditional Heteroscedasticity (ARCH) models. ARCH models were introduced by Engle (1982) and

generalized as GARCH (Generalized ARCH) by (Bollerslev, 1986) which concerns understanding and modeling of volatility.

Prior to the ARCH model introduced by Engle (1982), the most common way to forecast volatility was to determine the standard deviation using a fixed number of the most recent observations. As we know that the variance is not constant. The ARCH model overcomes these assumptions by letting the weights be parameters to be estimated thereby determining the most appropriate weights to forecast the variance (Bollerslev, 1986).

However, ARCH model has shortcomings. For instance, ARCH imposes restriction on the conditional variance equation to prevent getting a negative result in the conditional variance (Enders, 1995).

To overcome this limitation of the ARCH model GARCH model was developed by (Boleslaw, 1986). GARCH is more economical than ARCH as it has only three parameters and allows an infinite number of past squared errors to influence the current conditional variance (Brooks, 2005). The GARCH model allows the conditional variance to be dependent upon previous own lags. In effect, we can forecast the next period's variance.

Discussion and Analysis

The mean is average or central value of set members in a time series data. As we can see from the above table, the quarterly average value of real GDP from 1991 to 2014 is 79195.9 million. Similarly, for all the variables of raw data, average values are presented in the 1st column of the above table and defined similarly.

The last two columns in the above table show the minimum and the maximum values of numbers in a time series data from 1991 till 2014. The minimum and maximum values of real GDP are 30114.28 and 201965.7 that are in the 3rd quarter of 1991 and 1st quarter of 2014 respectively. This implies that even if there is some fluctuation, RGDP is increasing from quarter to quarter.

Table 1

Summary Statistics

Variable	Mean	Std. Dev	Min	Max
Rgdp	79195.86	45360.98	30114.28	201965.7
Ev	30638.46	73247.42	807.16	414925.8
Ep	192382.9	150471.2	7.920507	589280.8
L	79580.33	21898.27	45460.89	119142.9
Iv	31343.84	21210.75	10807.36	111517
Im	6286252	1.49	269618	9.17
Epx	77643.2	98864.86	-256427.7	325231
Evx	6805.129	6502.439	-4572.9	31518.26

Source: Own estimation

Augment Dickey- fuller test (ADF) unit root test

The ADF test modifies the DF test to account for possible serial correlation in the error terms by including the dependent variable's lagged difference terms, with the null hypothesis being that the error term is non-stationary (Greene, 2003).

Table2

Unit Root Test Results for the Error Term

Variable	t statistic	1% Critical value	5% Critical value	10% Critical value
Residual	-6.107	-3.517	-2.894	-2.582

Source: Own estimation

Here the absolute value of the test statistics is greater than the critical values, which indicates that the error term is stationary showing that our model will show the long run relationship between dependent and independent variables (Gujarati, 2004).

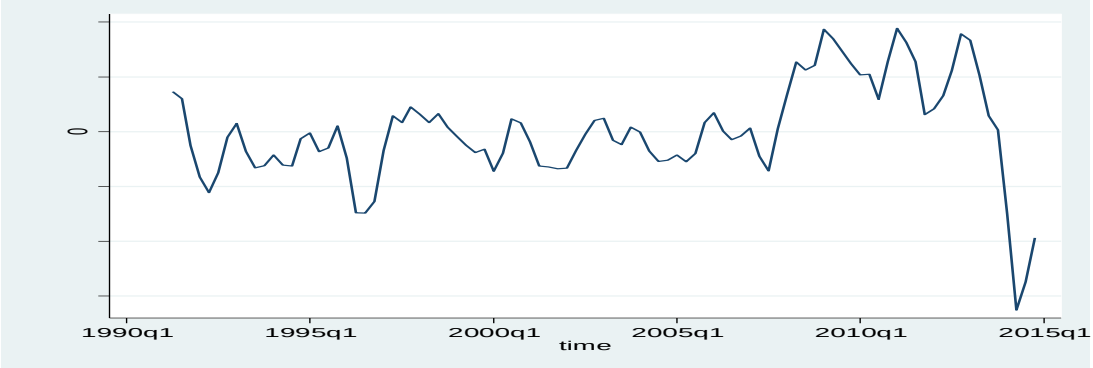
Estimation result of GARCH (1,1) Model

To estimate an ARCH/GARCH model, first we must check the presence of ARCH effects and clustering volatility in the residual.

Generally, to run GARCH (1, 1) model, two preconditions must be fulfilled: (1) There must be clustering volatility in the residual which suggests that the residual term is conditionally heteroskedastic, and it can be represented by ARCH and GARCH model. (2) ARCH effects in the residual using the Lagrange multiplier test

Figure 1

Residual Plot of the Export Price Volatility Index

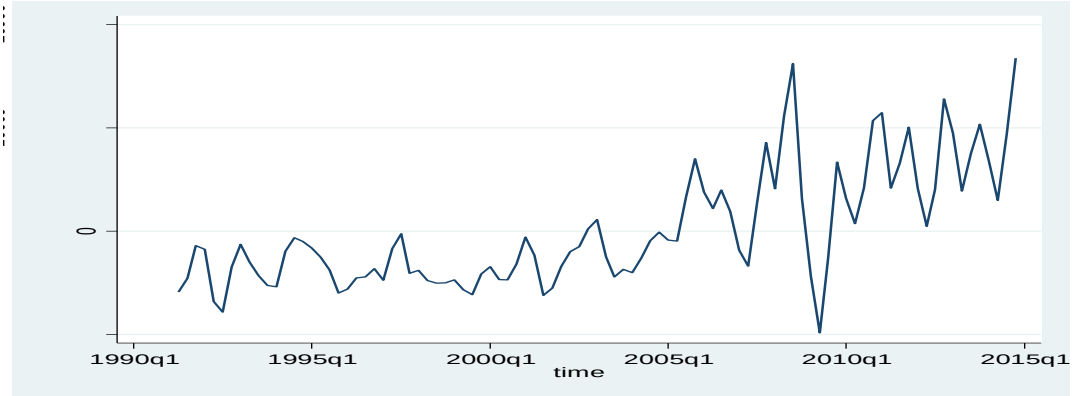


Source: Own estimation

As we see from the graph, periods of low volatility are followed by periods of low volatility and periods of high volatility are followed by periods of high volatility so that it fulfills the precondition for volatility clustering in the residual.

Figure 2

Residual Plot of the Export Volume Volatility Index



Source: Own estimation

As we see from the graph, periods of low volatility are followed by periods of low volatility and periods of high volatility are followed by periods of high volatility so that it fulfills the precondition for volatility clustering in the residual.

LM Test for Autoregressive Conditional Heteroskedasticity (ARCH)

A Lagrange multiplier test can be used to test for the presence of ARCH effects. First, we estimate the mean equation (e.g. regression of the variable on a constant and possibly other variable). Save the estimated residuals and obtain their squares εt2. Then Regress εt2 on ε2 t-1.....εt-q2 and save R^2 value.

$$(\text{T-q})R^2 = xq^2 \qquad (7)$$

Finally, we reject the null hypothesis of "No ARCH effects" if the calculated statistic is greater than the tabulated chi-squared value or accept otherwise (Enders, 1995). If we get evidence for the existence of ARCH effect, we can model it either using ARCH or GARCH estimation.

Table 3

Results of LM Test

Variable	chi2	Prob> chi2
EPX	61.105	0.0000
EVX	52.203	0.0000

Source: Own estimation

As we see from the above LM test, both probability values of the export price volatility index and the export volume volatility index are less than 5 percent so that we reject the null hypothesis, and we accept the alternative hypothesis that there is an ARCH effect.

Table 4

Estimation Result of GARCH (1, 1) Model for Export Price

	Lagepx	ARCH L1	GARCH L1
β-coefficients	0.4633177	0.7206726	0.3502487
z-value	7.68	2.07	2.08
p-value	0.000	0.039	0.037

Source: Own estimation

Therefore, the mean model has clustering volatility and ARCH effect. Hence, we can estimate GARCH (1, 1) model which is the most reliable, economical, and robust.

The estimated GARCH (1, 1) model for export price can be written as:

$$\delta^2 t = 3.52 + 0.72\varepsilon^2_{t-1} + 0.35\delta^2_{t-1} \quad (8)$$

As we can see from the estimated result, the probability value of the ARCH effect is 3.9 which are less than 5 percent. Therefore, the ARCH effect is significant. In other words, previous day's Ethiopian export price volatility information can affect the volatility of Ethiopian export.

Besides, the probability value of the GARCH effect is 2.08 which is less than 5 percent showing that the previous day's volatility of Ethiopian export price can influence the volatility of Ethiopian export.

Table5

Estimation Result of GARCH (1, 1) model for export volume

	Lagevx	ARCH L1	GARCH L1
β-coefficients	0.5156443	0.599621	0.4928815
z-value	8.94	2.43	3.28
p-value	0.000	0.015	0.001

Source: Author, 2016 (compiled from NBE, MoFED and UNCTAD)

The estimated GARCH (1, 1) model for export price can be written as:

$$\delta^2 t = 631{,}791.4 + 0.599\varepsilon^2_{t-1} + 0.4493\delta^2_{t-1} \quad (9)$$

As we can see from the estimated result, the probability value of the ARCH effect is 1.5 which is less than 5 percent. Therefore, the ARCH effect is significant, indicating that previous day's Ethiopian export volume volatility information can affect the volatility of Ethiopian export.

On the other hand, the probability value of the GARCH effect is 0.1 which is less than 5 percent showing that the previous day's volatility of Ethiopian export volume can influence the volatility of Ethiopian export. Table 6 above presents the estimation results of all specified models using Extended Cobb-Douglas production model. The result shows that the impact of the natural

logarithm of export volume, export price and labor have positive and significant effect on real GDP of Ethiopia.

Table 6

Estimation Result of extended Cobb-Douglas Model

Variables	**Growth**
Lnep	0.20522*** (0.000)
Lnev	0.19533*** (0.000)
lnl	0.73126*** (0.000)
Lniv	0.20215 (0.161)
Lnim	0.000093 (0.367)
Lnepx	-0.14889*** (0.000)
Lnevx	-0.071291 (0.793)
Constant	-19280.6*** (0.010)
R-sq	0.9297
adj. R-sq	0.9241

Source: Own estimation

However, the impact of logarithm of investment has a positive effect on real GDP, but it is insignificant, and the coefficient value is (0.202). Labor is a significant factor that positively affects long-run growth in Ethiopia. The result showed that increase in labor by 1percent increase long-run economic growth by 73.12 percent. The growth of a country can be measured by GDP. GDP is substantially affected by the industrial output. Industrial gross output is primarily determined by capital and labor input. If the effect of labor and capital input to output in an industry or group of industries is sufficient, industrial investment will rise. This idea was supported by Hossain & Basak (2012).

Increase in export volume is a significant and determinant factor of growth of Ethiopia. The result reveals that increase in export volume by 1 percent enhance long-run economic growth by 0.195 percent. Export generates more revenue for the country, which can be used to invest in various sectors such as infrastructure, education, and healthcare. It can lead to an increase in productivity and efficiency as companies strive to produce goods that are more competitive in the global market. Moreover, it leads to a decrease in the trade deficit and an increase in the balance of trade which can contribute to the overall economic growth. This idea was supported by Feder (1983), Bhagwati (1978) and (Krueger, 1978). Open economies may experience faster productivity growth, and exports may be a source of productivity gains and foreign exchange (Johnston & Mellor, 1961).

The result also shows that the increase in export price by 1percent enhances economic growth by 20.52 percent. An increase in export prices can lead to economic growth in a several ways. First, it can lead to an increase in revenue for domestic firms that are exporting goods. This can lead to increased investment and hiring, which can drive economic growth. Additionally, an increase in export prices can also lead to an appreciation of a country's currency, making imports cheaper and increasing domestic consumption, which can also drive economic growth. Finally, increasing export prices can also lead to increased demand for domestic goods and services, which can help to boost domestic production and economic growth. This argument is consistent with the works of (Buckley & Prescott, 1988).

Post-Estimation Tests

Test for Multicollinearity

This assumption is concerned with the relationship that exists between explanatory variables (Brooks, 2005). Multicollinearity condition exists where there is high, but not perfect, correlation between two or more explanatory variables (Wooldridge, 2012).

Table 7

Test of Multicollinearity

Variables	vif	1/vif
Ep	9.54	0.104872
Epx	7.66	0.190542
L	6.00	0.178490
Iv	5.60	0.27723
Ev	9.61	0.529621
Evx	1.89	0.876791
Im	1.14	0.64221
Mean vif	5.60	

Source: Own estimation

According to Churchill & Iacobucci (2005), when there is multicollinearity, the amount of information about the effect of explanatory variables on dependent variables decreases. This study used VIF test of multicollinearity in the model. As we can see from the result, all vif values are less than 10 which indicate that there is no multicollinearity problem.

Test of Normality of the Error Term

Exact inference based on t and F statistics requires the normality assumption (Wooldridge, 2012). We used Shapiro-Wilk W test for normal data and from table (8), the result shows that the probability value is greater than 5 percent so that we accept the null hypothesis which shows that the residual is normally distributed.

Table 8

Tests of Normality, Heteroscedasticity, and Autocorrelation

Tests	Chi^2	Z value	P value
Shapiro-wilk Test		0.569	0.28460
Breush-pagan Test	9.82		0.0017
Durbin's Alternative Test	20.802		0.0000

Source: Author, 2016 (own estimation)

Test for Heteroscedasticity

To test the presence of heteroskedasticity, we used Brush-pagan/cook-Weisberg test of heteroskedasticity. As per the result which is shown in table (8), the probability value is less than 5 percent; hence we fail to reject the null hypothesis where there is heteroscedasticity problem. But to correct both autocorrelation and heteroscedasticity simultaneously, we applied the newey-west method.

Test for Model Specification

We used the linktest command to perform a model specification linktest for single-equation models with the null hypothesis of no model specification problem. The test result from table (9) shows that the all t values are significant which indicates that the prediction squared does have explanatory power, so that my specification is not as good.

Table 9

Model Specification Test

	_cons	_hat	_hatsq
T value	2.18	5.75	2.50
P value	0.032	0.000	0.014

Source: Own estimation

Although linktest is formally a test of the specification of the dependent variable, it is often interpreted as a test that, conditional on the specification, the independent variables are specified incorrectly. We followed that interpretation and now include labor squared in the model that is shown in table (10) so that we passed the linktest.

Table 10

Model Specification Test with labor squared in the model

	_cons	_hat	_hatsq
T value	1.20	9.43	1.32
P value	0.235	0.000	0.191

Source: Own estimation

Conclusion and Policy Implications

The study aims to establish the long-run relationship between export price and export volume volatility and economic growth. The estimation result of GARCH (1, 1) indicates that both previous quarter's volatility information and current day's volatility of export prices and volumes can influence future day's export volatilities.

The result from extended Cobb-Douglas shows that the impact of the natural logarithm of export volume, natural logarithm of export price and natural logarithm of labor have positive and statistically significant effect on real GDP of Ethiopia. However, the impact of natural logarithm of investment has a positive effect on real GDP but it is statistically insignificant.

In general, based on the above main findings the study makes the following recommendations. There should be export promotion strategies, policies, product specific export market research conducive towards stimulating competitiveness. The government needs to work together with the business community to build business confidence by designing and implementing appropriate policies. Finally, from this study, it is noted that further studies can be held to see the causes and impact of export volatility, whether it is bad news or good news on the overall economic growth of the country.

References

Aggarwal, M. (1982). Export Earning Instability and Economic Development in Less Developed Countries. The Indian Econometric Journal, 29, 60-70.

Bhagwati, J. (1978). Foreign Trade Regimes and Economic Development. Journal of International Economics, 9, 429-452.

Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroscedasticity. Journal of Econometrics, 31, 307-327.

Brooks, N. (2005). The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. Global Economic Change, 15, 151-163.

Buckley, T, & Prescott, K. (1988). Measures of International Competitiveness. Journal of Marketing Management, 4, 175-200.

Chow, C, & Lin, A. (1971). Best linear unbiased interpolation, distribution, and extrapolation of time series by related series. The Review of Economics and Statistics, 53, 372-375.

Churchill, G, & Iacobucci, D. (2005). Marketing Research Methodological Foundations. USA: Thomson South-Western Publishing.

Dipendra, S. (1999). Export Instability, Investment, and Economic Growth in Asian Countries: A timeseries analysis, Yale University, USA.

Dominick, S. (2016). International Economics. Fordham: Wiley Publisher.

Firoz, A. (2014). Impact of Export Earning Instability on Economic Growth.

International Journal of Research in Commerce, Economics and Management, 4, 2231-4245.

Enders, W. (1995). Applied Econometric Time Series. New York: Wiley Publisher.

Engle, R. (1982). Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. Econometrica: Journal of the Econometric Society, 50, 987-1007.

Farhat, R, Sami, U, & Bedi, Z. (2012). Effects of Export Instability on Economic Growth in SAARC Region Countries. Journal of Development Economics, 6, 97-120

Feder, G. (1983). On Exports and Economic Growth. Journal of Development Economics, 12, 59-73.

Gebru, G. (2004). Export Instability and Economic Growth in Ethiopia. Dakar, Senegal.

Gezahegn, G. (2012). Long-run Effect of Export Volatility on GDP: Case of Ethiopia. Södertörn University, Sweden.

Greene, W. (2003). Econometric Analysis. New York: Prentice Hall Publishing.

Gujarati, D. (2004). Basic Econometrics New York: McGraw-Hill Companies.

Haile, K. (2001). Monetary Policy and the Monetary Approach to Balance of Payment in Ethiopia. Addis Ababa University, Ethiopia.

Heckscher, E. F. (1919): Utrikeshandelns verkan på inkomstfördelningen, Ekonomisk Tidskrift, Vol. 21, pp. 497-512; English translation: The Effect of Foreign Trade on the Distribution of Income, In: Readings in the Theory of International Trade, Ed. by Ellis, H. S., Metzler L. A., Blakiston, Garden City, NY, pp. 272-300; reprinted in: Heckscher-Ohlin Trade Theory, Ed. by Flam, H., Flanders M. J., MIT Press, Cambridge, Massachusetts, 1991.

Hossain, M, & Basak, T. (2012). An Application of Non-Linear Cobb-Douglas Production Function to Selected Manufacturing Industries in Bangladesh. Open Journal of Statistics, 2, 460-468.

Johnston, B, & Mellor, W. (1961). The Role of Agriculture in Economic Development. American Economic Review, 51, 566-593.

Kagnew, D. (2007). Export Performance and Economic Growth in Ethiopia. Addis Ababa University, Ethiopia.

Kiros, H. (2012). Determinants of Export Growth Rate in Ethiopia. Addis Ababa University, Ethiopia.

Krueger, A. (1978). Trade Policy as an Input to Development. American Economic Review, 70, 288-92.

Kwabena, B. (1991). Export Instability and Economic Growth in Sub-Saharan Africa. Economic Development and Cultural Change, 39, 815-828.

Lim, D. (1991). Export instability and compensatory finding. London: Routlege 11 Publishing.

Love, J. (1986) 'Commodity Concentration and Export Earnings Instability: A Shift from Cross-section to Time Series Analysis', Journal of Development Economics 24:239-248.

Mcbean, A. (1966). Export Instability and Economic Development. Harvard University Press, Cambridge, USA.

Mulugeta, A. (2007). The Effect of Export Earnings Fluctuation and Economic Growth in Ethiopia. Addis Ababa University, Ethiopia.

NBE. (2013/14). The Overall Economic Performance. Annual Report. Addis Ababa, Ethiopia.

Ramey, G, & Ramey, V. (1995). Cross-country Evidence on the Link Between Volatility and Growth. American Economic Review, 85, 1138-1151.

Shewangizaw, S. (2003). The Role of Diversification in Reducing Impacts of Export Instability on Ethiopian Economic Growth., Addis Ababa University, Ethiopia.

Sule, O, & James, H. (1988). Export Instability and Growth, working paper No 486, University of California, Los Angles.

UNCTAD. (2015). Reforming International Investment Governance. World Investment Report.

UNDP (2015). Human Development Report 2015. Work for Human Development.

WB. (2014). Strengthening Export Performance through Improved Competitiveness: Third Ethiopia Economic Update. Washington, DC.

Wooldridge. (2012). Introductory Econometrics: A modern Approach. Michigan State University: South-Western Cengage Learning.

Yishak (2009). Determinants of Ethiopia's export performance: A gravity model analysis, Trade and Development discussion Paper No. 01/2009, Development, Research and Consulting. Munich, Germany.