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Nexus between Economic Growth, Unemployment and Inflation in Ethiopia

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Abstract

Empirical literature reveals that the fast-economic growth in Ethiopia during 2004-2016, averaging 10.6 percent, was affected by inflationary and unemployment pressures. The question of how to maintain low and stable unemployment and price levels and achieve high economic growth were a puzzle for policy makers in Ethiopia. The objective of this study was to investigate the short-run and long run relationships and causalities among inflation, unemployment and economic growth in Ethiopia. The time series data from World Bank: World Development Indicator databases, for the period 1991–2016, were employed. Autoregressive Distributed Lag bounds testing for cointegration and Error Correction Model were used for the analysis. The results indicated the existence of a long run relationship among the variables. In the short-run, a single digit rise in price promotes economic growth in Ethiopia. There is a short run causality running from inflation to real Gross Domestic Product; and in the long run economic growth and inflation move together. The short run, long run and ECM estimates all agree over significance and causation: inflation and unemployment estimates have inverse and significant relationship while inflation and GDP have positive and significant relationship. The speed at which inflation returns to equilibrium after changes in unemployment and real GDP, as measured by ECM, is 112 percent, indicating the strength of the economy's ability to accommodate shocks. Since unemployment and GDP have diverse and opposite effects on inflation, policy choices need to be taken with care and vigilance.

Keywords: Real GDP, Inflation, Unemployment, ARDL, ECM, Ethiopia
JEL Classification: E31, J64, O47

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1. Introduction

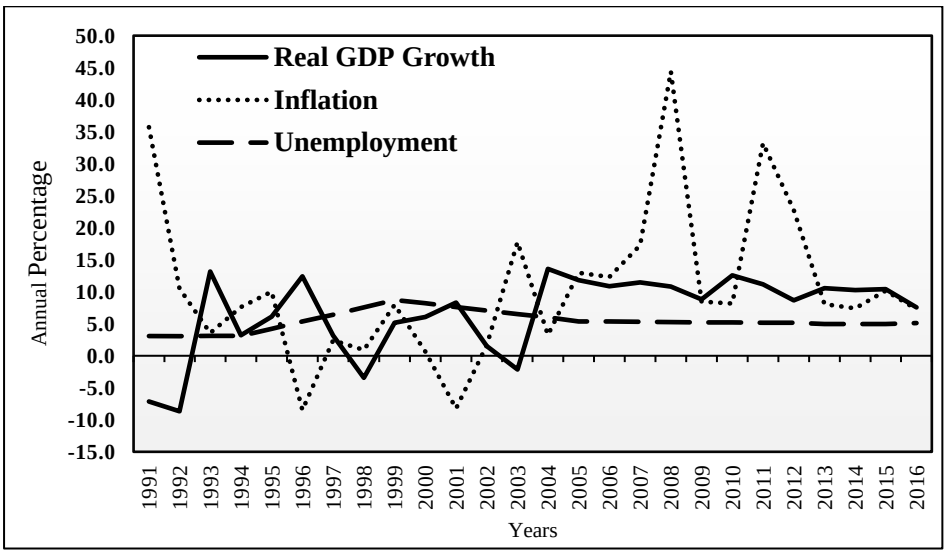
Ethiopia registered 10.6 percent economic growth, one of the fastest in Africa, for the period 2004-2016, but during the same period it was accompanied by an inflation rate of 15 percent and an unemployment rate of more than 17 percent (WB: WDI, 2018).

There are different theories and empirical testimonies on the relation between major macroeconomic variables such as economic growth, inflation and unemployment. In the short run, according to Phillips (1958) and Dornbusch et al (2011), inflation and unemployment have an inverse relationship. Classical economists observe no relationship between inflation and unemployment in the long run, further emphasizing that inflation is caused by alterations in the supply of money. Monetary economists were of the opinion that inflation was a monetary phenomenon (Friedman, 1968); and Keynesians (Keynes, 1936), regarded inflation as an aftermath of increases in money supply.

During 1990s Ethiopia experienced economic stagnation. In 1990/1991 the Ethiopian economy registered a 7.2 percent decline in Gross Domestic Product (GDP), with 12 percent unemployment, 35.7 percent inflation and a budget deficit/GDP ratio of 29 percent (WB: WDI, 2018). Owing to the economy's reliance on nature and external shocks, the Ethiopian economy is characterized by unpredictable growth in output (Alemayehu, 2008). Because agriculture accounted for more than half of GDP for the majority of the recent past, when weather conditions deteriorated, agricultural production fell and GDP fell with it. A systematic price trend resulted from the systematic relationship between GDP and rainfall. Prices followed the inverse trend of output growth. During years of abundant rainfall, as output rises, prices frequently fall precipitously. Even within a single year, prices have been low during harvest seasons (Alemayehu and Kibrom, 2011). Since 2004, Ethiopia has marked double-digit steady economic growth. Unfortunately, that achievement was attended by the challenges of inflation and unemployment (Demissie, 2008; Kassahun, 2002 and NPC, 2016). It is alleged to be deeply rooted in academics and policymaking that a boost in the economy leads to a reduction in unemployment. Although many factors contribute to variation in output, unemployment is singled out as the most important because it has a direct impact on output.

Unemployment and underemployment are features of the informal labour market in Ethiopia. Unemployment has undesirable social, economic and psychological effects. In least developing countries such as Ethiopia in which physical capital is in short supply, labour resources play a significant role in economic growth. However, a sizeable portion of the labour force in Ethiopia is unemployed. Indeed, unemployment caused by political instability, operational problems in industry, volatile investment and a large and growing flow of new graduates into the labour market from an increasing number of higher educational institutions, have been widespread phenomena in Ethiopia for several decades (Gizaw, 2016).

Figure 1: Inflation, unemployment and GDP growth in Ethiopia



Source: WB: WDI, 2018

In Figure 1, the inflation, unemployment and GDP growth trend show how the economy has fluctuated. From WB: WDI (2018) data from 1991-2016 in Figure 1, it is evident that the average growth rate of GDP in Ethiopia was 6.8 percent, lower than the 10.7 percent average growth rate of inflation. The inflation rate, described by average consumer prices in Ethiopia jumped from its 1.7 percent level in 2002 to 17.8 percent in 2003 and a record rate of 44.4 percent during the 2008's world financial crises. After two years of single digit inflation, prices skyrocketed to 33.3 percent in 2011, possibly the result of the exchange

rate devaluation carried out in 2010. The unemployment level in Ethiopia remained high after the downfall of the Derg government in 1991 and increased further in the mid 1990's. It again showed a tendency to rise in 2009-2010 following the global financial crisis. However, as of Figure 1, since 2004, with the country's broad-based and continued achievement of double-digit economic growth, the overall unemployment rate has slightly declined (WB: WDI, 2018).

The economic fluctuations observed in last couple of decades necessitated the importance of taking measures by government to provide efficiencies of allocation, distribution and stabilization. Fiscal and monetary policies in Ethiopia have been unable to realize the combined targets of economic growth, price stability and lower unemployment levels all together. The aim and intention of managing the economic fluctuations has underlined the rationale of increasing government intervention with its fiscal and monetary policy measures; however, the Ethiopian government has not been in a position to treat the troubles of the economy successfully[3].

Even though the economic fluctuations endure and the choice of appropriate policy difficulties related to output, unemployment and inflation relationships persist in Ethiopia, the magnitude of effect, short run and long run causalities, and the statistical significance of those relationships, have not been properly addressed. Yet, policy makers in Ethiopia would be able to use the findings of this study as an input for policy design and intervention. Also, this study on the relationship among output, unemployment and inflation could be expected to add to the literature in the area. To the best of the researchers' knowledge, research encompassing unemployment, inflation and economic growth together have not been carried out in Ethiopia. The studies conducted so far have either covered the relationship between economic growth and inflation, or between unemployment and economic growth. The intention of this study was, therefore, to identify the type and nature of the relationships that exist among those three central macroeconomic indicators. Specifically, the study intended:

- To determine the short-run and long run relationships among inflation, unemployment and economic growth in Ethiopia, and
- To examine the causalities (unidirectional, bi-directional or absence of causality) of inflation, unemployment and economic growth in Ethiopia.

[3] See NPC (2016).

2. Literature Review

The interrelationship among economic growth, unemployment and inflation are governing by the two famous concepts of Okun's law and Phillips's curve.

Okun's law, the empirical relation between unemployment and output, states that if GDP grows rapidly, the unemployment rate declines and if growth is very low or negative, the unemployment rate rises. When the actual growth equals the potential, unemployment rate remains unchanged (Okun, 1962). That law by Okun indicates a short run inverse relation of cyclical unemployment rate and economic growth in the United States of America economy in the period from 1947 to 1960 (Okun, 1962). Since the inception of Okun's law, several studies have been done to validate Okun's coefficient. Some have adopted a single country approach (Caraiani, 2006; Evans, 1989 and Weber, 1995); others consider a pool of countries (Fouquau, 2008) and regional data (Guisinger, et al, 2015 and Freeman, 2000). A remarkable stable result was observed in the United States, but in OECD countries, the estimates have been less stable.

The Phillips curve is a single-equation economic model named after William Phillips that hypothesizes a stable and inverse relationship between rates of unemployment and corresponding rates of wage rises in an economy. According to the theory, economic growth leads to inflation, which leads to more jobs and lower unemployment. Furthermore, the Phillips curve concept states that changes in unemployment within an economy have a predictable effect on price inflation (Phillips, 1958). Studies related to the supposedly inverse relationship between inflation (wage) and unemployment have also been conducted. Stock and Watson (1999) used the conventional Phillips curve to investigate the forecasts of the United States. Inflation at the 12-month horizon and inflation forecasts produced by Phillips's curve have generally been more accurate than forecasts based on other macroeconomic variables. In a related study, Popovic and Popovic (2009) on a comparative analysis of Phillips regularity in the European Union for the period 1998-2007, using a correlation analysis, found an inverse relation of unemployment and inflation.

The work of Fakhri (2011) on the connection between economic growth and inflation in Azerbaijan provides a nonlinear link of those variables with the threshold level of 13 percent. In China, Chang-Shuai and Zi-Juan (2012) researched the link among inflation, unemployment and economic growth by

applying time series models. They found out that unemployment and inflation affected economic growth negatively and positively, respectively. Regarding the short run causality, they observed a two-way causality between economic growth and inflation, a one-way causality between economic growth and unemployment, and no causality between inflation and unemployment.

In Nigeria, a study focused on the links among economic growth, inflation and unemployment (Mohammed et al., 2015). The long run ordinary least squares analysis found that unemployment and inflation had a negative effect on economic growth. Guglielmo and Marinko (2011) employed a panel co-integration method and causality tests by pooling data from 119 countries for the period 1970-2010 to assess the short run and long run linkages among employment, inflation and output. It revealed that employment and output were caused by inflation positively in the short run and negatively in the long run.

Studies in Ethiopia have specifically focused analysis either on the relationship between inflation and economic growth, unemployment and economic growth or one of the variables only, not on the relationship of all three indicators together. In addition, the analytical procedures and datasets adopted in those studies have been diverse. Findings have been contradictory.

Gizaw (2016) assessed the relationship between inflation and economic growth in Ethiopia using co-integration and an Error Correction Model (ECM) for the period from 1991 to 2014. The results indicated the existence of a long run relationship in which the causality runs from economic growth to inflation. The error correction term in the study showed that any disequilibrium in a given period would adjust back to equilibrium by 80.3 percent.

The multiple regression analysis results of Asayehgn (2009) on the relationship between economic growth and inflation concluded that the main determinants of inflation in Ethiopia are imports, depreciation of the Ethiopian Birr (ETB), and a decline in the domestic lending interest rates or an increase in broad money supply. A study by Nandeeswara and Abate (2015) on inflation and economic growth used the framework of VAR, ECM, and causality test and threshold level analysis using annual data covering the period from 1974 to 2012. The results provided a short run and long run connection and bidirectional causality between inflation and economic growth. A recommended level of 9-10 percent threshold inflation level was among the findings.

Even if unemployment has been prevalent in urban centres in Ethiopia, Nzinga and Tsegay (2012) found that national youth unemployment had steadily

fallen since 1999. Women, however, had not benefited from this reduction, and this could possibly explain the severity of poverty prevailing among households headed by females in urban Ethiopia (Jayamohan and Amenu, 2014).

Gizaw (2016), Nandeeswara and Abate (2015) and Asayehgn (2009) focused only on the relationship between inflation and economic growth; unemployment was not included in their work. Nzinga and Tsegay (2012) focused on the youth labour market and their study did not cover the relationship of employment with inflation and economic growth. Contrary to these studies, this study extends the analysis of the association of the variables by bringing in unemployment, one of the significant variables in macroeconomic analysis, and including all the three variables together.

3. Research Method

3.1 Data

This study has employed World Bank (WB) World Development Indicator (WDI) data. It considered the data of three main economic indicators, namely: economic growth, unemployment, and inflation in Ethiopia for the period 1991 to 2016.

3.2 Model Specification

The study adopted the basic Okun's law upon some modifications to offer a sound reflection on the relationship of the main macroeconomic indicators. By assuming a linear relationship among the rate of growth of GDP, unemployment and inflation, the model looks like the following:

$$Rgdp = \beta_0 + \beta_1 Unempl + \beta_2 Infl + u \qquad \textbf{(1)}$$

Where: $Rgdp$- The annual percentage growth rate of GDP at market prices based on constant currency is referred to as the real GDP growth rate (Mankiw, 2013).

$Real\ GDP\ Growth\ Rate = \frac{Y_t - Y_{t-1}}{Y_{t-1}} * 100$, Where: Y_t–current year GDP and Y_{t-1} - previous year GDP.

$Unempl$ – unemployment rate, it refers to the share of the labour force that is without work but available for and seeking employment.

$$Unemployment\ Rate = \frac{Unemployed\ People}{Labor\ Force}$$ (Dornbusch et al., 2011).

$Infl$ – inflation rate, the Consumer Price Index (CPI) reflects the annual percentage change in the cost of acquiring a basket of goods and services to the average consumer.

$$Inflation\ Rate = \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}} * 100,$$

Where: CPI_t- current *CPI*, CPI_{t-1} - preceding year *CPI* (Romer, 2012) and u- error term.

***Testing Stationary*:** The first task in analysing econometric time series data is the testing for the presence of unit roots. The normal stochastic process is fully specified by its two moments, the mean and the variance (Gujarati and Porter, 2008). Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests were used in this study to test the status of unit root in data series (Dickey and Fuller, 1979, 1981 and Phillips and Perron, 1988). The ADF test is presented as follows:

$$\Delta Y_t = \alpha + \beta Y_{t-1} \sum_{i=1}^{n} \beta_1 \Delta Y_t + \varepsilon_t \qquad \textbf{(2)}$$

Where: Y- linear time series, *n*- optimum number of lags and ε- random error term.

Autoregressive Distributed Lag (ARDL) bounds testing for co-integration: This study used Akaike Information Criterion, Schwarz Information Criterion, and Hannan-Quin Information, which are the widely applied criteria for selecting the lag order. If the unit root tests demonstrate a mixture of various orders of integration such as I(0) (order of integration at level) and I(1) (order integrations at first difference), the ARDL bounds testing technique is an appropriate tool to estimate the status of long run relationship among the variables (Pesaran, 1997; Pesaran and Shin, 1999 and Pesaran et al., 2001). The single reduced form ARDL bounds testing equation that simultaneously estimate long run and short run parameters is specified as follows:

$$\Delta \mathrm{GDP_t} = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta \mathrm{GDP_{t-i}} + \sum_{i=0}^{m} \alpha_{2i} \Delta UNEMPL_{t-i} + \sum_{i=0}^{q} \alpha_{3i} \Delta INFL_{t-i} + \delta_{1i} \mathrm{GDP}_{t-1} + \delta_{2i} \mathrm{UNEMPL}_{t-1} + \delta_{3i} \mathrm{INFL}_{t-1} + \varepsilon_{it} \quad \textbf{(3)}$$

***Granger causality tests*:** These examine whether a variable with its lagged values has any predicting ability on another variable. The F-statistic value determines the parameter under consideration is zero or different from zero (Granger, 1969). It was employed in this study to examine the causal relationship among economic growth, unemployment and inflation.

***Error Correction Model*:** An ECM is intended to estimate a long run co-integration of variables. It explains the achievement of the long run equilibrium of endogenous variables through short run adjustments. The co-integration term, known as error correction term, works to correct the deviation from the long run equilibrium through short-run adjustments. Given the variables are co integrated, the error correction term should be entered into the system to avoid misspecification of constraints. Thus, as of Lütkepohl (2005) ARDL can be reparametrized as ECM and the model is:

$$\Delta \mathrm{GDP_t} = \alpha_0 + \sum_{i=1}^{q} \beta_{1i} \Delta GDP_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta UNEPL_{t-i} + \sum_{i=0}^{n} \beta_{3i} \Delta INFL_{t-i} + \lambda \mathrm{ECT}_{t-1} + \varepsilon_t \quad \textbf{(4)}$$

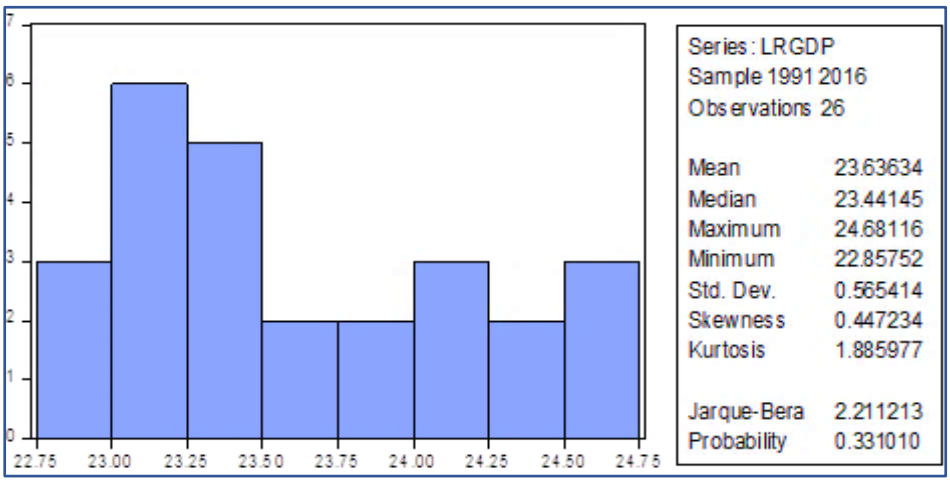
Where: ECT_{t-1}- error correction term, λ–the speed of adjustment parameter is negative and statistically significant as a condition for long run co-integration (Kremers et al., 1992)

***Diagnostics test*:** The pre- and post- estimation tests applied in this study include: a serial correlation test (Breusch, 1978 and Godfrey, 1978) and heteroscedasticity test (Pearson, 1905; Goldberger, 1964 and Johnston, 1972). In addition, Jarque-Bera normality (Jarque and Bera, 1980), and the Cumulative Sum of Recursive (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ) (Brown et al., 1975) tests were used to check the data distribution and post-estimation stability, respectively.

4. Results and Discussion

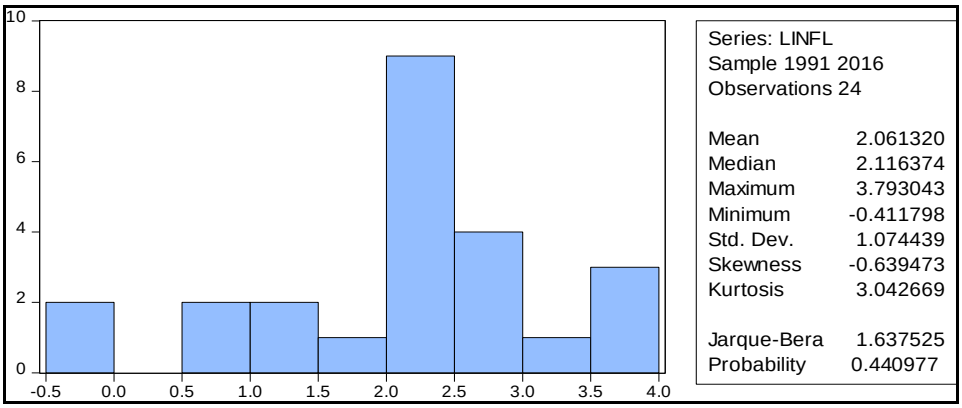
Figure 2 shows the descriptive statistics of Natural logarithm (L) Real Gross Domestic Product (LRGDP), Inflation Rate (LINFL) and Unemployment Rate (LUNEMPL). Of the three, the highest dispersion during the period was for inflation. In this study, the unemployment rate and inflation rate were expressed as percentages, and GDP was expressed in billion US$. To standardize the scales, all variables were converted from level to natural logarithmic form prior to analysis. Furthermore, the Jarque-Bera[4] normality test statistics in Figure 2 showed that compared to the actual data distribution, the data series in the natural logarithm form[5] were normally distributed.

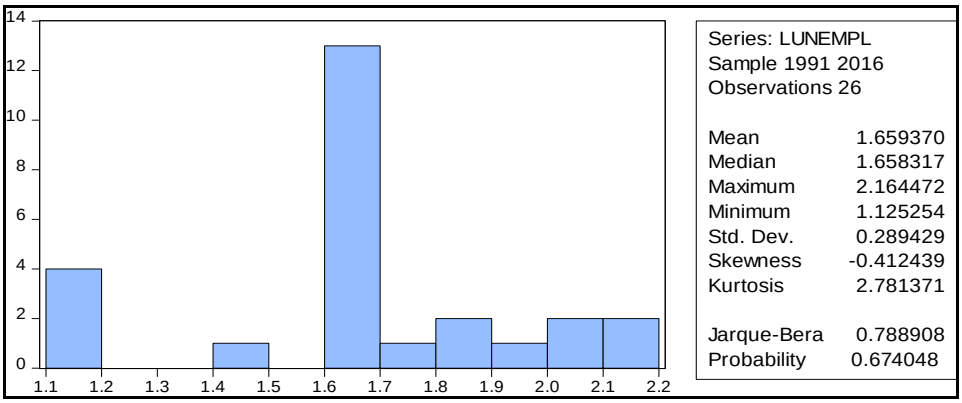
Figure 2: Real GDP, inflation and unemployment during 1991-2016



[4] We reject the null hypothesis of normal distribution when the probability level is less than 5%.

[5] Changing the series to natural logarithmic form is one method for converting the data to a normal distribution.





4.1 Unit Root Test

To examine whether the data series contains a unit root or not, the ADF test was used at level and first difference. The results in Table 1 indicate that LRGDP and LINFL were I(1) order of integration, i.e. stationary at first difference and LUNEMPL was stationary at level, I(0) order of integration.

Table 1: Augmented Dickey-Fuller test

Variables	Level	1st difference
LRGDP	(-1.741484) [0.7021]	(-3.699606) [0.0430]**
LINFL	(0.625797) [0.9969]	(-4.697650) [0.0208]**
LUNEMPL	(-4.910994) [0.0041]*	

Note: * and ** symbolize rejection of the null hypothesis (unit root) at 1% and 5% level of significance, respectively.

: ( ) and [ ] *present* Augmented Dickey-Fuller t-statistic and probability values, respectively.

4.2 Bounds Test for Co-integration

Since the variables in the model of this study are stationary at varied orders of integration, the ARDL bounds test for co-integration method is the appropriate tool to observe the long run relationship. To conduct the test, the maximum lag length for each variable was determined based on the lag order selection criteria. As shown in Appendix 1, the maximum lag length for real GDP, inflation and unemployment, were found to be three, zero, and two respectively. The co-integration test results in Table 2 showed a long run relationship among inflation, unemployment and real GDP. The F-statistic and t-statistic values indicated the existence of the long run relationship when the inflation rate was used as the dependent variable.

Table 2: Bounds test for co-integration

Dependent variable	F-statistic and t –statistic	Co-integration	Estimation procedure
LRGDP	F_{LRGDP} = 1.917001, t_{LRGDP}= 1.919901	NO	ARDL (Short run model)
LINFL	F_{LINFL} = 6.535460, t_{LINFL} = -4.380743	YES	ECM (Long run model)
LUNEMPL	$F_{LUNEMPL}$ = 1.661981, $t_{LUNEMPL}$= -1.747666	NO	ARDL (Short run model)

4.3 Short Run Estimates

Short run estimation results are presented in Table 3 by considering LRGDP as the dependent variable. The variables are denoted by differences and lags of different period such as D(LRGDP(-1))[6], D(LRGDP(-2)) and D(LRGDP(-3)). In the short run, inflation and real GDP exhibit a causal relationship. They are positively related and the coefficients are statistically significant. A Wald test was also used to examine the short run causation and direction of causality. As shown in Table 4, the Wald test's hypothesis that inflation lags do not jointly affect real GDP was rejected at five percent significance level.

The short run estimates and the Wald test results in Table 3 and Table 4 indicate inflation affects economic growth. A moderate rise in price supplements returns to savers, enhances investment and improves productivity. A small

[6] The differenced real GDP lagged by one period.

increase in prices encourages consumers to buy goods and services. It then, rises aggregate demands and the growth rate of the economy. A low inflation rate is also accompanied by low interest rates which increase investment activities and productivity. Therefore, the economic growth and price relationship is justified by a situation where a single digit rise of price promotes short run economic growth[7]. Furthermore, as shown in Table 4, the first and second lags of LRGDP positively and significantly affect LRGDP itself at 5 percent significance level, though after the third lag the effect turns out to be negative.

Table 3: Short run estimates of real GDP

Dependent Variable: D(LRGDP):

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C[8]	-0.062005	0.045539	-1.361594	0.2450
D(LRGDP(-1))	1.107034	0.305906	3.618874	0.0224
D(LRGDP(-2))	0.785757	0.275846	2.848532	0.0465
D(LRGDP(-3))	-0.275950	0.095459	-2.890761	0.0445
D(LINFL(-2))	0.007032	0.002422	2.903351	0.0440
D(LINFL(-3))	0.007470	0.002111	3.538585	0.0240
D(LUNEMPL(-1))	0.425918	0.103927	4.098258	0.0149
R-squared	0.963278	Mean dependent var		0.095117
Adjusted R-squared	0.880653	S.D. dependent var		0.016969
S.E. of regression	0.005862	Akaike info criterion		-7.264745
Sum squared resid.	0.000137	Schwarz criterion		-6.808276
Log likelihood	60.85322	Hannan-Quinn criterion		-7.307000
F-statistic	11.65845	Durbin-Watson stat		2.577853
Prob(F-statistic)	0.015307			
Breusch-Godfrey Serial Correlation LM Test: 12.26640 (0.2062)				

[7] The threshold level of inflation has been reported as 9-10 percent.

[8] Coefficient of constant term.

Table 4: Wad Test (Joint effect of inflation on LRGDP)

Dependent variable (LRGDP)
Null Hypothesis: C(5)=C(6)=C(7)=0

Test Statistic	Value	df	Probability
F-statistic	12.11794	(3, 4)	0.0178
Chi-square	36.35382	3	0.0000

In the short run, real GDP and inflation are negatively related to unemployment and the coefficients are statistically significant (Table 5). Likewise, real GDP and inflation lags that do not jointly affect unemployment were rejected at five percent significance level. As presented in Table 5, the Wald test confirms the joint lags of real GDP and inflation to have a negative effect on unemployment.

Table 5: Wad Test (Joint effect of LRGDP on unemployment and inflation on unemployment)

LRGDP to Unemployment
Null Hypothesis: C(4)=C(5)=0

Test Statistic	Value	df	Probability
F-statistic	11.68537	(2, 10)	0.0024
Chi-square	23.37075	2	0.0000

Inflation to Unemployment
Null Hypothesis: C(6)=C(7)=0

Test Statistic	Value	df	Probability
F-statistic	3.439941	(2, 10)	0.0730
Chi-square	6.879881	2	0.0321

The above results are in line with the inverse relationship between unemployment and output of Okun's law. The Phillips curve, which works along the short run aggregates supply curve, describes the empirical trade-off between unemployment and inflation.

Short run estimation was tested using various pre- and post- diagnostics tests such as Breusch-Godfrey serial correlation, heteroscedasticity and stability. The results in Table 3 and 6 exhibits the absence of serial correlation in the data series. Furthermore, the CUSUM and CUSUMSQ tests were employed to detect the post-stability of the estimation. As shown in Appendix 2, the plots do not cross the five percent critical lines, implying the existence of stability of estimated coefficients over the sample period of investigation.

Table 6: Short run estimate of unemployment

Dependent Variable: D(LUNEMPL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.313116	0.092633	3.380189	0.0070
D(LUNEMPL(-1))	0.411766	0.215160	1.913773	0.0847
D(LUNEMPL(-2))	-1.076143	0.318747	-3.376169	0.0070
D(LRGDP(-1))	-3.390371	0.851147	-3.983296	0.0026
D(LINFL(-2))	-0.036975	0.014221	-2.599941	0.0265
R-squared	0.806636	Mean dependent var		0.014447
Adjusted R-squared	0.690618	S.D. dependent var		0.102748
S.E. of regression	0.057151	Akaike info criterion		-2.593348
Sum squared resid.	0.032662	Schwarz criterion		-2.250261
Log likelihood	29.04346	Hannan-Quinn criterion		-2.559245
F-statistic	6.952655	Durbin-Watson stat		1.956654
Prob(F-statistic)	0.003999			
Breusch-Godfrey Serial Correlation LM Test: 0.474215 (0.6388)				

4.4 Granger Causality Analysis

The Granger Causality test results in Table 7 show the effect of variables on one another. The test was performed to predict whether the former variable Granger causes the later variable or otherwise. Accordingly, the hypothesis that a real GDP Granger causes unemployment was acceptable at one percent significance level. On the other hand, the hypothesis that an unemployment Granger causes and predicts inflation was significant at 8 percent level. When unemployment is low, more consumers have extra money to spend on goods.

Demand for goods rises, and as demand rises, so do prices. Customers purchase fewer goods during periods of high unemployment, which puts downward pressure on prices and reduces inflation. It also shows unemployment to have weak predicting power for inflation but inflation itself does not predict unemployment. There was also short run causality that runs from inflation to real GDP at five percent significance level. All the causalities found at this point are unidirectional, which in turn pave a way for policy makers to design targets for short run macroeconomic objectives.

Table 7: Granger Causality Tests

Pairwise Granger Causality Tests	**Lags: 3**	
Null Hypothesis:	**F-Statistic**	**Prob.**
D(LRGDP) does not Granger Cause D(LUNEMPL)	12.3933	0.0002*
D(LUNEMPL) does not Granger Cause D(LRGDP)	2.15030	0.1366
D(LINFL) does not Granger Cause D(LUNEMPL)	1.57380	0.3063
D(LUNEMPL) does not Granger Cause D(LINFL)	4.22840	0.0773***
D(LINFL) does not Granger Cause D(LRGDP)	9.72810	0.0158**
D(LRGDP) does not Granger Cause D(LINFL)	0.16199	0.9175

Note: *, ** and *** symbolize statistically significance at 1%, 5% and 10% levels, respectively

4.5 Long Run Estimates

Regression results of long run estimates indicate that unemployment and real GDP coefficients are statistically significant. Real GDP contains positive coefficient, indicating GDP and inflation to grow together. When economic activities rise by one percent, the price level in the economy increases by 0.7 percent. General government total expenditure in Ethiopia rose from 4.9 billion ETB in 1991 to 280.7 billion ETB in 2016, with a sharp increase starting from 2005-2016 (IMF, 2018). The upsurge in government expenditure suggests that the recent Ethiopian government expansion of fiscal policy coupled with the fast growth in the country leading to excess demand for goods and services, could be reasons for the persistent annual increase in inflation. Besides the effect of cost inflation, price power inflation and sectoral inflation would be the contributing factors.

Table 8: Long run estimations

Dependent Variable: LINFL

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.26715	7.890415	-1.427954	0.1680
LRGDP	0.690416	0.337824	2.043715	0.0537**
LUNEMPL	-1.832380	0.671656	-2.728153	0.0126*
R-squared	0.323726	Mean dependent var		2.061320
Adjusted R-squared	0.259319	S.D. dependent var		1.074439
S.E. of regression	0.924692	Akaike info criterion		2.797757
Sum squared resid.	17.95617	Schwarz criterion		2.945014
Log likelihood	-30.57308	Hannan-Quinn criterion.		2.836824
F-statistic	5.026251	Durbin-Watson stat		2.086447
Prob(F-statistic)	0.016455			
JB –1.509976 (0.470016)				
Heteroskedasticity Test: Breusch-Pagan-Godfrey - 1.897033 (0.1748)				
Breusch-Godfrey Serial Correlation LM: Test - 0.171270 (0.6834)				

Note: * and ** symbolize statistically significance at 5% and 10% levels, respectively.

The F-statistic value of 5.02 represents the two explanatory variables which are jointly accountable for inflation change in the long run. The estimated model is free from serial correlation and heteroscedasticity.

Figure 3 presents the Jarque-Bera statistic of 1.51 with P-value of 0.47, so the data series is normally distributed. Furthermore, the CUSUM and CUSUMS plots as presented in Figure 4 do not cross the five percent critical lines, which implies the existence of stability of variables over the entire sample period of investigation.

Figure 3: Normality test of long run estimates

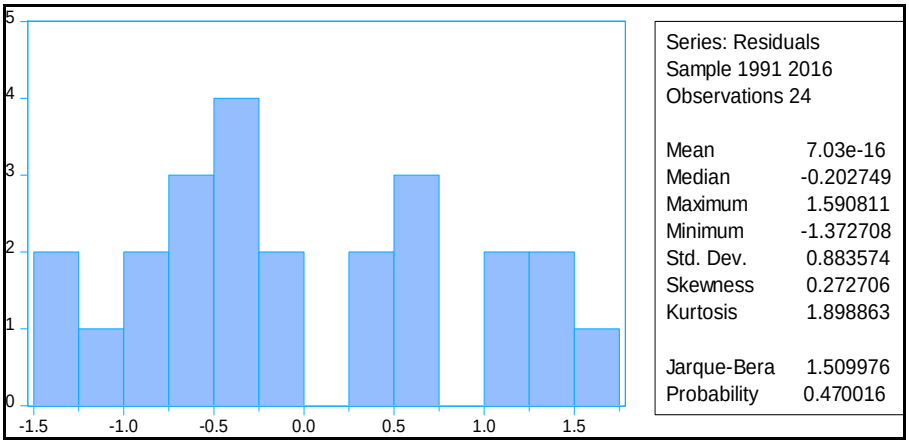
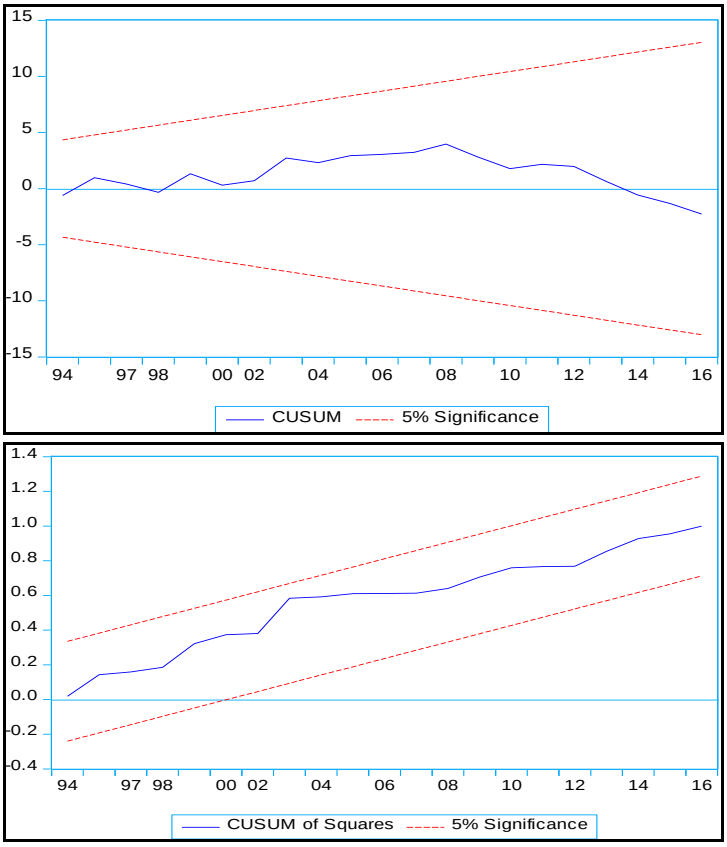


Figure 4: Stability tests of long run estimates of inflation, real GDP and unemployment



4.6 Long Run Equilibrium and Short Run Adjustments

ECM is an amalgamation of short run equation and long run representation. The regression coefficient and probability values in Table 9 exhibit a negative and statistically significant error correction term at one percent level, proving the existence of the long run relationship and short run dynamics. The speed of adjustment of the whole system from short run deviation to long run equilibrium is 1.122. The system is being adjusted towards long run equilibrium at the speed of 112 percent. A study by Gizaw (2016) has indicated 80.3 percent speed of adjustment to long run in Ethiopia. The ECM (-1) explains the previous period's deviation from long run equilibrium influence short-run movement in the dependent variable. In the last two and half decades, the Ethiopian economy has been hit by a series of policy and non-policy shocks; however, as the ECM result demonstrates, the effect of these shocks was not persistent.

Table 9: Error Correction Model results

Dependent Variable: D(LINFL)

Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005157	0.352716	0.014621	0.9885
D(LRGDP)	0.993794	3.884987	0.255804	0.8012
D(LUNEMPL)	-2.315229	2.565732	-0.902366	0.3795
ECM(-1)	-1.121449	0.263570	-4.254837	0.0005*

R-squared	0.519296	Mean dependent var	2.061320
Adjusted R-squared	0.434466	S.D. dependent var	1.074439
S.E. of regression	0.962723	Akaike info criterion	2.797757
Sum squared resid	15.75620	Schwarz criterion	2.945014
Log likelihood	-26.78118	Hannan-Quinn criterion	2.836824
F-statistic	6.121600	Durbin-Watson stat	2.086447
Prob(F-statistic)	0.005118		

JB –1.226526 (0.541581)

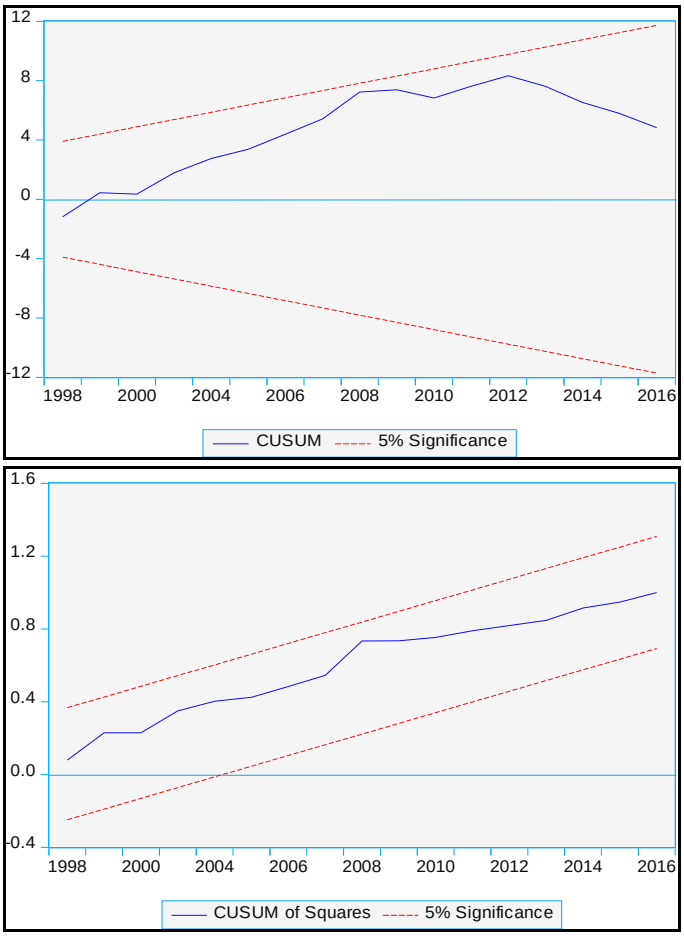
Heteroskedasticity Test: Breusch-Pagan-Godfrey - 0.171861(0.9139)

Breusch-Godfrey Serial Correlation LM: Test - 0.084609 **(**0.7749**)**

Note: *symbolizes the error correction model is negative and statistically significant at 1% level.

As observed in Table 9, there are no serial correlation and heteroscedasticity problems in the model estimation. The Jarque-Bera statistic value is 1.23 with P-value of 0.54, implying the data is normally distributed. Figure 5 indicates that the post-estimation procedure is stable; this allows us to rely on the estimated coefficients for policy-making.

Figure 5: Stability tests of ECM estimates (inflation, real GDP and unemployment)



The estimates show that inflation and unemployment have significant inverse relations, and that inflation and GDP have a significant and positive relationship. The speed at which inflation has returned to equilibrium after changes in unemployment and real GDP and after economic shocks, has been

impressively fast. It implies the Ethiopian economy has been experiencing fluctuations in the past two and half decades. However, the main economic activities have quickly been able to return to long run equilibrium. Nevertheless, since unemployment and real GDP have diverse effects on inflation, policy decisions on the matter require proper attention. The government and policy making institutions in Ethiopia should adopt a combination of fiscal, monetary, price and income polices for careful analysis and close observation.

5. Conclusions

Growth in Ethiopia in recent decades has been strongly influenced by unemployment and inflation rates. The objective of this study was to find the nature of the relationship between central macroeconomic indicators. The data set covered the period from 1991 to 2018. ARDL bounds testing for co-integration methods was used for analysis. The short run model and Wald test results indicated a subsequent single digit rise in price promoted short run economic growth in Ethiopia. The short run results were in line with the inverse relationship between unemployment and output and the trade-off between unemployment and inflation of Okun's law and Phillips's curve, respectively. All causalities found were unidirectional, which offers a way for policy makers to design suitable targets for short run macroeconomic objectives. In the long run, output and inflation rise together. This can be explained by the expansionary policies adopted by the government and the fast-economic growth's increasing demand for goods and serves. The Bounds test for co-integration results demonstrated the existence of a long run relationship among the variables. The speed, as measured by ECM terms, at which inflation returns to equilibrium after changes in real GDP and unemployment, is 112 percent. This study, by including unemployment in the model and extending the time to 2016, found out that the economic fluctuations and shocks Ethiopia has experienced can be cured by fast restoration of the economy to long run. However, since unemployment and real GDP have diverse effects on inflation both in the short and the long term, fiscal-monetary policy choices need careful and vigilant decisions.

List of Abbreviations

ADF	Augmented Dickey Fuller
ARDL	Autoregressive Distributed Lag
CPI	Consumer Price Index
CUSUM	Cumulative Sum of Recursive
CUSUMSQ	Cumulative Sum of Squares of Recursive Residuals
ECM	Error Correction Model
ETB	Ethiopian Birr
GDP	Gross Domestic Product
LINFL	Natural logarithm Inflation Rate
LRGDP	Natural logarithm Real Gross Domestic Product
LUNEMPL	Natural logarithm Unemployment Rate
PP	Phillips-Perron
US$	United States Dollar
WB: WDI	World Bank: World Development Indicator

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List of Appendices

Appendix 1: Lag Order Selection Criteria

Endogenous variables: LRGDP

Exogenous variables: C LINFL LUNEMPL

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2.442186	NA	0.104105	0.572862	0.721984	0.598099
1	37.54221	63.13326	0.001725	-3.530759	-3.331930	-3.497109
2	37.83153	0.426362	0.001871	-3.455950	-3.207414	-3.413888
3	41.62070	5.185177*	0.001409*	-3.749547*	-3.451303*	-3.699072*
4	42.20343	0.736081	0.001493	-3.705624	-3.357673	-3.646737
5	42.21685	0.015545	0.001689	-3.601774	-3.204116	-3.534474

* 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

Endogenous variables: LINFL

Exogenous variables: C LRGDP LUNEMPL

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-21.67020	NA*	0.910643*	2.741133*	2.889529*	2.761595*
1	-21.56108	0.169746	1.009831	2.840120	3.037980	2.867402
2	-21.38638	0.252344	1.115086	2.931820	3.179145	2.965923

* Indicates lag order selected by the criterion

Endogenous variables: LUNEMPL

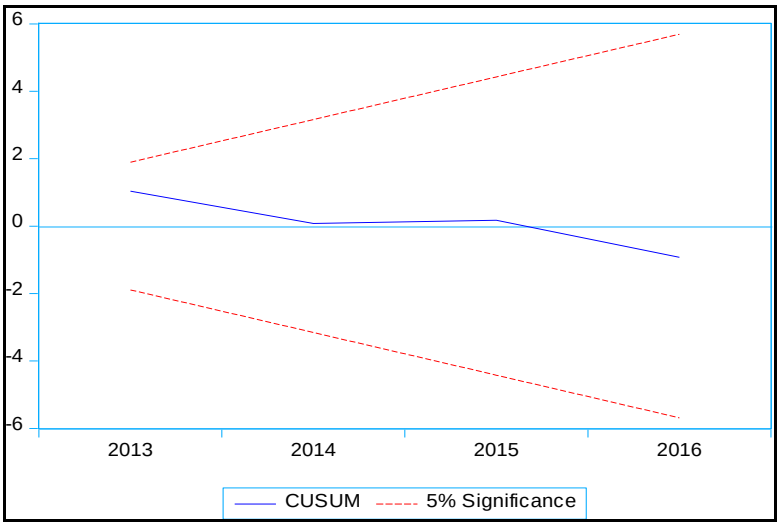
Exogenous variables: C LRGDP LINFL

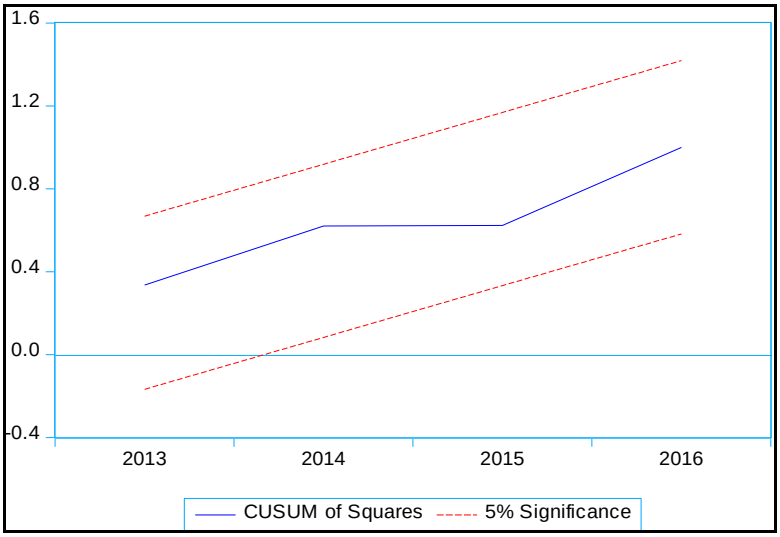
Lag	LogL	LR	FPE	AIC	SC	HQ
0	4.925246	NA	0.048837	-0.183357	-0.034139	-0.150973
1	23.06630	29.37123	0.009571	-1.815838	-1.616881	-1.772659
2	29.59273	9.945031*	0.005680	-2.342164	-2.093469*	-2.288191
3	30.82461	1.759838	0.005596*	-2.364249*	-2.065814	-2.299481*

* Indicates lag order selected by the criterion

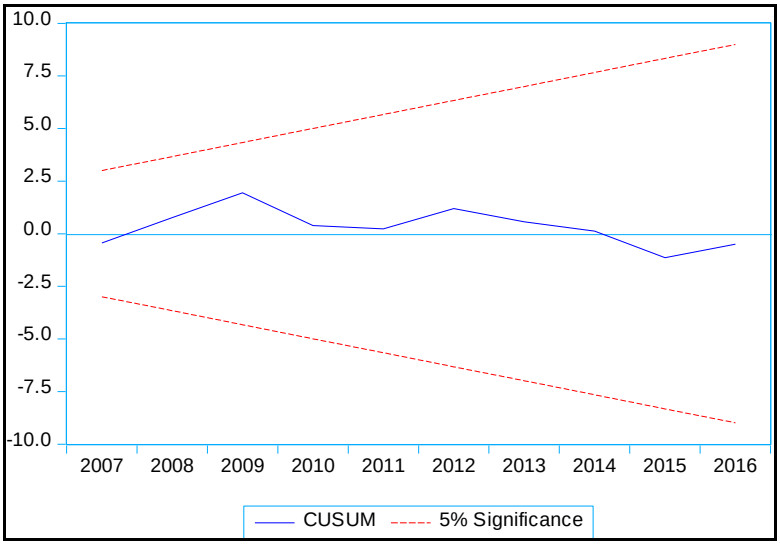
Appendix 2: Stability tests

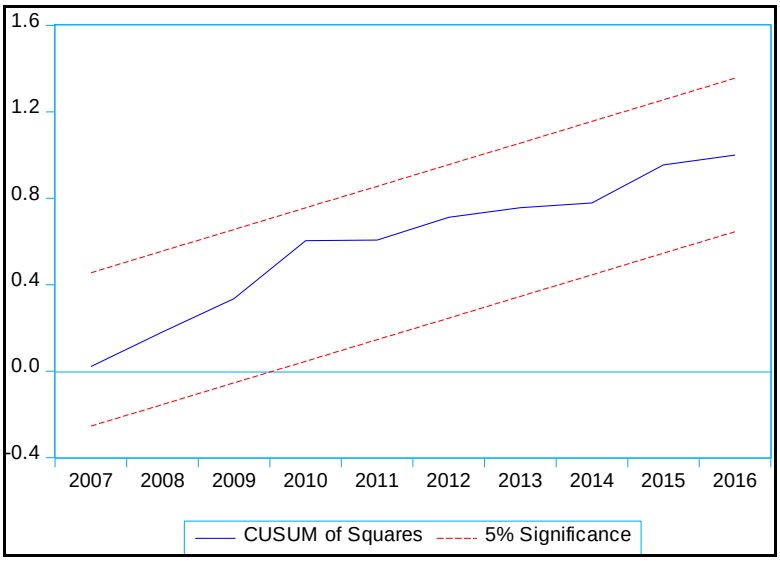
Stability tests of short run estimates of real GDP, inflation and unemployment





Stability tests of short run estimates of unemployment, inflation and real GDP





Factors Affecting People's Environmental Awareness in the Urban Areas: A case of Addis Ababa, Ethiopia

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Abstract

In developing countries, the urban environment is deteriorating over time. In the meantime, people's demand for clean and green residential and recreational places has increased. If so, why has it been hard to keep cities clean and green? This study investigates the level and determinants of environmental awareness in Addis Ababa. From three sub-cities, three-stage sampling procedure has been applied to select 293 respondents. A five-point Likert scale was used to classify the levels of awareness and an ordered logit model was applied to analyze its determinants. The result shows a high level of knowledge on forest degradation, while a medium level of attitude on the possible cause of acid rain. From the marginal effect result, the probability of low (13%) and medium (25%) levels of environmental awareness increases for the income group of 601 to 1650.

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Likewise, for the age of 50 to 59, the likelihood of having low and moderate levels of environmental awareness rises by 8% and 11%, respectively. For respondents at TVET educational level, the chance of having low and medium levels of awareness reduces by 8% and 12%, respectively. In conclusion, being in a high-income category and education levels have more probability to a better level of environmental awareness while young respondents have a high probability for better environmental awareness. So, improving the income and access to higher education will assure clean and green cities, particularly in young populated urban areas. Besides formal education, adult education, training, and workshops are alternatives to enhance environmental awareness.

Keywords: Addis Ababa; environmental awareness; Likert scale; urban environment; ordered logit

JEL Classification: C10; Q53; Q57; Z13

1. Introduction

In the production of goods and services, every socio-economic activity is tied-up with resource extraction and waste emission. There is no perfect process that efficiently converts inputs into useful output; however, waste is released as a byproduct (Hill, 2010). When this waste occurs in the wrong place, at the erroneous time, and in the way-out amount affects the carrying capacity of the environment (Hoornweg et al., 2011) and causes environmental pollution (Metcalfe and Derwent, 2005).

Environmental pollution is highly related to waste management (Hoornweg et al., 2011), greenhouse gas emission (Shanmugam and Hertelendy, 2011), and urban planning (Liu et al., 2015; Colombani et al., 2018). In addition, lack of standard inbuilt sewerage system, poor solid waste management (Gondo et al., 2010), and failure to neutralize volatile gases from dumpsites and industries (Kaushal and Sharma, 2016; Kumar et al., 2016) exacerbate the environmental pollution. In this regard, households and institutions are the eminent contributors to environmental pollution (Gücker et al., 2006; Satterthwaite, 2008; Getahun et al., 2012; Do et al., 2013). So, environmental pollution is anything discharged into the air, water, soil, or food; it threatens the existence of living organisms (Miller, 2006) and poses an impact on human health and wellbeing (Corvalan et al., 2005; Zommers et al., 2014).

Environmental pollution is also associated with people's environmental awareness (ECLAC, 2004; Momoh and Oladebeye, 2010) and their consumption behavior (Xu et al., 2019). Considering several factors such as education (Mutisya and Barker, 2011), residential places (Bickersta and Walker, 2001), and technological knowledge (Giudici et al., 2019) which determine environmental pollution, a society with lower environmental awareness has been highly labeled to a polluted environment (Partanen-Hertell et at., 1999).

Rivers and groundwater deterioration (Ademe and Molla, 2014; Eriksson and Sigvant, 2019) and air pollution are more common in urban areas (UN Environment, 2018). Over the last 30 years, the urban environment in Ethiopia impaired following population expansion, industrialization, and urbanization (Akalu et al., 2011; Eriksson and Sigvant, 2019; Worku and Giweta, 2018). In this period, emphasis has been given to improving, sustaining, and keeping the environment (Ethiopian Environmental Protection Authority,1997) through green cities development, landfill gas control, wastes management (FDRE, 2011), and emission reduction from automobile (Ministry of Transport, 2011).

Considering the importance of environmental awareness training to keep the environment clean and green (Weinrach, 2002), efforts were made to enhance people's awareness in Ethiopia (MoFED, 2006). Nevertheless, the environment faces multi-dimensional problems (Danyo et al., 2017). Several studies in the urban areas focused on the human environmental impact, urban rivers, watershed land use, surface water pollution, and flood vulnerability (Akalu et al., 2011; Asnake et al., 2021; Eriksson and Sigvant, 2019; Mohamed and Worku, 2020). Moreover, studies in several parts of Ethiopia emphasized on solid waste (Beyene and Banerjee, 2011; Destaw et al., 2013; Getahun et al., 2012; Regassa et al., 2011), river and groundwater contamination (Awoke et al., 2016; Gebre and Rooijen, 2009; Gondo et al., 2010; Goshu et al., 2010; Mazhindu et al., 2010), and air pollution (Do et al., 2013). On the other hand, few studies could be found which focus on environmental awareness in the farming communities (Adem, 2017) and environmental awareness of higher education students' and the implications to the Paris agreement (Emiru and Waktola, 2018). Despite the importance of the topic, empirical studies hardly examined environmental awareness in Addis Ababa. Therefore, this study aims to address the literature gap and to provide empirical evidence on the level of people's environmental awareness and its determinants.

With the aim above mentioned, this article is organized into five sections: following the introduction, materials and methods section explains the conceptual framework, study area, sampling and questionnaire design, model specification, and variable characteristics. The result section explains the demographic characteristics, level of environmental awareness, and factors determining awareness. Following the result, the discussion section elaborates the key findings concerning the existing knowledge. Last, the conclusion section summarizes the main findings and forwards recommendations.

2. Materials and Methods

2.1 Conceptual Framework

The basis for this conceptual framework is to provide the interconnection between environmental knowledge-belief, environmental attitude-feeling, and environmental behavior-intention. This framework aims to expose readers to the theoretical viewpoint, while at the same time combining these variables to overview the overall people's awareness of environmental concern. Although the concept is complicated with wider theoretical underpinnings, the researchers have made it specific to the topic of interest and explained it simplistically.

Environmental concern is a multifaceted concept consisting of two major components, environment, and concern. Environment represents the core object of the general environmental events such as quality, pollution, degradation, and conservation. Whereas, the concern aspect is a psychological state of the attribute that represents people's beliefs, feelings, and intent to environmental events (Pellow et al., 2003). So, environmental concern examines the degree of people's environmental awareness in terms of environmental knowledge, environmental attitudes, and environmental behavior (Fishbein and Ajzen, 1975). Henceforth, the phrase 'environmental awareness' will be used instead of environmental concern.

Environmental knowledge is conceptualized based on the theoretical ground of propositional, acquaintance, and "how-to" knowledge which focuses on the extent of people's belief, familiarity, and engagement, respectively (Lemos, 2007). In this regard, belief represents information about the events and the associated attribute (Fishbein and Ajzen, 1975) corresponds to the fact of a circumstance which is verbally predetermined as the concept, source, causes, and effect of environmental pollution (Newman, 2004; Pollock and Cruz, 1999).

Unlike the belief, acquaintance knowledge is acquired in the day-to-day contact with an event, while "how-to" knowledge is developed through involvement in environmental circumstances. On the other way, Morreale et al. (2007) divided knowledge into content knowledge and procedural knowledge. Content knowledge is a literal understanding of the subjects, words, or meanings, while procedural knowledge emphasizes practicing the content knowledge. Even though knowledge is a process that can develop and grow constantly (Watson and West, 2006), it is a combination of belief and fact (Williams, 2002). So, from the theories of knowledge, we conclude that there is no clear-cut boundary within different types of knowledge; however, belief is the common foundation for all types of knowledge.

Given the importance of knowledge, people's attitude to react with a certain degree of satisfaction to an event is the other component of environmental awareness. (Fishbein and Ajzen, 1975) theorized attitude as the level of affect in which people feel concerning an event. Affective reactions are the verbal expression of feelings, facial expressions, and nonverbal signs of emotion (Ajzen, 1993). Indeed Fazio (1990) noted that attitude is the association between an object and the evaluation of that object. Although attitude is viewed as a latent variable that influences an individual's behavior, there is no clear demarcation between attitude and behavior (Borba, 2004; Fazio, 1990). However, Borba (2004) put the distinction between attitude and behavior as:

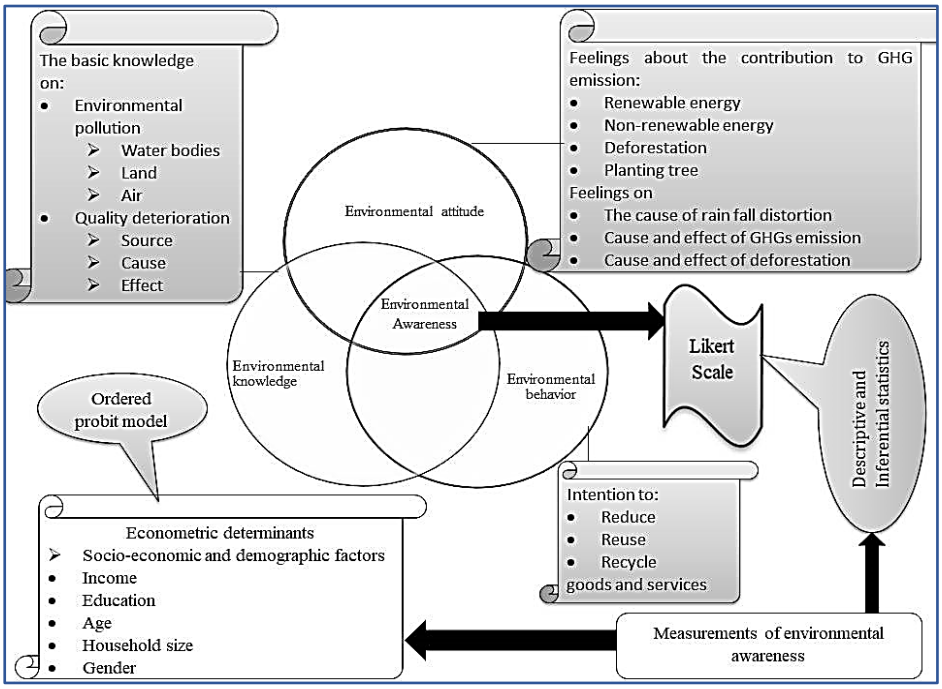
> *Behaviors are on the surface; attitudes run deep. Behaviors are actions; attitudes are a way of looking at life. Behaviors you can see the; attitudes are often hidden and hard to figure. Behaviors are more reactive and impulsive; attitudes are long term* (P.8).

Taking into account the basic concept of attitude, behavior stands for an observable act on an event that can be studied in its own right (Fishbein and Ajzen, 1975). Considering environmental behavior as an observable action, the theory of planned behavior focuses on how people intended to act on environmental events (Ajzen, 1993).

Environmental awareness helps to assess people's consciousness in their day-to-day environmental activity (Partanen-Hertell et al., 1999). According to Rohrer (2002), awareness is the sum of all abilities which permits humans to respect fundamental rights. Thus, a high level of awareness correlates with the

conscious choice of environmentally friendly practices (Partanen-Hertell et al., 1999). Hence the conceptual framework in Figure 1 below shows that there is a nexus among environmental knowledge, attitude, and behavior which collectively explains the level of people's environmental awareness. To this end, the socio-economic and demographic factors are expected to determine the level of environmental awareness.

Figure 1: Analytical framework for environmental awareness



Source: adapted from (Partanen-Hertell et al., 1999)

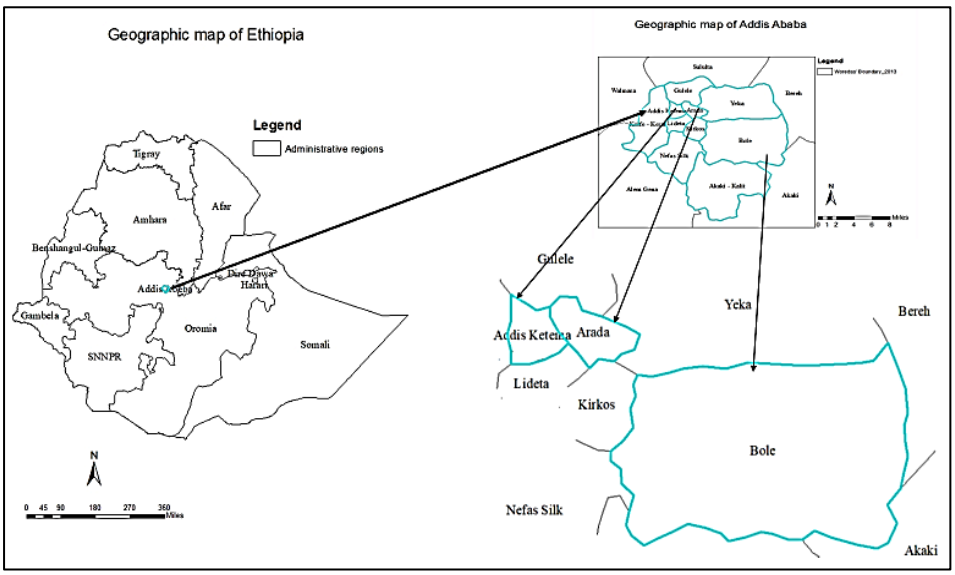
2.2 The Study Area

Figure 2 below depicts the geographic map of Addis Ababa, the capital city of Democratic Republic of Ethiopia. Addis Ababa was founded and got its name in 1886 by Emperor Menelik II and his wife, Empress Taitu (UN-Habitat, 2017). The city has an altitude between 2300 meters in the south and 3000 meters in the north. According to CSA (2013), the total population size and density were 3,434,000 and 6,516.25/ km^2, respectively. Among the total population, 47.3%

were male and 52.7% female. The annual fertility rate was 2.1 (CSA, 2013). The organization of the city was by ten sub-cities and 118 districts (Abebe et al., 2018).

Addis Ababa hosts 17 percent of the total urban population (UN-Habitat, 2017). Although the employment rate in the city was low, the majority were employed in low-skills, non-permanent, daily labor and related occupations (Erena et al., 2017). The environment in the city was unable to provide the functions of ecosystem services. Fast urbanization and built-up areas caused biodiversity loss and land degradations. According to the UN-Habitat report, densely populated sub-cities such as Addis Ketema, Arada, and Lideta were more vulnerable to environmental services, while Kolfe, Nifassilk Lafto, Kirkos, and Akaki Kality, sub-cities were less vulnerable. Bole, Gulele, and Yeka sub-cities were the lowest vulnerable for environmental services (UN-Habitat, 2017).

Figure 2: Geographic map of the study area



Source: Own sketch by using ArcGIS 10.5 adopting shape-file from Google search (2020)

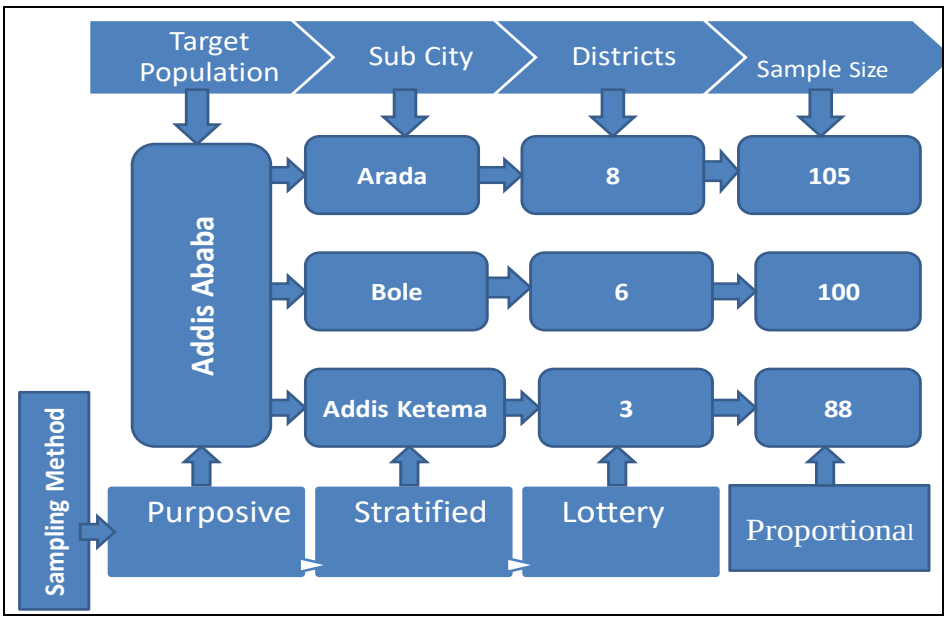
Biomass was the major source of energy for cooking and heating to the lower-income group. In the city, only 14% of the urban population used the sewerage system for liquid waste disposal while a quarter of the dry waste was collected. The remaining dumped to open space, drainage channels, and rivers which are the drivers of river and soil pollution. In addition, vehicles in the city committed 48% of the CO_2 and 90% of hydrocarbon and carbon monoxide

emissions (UN-Habitat, 2017). As a result, human health is impaired by indoor and outdoor pollution, and by consuming contaminated vegetables produced by wastewater irrigated fields.

2.3 Sampling and Questionnaire Design

Non-probability and probability sampling methods were adopted to collect primary data. As shown in Figure 3, the researchers followed a three-stage sampling procedure to determine the sample size. In the first stage, ten sub-cities were categorized into three strata based on their population density. The official document shows that six sub-cities such as Bole, Gulele, Kolfe-Keraniyo, Nifas Silk, Yeka and Akaki-Kality, had a population density lower than ten thousand which is the first stratum. The second stratum includes Arada and Kirkos sub-cities that had population density above ten thousand and below twenty-four thousand. Lideta and Addis-Ketema sub-cities were classified in the third stratum which contains population density over twenty-four thousand. So, one sub-city was selected in a lottery method from each stratum. In the second stage, one district was selected randomly using a lottery method from each sample sub-cities. Finally, sample HHs were proportionally identified from each district.

Figure 1: Summary of sampling and sample size determination



Thus, the total sample size were identified using the statistical formula developed by Yamane (1967 cited in, Israel 1992) which is a total of 293 HHs (Equation 1)

$$n = \frac{N}{1 + N(e)^2} \quad \textbf{(1)}$$

Where, n =Sample size, N = Total target HHs in the study area, e = precision at 5%. Consequently, the sample size from each district is proportionally computed using Equation 2.

$$S_i = \frac{D_i}{N} \times n \quad \textbf{(2)}$$

Where S_i is sample HHs from the ith district, D_i is the total HHs in the district, and N is the total HHs in the three districts (Eq.3).

Hence, $n = \sum_{i=1}^{3} S_i$ **(3)**

So, from the document of HHs list found in the district, the first sample respondent was selected in a lottery approach from the first four consecutive lists of HHs. Then, interval method was applied to select all samples from each district. A questionnaire was developed and pretested to investigate peoples' environmental awareness. The tool contains questions on socio-economic variables such as income and education; demographic characteristics such as age, gender, and household size. Moreover, the questions on environmental items for knowledge, attitude, and behavior scaled to signify the dependent variable. Environmental knowledge addressed respondents' beliefs on the cause, source, and the effect of solid, liquid, and gaseous wastes. The attitude questions focused on respondents' feelings about the effect of consuming goods and services on the environment, for instance, using different types of energy sources, tree planting and deforestation, solid and liquid waste disposals. Behavioral questions reflect the respondents' intention to reduce, reuse, and recycle goods and services. In this regard, the respondents addressed the questions by giving rank on a five scale, '1= very less to 5 = very much'. Thus, the data were collected on a face-to-face basis for three weeks, starting from the end of May 2019 to mid-June 2019.

2.4 Model Specification and Data Analysis

Descriptive and inferential statistics were used to analyze the data. Five-point Likert scales (LS) were prepared to see the level of environmental awareness through the environmental items under the three components: environmental knowledge, attitude, and behavior. To avoid bias, environmental aspects are expressed in negative and positive statements. The response scale for each environmental item is 1 to 5. Thus, the response to the negative report has a reverse value. The sum of the scale is represented the full scale. The maximum total scale is 5*n, and the lowest possible scale is 1*n. Where 'n' is the total number of environmental items listed under the three components; each respondent's level of environmental awareness is computed by Equation 4.

$$EA_r = \frac{\sum_{i=1}^{n} LS}{n} \quad \textbf{(4)}$$

Where EAr represents the level of environmental awareness for the respondent (r); i represents the environmental questions listed in the three components (i = 1… n), LS represents the scale for each environmental question (1… 5). The value of EAr categorized as "1= very low if the value of EAr < 1.5", "2= low if 1.5 ≤ EAr < 2.5", "3= medium if 2.5 ≤ EAr < 3.5", "4= high if 3.5 ≤ EAr < 4.5", "5= very high if EAr ≥ 4.5=".

An econometric model was also used to examine factors affecting people's environmental awareness. Here, environmental awareness is a categorical dependent variable ordered as very high, high, medium, low, and very low. Although an unordered multinomial model can estimate such data, a much more economical and sensible model considers this ordering. Thus, the choice of the ordinal probit model fits more critically than the multinomial model to address the level of environmental awareness (Gujarati, 2004). Therefore, the starting point is an index model with a single latent variable, y* (Equation 5).

$$y_i^* = \sum_{k=1}^{k} X_{ki}\beta_k + \varepsilon_i = z_i + \varepsilon_i \quad \textbf{(5)}$$

$$Z_i = \sum_{k=1}^{k} X_{ki}\beta_k = E(Y_i) \quad \textbf{(6)}$$

Y is collapsing a version of y*, e.g., y* can take an infinite range of values which might be five orders of Y. As y* crosses a series of increasing unknown thresholds (Cut, αi), we move up the ordering of alternatives. For example, for y*< α1, awareness is very low, for y* > α1, awareness improved to the highest level. So, the observed variable 'Y' value depends on whether it crossed a particular threshold. Since there are five potential values for Y (Cameron and Trivedi, 2005; Greene, 2003), the respondents' awareness probability is in one of the fifth levels (Equation 7).

$$P(y_i *= m) = \frac{exp^{(X_i\beta-\alpha_{m-1})}}{1+[exp^{(X_i\beta-\alpha_{m-1})}]} \quad \textbf{(7)}$$

Where m is the level of awareness, α is a particular threshold (4 cuts) in which the value of the observed variable Y, Xi is an explanatory variable that affects the level of awareness, and β is the unknown estimated parameter. Therefore, factors affecting people's environmental awareness are analyzed by the Ordinal probit model expressed as Eq. 8 using STATA software version 15.

$$EA = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + \varepsilon_i \quad \textbf{(8)}$$

$$Z_i * = \sum_{k=1}^{k} \beta_k X_{ki} = E(y_i *) \quad \textbf{(9)}$$

Where y* is the unmeasured latent variable whose values figure the observed ordinal environmental awareness, EA, Xi is an explanatory variable such as income group (I), family member (F), educational level (E), age (A), and sex (S). So, the probability of environmental awareness being in one of the five levels is computed as in Eq. 10-14.

$$P(EA = 1) = \frac{1}{1 + exp^{(Z_i-\alpha_1)}} \quad \textbf{(10)}$$

$$P(EA = 2) = \frac{1}{1+ exp^{(Z_i-\alpha_2)}} - \frac{1}{1+ exp^{(z_i-\alpha_1)}} \quad \textbf{(11)}$$

$$P(EA = 3) = \frac{1}{1+ exp^{(Z_i-\alpha_3)}} - \frac{1}{1+ exp^{(z_i-\alpha_2)}} \quad \textbf{(12)}$$

$$P(EA = 4) = \frac{1}{1+ exp^{(Z_i-\alpha_4)}} - \frac{1}{1+ exp^{(z_i-\alpha_3)}} \quad \textbf{(13)}$$

$$P(EA = 5) = 1 - \frac{1}{1 + exp^{(Z_i - \alpha_4)}} \quad \textbf{(14)}$$

Where,

EA= 1 if y*i ≤ α 1; very low level of environmental awareness

EA = 2 if α 1≤ y*i ≤ α 2; low level of environmental awareness

EA = 3 if α 2 ≤ y*i ≤ α 3; medium level of environmental awareness

EA = 4 if α 3 ≤ y*i ≤ α 4; high level of environmental awareness

EA = 5 if y*i ≥ α 4; very high level of environmental awareness

2.5 Variables Characteristic

Explanatory variables were identified and defined to assess the socio-economic and demographic factors that determine environmental awareness. As shown in Table 1, environmental awareness is an ordered categorical dependent variable. Individuals may have a very low, low, medium, high, and very high level of environmental awareness depending on socio-economic factors such as income, household size, education, age, and gender. Since a unit change in such variables might not show a variation in the level of environmental awareness, we have categorized them to see the difference among the group of respondents. Accordingly, income is a continuous categorical variable, grouped based on the personal income tax of Ethiopian tax revenue authority, which shows the family's total income in Ethiopian currency, Birr (ETB) (1USD = 38.02 ETB) per month. The household size is a continuous, categorical variable that shows the number of persons who lived together with the respondent. It was categorized into 1 to 5 household sizes, 6 to 10 household size, and over ten household sizes. Education level is the other continuous categorical variable which is measured by the attained education groups such as primary, secondary, Technical Vocational Educational and Training (TVET), and Higher education (First degree and above). The respondent's age is a continuous categorical variable that was arranged into six groups (17-29, 30-39, 40-49, 50-59, 60-69, and 70-100). Gender is the biological classification of the respondent's sex. It is a dummy variable that is assigned 1 if the respondent is male, otherwise 0 for female respondents.

Table 1: Definition of variables and expected sign

Variable	Type	Expected sign	Reference
Dependent Variable			
Environmental awareness	Ordered categorical variable 1. very low 2. low 3. Medium 4. High 5. Very high		
Explanatory variables			
Income levels	A categorical variable in Birr • 0-600 • 601-1650 • 1651-3200 • 3201-5250 • 5251-7800 • 7801-10900 • Over 10900	+ve/-ve	(Mehmetoglu, 2010) (Xu et al., 2019; Zhang et al., 2015)
Household size	A categorical variable in number • 1 to 5 • 6 to 10 • over 10	+ve/-ve	
Education levels	A categorical variable • primary • Secondary, and • TVET • Higher education	+ve/-ve	(Jorgenson and Givens, 2014; Mehmetoglu, 2010)
Age groups	A categorical variable in years • 17-29 • 30-39 • 40-49 • 50-59 • 60-69 • 70-100	+ve/-ve	(Jorgenson and Givens, 2014) (Ziadat, 2010) (Aminrad et al., 2013) (Karytsas and Theodoropoulou 2014) (Mehmetoglu, 2010)
Gender	A dummy variable • 0= Female • 1= Male	+ve /-ve	(Bhartiya, 2017) (Jorgenson and Givens, 2014)

3. Results

This section presents the environmental awareness components, socio-demographic characteristics, and order logit model results. The first three subsections explain statistical results regarding the respondents' environmental knowledge, attitude, and behavior. Then, respondents' demographic, economic characteristics, and ordered logit results are described.

3.1 Environmental Knowledge, Attitude, and Behaviour

Five Likert scales were applied to assess the level of people's environmental awareness. The first step undertaken was checking the reliability of questions using Cronbach's alpha test. Among the first 87 environmental questions, 46 questions were found to be reliable; hence, passed the test of Cronbach's $\alpha > 0.7$ and the item test correlation was found to be over 0.3. The high reliable index is evidence that the instrument is free from measurement error (Fishbein and Ajzen, 1975).

Table 2 shows respondents' answers to questions about environmental know led rated on a five-point scale. The questions focused on the concepts, causes, sources, and effects of pollution, degradation, and conservation. Accordingly, 45.7% of the respondents have lower knowledge about water shade management, while 46.8% and 37.2% of the respondents have medium knowledge about air pollution and natural resource conservation respectively. The majority of them have higher knowledge about the causes of groundwater pollution (53%), river and stream pollution (55%), solid waste (53%), and forest degradation (57%). Indeed, their knowledge on the effect of groundwater pollution (75%), river and stream pollution (72%), air pollution (65%), solid waste (70%), and forest degradation (57%) are also higher.

Table 2: Respondents' environmental knowledge in terms of percent and mean

Environmental items, n = 293, (%) Your knowledge about	Very less (1)	Less (2)	Medium (3)	Much (4)	Very much (5)	Mean (S.D)	Item test corr.	Alpha
groundwater pollution	14.3	5.8	35.8	6.8	37.2	3.47 (1.41)	0.71	0.95
river and stream pollution	13.3	7.2	32.1	11.6	35.8	3.5 (1.38)	0.74	0.95
air pollution	17.1	0.0	46.8	8.5	27.7	3.297 (1.34)	0.75	0.95
solid waste pollution	10.2	5.1	35.5	9.9	39.3	3.63 (1.32)	0.70	0.95
forest degradation	12.3	6.5	33.1	8.5	39.6	3.57 (1.38)	0.68	0.95
water shade management	36.5	9.2	33. 5	4. 8	16.0	2.546 (1.43)	0.57	0.96
natural resource conservation	28.3	5.5	37.2	8.5	20.5	2.87 (1.44)	0.60	0.95
the cause of groundwater pollution	11.3	6.1	29.7	14	38.9	3.631 (1.35)	0.77	0.95
the cause of river and stream pollution	9. 6	6.1	29.4	12.3	42.7	3.72 (1.33)	0.77	0.95
the cause of air pollution	16.4	8.5	32.4	9.9	32.8	3.34 (1.43)	0.78	0.95
the cause of solid waste	11.3	7.9	28	16.7	36.2	3.59 (1.34)	0.77	0.95
the cause of forest degradation	10.9	5.8	25.9	13.7	43.7	3.73 (1.36)	0.71	0.95
the source of groundwater pollution	18.8	8.9	30.7	12.3	29.4	3.25 (1.44)	0.73	0.95
the source of river and stream pollution	16.0	8.2	29.7	15.0	31.1	3.37 (1.41)	0.72	0.95
the source of air pollution	23.2	9.9	31.4	9. 6	25.9	3.05 (1.47)	0.74	0.95
the sources of solid waste	17.1	7.5	34.4	10.6	30.4	3.30 (1.41)	0.73	0.95
the source of forest degradation	17.1	6.1	27	11.6	38.2	3.48 (1.47)	0.71	0.95
the effect of groundwater pollution	7.2	2.7	14.7	7.5	67.9	4.26 (1.23)	0.65	0.95
the effect of river and stream pollution	7.2	3.1	17.4	9.2	63.1	4.18 (1.24)	0.64	0.95
the effect of air pollution	12	4.4	18.8	8.5	56.3	3.93 (1.42)	0.66	0.93
the effect of solid waste	8.19	3.1	18.4	10.9	59.4	4.10 (1.28)	0.66	0.95
the effect of forest degradation	6.5	2.1	15.0	8.5	67.9	4.29 (1.19)	0.65	0.95
Mean (unstandardized items)							0.47	0.95

Table 3 shows respondents' feeling on environmental issues. The questions focused on their attitude about energy use, deforestation, planting trees, and GHG. Accordingly, respondents have strongly agreed on the negative contribution of charcoal (42%), fuelwood (47%), fossil fuel (38%), burning waste (42%), and deforestation (56%) on GHG emission. Moreover, they have agreed on the contribution of planting a tree to reduce CO_2 (59%), disposing waste into a river that harms living organisms (75%), and the effect of deforestation on rainfall distortion (68%), wild life (74%), and soil degradation (74%). In contrast, the respondents have disagreed on the contribution of solar energy to reduce environmental pollution (41%), the cause of acid rain (43%), and the effect of accumulated GHG (51%).

Table 3: Respondents' environmental attitude (feelings)

Environmental items, n= 293	Str. disagree (1)	Disagree (2)	Medium (3)	Agree (4)	Str. agree (5)	Mean (S.D)	Item-test corr.	Alpha
Solar energy contributes the least to environmental pollution	35.5	5.8	22.9	5.5	30.4	2.89 (1.66)	0.6	0.91
Burning charcoal increases GHG in the atmosphere	29.0	7.5	21.2	10.6	31.7	3.09 (1.62)	0.66	0.91
Burning fuel wood increase the GHG in the atmosphere	22.5	8.5	21.2	10.9	36.9	3.31 (1.58)	0.78	0.91
Burning fossil fuel increases GHG in the atmosphere	28	6.1	25.9	7.5	32.4	3.10 (1.6)	0.75	0.91
Burning household waste increase GHG in the atmosphere	26.6	7.2	24.2	7.5	34.5	3.16 (1.60)	0.67	0.91
Deforestation increases the amount of CO_2 in the atmosphere	17.1	5.8	20.8	10.2	46	3.63 (1.52)	0.73	0.91
Planting trees decrease the amount of CO_2 in the atmosphere	15.4	7.5	17.8	10.6	48.8	3.70 (1.51)	0.67	0.91
Waste thrown into the river kills fish and other living organisms	10.2	2.4	12	6.5	68.9	4.22 (1.34)	0.56	0.91
Accumulation of GHG in the atmosphere increases acidic rain	45.1	5.5	15	4.4	30	2.69 (1.74)	0.65	0.91
Deforestation cause rainfall distortion	10.6	6.5	15	11.3	56.7	3.97 (1.39)	0.69	0.91
Deforestation affects the wildlife habitat and food	7.9	4.1	14	9.9	64.2	4.18 (1.27)	0.70	0.91
Deforestation cause soil degradation	7.9	4. 8	13	9.2	65.2	4.19 (1.28)	0.7	0.91
Cutting trees lead to CO_2 accumulation in the atmosphere	29.0	6.5	18.1	6.8	39.6	3.22 (1.69)	0.58	0.92
CO_2 accumulation cause global warming	37.5	4.1	25.9	4.4	28	2.81 (1.64)	0.77	0.91
Acidic rain can be caused by atmospheric pollution	38.6	4.4	23. 9	4.1	29	2.81 (1.66)	0.72	0.91
Mean (unstandardized items)							0.43	0.92

Table 4 shows behavioral questions that focus on respondents' intention to reduce the use of glass bottles, plastic bottles, cans, fossil fuels, and transportation services, which is likely to affect the environment. Accordingly, respondents have lower intention to reduce the use of bicycles (70%), taxis (68%), and private cars (74%) which is likely to increase the per capita GHG emission. Yet, most respondents show high intention to reduce the use of plastic bottles (38%), cans (56%), fossil fuels (68%), cylinder gas (76%), and fuelwood (64%).

Table 4: Respondents' environmental behaviour

Environmental items, n= 293 **Your intention to**	**Very less (1)**	**Less (2)**	**Medium (3)**	**Much (4)**	**Very much (5)**	**Mean (S.D)**	**Item test corr.**	**Alpha**
reduce the use of glass bottles	31.7	18.1	15.5	44.7	0	2.63 (1.33)	0.62	0.85
reduce the use of plastic bottles	25.6	10.2	26.3	4.4	33. 5	3.1 (1.58)	0.62	0.85
reduce the use of metal bottles	22.2	6.1	16.7	7.9	47.1	3.52 (1.63)	0.71	0.84
reduce the use of naphtha	15.0	7.2	9.2	1.4	67.2	3.99 (1.55)	0.68	0.85
reduce the use of cylinder gas	15.7	3.4	4. 8	0	76.1	4.17 (1.53)	0.76	0.84
reduce the use of fuelwood	15.7	7.2	13.7	5.5	58	3.83 (1.55)	0.7	0.84
the use of a bicycle to travel	21.2	2.7	5.8	6.1	64.2	3.89 (1.65)	0.64	0.85
the use a contractual taxi to travel	19.1	2.1	10.2	7.2	61.4	3.9 (1.59)	0.76	0.84
use a private car to travel	18.4	1.7	5.5	0.7	73.7	4.1 (1.59)	0.71	0.84
Mean (unstandardized items)							0.41	0.86

Table 5 summarizes respondents' level of knowledge, attitude, and behaviour about the listed environmental issues. According to the score, 57% have higher knowledge, 32% have medium and 12% of the respondents reflected lower knowledge. Likewise, the environmental attitude of respondents is expressed in terms of very low (5%), low (13%), medium (31%), high (29%), and very high (21%). In addition, the environmental behavior of the respondents is also classified as very low (8%), low (7%), medium (18%), high (37%), and very high (31%). To sum up, the descriptive result shows us most of the respondents have higher level of environmental knowledge, attitude, and behaviour. But it does not to mean that most of them have high level of environmental awareness since it is the combination of the three components. For instance, for a respondent to be considered to have higher environmental awareness, the scored average value of the three components should be greater than medium values.

Table 5: The proportion and mean value of environmental knowledge, attitude and behavior

Environmental components n=293 (in %)	Very low	Low	Medium	High	Very high
knowledge	2.05	9.56	31.74	36.86	19.8
Attitude	5.12	13.31	31.4	29.35	20.82
Behaviour	7.51	6.83	18.43	36.52	30.72

3.2 Respondents' Characteristics and Environmental Awareness

The descriptive result in Table 6 shows the variation in the level of environmental awareness. There are variations among the income groups, household size, educational level, age groups, gender, and districts. The Chi-square value shows that awareness varies significantly among income groups, education, age, and the gender of respondents. Nevertheless, the levels of environmental awareness do not show substantial variation within the family member and among districts.

Table 6: Socio-economic characteristics and environmental awareness of the respondents

Variables	Category	Environmental awareness level (%)					Total (n)	χ^2	Pr.
		V. low	Low	Medium	High	V. high			
Income group n=264	0-600	0.0	8.7	34.8	43.5	13.0	23	49.22	0.002
	601-1650	0.0	8.9	48.9	42.2	0.0	45		
	1651-3200	1.4	19.2	31.5	31.5	16.4	73		
	3201-5250	0.0	6.5	30.6	53.2	9.7	62		
	5251-7800	0.0	0.0	19.0	61.9	19.0	21		
	7801-10900	0.0	5.9	11.8	64.7	17.6	17		
	over 10900	0.0	0.0	8.7	56.5	34.8	23		
Family member n=293	1 to 5	1.1	9.4	32.8	42.2	14.4	180	10.58	0.210
	6 to 10	0	10	10	40	40	10		
	> 10	0.9	8.7	32.0	50.5	7.8	103		
Education n=293	Primary	1.9	14.0	37.4	40.2	6.5	107	36.25	0.000
	Secondary	1.4	11.6	39.1	42.0	5.8	69		
	TVET	0.0	4.8	22.2	55.6	17.5	63		
	Higher Edu.	0.0	1.9	22.2	46.3	29.6	54		
Age group n=280	17-29	0.0	4.5	28.4	43.3	23.9	67	31.06	0.054
	30-39	1.5	12.1	27.3	45.5	13.6	66		
	40-49	2.1	4.2	27.1	52.1	14.6	48		
	50-59	0.0	9.5	38.1	50.0	2.4	42		
	60-69	3.0	21.2	21.2	45.5	9.1	33		
	70-100	0.0	4.2	54.2	33.3	8.3	24		
Gender n=293	Male	0.0	5.4	24.7	49.5	20.4	93	12.12	0.016
	Female	1.5	11.0	35.0	43.0	9.5	200		
District n=293	District 3	1.1	6.8	29.5	44.3	18.2	88	10.02	0.264
	District 6	2.0	14.0	34.0	41.0	9.0	100		
	District 8	0.0	6.7	31.4	49.5	12.4	105		

The level of environmental awareness differs across income groups at $p < 0.01$. In all income groups high level of environmental awareness is the dominant, except the income group 601-1650. It is high and very high for 91% of respondents in the highest income group, while the remaining 8.7% have a medium level of awareness. Environmental awareness varies among educational groups at $p < 0.001$. Most TVET (55.6%) and higher education (29.6) score a high and very high level of awareness, respectively.

In contrast, the secondary academic level has a medium level of awareness (33%) compared to others. The primary education level has very low (1.9%) and low (14%) environmental awareness. It suggests that as the educational level increases, the level of environmental awareness shows improvement.

The levels of environmental awareness also vary within the respondents' age group at $p < 0.1$. The level of awareness is highest with the age group of 40-49, while it is the lowest for 17-29, 50-59, and 70-100 years old. Gender variation also shows a difference in the level of environmental awareness. Most male (50%) and female (43%) respondents have a high level of environmental awareness, while 24.7% of males and 35% of females have medium awareness. The number of male respondents with a high and very high level of environmental awareness is greater than female respondents.

3.3 Variation in the Level of Environmental Awareness

Table 7 shows the model fitness by Chi-square result, at $P<0.0001$ level of significance. It means the model has at least one explanatory variable which affects environmental awareness. The post estimation values such as Heteroskedasticity, omitted variables, and Multicollinearity reveal that the results are free from bias. The result shows variation in the level of environmental awareness within the income group, education level, and age group.

The respondents' environmental awareness level significantly varies within the income groups 0-600, 601-1650, 1651- 3200, and 3201-5250 as compared to the base, over 10900, which will be discussed in the marginal effect section. Similarly, levels of environmental awareness for respondents within TVET and first degree and above education levels significantly vary as compared to the base, secondary education. Moreover, the levels of environmental

awareness significantly vary within 50-59 and 60-69 years old as compared to the base, 17-29 years old.

Table 7: Determinants of the level of environmental awareness

The number of obs. = 252		LR chi2(17) =52.31		
		Prob. > chi^2 = 0.000		
Log likelihood = -284.21894		Pseudo R^2 = 0.0843		
Variables	**Coef.**	**Std. Err.**	**z**	**P>z**
Income group (ETB)				
0-600	-0.75328	0.381765	-1.97	**0.048**
601-1650	-1.21703	0.332743	-3.66	**0.000**
1651-3200	-1.0261	0.313493	-3.27	**0.001**
3201-5250	-0.86187	0.311043	-2.77	**0.006**
5251-7800	-0.50899	0.367378	-1.39	0.166
7801-10900	-0.59157	0.393753	-1.5	0.133
Family member (No.)				
6 to 10	0.242077	0.395909	0.61	0.541
Above 10	-0.04482	0.150611	-0.3	0.766
Educational Level				
Primary	0.230337	0.194481	1.18	0.236
TVET/College Diploma	0.588087	0.214887	2.74	**0.006**
First degree and above	0.489567	0.230648	2.12	**0.034**
Age group (Years)				
30-39	-0.38263	0.205987	-1.86	0.063
40-49	-0.14331	0.22975	-0.62	0.533
50-59	-0.54445	0.238923	-2.28	**0.023**
60-69	-0.54285	0.267771	-2.03	**0.043**
70-100	-0.35869	0.306406	-1.17	0.242
Sex				
Male	0.18405	0.1601	1.15	0.25
/cut1	-4.06703	0.563799		
/cut2	-2.62726	0.451448		
/cut3	-1.49643	0.439673		
/cut4	0.056353	0.430167		

Since the parallel regression assumptions were met (Annex Table 1), the marginal effect of the predicted value is described keeping other variables constant (Table 8). The results are interpreted compared with the base categorical variables. Accordingly, the base category for income is over 10900, household size is 1 to 5, education is secondary level, and age group is 17 to 29 years old. For the income 601 to 1650, the probability of respondents at low and a medium level of environmental awareness increases by 13% and 25%, respectively. Also, the probability of a very high level of environmental awareness decreases by 30% as compared to the base income group. Similarly, the probability of respondents in low and medium levels of environmental awareness increases by 9% and 21%, respectively, for the income group of 1651 to 3200. At the same time the probability of respondents in a very high level of environmental awareness decreases by 27%. The corresponding likelihood of low and medium levels of environmental awareness increases by 7% and 18%, while the probability of very high levels of environmental awareness decreases by 24%, for the income group of 3201 to 5250.

The marginal effect of TVET education shows that the odds of respondents being in low and medium levels of environmental awareness decreases by 8% and 12% as compared to the base, secondary education level. However, the chance of being in high and very high levels of environmental awareness increased by 9% and 11% respectively. Similarly, the probability of low and medium levels of environmental awareness declines by 7% and 10% for those who completed their first degree and above, while the odds of the high level of environmental awareness increases by 8%.

The marginal effect proves that age groups of respondents determine the level of environmental awareness. Being in 50-59 years old, the corresponding probability of low and medium levels of environmental awareness increases by 8% and 11%, whereas, the chance of very high levels of environmental awareness declines by 11% as compared to 17 to 29 years old respondents. For 60-69 years old respondents, the odds of medium and very high levels of environmental awareness increases and decreases by 11%.

Table 8: Marginal fixed effect for the levels of environmental awareness

Variables	1	2	3	4	5
Income group					
0-600	0.002(0.76)	0.054 (1.66)	**0.156*(2.05)**	0.007 (0.14)	-0.219(-1.92)
601-1650	0.008 (0.99)	**0.128***(3.31)**	**0.246***(3.97)**	-0.086 (-1.44)	**-0.296**(-2.97)**
1651-3200	0.005(1.00)	**0.093***(3.45**	**0.213***(3.54**	-0.041(-0.83	**-0.269**(-2.68**
3201-5250	0.003(0.89)	**0.068**(2.73)**	**0.179**(3.08)**	-0.009(-0.19)	**-0.241*(-2.40)**
5251-7800	0.001(0.66)	0.029(1.22)	0.101(1.42)	0.029(0.67)	-0.16(-1.37)
7801-10900	0.001(0.64)	0.036(1.18)	0.12(1.5)	0.024(0.5)	-0.181(-1.53)
Household size					
6 to 10	-0.002(-0.66)	-0.030(-0.70)	-0.048(-0.60)	0.027(0.86)	0.053(0.56)
Above 10	0.001(0.28)	0.006 (0.3)	0.008 (0.3)	-0.007(-0.29)	-0.009(-0.30)
Education level					
Primary	-0.003(-0.82)	-0.039(-1.15)	-0.041(-1.21)	0.047(1.17)	0.037(1.19)
TVET	-0.006(-1.03)	**-0.083*(-2.55)**	**-0.116**(-2.63)**	**0.091*(2.5)**	**0.114*(2.55)**
First degree and above	-0.006(-1.01)	**-0.073*(-2.11)**	**-0.095*(-1.97)**	**0.083*(2.11)**	0.090 (1.95)
Age group					
30-39	0.003(0.91)	0.048(1.79)	0.079(1.83)	-0.047(-1.70)	-0.082(-1.81)
40-49	0.001(0.52)	0.015 (0.61)	0.030(0.62)	-0.012(-0.58)	-0.034(-0.63)
50-59	0.005(0.95)	**0.075*(2.05)**	**0.107*(2.28)**	-0.079(-1.94)	**-0.108*(-2.28)**
60-69	0.005(0.9)	0.074(1.76)	**0.107*(2.09)**	-0.079(-1.64)	**-0.108*(-2.12)**
70-100	0.003(0.68)	0.044(1.03)	0.074(1.2)	-0.043(-0.92)	-0.078(-1.25)
Sex					
Male	0.002(0.81)	0.026(1.13)	0.034(1.15)	-0.027(-1.14)	-0.036(-1.15)

t-statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

4. Discussions

There is high knowledge about river deterioration, air pollution, and forest degradation in Addis Ababa. River pollution is common in most developing countries (Capps et al., 2016). Poor sewerage and inadequate infrastructure could aggravate the river and stream pollution (Colombani et al., 2018; Liu et al., 2015). Similarly, the quality of air and tree cover has reduced following the expansion of industries (Ejaz et al., 2010; Li and Lin, 2015), urbanization (Gasimli et al.,

2019; Kleppel, 2002; Li and Lin, 2015), and the population (Li and Lin, 2015). Besides, the respondents have strong feelings on the negative contribution of waste disposal and deforestation to wildlife disturbance and soil erosion.

There is an agreement on the effect of wastes on the environment. The feeling of the influence of deforestation on wildlife and soil erosion is also high. Nevertheless, respondents have a medium feeling on the cause of acidic rain. There is high and medium intention to reduce the consumption of cylinder gas and glass bottles respectively. It means environmental knowledge, attitude, and behavior vary between respondents because of heterogeneity in their socio-economic status.

Descriptive and ordered logit result shows variation in the level of environmental awareness within the income groups (Duroy, 2005; Ito and Kawazoe, 2017; Strieder et al., 2017). This finding is in line with Xun et al. (2017), Strieder Philippsen et al. (2017) and Altin et al. (2014), yet against Üstün and Celep (2007). This means, the higher the income, the more access to knowledge, attitude change, and behavioral improvement. Thus, higher income led to a high level of environmentally friendly actions (Xu et al., 2019; Zhang et al., 2015) and is likely to push to demand a better residential environment (White et al., 2007).

Respondents between the ages of 17-29 years old have a high and very high level of environmental awareness. The marginal effect shows a lower chance of high and very high levels of environmental awareness for the age greater or equal to 50 years old which is against Ziadat (2010) who investigated the high level of awareness for older ages. While the finding of this study is in line with Aminrad et al. (2013) and Karytsas and Theodoropoulou (2014) who explored young people to have better environmental awareness than the elderly ones. The reasons are as follows: first, they have had better access to information on the environmental damage in Addis Ababa for the last thirty years; second, they passed through the revised educational curriculum, which incorporates environmental items. Third, they are more popular with climate change and global warming in the last thirty years.

Education could influence the level of environmental awareness (Aminrad et al., 2011; Preston et al., 2000), which is against Üstün and Celep (2007) who found no evidence for the variation between lower education and university level. Peoples at higher educational levels have better environmental awareness levels. The finding of the present study agrees with Karytsas and

Theodoropoulou (2014) who found that being at higher education level positively influences their environmental knowledge. Similarly, education reduces the low and medium levels of environmental awareness and enhances the high and very high levels of awareness which is in line with Strieder Philippsen et al. (2017), Altin et al. (2014), Ziadat (2010), and Duroy (2005).

5. Conclusions

This article provides an insight into the measurement of environmental awareness through environmental knowledge, attitude, and behavior. Besides, to investigate factors that affect environmental awareness, the researchers used an ordered logit model. The questionnaire survey data was applied to conduct this study in Addis Ababa, Ethiopia.

From the empirical analysis, several interesting findings have been identified. First, the results of descriptive statistics show that there is a knowledge gap in watershed management, natural resource conservation, and air pollution. Besides, there are also sentiment gaps regards the cause of acid rain and global warming. Indeed, there is a lack of intention to reduce the use of bicycles, taxis, and private cars. This implies that there could possibly be high per capita GHG emissions in the future following population growth and income expansion. So, it would be crucial to manage people's behaviour at the infant stage. Thus, awareness creation training about the environmental and economic benefits of using public transport is substantial. Side by side, public transport agencies should plan and implement better transport services to attract residents. Furthermore, private companies should supply vehicles that consume nonrenewable energy. Considering the per capita GHG emission, people intend to reduce the use of nonrenewable energy for cooking and heating is an opportunity to reduce GHG by enhancing the supply of renewable energy.

Second, people's environmental awareness varies with income level, age group, and education level. Hence, most of the residents in Addis Ababa are low-income groups and employed as daily labor; improving the livelihood will improve the level of environmental awareness. Having a better income can influence their environmental mindset. In this regard, it is better to provide environmentally friendly income-generating activities for the urban low-income groups.

The respondents' age group also affects the level of environmental awareness. Young people have a better awareness than the elderly people. It might be associated with their information access and use of technologies. Hence, it will be better to use religious and informal institutions to address the environmental awareness of elderly people. Likewise, education was found to influence the level of environmental awareness. The higher the education, the better their environmental knowledge, attitude, and behaviour would be. In this respect, adult education, short-term training, and workshops are alternative options besides the formal education system to enhance environmental awareness.

This article has some limitations. First, using only quantitative analysis is one curb because environmental issues are not only expressed in verbal approaches of belief, feelings, and intention but also nonverbally reacted as a perceptual and physiological response. So, future research may benefit from a mixed approach. Second, the study area was delimited to in Addis Ababa. Hence, to get a better image, it would be more pragmatic to include regional towns. Therefore, it would be sound for future work to use an in-depth interview and ethnographic study.

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Annex Table 1: Tests of the parallel regression assumption

Tests	Chi2	df	P>Chi2
Wolfe Gould	11.19	15	0.739
Brant	-5638	15	1.000
score	10.66	15	0.777
likelihood ratio	11.63	15	0.707
Wald	9.946	15	0.823

Tax Revenue Potential and Effort in Ethiopia: Evidence from Stochastic Frontier Analysis

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Abstract

This study aims to estimate the actual tax effort and tax revenue potential of the country, measuring the gap between realized performance and the stochastic tax frontier, as well as between income and consumption using utility maximization function. The results from the stochastic tax frontier model have been compared with the utility maximization function as a robustness check. Very close values for tax effort, tax potential, and tax gap are recorded under each model. The estimated tax potential, effort, and gap from the two methods are found to be 22.89 percent, 23.69 percent, 36 percent, 34 percent 14.37 percent, and 15.58 percent, respectively. The empirical results revealed that Ethiopia is characterized by a huge tax gap and low tax effort, mainly resulting from the country's policy choice and enforcement mechanisms.

Key words: tax potential; tax effort; utility maximization; stochastic frontier; inefficiency
JEL Classification: H21, H25, H26

1. Introduction

Multilateral and bilateral donor organizations have increasingly acknowledged the importance of taxation in guaranteeing sustainability and ownership, particularly, in the development process (Mascagni & Mengistu, 2016). Countries have undertaken various reforms by prioritizing this issue: for example, African governments and pan-African institutions have undertaken several significant

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reforms in the last decade, elevating taxation to a higher priority on the policy agenda; the African Tax Administration Forum, established in 2008 (Mascagni & Mengistu, 2016). Tax revenue mobilization has piqued the curiosity of many experts, notably in the fields of economics and political science (Fjeldstad, 2013; Fjeldstad & Brun, 2014). The essential question here is why, after decades of living in the shadows of other, ostensibly more serious issues, taxation has recently (re-)established itself as a priority issue in the international debate? Mascagni (2016) raised five broad issues in his policy development study to help answer this question: the potential benefits of taxation on state-building; long-term independence from foreign assistance and the shifting aid paradigm; trade liberalization; the increased prominence of fiscal issues in the West due to the financial and debt crisis; and developing countries continued acute financial needs.

Given the aforementioned initiatives, developing countries urgently require additional financial resources to address important development challenges such as poverty, malnutrition, natural disaster vulnerability, and disease prevention. Developing countries raise significantly less revenue than advanced economies, as evidenced by tax to GDP ratios ranging from 10% to 20%; whereas, OECD economies range from 30% to 40%, indicating a significant tax gap that must be filled from the enormous tax potential in these countries, of which Ethiopia is a member (Mascagni & Mengistu, 2016; Richardson, 2006; Torgler & Schneider, 2009). This pattern suggests that more work remains to be done to increase tax revenue mobilization in low-income and Sub-Saharan African (SSA) countries (Addison & Levin, n.d.; Agbeyegbe et al., 2006; Fjeldstad & Brun, 2014; Moore, 2013). To boost their revenue mobilization, low-income countries (LICs) must increase their tax-to-GDP ratios by roughly 2-4 percentage points, substantiating requirements for poverty alleviation and infrastructure improvement.

A growing body of theoretical and empirical work suggests that developing countries' revenue-raising challenges are two-fold: first, they typically have a low taxable capacity (a small tax base) and a significant share of economic activity in the informal (40-60 percent) and difficult-to-tax sectors, and second, their tax regimes may be littered with a slew of tax relief measures. IMF (2018) goes on to say that weak administration, informality, taxing mobile capital, high compliance costs, a lack of data, bad governance and corruption, and methodological flaws limit estimates of tax revenue losses from evasion and

avoidance in developing countries. Furthermore, these countries use excessive incentives to entice investment, and they suffer from profit shifting through transfer pricing, a lack of integrated tax structures in terms of horizontal and vertical tax equality, and political and economic instability.

In line with the developmental state model, Ethiopia's government established the Growth and Transformation Plan (GTP I, 2010-2015) and significantly increased its infrastructure development activities. As a result, income mobilization through taxes is thought to be the most realistic and practicable method of financing Ethiopia's development. The GTP I had expected a nominal growth in tax collection of roughly 25 percent per year by 2015, resulting in a tax-to-GDP ratio of 15 percent. However, according to World Bank data, Ethiopia's tax share was around 9 percent of GDP at the start of the GTP I, which is an ambitious goal. This trend has been supported by empirical studies, out of 85 countries analysed in a cross-country study by Langford and Oldenburg (2015), Ethiopia was found to have the worst performance, with a tax-to-GDP ratio of 8.6 percent. Apart from revenue deficits, the country's tax-to-GDP ratio remains below 15 percent, which is considered a good benchmark for ensuring government operation (Mascagni, 2016b). Ethiopia's national bank (NBE) announced a tax-to-GDP ratio of 11.55 percent for the 2018/2019 fiscal year, down from an average of 11.70 percent for the previous two decades (Mascagni, 2016b). Moreover, despite many tax reforms since 2002, literature suggests serious and impartial research by highly skilled experts and institutions to address why Ethiopia's tax to GDP ratio has been substantially lower than the Sub-Saharan African average of 15 percent for the past two decades (Mascagni & Mengistu, 2016).

The focus of prior studies in the country was on tax compliance of regional taxpayers and corporations, which is inconclusive to the nation. To his knowledge, the researcher has never come across a single study on the current tax potential and effort of the country. To fill this gap, the study aims to estimate the actual tax effort and tax potential of the country, measuring the gap between realized performance and the stochastic tax frontier, as well as between income and consumption using utility maximization function for robustness checks. The major aim of this research, from a tax policy standpoint, is to provide a quantitative indication of the country's potential for greater domestic revenue mobilization.

The rest of the article is organized as follows: Section 2 presents the review of related literature; section 3 specifies research methodology and data; section 4 presents results and discussions, and section 5 concludes the article.

2. Theoretical Reviews

In the economics literature concentrating on public finance and taxation, many taxation models have been highlighted as the subject of discussion. Until recently, the allocation theory of taxation, the theory of public expenditure, normative tax theory, and the distributional theory of taxation are some of the most important ones. Tax allocational theory has been analysing welfare losses induced by tax distortions since the beginning of public sector economics. Many-person economies have seen the most substantial progress in understanding the trade-offs between equality and efficiency. As a result, tax and government spending theories are becoming increasingly interwoven (Tresch, 2014, 2015; Alan et al., 2013).

Logically, public expenditure theory which defines the legitimate areas of public concern as well as the permissible forms that policy may take, should come before theory of taxation. Moreover, public expenditure theory often contains its own theory of taxation in the sense that the expenditure decision rules define a set of taxes and transfers necessary to guide the market system to an optimum. In these instances, taxes contribute to the pursuit of efficiency and equity. Public expenditure theory addresses two fundamental questions: in what area of economic activity can the government legitimately become involved and what decision rules should the government follow in each area? Taxation theory becomes relevant in and of itself only when the expenditure decision criteria signal the need for certain government expenditures without also articulating how those expenditures will be funded. When this occurs, the same criteria that drive the analysis of public expenditures also regulate the collection of tax income. Taxes should advance the microeconomic goals of allocational efficiency and distributional equality in society (Tresch, 2015).

According to the classic theory of optimum taxation, a tax system should be chosen to maximize a social welfare function within a set of restrictions. The social planner is often treated as a utilitarian in the literature on optimal taxation: that is, the social welfare function is based on the individual utility of society members (Ramsey, 1927; Besley & Persson, 2013). However, there is a natural

conflict between tax policy and the goal of allocational efficiency. Most taxes cause market distortions by requiring producers and demanders to compete on different pricing. These distortions cause resource misallocation, resulting in allocational inefficiencies. Of course, resource misallocation is undesirable, but it is an unavoidable consequence of raising tax collections. For any given amount of money to be collected, one goal of normative tax theory is to design taxes that minimize these distortions. Alternatively, if the government relies on one of two or three types of taxes to produce money, normative tax theory should determine which of these taxes causes the least degree of inefficiency. The guiding premise in both the allocational theory of taxation and the allocational theory of public expenditure is Pareto optimality. According to the Pareto criterion, the government should collect a certain amount of money such that it would not be able to generate the same amount of revenue with an alternative set of taxes that would improve the welfare of at least one consumer without lowering the welfare of any other consumer. If such Pareto improvements are not achievable, then, tax policy satisfies the Pareto requirement of allocational efficiency, even if it causes inefficiencies in comparison to a no-tax condition. In the context of a finite set of different groups, Pareto efficient tax structures maximize the utility of one individual (group) given the utility of others and given the budget balance and informational constraints on the government (Stieglitz, 2018; Dagobert, 1990).

Apart from a natural conflict between tax policy and the goal of allocational efficiency, the other inescapable effect of taxes is that they lower the purchasing power of taxpayers, forcing them to participate in the government's redistribution program. Naturally, the government wants its taxes to help society achieve its distributional goals, but there are two obstacles. The first is that the redistribution theory of taxation suffers from all of re-distributional theory's indeterminacies in general. While public sector economists usually agree on normative tax policy in terms of society's allocational aims, there is significant disagreement about what constitutes appropriate tax policy in terms of distribution. The second issue is the trade-off that exists in taxation between equity and efficiency. In general, higher tax rates on the rich are required to achieve greater redistribution, but higher tax rates tend to increase inefficiency. Furthermore, taxing a certain product may be desirable in terms of societal distributional aims but highly undesirable in terms of efficiency, or vice versa. Understanding the nature of these kinds of equity–efficiency trade-offs has

always been one of normative tax theory's main goals (Pedone, 2009; Tresch, 2015).

The expanding specialization and refinement of theoretical and empirical research of numerous areas of taxation economics, as well as continual changes in an increasingly complex economic and social reality, make communication between tax theorists and tax practitioners challenging. Furthermore, analytical models and econometric estimations, like other fields of theoretical and applied economic study, produce ambiguous findings and mixed results; whereas, tax practitioners want unequivocal and realistic propositions (Pedone, 2009; Ramsey, 1927; Tresch, 2015).

The level and optimal structure of tax rates is the subject of taxation theory, given that tax bases are clearly defined, accurately measured, and easily and uniformly assessable. In actuality, the impacts produced in terms of efficiency, equality, and other major economic variables are nearly always different from the effects anticipated based on the theoretical model when shifting from theoretical models to the concrete application of any kind of taxation regarded optimal. The bigger the difference between theoretical and practical consequences, the more those particular constraints vary and are subject to change from how they are described in the theoretical model (Pedone, 2009). These constraints have been grouped into five namely: the prevailing social and economic structure, the degree of international integration, institutional set-ups, how the tax administration is organized, and the attitudes and behaviours of taxpayers. Depending on the availability of data and experiences to draw on, their relative importance in different circumstances, and the way they interact, these constraints may be approximated by a set of indicators that are more or less representative. However, these constraints are often ignored or inadequately considered in many current studies, which assume the existence of well-defined and consistent, and uniformly measurable and assessable tax bases, thus, focusing research efforts on optimal tax-rate schedules. As a result, tax-related studies and proposals that ignore these aspects and rely entirely on data drawn from necessarily aggregated and simplified theoretical models can be deceptive (Pedone, 2009; Tresch, 2018).

In general, the difference between tax theory and practice could be traced back to variances in ideal taxation (tax design), legally imposed taxation (tax law), the effective impact of taxation (tax impact), the effective incidence of taxation (tax incidence), and perceived taxation (tax perception). It is possible to

obtain an understanding of the extent to which theoretical indications and pragmatic applications of a certain system of taxation coincide or diverge by identifying the challenges highlighted by each of these phases and the relationships between them. It's also possible to compare the effects predicted by the theoretical model with those observed in a particular country's economic and institutional structure over time.

The concept of tax effort is subjective and difficult to quantify because it is not directly observable. The most frequently accepted trend in the literature is the ratio of a country's real tax income to its potential tax revenue or tax capacity. A jurisdiction's tax capacity refers to the amount of tax revenue that a government can collect by fully utilizing and properly managing its regulatory power over the taxes within its jurisdiction (legal tax capacity). As a result, the denominator measurement's quality will decide how accurate the tax effort indicator is (or tax capacity). However, the most popular strategy is to use an economic approach, which predicts a country's maximum tax revenue based on its economic, social, institutional, and demographic characteristics (economic tax capacity). Thus, the econometric method has become the most popular for empirical investigations of tax capacity. This is a method for assessing tax capacity that relies on regressions of reported tax income against objective, non-manipulable parameters that serve as proxies for tax bases (Brun & Diakite, 2016; Langford, 2015; Zárate-marco & Vallés-giménez, 2019).

This study is led by the idea that a country's revenue capacity is validly dependent on two sets of factors: economic and institutional, based on the aforementioned taxation theories (Brun & Diakite, 2016; Alamirew et al., 2020; Mebratu & Fentaw, 2020; Castro & Ramírez, 2014; Langford, 2015). GDP per capita, shares of hard to tax sectors/ productive specialisation or structural (manufacturing and service value added, all scaled by GDP), trade openness/ trade volume, and external debt are among economic factors. Corruption level is included to account for country’s institutional setting. It is through these factors that one can assure the validity of both supply and demand side factors which could affect the tax potential and effort of a country (Langford & Ohlenburg, 2015; Alamirew et al., 2020).

The dependent variable is the tax ratio computed as tax revenue as Percent of GDP or simply tax-to GDP ratio. As a proxy for development, GDP per capita is one of the variables that are most commonly used in the tax effort literature. Because of higher ability to pay in a society with higher income, one

would expect a positive relationship between GDP per capital and revenue collection (Cyan, Martinez-Vazquez & Vulovic, 2016). As a higher level of income typically correlates with a greater demand for public goods and services, and higher income increases the overall ability to pay in a society, one should expect higher tax payment and collection (Bahl, 1971; Fox *et al*., 2005). Richer countries tend to collect more revenues, and similarly, countries tend to collect more revenues as they become more affluent, as a country expands the level of development, the formal sector of the economy increases in relative terms (Le, Moreno-Dodson & Rojchaichaninthorn, 2008).

Tax potential might also depend on the ease of tax collection, that is, Productive Specialisation or Structural factors such as agricultural, manufacturing and service value added. Due to its inherent difficulty to collect the tax, especially, in developing countries where production tends to be organized on small-scale basis or due to equity and political reasons, most developing countries exempt from taxes a large share of agricultural activities.
Manufacturing value added, measured as a fraction of GDP, is the net output of the manufacturing sector after adding up all outputs and subtracting intermediate inputs. Specialization on industry as a percentage of the economy can have positive effects on taxation as industrial enterprises are typically easier to tax and manufacturing can generate larger taxable than agriculture **(**Castro & Camarillo, 2014**).** A larger tax base makes for more tax potential, and indeed industrialisation, in the form of a high manufacturing share of output, is associated with a rise in tax potential (Langford & Ohlenburg, 2015). Authors such as Cyan, Martinez-Vazquez and Vulovic, (2016), argued that certain sectors in the economy such as agriculture, services, and construction have been traditionally hard to tax, and because of that and other reasons (equity and political economy issues), many countries exempt agriculture from taxes. They conclude similar case to be made for many services.

Trade openness is an aggregated level of export and import calculated as a fraction of GDP. It is expected to have a positive relationship between trade openness and taxable capacity due to the taxes applied on imports, and as trade expands, the formalisation and the competitiveness of the economy increases; therefore, more possibilities to collect taxes. However, globalization and international competition have gradually led countries to reduce their reliance on trade taxes, the strength of this correlation should be gradually decreased (Le, Moreno-Dodson & Rojchaichaninthorn, 2008). On the other hand, an open

economy reduces tariffs and trade barriers and this fact can have negative effects on tax collection (Baunsgaard & Keen, 2010). Taxes from trade are an important source of revenue that is relatively easier to tax even with a weak tax administration. Hence, trade openness is a variable which is expected to have a positive coefficient in the regression (Khwaja & Iyer, 2014).

The International Country Risk Guide (ICRG) provides alternatives for gauging the quality of the institutional setting of a country, particularly, the corruption index. Corruption is measured by the corruption index developed by International Country Risk Guide (ICRG's) assessment of corruption in the political system through assigning a numerical value to a country. The index ranges from 0 to 6; close to 6 means a lower risk of corruption and vice-versa. Literature argues a high level of corruption reduces revenues collection (Abed & Gupta, 2002; Le, Moreno-Dodson & Rojchaichaninthorn, 2008); taxpayers who deal with rampant corruption are less willing to pay taxes (Bird et al., 2008; Cyan, Martinez-Vazquez & Vulovic, 2016). Corruption also discourages foreign investment, which negatively affects economic activity and the tax base.

The degree of external indebtedness of a country may affect revenue performance as well. To generate the necessary foreign exchange and service the debt, a country may choose to reduce imports. In such a scenario, import taxes will be lower. Alternatively, the country may choose to increase import tariffs or other taxes with a view to generate a primary budget surplus to service the debt (Alamirew et al., 2020; Javid & Arif, 2012; Sen Gupta, 2007).

3. Empirical Studies

A number of empirical studies attempted to investigate the effect of economic and institutional variables on economies' overall tax potential and tax effort (Alamirew et al., 2020; Bird et al., 2008; J.-F. Brun & Diakite, 2016; Langford, 2015; Fenochietto & Pessino, 2013; Grigorian & Davoodi, 2007; Khwaja & Iyer, 2014; Le et al., 2012; Mascagni, 2016b; Mascagni & Mengistu, 2016; Mebratu & Fentaw, 2020).

Using different specifications of the stochastic frontier panel data (the Battese-Coelli half normal and truncated normal models) and the Mundlak version of the Random Effects Model, Brun and Diakite (2016) and Fenochietto and Pessino (2013) find a positive and significant relationship between tax revenue as scaled by GDP and per capita GDP (indicates country's level of

development and the capacity to tax) and trade openness. The studies also demonstrate a negative relationship between tax revenue as a Percent of GDP and corruption. In a cross-country study by Langford (2015), corruption-reflecting the political and administrative components of taxation-is found to be significant determinants of tax effort.

In a similar cross-country study, Sen Gupta (2007) finds strongly significant relationship between revenue performance and several structural factors such as per capita GDP, share of agriculture in GDP and trade openness are statistically significant. These variables judged by the author as strong determinants of revenue performance. As to the impact of foreign aid and foreign debt on revenue mobilization, he finds that although foreign aid improves revenue performance significantly, debt does not. On the other hand, the result revealed the negative and significant effect of corruption on revenue performance. Findings further revealed that countries that depend on taxing goods and services, as their primary source of tax revenue, tend to have poorer revenue performance than countries that put greater emphasis on taxing income, profits and capital gains.

Le and Moreno-dodson (2012) examined determinants of countries' taxable capacity and tax effort covering a sample of 110 developing and developed countries during 1994–2009. Among the economic variables, GDP per capita and trade openness are found to be positive and statistically significant determinants of tax potential and effort, while the effect of corruption index is found negative and significant. Bird et al. (2008) studied the impact of corruption, voice and accountability on low-income and high-income countries' tax effort. The estimation result of 2SLS techniques shows negative and significant effect of GDP per capita on developing countries tax effort, while the effects of corruption is found to be positive and statistically significant for both low- and high-income countries.

By employing a robust stochastic frontier estimation technique (Brun & Diakite, 2016; Fjeldstad & Brun, 2014) studied factors affecting Tax Potential and Tax Effort for a large sample of developing countries over the period 1980-2014. Findings revealed the positive and significant effect of GDP per capita and trade openness, and suggested that inefficiency in taxation depends more on policy decisions than on tax administration performance. Employing a fixed effect estimation technique (Grigorian & Davoodi, 2007) conducted a cross country study on determinants of tax potential versus tax Effort, and points out

positive and significant effect of GDP per capita and institutional quality on tax potential and then effort.

Alamirew et al. (2020) conducted a comprehensive assessment of the tax revenue potential and effort of 23 Sub-Saharan African nations from 2000 to 2018. On average, almost all sample countries' tax effort is found lower than the global average index. These show that Sub-Saharan African countries collect taxes below what could be collected due to reasons attributed to nation's economic, demographic, policy and institutional factors.

Thus, for country level studies are rare in the tax effort literature, studies are largely dominated by cross-country studies that are useful in identifying broad trends but that also suffer from problems related to countries and factors heterogeneity. Cross-country studies do not provide fully conclusive evidence on whether the effect of economic, institutional and demographic factors on tax effort is positive or negative. On top of that, countries' tax potential and thereby their efforts tend to be under or overestimated due to methodological dynamics and their sensitivity to the set of countries, and the period of analysis (Mascagni, 2016b). Thus, this article aims to better investigate the determinants of tax revenue potential and then effort in Ethiopia using appropriate methodologies detailed in the next section.

4. Empirical Model of the Study

4.1 The Cobb-Douglas Production Function

The production function is one of the key concepts of mainstream neoclassical theories since almost all economic theories presuppose a production function, either on the firm level or the aggregate level. In both microeconomics and macroeconomics, the production functions are positive non-constant functions that specify the output of a firm, an industry, or an entire economy for all combinations of inputs. A famous two factor production function was first introduced in 1928 by Cobb and Douglas, nowadays called Cobb-Douglas production function, in order to describe the distribution of the national income (Belotti et al., 2013). This function reflects the relationships between its inputs (physical capital and labour) and the amount of output produced. It is a means for calculating the impact of changes in the inputs, the relevant efficiencies, and the yields of a production activity.

The basic form of two factor Cobb-Douglas production function is given by:

$$Y = bL^{k}C^{21-k}, \qquad (\mathbf{1})$$

Where Y denotes the total production, L the labor input, C is the capital input, and b is the total factor productivity (TFP). Besides production, this function has also been applied to many other issues. The generalized form of the function is written as:

$$F\ (x1, \ldots\ldots xn) = Ax1^{\alpha 1 \cdots\cdots} xn^{\alpha n}, \qquad (\mathbf{2})$$

Where $xi > 0\ (i = 1, \ldots, n), A$ is a positive constant, and $\alpha 1, \ldots, \alpha n,$ are nonzero constants.

In theory, because of similarities between firms' problems in producing output and governments' problems in generating taxes, where both types of institutions are concerned with the unused production or tax potential, generally interpreted as inefficiency, the application of the stochastic frontier should work well in tax frontier estimation. However, for the stochastic frontier technique to work, it requires some conditions, such as the negative third moment of the OLS residuals. Another main difference is in the interpretation, the difference between current tax ratio and tax frontier cannot purely represent the level of inefficiency like that of the production frontier, rather the difference be interpreted only as the level of unused tax potential which may be caused by at least two factors (i) policy issue; differences in tax legislation, for instance, in the level of tax rates (Pessino & Fenochietto, 2010), the low tax ratio may be chosen intentionally following local people's preferences of low provision of public goods and services, and/or (ii) the existence of technical inefficiencies, inefficiency of local governments.

In the case of production function, the determinants of outputs are very clear that output is produced by some inputs, such as: labour, capital, and some other factors. This situation becomes less clear when it comes to the tax frontier estimation, that is because output, in this case the tax ratio, is the output of some combination of inputs, such as tax bases and tax rates. Therefore, the empirical study of tax ratio is reduced to tax bases and the standard proxies normally used for estimating tax bases are output or income, among others. Thus, finding of the right combination of tax ratio determinants to find the tax frontier is the main issue of concern for such a research, otherwise, the stochastic frontier approach will not work well (Langford, 2015).

4.2 Model Specification and Estimation Issues

The theme of this study is to answer the question of how much tax revenue Ethiopia as a country *could, (*the theoretical liability), rise by giving a quantitative suggestion of the scope for additional domestic revenue mobilisation. Clearly, the way tax effort is calculated is affected by the choice of the measure of revenue potential, the denominator of any tax effort indicator. Thus, one way to research the tax effort concept is to see how the revenue potential benchmark or desired tax capacity is estimated.

4.2.1 Stochastic frontier analysis (SFA)

This article models tax potential using the stochastic frontier analysis (SFA), adopted from the production function, and first pioneered by (Aigner & Schmidt, 1977). Stochastic frontier analysis technique is found to be advantageous as compared to the traditional regression approach of OLS based cross-section and panel data techniques, which are more akin to an average level achieved for a given set of determinants rather than an indication of true maximum potential. SFA provides measure of the extent to which a country may be able to raise additional revenue. Besides, SFA technique supports a more intuitive and potentially more policy-relevant measure of tax potential and effort, and can be used to generate a stochastic tax frontier (Tsionas, 2012; Belotti *et al.*, 2013; Fenochietto & Pessino, 2013; Brun & Diakite, 2016; Langford, 2015; Alamirew & Leykun, 2020; Mebratu & Fentaw, 2020). Hence, in this study, the researcher builds on advances in the stochastic frontier literature by applying time-series data techniques to the estimation of overall tax potential and effort**.**

The most likely explanation is that the stochastic frontier approach combines elements from both the standard regression analysis and an incomplete utility maximization process (Dalamagas et al., 2019)**.** The tax stochastic frontier model, which measures time-varying inefficiency, has two disturbances. The first disturbance is the usual mean zero statistical error term and the second one is the estimate of technical inefficiency. The SFA model separates the overall tax effort into a constant tax effort resulting from policy economic decisions and a time-varying tax effort resulting from tax administration efficiency (Alamirew et al., 2020; Brun & Diakité, n.d., 2016; Fenochietto, 2014; Fenochietto & Pessino, n.d.; Langford, 2015; Le et al., 2012; Pessino & Fenochietto, 2010; Yohou, 2017;

Zárate-marco & Vallés-giménez, 2019). The general specification of these models is as follows:

$$\log Y_t = \alpha + f(\log X_t; \beta) + \epsilon_t \quad \textbf{(3)}$$

$$\epsilon_t = v_t - u_t \quad \textbf{(3.1)}$$

Where, $\mathbf{Y_t}$ represents Log of tax to GDP ratio for the country, $\mathbf{u_t} > \mathbf{0}$, represents the error in obtaining the maximum amount of revenue for given inputs or tax bases (inefficiency in tax collection) and would be the function of variables $\boldsymbol{zt}$, which may vary over time and would include observed heterogeneity, $\mathbf{v_t}$ denots random error term that captures omitted variable bias and measurement errors, β denotes vector of unknown parameters and X_t represents vector of economic and institutional variables that affect tax capacity in the country (GDP per capita, trade openness, manufacturing value added, service value added, external debt and corruption, all scaled by GDP except corruption index retrieved from ICRG). However, agricultural value added and shadow economy have been dropped from the model due to colinearity issues, see correlation matrix in the appendix.

Another element of the tax stochastic frontier model is that, while some of the inputs needed to produce the output, such as economic inputs, are well-known, others, such as institutions, are not. The value of the stochastic frontier tax function may simply lay in having a more obvious interpretation of specific institutional restrictions to tax effort, as the SFA is an extension of the traditional regression model.

For tax potential analysis, this study employs Battese (1995) and Battese and Tessema (1993) time-varying cross-sectional model with observable heterogeneity. Observable heterogeneity refers to variables that do not directly affect the tax capacity of a country but could affect efficiency through other variables determining tax effort, say ze. The cross-sectional specifications for time-varying cross-sections are as follows:

$$y_t = f(X_t; \beta).\xi_t.e^{vi} \quad \textbf{(3.2)}$$

$$Y_t = \alpha + \beta' X_t + v_t - u_t \quad (\mathbf{3.3})$$

where $u_t = -\ln(\xi_t)$

$$v_t \sim N(0, \sigma^2 v) \tag{3.3a}$$

$$u_t \sim N^+(\mu_t, \sigma_u^2), \mu_t = \delta_e z_{t,e} \tag{3.3b}$$

Where, ξ is tax effort, and is restricted to being between 0 and 1, the final term e^{vi} represents random shocks to reflect factors such as one-off windfalls, measurement errors and model misspecification.

Assumptions for Maximum Likelihood (ML) Estimators

Testing the underlined assumption is required prior to estimating the ML in order to produce efficient and consistent results.

Table 1: Assumptions, tests and expected results

Assumptions	Tests	Expected results
Residual's skewness	OLS residual test to check for the validity of the SFA specification	For a production-type stochastic frontier model with the composed error, $v_t - u_t, u_t \geq 0$ and vt distributed symmetrically around zero, (i.e., negative Skewness).
Parametric Distributional Assumptions for the inefficiency term u_t	a normal distribution on v_i and a half-normal distribution on u_i is represented as the following: $\ln y_t = \ln yt^* - u_t,$ $\ln y_t{}^* = f(x_t; \beta) + v_t$ u_t ~i. i. d. $N^+(0, \sigma 2ut)$, u_t ~i. i. d. $N(0, \sigma 2v_t)$, truncated-normal distribution of u_t ; $\ln y_t = \ln y_t{}^* - u_t, u_t \geq 0$ $\ln y *_t = f(x_t; \beta) + v$ $u_t \sim N^+(\mu, \sigma^2 u)$ $v_t \sim N(0, \sigma^2 v)$	Zero-mean normal distribution forv_t. The efficiency term can be either half-normal distribution (assumes that the mode in the distribution is zero) or truncated normal distributed (assumes the ui distribution to have nonzero mode).
A Likelihood Ratio Test of technical Inefficiency u_t	A likelihood ratio test statistics computed as the difference between the estimated restricted model (Cobb- Douglas) and the estimated unrestricted model (SFA), $-2 * (\text{restricted value} - \text{unrestricted value})$.	The null hypothesis of stochastic frontier model is not appropriate or no technical inefficiency- to test the existence of the one-sided error for the model. For a half-normal model, the LR tests the hypothesis that $\sigma^2 u = 0$.

Heteroscedasticity in v and u	Heteroscedasticity can be parameterized by a vector of observable variables and associated parameters; the exponential function is used to ensure a positive estimate of the variance parameter. $$\sigma^2 u,_t = \exp(z'_{u,i} w_u)$$ $$\sigma^2 v,_t = \exp(z'_{v,i} w_v)$$ Where $z_{u,i}$ is a mX_1 vector of variables including a constant of 1, and wu is the mx1 corresponding parameter vector.	The Aigner et al. (1977) original half-normal model assumes that vi and the pre-truncated u_i are homoscedastic, that is, both $\sigma^2 v$ and $\sigma^2 u$ parameters are constants.
Exogenous Determinants of Inefficiency	In the maximum likelihood method, the single-step truncated normal approach predicts the parameters of the relationship between ui and z- t, as well as all other model parameters.	The variance of the ui is assumed to be a function of z variables, which they call inefficiency explanatory variables; Note that, given $u_t \sim N^+ (0, \sigma^2 u)$, the mean of $u_i$is a function of$\sigma^2 u$ (instead of 0) because of the truncation.
Endogeneity and omitted variable bias	Though the slow-moving nature of structural determinants precludes a substantial contemporaneous influence from tax revenues, observed endogeneity can be captured by integrating corruption and external debt stock, while unobserved heterogeneity is not a problem for a country-specific analysis.	By using what if analysis and robustness checks with different estimation model specifications, the output is maintained to be consistent and efficient.

Source: Author's computation

4.2.2 Utility maximization function (UMF)

Cross-country or country-level investigations of the factors that might explain changes in tax effort over time would necessitate more advanced theoretical and econometric analytical approaches. Economic, institutional, and demographic factors, among others, have been discussed in the literature as potential drivers of a country's tax capacity, and then, as direct inputs as determinants of tax effort index and indirect inputs to the tax base as environmental variables (Dalamagas et al., 2019; Albouy, n.d.; Misch et al., n.d.). Furthermore, these variables, as well as unobserved or non-economic factors (political, institutional, demographic, geographical, ethical and legal indices, cultural, and so on) and remaining factors used by previous researchers, are already embodied by assumption- there is no adequate priori justification for an ad hoc use of variables selected as measures of taxable capacity, whereas, data, particularly on non-economic factors, is unreliable, and regression results are not reliable, suffering from Hetroskedasticity, contemporaneously correlated and auto regression.

Throughout, however, some structural macroeconomic variables are well established both theoretically and methodologically, while other existing, but not yet well-developed latent data as ad hoc regressors in tax equations are extremely difficult to specify in the regression model. As a result, Dalamagas et al. (2019) propose a new optimization technique for evaluating tax effort based solely on observable macroeconomic factors, ignoring other existing but less well-established latent data as ad hoc regressors in tax equations.

According to Dalamagas et al. (2019), no meaningful attempts to provide a theoretical underpinning to tax effort econometric estimations have been made till now. The most likely explanation is that the stochastic frontier method incorporates aspects of both traditional regression analysis and an incomplete utility maximizing technique. Regardless of the differences in estimated tax effort values, the major problem with all previous tax-effort methods is that they do not lead to a Pareto optimal outcome. Therefore, the natural question about Pareto efficiency is whether a distortionary tax system could lead to Pareto optimal tax revenue. In most cases, an optimal outcome would be achieved if the government could maximize social welfare through a combination of direct (equitable but inefficient) and indirect (inequitable and inefficient) taxes, subject to the constraint that sufficient revenue is generated to finance the provision of public

goods (Albouy, n.d.; Griffith et al., 2010; Mankiw et al., 2009; Arrow & Debreu, 1954; Stieglitz, 2018).

In comparison to the tax frontier regression model, SFA, used, this study has tested the new measure of tax effort proposed by Dalamagas et al. (2019), who suggested that in the context of an Arrow-Debreu economy with fixed labor supply and no savings, a utility function with two arguments (income and government spending) is maximized with respect to direct and indirect tax rates. Thus, regardless of the prevailing economic, institutional, political, and other variables in any country, the ideal level of tax revenue is calculated through utility maximization procedure and demonstrated to be equal to the gap between income (Y) and consumption (C). The first-order conditions are then, manipulated to provide the optimal tax revenue as the difference between income and consumption ($T^* = Y - C$).

The most often used definition of tax effort, namely the ratio of actual to optimal tax revenue (T/T^*), is used to evaluate whether the economy is overtaxed ($T/T^* > 1$) or undertaxed ($T/T^* < 1$). All of the previous researches of both economic and non-economic aspects are considered to have been included into private and public agents' priorities for labor effort and consumer preferences. As a result, three important macroeconomic variables are required in this new model to compute the variable in the above formula: GDP, Tax revenue (direct and indirect), and Consumption (Private consumption net of indirect tax) (Dalamagas et al., 2019: Griffith, 2010; Arrow & Debreu, 1954).

5. Results and Discussion

5.1 Data Description

Table 2 displays descriptive statistics for government revenue indicators from 1981 to 2018. Ethiopian government revenue accounts for about 8 percent of the country's GDP on average. The low standard deviation indicates that there are little differences over time, implying that the tax-to-GDP ratio in the country has been stable for over three decades. In the years 1988 and 1997, the lowest and highest levels of government revenues were recorded. As shown in the table, the average per capita GDP is $921.5, with a large standard deviation, indicating greater differences over time (1981-2018). The lowest and highest level of per capita income was reported in 1981 and 2018, respectively, indicating a steady increase over time. The trade openness as a percentage of GDP can be explained

in the same way. It provides 33 percent of GDP on average, with a high standard deviation that shows huge fluctuations over time, with the highest amount in 2004 and the lowest in 1993.

Table 2: Summary of statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Actual tax (% GDP)	38	8.113	1.760	.500	11.262
GDP per capita	38	921.5	476.91	421.36	2103.5
Trade openness (% GDP)	38	33.16	10.592	18.3	51.086
Manufacturing value added (% GDP)	38	4.731	.904	3.113	7.301
Service value added (%GDP)	38	35.93	4.043	26.82	42.75
Corruption (ICRG index)	38	.3476	.026	.25	.396
External debt stocks (%GNI)	38	60.56	36.891	10.50	147.18

Source: Author's own computation

As shown in Table 2, the hard-to-tax sectors of the country's economy, manufacturing and service value added, contribute on average 5 percent and 36 percent of the country's total output, respectively. With relatively small standard deviations, both the service and industrial sectors show less volatility over time. ICRG includes a corruption component in its political risk index that goes from 0 to 6, with 0 corresponding to the highest conceivable level of corruption and 6 corresponding to the lowest possible level of corruption. Ethiopia's ICRG corruption index, on average, is nearer to zero (i.e., 0.35), suggesting that the country has the highest level of corruption. On average, the country's external debt as a proportion of gross national income reveals a massive debt burden with a large standard deviation, showing considerable changes over time, with minimum and maximum values recorded in 2008 and 1994, respectively.

5.2 Estimation Methods: Assumptions and Maximum Likelihood Estimators

A Skewness Test on OLS Residuals

As a requirement for justifying the appropriateness of the SFA, a skewness test on the distribution of OLS residuals ensures the left (negative skewness). As a result, the OLS residuals for estimated 'inefficiency' (that is, lack of tax effort)

have a negative skewness (-4.5), which is consistent with a production frontier specification (Kumbhakar et al., 2015; Skolrud, 2005). The Table is not included simply to save space. This finding has been complemented by a *sktes*t, which presents a skewness-based normality test and a kurtosis-based normality test, then, combines the two tests into an overall test statistic. The null hypothesis of no skewness is safely rejected when the test produces a p-value of less than 0.01. As a result, we uncovered evidence for a left-skewed error distribution with statistically significant skewness. As a result, we may be quite confident that we do not need to re-examine the model's specification at this time and can move on to the next step of estimating the stochastic frontier model. As a result of finding support for the model's stochastic frontier specification, we can proceed to estimate it using parametric distributional assumptions on v_t & u_t.

Parametric Distributional Assumption

The two common statistics are relevant for diagnostic checks for the distribution of technical inefficiency term (u_i): variance of the inefficiency term and likelihood ratio test statistics.

a) Variance of the inefficiency term (u_i)

Compute the total variance of the error term, $\sigma = \sigma ut^2 + \sigma vt^2$ and then make sure that the ratio of the variance coming from the technical inefficiency term (u_t) to the total variance closes to 1. That is, $y = \sigma ut^2/(\sigma ut^2 + \sigma vt^2) \approx 1$

Table 3: Summary of technical inefficiency variance

Variances	SD	Variance
Var_u	7.003711	49.05197
Var_v	1.49E-07	2.22E-14
Total variance		4.91E+01
Variance of technical inefficiency		1.00E+00

Source: Author's own computation

This statistics is found greater than 0.8 (close to 1) showing that most of the variances are coming from the technical inefficiency, not from the stochastic error term, suggests the SFA as appropriate model.

b) Likelihood ratio test statistics

However, according to Kumbhakar, Wand and Horncastio (2015), the above statistics (technical inefficiency variance) is not really advisable in order to check the appropriateness of SFA for analysis, and hence, they suggest to conduct a likelihood ratio test statistics computed as the difference between the estimated restricted model (Cobb- Douglas) and the estimated unrestricted model (SFA), $-2 * (restricted\ value - unrestricted\ value)$. Then, compare this value with the critical values at 1% level of significance with 1 degree of freedom developed by (Kodde & Polm, 1987).

Table 4: Summary of Likelihood ratio test statistics

Likelihood ratio computation, Kumbhakar et al. (2015)	
Unrestricted	19.809
Restricted	-22.080
likelihood ratio	83.781

Source: STATA output

Critical value at 1% significant level is 5.412, since 83.783 is much greater than 5.412, reject the null hypothesis of stochastic frontier model is not appropriate or no technical inefficiency. Hence, the two test statistics confirms the appropriateness of the stochastic frontier model and the existence of technical inefficiency.

6. Empirical Results and Discussion

The usages of two-step and one-step techniques, as well as the distribution of the technical inefficiency component, are all important considerations when estimating SFA (Ui). In the first of two steps, we must first estimate the SFA and then, construct levels of technical inefficiency on environmental factors, which are normally observable at the time decisions are taken. Then, in the second stage, such degrees of technical inefficiency are employed as a dependent variable, and other exogenous variables are included as independent variables in the model $ui = f\ (z)$. The literature implies, however, that if we use the two-step technique, we may end up with system-biased results. To overcome this bias, this study adopted a one-step approach in which the SFA is simply estimated and variables affecting technical inefficiency are factored in.

A functional form of the production possibility frontier is another important consideration. The Cobb-Douglas production function and the Translog are the two most often used functional forms; the Translog is more versatile than the Cobb-Douglas, while the Cobb-Douglas is more limiting. This study follows the best practice that is to estimate both functional forms and perform a likelihood ratio test to see which one is more appropriate.

The Half-normal distribution, exponential normal, and truncated normal are among the distributional assumptions accessible for ui (Aigner et al., 1977). The first two are single parameter distributions that are simple to estimate, although they are less flexible. Literature suggests that a more flexible distribution, such as the truncated normal, used in this study, can help to relieve rigidity.

The stochastic frontier model (SFA) seems to fit very well (Table 5) in that all of the coefficients of the frontier determinants are statistically significant and have signs as expected across the three alternative models. The result is consistent with prior empirical studies (Alamirew et al., 2020; Brun & Diakite, 2016; Fenochietto & Pessino, 2013; Langford, 2015; Le et al., 2008; Rao et al., 2018; Zárate-marco & Vallés-giménez, 2019). The exception is that in some regression specifications, an institutional variable (corruption) and an economic variable (external debt) are included as determinants of inefficiency (column 5). The value of lambda over each model indicates that lack of tax effort accounts for a large proportion of the composite error. For example, the variance components are $(1 - 2/\pi)\,\sigma\,\hat{}\,2u = 0.183$ and $\sigma\,\hat{}\,2v = 0.104$, so about 64 percent of the total variance ε is accounted for the variance of inefficiency u under half normal distribution. Same calculation can be applied for the rest of the distribution, truncated normal and Truncated normal heterogeneous in Mean and Decay Inefficiency. In other words, relatively huge value for lambda indicates much of the variations in the total variance coming from the inefficiency term u.

More interestingly, the result supports theories and practices in the country for variables included as hard to tax sectors (manufacturing and service value added), though agricultural value added is dropped due to multicollinearity issue. The argument for the former is that industrialisation, in the form of a high manufacturing share of output, is associated with a rise in tax potential Langford, (2015), specialization on industry as a percentage of the economy can have positive effects on taxation as industrial enterprises are typically easier to tax and manufacturing can generate larger taxable than agriculture (Castro & Camarillo, 2014). For the latter, authors such as Cyan et al. (2016) argued that certain sectors

in the economy have been traditionally hard to tax, such as agriculture, services, and construction, and because of that and other reasons (equity and political economy issues), many countries exempt these sectors from taxes.

Table 5: Summary results of SFA estimation: Maximum Likelihood Method

	Models					
Variables	**Half normal**		**Truncated normal**		**Truncated normal heterogeneous in Mean and Decay Inefficiency**	
	Coeff.	**Pv**	**Coeff.**	**Pv**	**Coeff.**	**Pv**
Log of GDP per capita	5.447	0.000	6.271	0.000	.323	0.000
The square of Log of GDP per capita	-.400	0.000	-.463	0.000	-4.456	0.000
Log of trade openness	.154	0.000	.128	0.000	.122	0.000
Log of manufacturing value added (%GDP)	.162	0.000	.128	0.002	.195	0.000
Log of service value added (%GDP)	-.390	0.000	-.257	0.000	-.477	0.000
Inefficiency (MU):						
Corruption					-13.155	0.126
External debt					-.021	0.564
Wald chi2	4.15e+	0.000	3.85e+10	0.000	3.63e+07	0.000
sigma_u	.504	0.000	7.692	0.510	1.253	0.000
sigma_v	6.18e-06	0.977	1.47e-07	0.988	.000329	0.740
Lambda ($\lambda = \sigma u / \sigma v$)	81635	0.000	5.23e+07	0.000	3809	0.000
No. of obs		38		38		38

Source: STATA output

Manufacturing companies are less difficult to tax than agricultural companies since their owners keep better records of obligations and facts. Green manufacturing can generate significant surpluses, affecting the tax effort. According to global economic.com (2020), Ethiopia's value-added in the agricultural, industrial, and service sectors was 35.45 percent, 23.11 percent, and 36.81 percent, respectively, as a percentage of GDP. In 2020, the global average, based on 168 countries, was 10.86 percent. When we look at these numbers, we can see that the share of the economy that is difficult to tax (35.45% & 36.81%)

is substantially higher than the share of the economy that is simpler to tax (23.11%). Apart from tax management issues, this reduces the country's tax base.

For a variety of reasons, including fairness and political-economic system issues, many nations exempt agriculture from taxes. Several service groups can be established to make a similar case. As a result, the higher the proportion of these industries in GDP, the more difficult it will be for tax administrations to collect money (Jewell et al., n.d.). This result is bolstered by the fact that, during the GTP (2010-2015), Ethiopia saw outstanding economic growth of 9.97 percent on average over a decade, but the tax-to-GDP ratio remained stable at 8 percent on average, demonstrating the absence of a trend. The IMF (2011) verified that tax collections in developing countries, particularly in LICs and SSA, had been static for 30 years. The tax base that is fundamental to increasing tax-to-GDP ratios in a sustained manner is formal sector employment and earnings (the income tax base) and private sector spending (the indirect tax base). It will be difficult to enhance the tax-to-GDP ratio if these bases do not rise at the same rate as GDP (IMF, 2011). Tax ratios are supposed to rise in lockstep with GDP, based on the assumption that tax collection efficiency improves with development, although there is little evidence to support this hypothesis.

In the Mean and Decay Inefficiency model, the other two variables (corruption and foreign debt) are considered independent predictors of tax inefficiency (Table 5, last column). The signs of both coefficients are as expected, even if they are statistically insignificant. The degree of corruption, which ranges from 0 to 6, has a negative sign, indicating that a high level of this variable, that is, less corruption, is linked to a lower level of inefficiency and a higher level of efficiency. In the same way, the negative sign for external debt indicates that it has a negative impact on inefficiency while having a favourable impact on tax collection efficiency. Literature argues that a high level of corruption reduces revenues collection (Le et al., 2012; Le & Moreno-dodson, 2008); taxpayers who deal with rampant corruption are less willing to pay taxes (Bird et al., n.d., 2008; Cyan et al., 2016). Corruption also discourages foreign investment, which negatively affects economic activity and the tax base.

Higher amounts of government debt, on the other hand, may have a positive influence on government efficiency in collecting taxes because the debt must be repaid in the future. This finding supports the idea that a large public debt necessitates government income increases in order to service the debt, particularly, when interest on the debt exceeds net borrowing plus non-interest

spending reductions. The country is suffering from the high stock of external debt, debt distress increased from moderate to high (UNDP, 2018), public external debt reached $24.2 billion, showing 12 percent annual growth. The central government's share of the debt was 56 percent, while public enterprises share the remaining 44 percent (52% of which is government-guaranteed). In the same year, the external debt to GDP ratio was 30 percent, and the annual debt service to exports ratio was 11.9 percent. On top of that, according to IMF/WB debt sustainability analysis (DSA) 2017, Ethiopia's risk of debt distress increased from moderate to high, and the country's trade deficit in the first six months of 2017/2018 was $6.6 Billion. These, among others, make it unquestionable that revenue mobilization through taxation is the most realistic and practical way of financing Ethiopia's development through broadening the country's tax bases.

Table 6 summarizes the actual tax ratio, tax potential, tax effort, and tax gap estimated using half normal, Truncated normal, and Truncated normal heterogeneous models. Across each model, the tax potential, effort, and gap all have very similar values. Using alternate estimation methodologies, tax effort determined to be almost identical for the given two-digit values. However, as we extend its decimal to three and above digits, these values become significantly different; the figures shown here are rounded to conserve space. Over a three-decade, from 1981 to 2018, the country's real tax to GDP ratio averaged 8.27 percent. The average tax potential values among other models for the same period show no substantial variance (see column 3, 4, 5). Each model (see columns 6, 7, and 8) finds the same average tax effort index of 36 percent, whereas, the average value for the tax gap is over 14 percent (see column 9, 10, and 11).

As seen in Table 6, the country has a high tax gap, which can be read as inefficiency in the case of a production frontier function. However, the interpretation of the tax frontier function is quite different, and this figure cannot be wholly attributed to technical inefficiencies. Because tax effort reflects two essential aspects: policy choices defined in terms of tax rates, tax bases, and any exemptions, and technical inefficiency in policy enforcement that encompasses issues of tax administration and taxpayer compliance, as well as the interconnections between these two. As a result, this figure represents the issues of policy choice and enforcement in the country's tax policy (see Le, Moreno-Dodson & Rojchaichaninthorn, 2008; Pessino & Fenochietto, 2010, 2013; Le, Moreno-Dodson & Bayraktar, 2012; Cyan, Martinez-Vazquez & Vulovic, 2016; Langford & Ohlenburg, 2015). Tax literature suggests that the primary causes of

tax collecting inefficiencies include: corruption, inadequate tax administrations, government ineffectiveness, and low enforcement (Alamirew et al., 2020; Mebratu & Fellow, 2020; Pessino & Fenochietto, 2010).

In Ethiopia, inefficient tax collection is mostly caused by policy choices and enforcement. As the realities on the ground, the country is currently plagued by corruption, poor tax administration, a patchwork of tax laws, and on-going political upheaval. Corruption, among other things, exacerbates tax collection inefficiencies, inhibits foreign investment, and erodes Ethiopia's revenue bases. It is worth noting that this variable encompasses both policy selection and enforcement. The country's corruption is so pervasive that the tax system is bound by politically connected tax officers and taxpayers. Furthermore, the country's constitution's Article 200(2) limits on tax power, as well as the country's dispersed tax laws, very expensive tax exemptions, and biased policy enforcement, all contribute to systemic corruption.

In spite of the fact that Ethiopian revenue and customs authority (ERCA) is not the only government agency involved in tax administration in the country, other government agencies are also involved. For example, the Federal Investment Agency, the Ministry of Mines and Energy, the Ministry of Tourism and Culture, and the National Bank of Ethiopia (NBE) are all involved in tax administration in some capacity (proclamation no.280/2002). As a result, while the distribution of tax administration across various government agencies in the country was unavoidable, it had unintended consequences (Gemechu, 2013; Alamirew et al., 2020)). Despite a slew of recent changes aimed at combining the authorities directly involved in tax administration, there are still a slew of government agencies participating (at least indirectly) in tax administration, raising worries about miscoordination and jurisdictional disputes. Most tax legislations repeat certain elements as if they were not already provided for in other tax legislations as a result of the country's uncoordinated tax laws, suffering from short-term duplication of tax regulations meant to treat a certain public or political group. When it comes to codifying tax legislation, the country has no track record. As a result, the country's tax legislation field remained chaotic, fragmented, uncoordinated, and worse, making it impossible for the common taxpayers to understand their responsibilities under the different tax laws in effect. Furthermore, Ethiopia's public finances are in shambles due to pervasive corruption involving tax fraud, illegitimate tax credits, and theft of government tax income (Gemechu, 2013; Alamirew et al., 2020; Mascagni & Mengistu, 2016).

Table 6: Summary of Tax revenue potential and tax revenue effort index computed

Year	Actual tax ratio (%GDP)	Tax potential			Tax effort			Tax gap		
		Battese Coelli Half Normal	Battese Coelli Truncated normal	Truncated normal heterogeneous in Mean and Decay Inefficiency	Battese Coelli Half Normal	Battese Coelli Truncated normal	Truncated normal heterogeneous in Mean and Decay Inefficiency	Battese Coelli Half normal	Battese Coelli Truncated normal	Truncated normal heterogeneous in Mean and Decay Inefficiency
1981	6.50	21.18	21.01	21.33	0.30	0.30	0.30	14.68	14.51	14.83
1982	7.00	21.04	20.97	21.12	0.33	0.33	0.33	14.04	13.97	14.12
1983	7.80	21.46	21.42	21.52	0.36	0.36	0.36	13.66	13.62	13.72
1984	8.00	20.79	20.79	20.86	0.38	0.38	0.38	12.79	12.79	12.86
1985	8.50	21.40	21.45	21.41	0.39	0.39	0.39	12.90	12.95	12.91
1986	7.45	21.45	21.51	21.47	0.34	0.34	0.34	14.00	14.06	14.02
1987	8.60	21.78	21.82	21.83	0.39	0.39	0.39	13.18	13.22	13.23
1988	7.50	21.57	21.68	21.59	0.34	0.34	0.34	14.07	14.18	14.09
1989	8.63	21.56	21.70	21.57	0.40	0.39	0.40	12.92	13.06	12.94
1990	7.45	22.55	22.79	22.56	0.33	0.32	0.33	15.10	15.34	15.11
1991	5.60	22.53	22.63	22.57	0.24	0.24	0.24	16.93	17.03	16.97
1992	5.91	22.50	22.47	22.62	0.26	0.26	0.26	16.59	16.56	16.71
1993	7.67	22.84	22.83	22.98	0.33	0.33	0.33	15.16	15.16	15.31
1994	8.42	23.07	23.13	22.94	0.36	0.36	0.36	14.64	14.70	14.52
1995	8.95	23.52	23.49	23.44	0.38	0.38	0.38	14.56	14.54	14.49
1996	10.52	23.53	23.53	23.54	0.44	0.44	0.44	13.01	13.01	13.02

1997	11.26	24.96	24.57	25.23	0.45	0.45	0.44	13.70	13.31	13.97
1998	10.88	23.97	23.87	23.88	0.45	0.45	0.45	13.09	12.98	13.00
1999	9.48	23.78	23.77	23.65	0.39	0.39	0.40	14.29	14.28	14.17
2000	8.08	23.61	23.67	23.45	0.34	0.34	0.34	15.53	15.58	15.37
2001	9.70	23.77	23.83	23.58	0.40	0.40	0.41	14.06	14.12	13.88
2002	9.11	23.52	23.67	23.25	0.38	0.38	0.39	14.41	14.55	14.14
2003	9.68	23.53	23.68	23.17	0.41	0.40	0.41	13.85	14.00	13.49
2004	8.72	23.93	23.99	23.61	0.36	0.36	0.36	15.20	15.26	14.89
2005	8.26	23.91	23.95	23.61	0.34	0.34	0.34	15.64	15.69	15.35
2006	7.81	23.71	23.76	23.50	0.32	0.32	0.33	15.90	15.95	15.69
2007	7.81	23.50	23.56	23.35	0.33	0.33	0.33	15.68	15.74	15.54
2008	6.58	23.24	23.27	23.16	0.28	0.28	0.28	16.66	16.69	16.58
2009	8.16	23.23	23.23	23.11	0.35	0.35	0.35	15.06	15.07	14.95
2010	9.20	22.80	22.83	22.72	0.40	0.40	0.40	13.59	13.62	13.52
2011	9.37	22.38	22.38	22.39	0.41	0.41	0.41	13.00	13.00	13.02
2012	8.76	22.20	22.11	22.35	0.39	0.39	0.39	13.44	13.35	13.59
2013	8.81	21.90	21.76	22.15	0.40	0.40	0.39	13.09	12.94	13.34
2014	8.35	21.64	21.41	22.02	0.38	0.39	0.37	13.29	13.06	13.67
2015	8.08	21.26	20.95	21.85	0.38	0.38	0.36	13.18	12.86	13.77
2016	7.60	21.53	20.97	22.39	0.35	0.36	0.33	13.92	13.36	14.79
2017	7.60	21.46	20.75	22.42	0.35	0.36	0.33	13.85	13.14	14.82
2018	6.50	21.17	20.41	22.18	0.30	0.31	0.29	14.67	13.91	15.68
Average	**8.27**	**22.57**	**22.51**	**21.33**	**0.36**	**0.36**	**0.36**	**14.30**	**14.34**	**14.37**

Source: Author's own computation

Regarding policy choice, the country has been losing a significant amount of revenue as a result of poorly designed tax exemptions, which include costly tax holidays and incentives and a wide range of tax rates (from 0% to 150%) that fail to attract investment while also narrowing the tax base. Absence of codified tax laws, complex tax system with unlimited number of rates, weak information management system, traditional registration and management of filling obligations, and lack of risk based and targeted audit programs, among other factors, reduce tax compliance and bring inefficiency to the country's tax administration.

7. Robustness Checks

Alternative model specifications and estimation approaches are often used to assess the consistency and efficiency of estimated outcomes from any model. Following the publication of Dalamagas et al. (2019) recent work on a new method to tax effort, this is the first research to compare tax effort estimation findings using the utility maximization function and the SFA, as shown in Table 7.

To compare summarised results with the Utility maximization function, truncated normal heterogeneous in Mean and Decay Inefficiency is utilized among the different models estimated in Table 6. Only 20 years (1999-2018) are considered due to real data availability limitations when computing tax potential using the Utility maximization function (UMF).

Table 7 shows that the average tax potential calculated using UMF is extremely close to the average value predicted using the SFA, at 23.69 percent and 22.89 percent, respectively. The tax effort calculated from the former (34%) is on average smaller than the average value estimated from the later (36%). In terms of the tax gap, the two models have relatively similar average values of 15.58 percent for UMF and 14.37 percent for SFA. These findings support the argument in the literature that tax potential calculated using the UMF is likely to be exaggerated when compared to SFA results (Dalamagas et al., 2019; Arrow & Debreu, 1954)). The reason for this is that in the case of the UMF, real revenue is compared to a theoretically optimal tax level that takes only three macroeconomic variables into account (GDP, tax revenue, consumption). In this scenario, the optimal level of tax revenue is determined using a utility maximization procedure and is proven to be equal to the difference between income and consumption, regardless of the country's economic, institutional, political, or other variables. The SFA, on the other hand, compares actual revenue to a notional capacity estimate based on economic, demographic, and institutional characteristics linked to tax revenue drivers (Arrow & Debreu, 1954; Dalamagas et al., 2019).

Table 7: Robustness checks using utility maximization function

Period (Year)	Actual tax ratio (%GDP)	Tax potential		Tax effort		Tax gap	
		Utility maximization function	Truncated normal heterogeneous in Mean and Decay Inefficiency	Utility maximization function	Truncated normal heterogeneous in Mean and Decay Inefficiency	Utility maximization function	Truncated normal heterogeneous in Mean and Decay Inefficiency
1999	9.48	30.87	23.65	0.30	0.40	21.39	14.17
2000	8.08	28.75	23.45	0.28	0.34	20.67	15.37
2001	9.70	25.15	23.58	0.38	0.41	15.44	13.88
2002	9.11	21.92	23.25	0.41	0.39	12.80	14.14
2003	9.68	29.06	23.17	0.33	0.41	19.37	13.49
2004	8.72	22.73	23.61	0.38	0.36	14.01	14.89
2005	8.26	21.32	23.61	0.38	0.34	13.06	15.35
2006	7.81	23.58	23.50	0.33	0.33	15.77	15.69
2007	7.81	19.67	23.35	0.39	0.33	11.86	15.54
2008	6.58	19.29	23.16	0.34	0.28	12.70	16.58
2009	8.16	18.46	23.11	0.44	0.35	10.30	14.95
2010	9.20	27.56	22.72	0.33	0.40	18.35	13.52
2011	9.37	27.53	22.39	0.34	0.41	18.15	13.02
2012	8.76	26.53	22.35	0.33	0.39	17.76	13.59
2013	8.81	29.77	22.15	0.29	0.39	20.96	13.34
2014	8.35	19.69	22.02	0.42	0.37	11.34	13.67
2015	8.08	22.23	21.85	0.36	0.36	14.15	13.77
2016	7.60	33.16	22.39	0.22	0.33	25.56	14.79
2017	7.60	21.39	22.42	0.35	0.33	13.79	14.82
2018	6.50	5.18	22.18	1.42	0.29	-2.21	15.68
Average	**8.43**	**23.69**	**22.89**	**0.34**	**0.36**	**15.58**	**14.37**

Source: Author's own computation

In conclusion, the comparison of SFA and UMF shows that there are no significant differences between the two types of estimations, at least at the average level. The most important finding is that the optimal overall tax potential is equal to the difference between GDP and private consumption. According to this criterion, Ethiopia's actual tax burden is lower than its optimal level, implying that the country is undertaxed with low tax effort and high tax potential. A country's tax effort index could be any value between zero and one, regardless of its level of economic growth. The difference between actual tax income and the tax frontier can only be read as the amount of uncollected tax or the tax gap, not as a rigorous measure of inefficiency. This uncollected tax may be due to two factors: people's choices for low-cost public goods and services, resulting in low tax income, and government inefficiencies in tax collection. Because Ethiopia is a developing country with a high need for public financing in order to meet its millennium development goals (MDGs) and to place the country in the middle-income group by 2025, the Ethiopian people seek a high level of public goods and services. As a result, policy choices such as tax exemptions and inefficiencies in policy enforcement are linked to low tax effort and a large tax gap.

8. Conclusions and Recommendations

This research examines Ethiopia's tax potential and effort using the two alternative models of SFA and UMF. The methodology and the results enable for a precise assessment of the country's tax potential, effort, and gap. The central economic and institutional factors that affect tax capacity in the two alternative models are determined in this study: GDP per capita, trade, manufacturing value-added, service value-added, external debt, and corruption in the former, and GDP, tax revenue, and private consumption net of indirect tax in the latter. Results from the UMF confirm the consistency of findings from SFA with no substantial differences between the two, at least at the average level. Of most importance of these findings is that the optimal level of total taxation is equal to the difference between GDP and private consumption.

This research contributes to the field by combining the UMF and the SFA as a new measure of tax effort. The empirical findings revealed that Ethiopia's economy is still undertaxed. The real tax to GDP ratio is significantly lower than the SSA average, and a significant tax gap exists as compared to the country's tax capacity, owing to policy difficulties such as policy choice and enforcement. To

maximize the country's tax potential, broaden the tax base and enhance tax collection efficiency in the economy, this study proposes two policy recommendations: 1) emphasize tax policy choice, and 2) focus on enforcement (tax administration). In terms of the former, the government should concentrate on structural changes that push the economy away from hard-to-tax sectors such as agriculture and services and toward easy-to-tax sectors such as manufacturing in order to expand the revenue base and reduce tax administration costs. The government should also reform the discretionary award of comprehensive tax exemptions by various authorities, such as the MoFED, which leads to corruption. Regarding the latter, the effectiveness of tax administration is influenced by the enforcement of tax laws. To that end, the government should codify the country's current scattered laws to maximize the benefits of accessibility and intelligibility, eliminate duplication of definitions and administrative provisions in individual pieces of legislation, avoid conflicting interpretations, and rationalize the tax system's overall structure towards encouraging voluntary compliance, detecting and penalizing non-compliance and rendering quality taxpayer service, and thereby, assure efficient tax collection practices. Future research could concentrate on investigating the impact of policy choice and enforcement on a country's tax revenue collection.

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Appendix

Table A: Summary of variables, description and classification

Variables	Description	Source	Classification	dd/ss	location in model specification	
					X	Ze
Tax_GDP	Tax revenue as percentage of GDP	WDI/NBE/ICTD	Eco	Ss		
GDPPC	GDP per capita, PPP (constant 2017 international $)	WDI	Eco	Ss	x	
Trade	Imports plus exports as percentage of GDP	WDI	Eco	Ss	x	
AGVA	Share of agriculture to GDP	WDI	Eco	Ss	x	
MAVA	share of manufacture to GDP	WDI	Eco	Ss	x	
SVA	Share of Service industry to GDP	WDI	Eco	Ss	x	
Imports	Imports of goods and services (% of GDP)	WDI	Eco	Ss	x	
Export	Exports of goods and services (% of GDP)	WDI	Eco	Ss	x	
EXD	External debt stocks (% of GNI).	WDI	Eco	Ss		X
CORR	Corruption index (ranges from 0-6, where 0 corresponds to the highest possible level of corruption and 6 – to the lowest.)	ICRG	Inst	dd		x

Where, eco denotes economic factors, dd/ss denotes demand or supply side factors, x denotes tax frontier determinants, and ze as determinants of tax effort.

Table B: Correlation Matrix

	Tax to GDP ratio	GDP per capita	trade openness	Agri. Value added	Mfg. value added	Service value added	Corruption	Imports	Exports	External debt	Shadow eco.
	1.000										
GDP per capita	0.205	1.000									
trade openness	0.396	0.610	1.000								
Agri. Value added*	-0.278	-0.623	-0.801*	1.000							
Mfg. value added	0.410	-0.305	0.136	-0.241	1.000						
Service value added	0.184	0.592	0.785	-0.948	0.052	1.000					
Corruption	-0.357	-0.695	-0.729	0.559	-0.017	-0.540	1.000				
imports	0.551	0.207	0.327	-0.201	0.356	0.112	-0.443	1.000			
exports	0.166	0.124	0.149	-0.067	-0.087	0.169	-0.081	0.334	1.000		
External debt	0.244	-0.471	-0.343	0.432	0.424	-0.495	0.154	0.492	0.010	1.00	
Shadow eco.*	-0.181	-0.975*	-0.569	0.530	0.354	-0.512	0.694	-0.189	-0.125	0.42	1.00

*Dropped from SFA model due to multicollinearity issue.

The Effect of Everything But Arms Trade Preference on the Exports of Ethiopia: Empirical Evidence Using Gravity Model

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Abstract

International trade is generally considered as an integral part of growth and development effort of an economy. Granting non-reciprocal trade preferences to developing countries has been a common practice by developed countries in their foreign trade policy. Many developing countries have also participated in reciprocal regional trade agreements. This study examined the effect of Everything-But-Arms trade preference on the exports of Ethiopia using bilateral export data with 34 major trade partners including the EU-15 over the period 2001-2019. The random effect model was used to estimate the generalized gravity model. The estimation results revealed that the EU non-reciprocal trade preference to the least developed countries, which is EBA dummy, has a negative and significant effect on the export performance of Ethiopia. The country's exports generally improve for a higher domestic production and trade partner's income, but decrease for a higher trade partners' population size, a longer geographic distance and common language sharing with trading partners. Thus, the country should work on easing domestic supply-side trade bottlenecks and promoting export diversification through auspicious investment climate for export-oriented value-added economic activities. This could help to ensure long-run global competitiveness and to effectively reap the trade opportunities of non-reciprocal trade preferences from developed economies, the EU in particular.

Key Words: export performance, trade preference, gravity model, Ethiopia, the EU
JEL Classification: F13, F14, F41

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1. Introduction

Economic integration and trade liberalization have been considered as the main deriving forces for the healthy growth of trade and economy since the creation of GAAT in 1948, following the ruin of World War-II. Growth and diversification of the export sector is crucial to ensure export stability, sustainable development, and self-sufficiency (Hesse, 2008). Free trade can be an optimal economic policy when it is implemented with complementary policies to address adverse interactions with market failures. But large countries may manipulate their terms of trade at the expense of their trade partners through an optimal tariff, which requires countries to enter into trade agreements to prevent mutually harmful trade protectionism (Rodrik, 2018). Accordingly, as part of liberalization, preferential market access agreements have become increasingly popular among the developed nations as tools to help poor countries. Non-reciprocal trade preference (NRTP) programs have been introduced by developed countries since 1960s to enable developing countries to benefit from international trade. As a major destination of goods from the Sub-Saharan Africa (SSA), the European Union (EU) has the most extensive network of one-way trade preferences than any WTO member (Borchert, Conconi, Ubaldo, & Herghelegiu, 2021). The EU introduced, inter alia, the Generalized System of Preferences (GSP) in 1971, nonreciprocal preferences to African-Caribbean-Pacific (ACP) countries in 1975, and 'Everything-But-Arms' (EBA) scheme in 2001.

The EBA scheme offers duty-free quota-free access to the EU market for all products, except arms, from Least Developed Countries (LDCs) including Ethiopia. Developing countries are expected to benefit more from export opportunities than aid, and market access agreements such as the EBA initiative are of potentially greater help to poverty reduction. Despite the unprecedented aid flows to the SSA, the traditional aid programs could have a harmful effect on institutional development in the region due to less accountability in the recipient country (Moss, Pettersson, & Walle, 2006). Annual aid to Africa actually represents only a fraction of what the continent loses because of unfair trade and investment practices by developed countries (Mold, 2005).

However, the trade impacts of preferential arrangements are left controversial and inconclusive even among pro-free trade economists. The EU's preferential arrangements, in particular, have no conspicuous positive impact on the trade performance of developing countries (Panagariya, 2002; Persson &

Wilhelmsson, 2013; Nicita & Seiermann, 2016). Due to the absence of proper internal policies for structural diversification, the trade preferences have been less successful in SSA (Mold, 2005). Unlike the East Asian economies, the SSA countries with extensive and deepest preferences failed to improve production growth and diversify their export bundles, and underused the NRTPs mainly due to administrative burdens and uncertainty about expiration of preferences (Zappile, 2011; Francois, Hoekman, & Manchin, 2006). One-way trade preference schemes, basically the EBA and AGOA, have not been effective in improving export growth and encouraging export diversification in SSA countries chiefly because of insufficient preference margin to surmount Africa's lack of competitiveness (Alves, Draper, & Khumalo, 2009). Given the deep integration of the EU itself, the LDCs such as Ethiopia cannot utilize the preference opportunities. Ironically, the destination of SSA countries' exports changing substantially, and forged with emerging markets mainly China regardless of the extensive EU preferences. Further, trade preferences may undermine internal policy reform by preference-receiving country to promote trade expansion and perhaps growth.

In general, even with massive NRTPs, Ethiopia's products remained less competitive in the global market. The country's balance of payments and trade balance have been incessantly in deficit partly because of strong relative import growth in imports of raw materials and capital goods for infrastructural development. Moreover, Ethiopia remained poverty-stricken, aid dependent and an exporter of few primary commodities for developed markets. Export diversification and structural transformation remains a major challenge, and like many SSA countries, the country's export sector is highly concentrated in few agricultural commodities, such as coffee and oilseeds, whose prices are volatile and exposed to global price swings.

This study, therefore, examined the impact of the EU preferential trade arrangements on the export performance of Ethiopia for two main reasons. First, the export share of Ethiopia in the markets of the preference giving countries, the EU in particular, has been deteriorating despite the full market access with deep preferences under the EBA scheme. Second, the country's external sector remains poorly diversified with incessant balance of payment difficulties that amplify the rising external debt. Understanding the effect of one-way trade preferences would have important policy implications to address domestic policy issues and structural problems in the external sector going forward.

The rest of the paper is organized as follows. The second section offers empirical reviews about the effect of various trade preferential arrangements on the export or trade performance of preference receiving countries. The third section presents the empirical model and data used, followed by the empirical results and discussions under section four. The last section concludes the study.

2. Empirical Reviews

The trade cooperation between the EU and SSA countries is traced back to the Yaounde convention-I, signed in 1963 between the EEC member states and eighteen African ex-colonies. The agreement had offered duty free access to specified goods from the signed SSA countries into the EU market, and lasted until 1975 when succeeded by Lome Convention that was first signed between nine EC members and 46 African, Carribean and Pacific (ACP) countries. The EU granted one-way trade preferences to all developing countries through the introduction of the GSP in 1971, with reduced tariffs or perfectly duty-free access depending on product sensitivity. The EBA scheme was also introduced in 2001, which offers unconditional duty-free quota-free access to the EU market for all products, except armaments, from eligible LDCs including Ethiopia (Francois, Hoekman, & Manchin, 2006). However, the impact of such non-reciprocal preferences in terms of enhancing trade and then welfare of preference receiving countries remain ambiguous and left empirically inconclusive.

Many empirical studies indicated that non-reciprocal trade preferences may help to improve export performance of preference receiving developing countries (Klasen, Martínez-Zarzoso, Nowak-Lehmann, & Bruckner, 2021; Aiello & Demaria, 2010; Frazer & Biesebroeck, 2010; Agostino, Aiello, & Cardamone, 2007; Cernat, Laird, Monge-Roffarello, & Turrini, 2003). The official designation of the preference beneficiary countries as a LDC is associated with higher aggregated exports particularly for LDCs exporting agricultural and light manufacturing goods. But individual trade preference regimes are not always beneficial in terms of increased export values. The impacts vary depending on the preference offering country and the sector of exports considered (Klasen, Martínez-Zarzoso, Nowak-Lehmann, & Bruckner, 2021). Aiello and Demaria (2010) also examined the impact of GSP on the exports of 169 developing nations to the EU markets over the period of 2001 – 2004, and the

results revealed that GSP positively affects the agricultural exports from preferred countries.

Despite the general transaction cost challenges in African countries, the empirical results of Frazer and Biesebroeck (2010) indicated that AGOA had a significant positive impact on African exports of apparel as well as agricultural and manufactured products under AGOA product list. The result also showed that AGOA exports were not merely diverted from other destinations including the European countries. The results of Agostino et al. (2007) also showed the effect of NRTPs of eight major OECD countries to exports from developing nations over the period 1995 – 2003 using different levels of data aggregation (total exports, total agricultural exports and 2-digit). The findings confirmed that the NRTPs have positive impact on exports of developing countries regardless of the estimators used. The gain from preferences is found to be very high in many 2-digit sectors for all preferential treatments while the preference gain may place at lower values when total exports are considered. By analysing the worldwide distribution of gains and losses of the EU's EBA initiative for LDCs using a general and partial equilibrium simulations, Cernat et al. (2003) exhibited the existence of moderate welfare and trade gains from the EBA initiative. The largest gains recorded for Sub-Saharan Africa while the effect on the EU itself is minimal.

However, various other studies (Gil-Pareja, Llorca-Vivero, & Martı´nez-Serrano, 2019; Nicita & Seiermann, 2016; Persson & Wilhelmsson, 2013; Zappile, 2011; Gradeva & Martínez-Zarzoso, 2009; Ozden & Reinhardt, 2005; Alam, 2010) confirmed that trade preferences of developed countries may not improve the exports of the preferred low income countries. Using the Poisson Pseudo-Maximum Likelihood (PPML) estimator on a panel of 182 countries over the period 1960 – 2016, Gil-Pareja et al. (2019) generally suggested that only reciprocal trade agreements between developed and developing countries would have a positive impact on trade flows when the exporter is the developing country. The results also showed that developing countries should abandon their reliance on non-reciprocal trade preferences in favour of two-way agreements. The results of Nicita and Seiermann (2016) generally indicated that tariff preferences would produce marginal effects only for a limited number of LDCs so that tariff preferences alone are not sufficient to improve market access for LDCs. Since G20 countries have ample room to enlarge and strengthen preferential schemes to LDCs, they should review factors that may limit the effectiveness of

preferential schemes towards LDCs. This may also include eligibility criteria, rules of origin, product coverage and exemptions and administrative costs. Using the data over the period 1962 – 2007, Persson and Wilhelmsson (2013) suggested that the EU's NRTPs have negative effect on the export diversification of ACP countries as they were specialized in fewer primary goods. But the preferences have no significant effect on Mediterranean countries. Gradeva and Martínez-Zarzoso (2009) also examined the effect of the EBA initiative on the exports of ACP LDCs to the EU-15, and the results revealed a very poor performance of the EBA regime on the exports of LDCs. The EBA scheme seems to have exactly the opposite effects of its goal in LDCs as the policy actually reduces exports into the EU market.

Indeed, regional trade agreements may increase trade flows even higher than the non-reciprocal EU-ACP PTAs. The bilateral trade between two Free Trade Agreement (FTA) member countries would double on average after ten years (Baier & Bergstrand, 2007). Developing countries removed from GSP eligibility adopt more liberal trade policy than those remain eligible. Developing countries are found to reap more trade benefits from full integration into the reciprocity-based trade regimes rather than GSP style preferences (Ozden & Reinhardt, 2005). Likewise, eligibility for AGOA textile benefits has no significant effect on the SSA's trade due to poor preference exploitation capacity of African countries, uncertainty about preference expiration, and eroding preferential margins (Zappile, 2011). Thus, the regional markets could be seen as a "nursery market" where the member countries could learn to improve efficiency and competitiveness so that they could favourably compete within the global trading system (Turkson, 2012). Using fixed effect model on panel data, the results of Alam (2010) also revealed that the SAFTA and PTAs with China and Iran would improve export performance while the bilateral PTAs with Sri Lanka and Mauritius have no evidence to affect export performance of Pakistan.

In general, due to indistinct characteristics of preference of receiving countries, the issue of non-reciprocal trade preference has no unanimous answer and yet remains open for further research and policy discussion. The exports of LDCs under the EBA scheme remain very limited and still represent only a diminutive share of EU imports. Despite the duty-free quota-free advantage, products from LDCs have not experienced significant export flows towards the EU market. This may be due to inadequate domestic production potential and poor competitive position of LDCs even with other exporters those do not benefit

from any tariff advantages. Thus, it is plausible to examine the effect of EU preferences, EBA in particular, on the export performance of Ethiopia.

3. Econometric Model and Data

3.1 Econometric Model

The gravity model was used to examine the effect of EBA on Ethiopia's exports. The use of gravity equation to explain determinants of international trade flows is traced back to the pioneering work of Tinbergen (1962), which is analogous with Newton's universal law of gravitation. The bilateral trade flows between two countries ($X_{i.j}$) is directly proportional to the gross national products of those countries (Y) and inversely proportional to the distance (D) between them. Thus, the standard gravity equation is typically given as:

$$X_{ij} = \frac{(Y_i)^{\alpha}(Y_j)^{\beta}}{(D_{ij})^{\theta}} \qquad (\mathbf{1})$$

This gravity equation has exhibited considerable empirical robustness and explanatory power to describe trade flows with formal theoretical foundation since 1979 (Anderson, 1979; Bergstrand, 1985), which is commonly expressed as:

$$X_{ij} = \beta_0 (Y_i)^{\beta_1} (Y_j)^{\beta_2} (D_{ij})^{\beta_3} (A_{ij})^{\beta_4} u_{ij} \qquad \mathbf{(2)}$$

Where, X_{ij} is the export flow from country *i* to country *j*; Y_i and Y_j are nominal GDP of the country *i* and *j*; D_{ij} is the distance from the economic centre of country *i* to *j*; A_{ij} is all other factors that either support or hinder trade between *i* and *j* such as bilateral real exchange rate (RER_{ij}), domestic population size (N_i), partner country population size (N_j), common language ($LANG_{ij}$), border (BOR_{ij}), and preferential trade arrangements; and u_{ij} is a log-normally error term.

The gravity specification can be applied to explain the effects of free trade agreements on trade flows (Baier & Bergstrand, 2007). Thus, to empirically examine the effect of the EBA's trade preference on the exports of Ethiopia, the generalized gravity model in equation (2) above is presented in a log-linearized form by including bilateral real exchange rate, population size and dummies for

common language, border, and preferential trade arrangements for country pair *(i, j)* at time *t* as follows:

$$lnX_{ijt} = \alpha + \beta_1 lnY_{it} + \beta_2 lnY_{jt} + \beta_3 lnN_{jt} + \beta_4 lnD_{ij} + \beta_4 lnRER_{ij} + \gamma_1 EBA_{ij} + \gamma_2 LANG_{ij} + \gamma_3 BOR_{ij} + \varepsilon_{ijt} \quad (\mathbf{3})$$

The bilateral export flow of Ethiopia, the dependent variable, is proxied as the aggregated total bilateral exports in U.S dollars to its partners. The income variable is the nominal GDP in U.S dollars for Ethiopia and trade partners. The income (GDP) represents both the productive and consumption capacity of trading partners that significantly affects the trade flows among them. Trade can be created from economies of scale when the partner countries are large and of similar economic size, and from comparative advantage if a significant difference in factor endowment exists (Leamer, 1995). As high-income consumers tend to consume larger budget shares of capital-intensive goods, high income countries produce disproportionate amounts of capital-intensive goods and trade more than average with each other and less than average with low-income labor-abundant countries (Deardorff, 1998). Indeed, the high level of domestic income indicates a high level of availability of goods to be exported and high partner's income may potentially create more demand for exports, and thus, $\beta_1 \; and \; \beta_2 > 0$.

Population variable is proxied as the total population size of each country. The sign of population is ambiguous. In fact, population size represents the market size of each country so that the larger countries trade more. Nevertheless, a larger exporting country in terms of population may need more production to satisfy domestic demand and export less. Similarly, large importing countries may import more because they cannot satisfy all domestic demand with their own production. The domestic population size variable was initially estimated, but omitted from final estimation due to potential multicollinearity problem with domestic income. The domestic income is nearly perfectly correlated with domestic population size variable (Table 2).

The real exchange rate is the bilateral exchange rate of Ethiopia against its trade partners adjusted for their relative price levels, and it is determined as:

$$RER = E\left(\frac{P}{P^*}\right) \quad (\mathbf{4})$$

Where, E is nominal bilateral rate, expressed as the units of foreign currency per unit of home currency, P is the price level of the home country, and P^* is the price level in the foreign country. An increase in value of the real exchange rate indicates an appreciation of the home currency, and it is expected to have a negative impact on export growth due to the resulting loss of international competitiveness. However, Berthou (2008) stated that the elasticity of real exchange rate may depend on the quality of institutions in destination country, the distance between trading partners, and the custom efficiency in both exporting and importing countries.

The distance variable is proxied as weighted distances between trade partners, and can be computed using bilateral distances between the biggest cities of trading partners, those inter-city distances being weighted by the share of the city in the overall country's population (Mayer & Zignago, 2011). The bilateral trade flow is nearly inversely proportional to distance between trading partners, that is, $\beta_4 < 0$. The long geographical distance between trading partners may represent higher transportation costs and more risks of trade. The negative trade impact of distance rose around the mid-20th century and has remained persistently high though some believe that technological change has revolutionized the world economy causing the impact of spatial separation to decline or disappear (Disdier & Head, 2008).

The EBA trade preference is a dummy variable, and 1 is for EU member countries that offered EBA preference to Ethiopia, otherwise zero. The non-reciprocal trade preference is assumed to create export opportunities for beneficiary countries. The preferential trade agreements may help to address some priority needs of low-income countries such as strengthening trade policy, improving investment climate and maintaining a competitive exchange rate (Hoekman, 2011), which ultimately may help to improve exports.

The border and language variables are proxied as dummies. Sharing border and common language may result in more trade between partners, and thus, $\gamma_2 \; and \; \gamma_3 > 0$. Trade agreement between natural trading partners (geographically proximate nations) results in a considerable amount of trade creation due to lower transportation costs, and may also reduce the risk of large amount of trade diversion (Krugman, 1991; Summers, 1991). Sharing common language is also expected to have a strong positive impact on bilateral trade flows as proficiency in the same language may facilitate communication and makes economic transactions easier and transparent (Fidrmuc & Fidrmuc, 2016).

Moreover, the dummy for regional trade agreements (RTAs), that is, COMESA, variable was initially estimated, but omitted from final estimation model due to potential multicollinearity problem with border variable.

3.2 Data Sources and Testing Tools

The effect of EBA on the exports of Ethiopia is examined using a panel of bilateral trade data of Ethiopia with its 34 major trade partners over the period 2001 – 2019. The trade statistics (bilateral exports in U.S dollars) is retrieved from International Trade Center (ITC) database. The importing countries comprise 34 major trade partners of Ethiopia including EU-15 countries. The trade partners were selected based on their trade share in Ethiopia's export and the availability of consistent bilateral trade statistics over the study period. To address the issue of model estimation in log-linearized form, the major trade partners with consistent and non-zero trade data over the study period were included. Some major trade partners of Ethiopia such as Somalia were omitted from the sample because of data unavailability. The importing countries with their respective share in Ethiopia's exports are listed in the Appendix-I. The data for nominal GDP and population size were retrieved from the World Bank's World Development Indicators (WDI) 2020 database, while the bilateral exchange rate data were obtained from the UN Comtrade 2020 database. Data for other variables including the geographical distance (weighted distance), common language and border were obtained from the CEPII database. The dummy for EBA is obtained from WTO database on regional trade agreements.

Using these data, the descriptive statistics and correlation results are presented in Tables 1 and 2, respectively. The correlation results show that bilateral export has a moderate positive coefficient with income and population size variables, while a negative coefficient with distance, EBA and common language.

Table 2: Descriptive summary statistics

Variable	lnX	lnY_i	lnY_j	lnN_i	lnN_j	lnD	$lnRER$
Mean	9.694	24.093	26.913	18.289	17.169	8.468	4.759
Std. Dev.	1.665	0.834	1.722	0.152	1.593	0.659	0.237
Min	2.639	22.784	20.165	18.037	13.505	6.252	4.180
Max	13.285	25.289	30.693	18.535	21.058	9.440	5.565

Source: STATA Outputs

Table 3: Correlation results

	lnX	lnY_i	lnY_j	lnN_i	lnN_j	lnD	$lnRER$	EBA	$LANG$	BOR
lnX	1.000									
lnY_i	0.396	1.000								
lnY_j	0.383	0.186	1.000							
lnN_i	0.391	0.990	0.183	1.000						
lnN_j	0.319	0.042	0.682	0.422	1.000					
lnD	-0.106	0.000	0.744	0.000	0.385	1.000				
$lnRER$	0.204	0.827	0.116	0.811	0.085	0.029	1.000			
EBA	-0.141	0.000	0.133	0.000	-0.268	0.152	-0.047	1.000		
$LANG$	-0.163	-0.000	0.088	0.000	0.116	0.151	-0.006	-0.278	1.000	
BOR	0.013	-0.000	-0.619	0.000	-0.247	-0.684	-0.060	-0.209	0.113	1.000

Source: STATA Outputs

For panel and time series data analysis, determining whether the data series is stationary or not is critical since non-stationary data could provide spurious regression results. However, panel unit root tests suffer from poor size and power distortions when the time-series dimension is too small compared to cross-sectional dimension N. Indeed, the Levin, Lin and Chu (LLC) test has smaller size distortions and would offer improved unit root results for short panels (Hlouskova & Wagner, 2006). Thus, unit root tests are conducted for time-variant variables using the LLC and ADF-Fisher Chi-square tests. The unit root results, presented in Table (3) below, show that all data series have no unit root at level under both tests albeit the domestic income variable seems to have a unit root at level under Fisher test, but stationary at first difference.

Table 4: Unit Root Tests Results

Tests	Unit Root	Variables				
		lnX	**lnY_i**	**lnY_j**	**lnN_j**	**lnRER**
LLC	Level	-8.3822	-8.2055	-9.1165	-7.5623	-2.6987
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0035)
	1st Diff.	-10.1344	-13.0945	-9.8502	-6.3292	-18.9766
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Fisher Type – ADF	Level	49.6126	0.9142	21.1829	24.2855	5.2573
		(0.0000)	(0.1803)	(0.0000)	(0.0000)	(0.0000)
	1st Diff.	18.4443	31.0619	25.7798	9.4246	36.5452
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Decision		I(0)	I(0)	I(0)	I(0)	I(0)

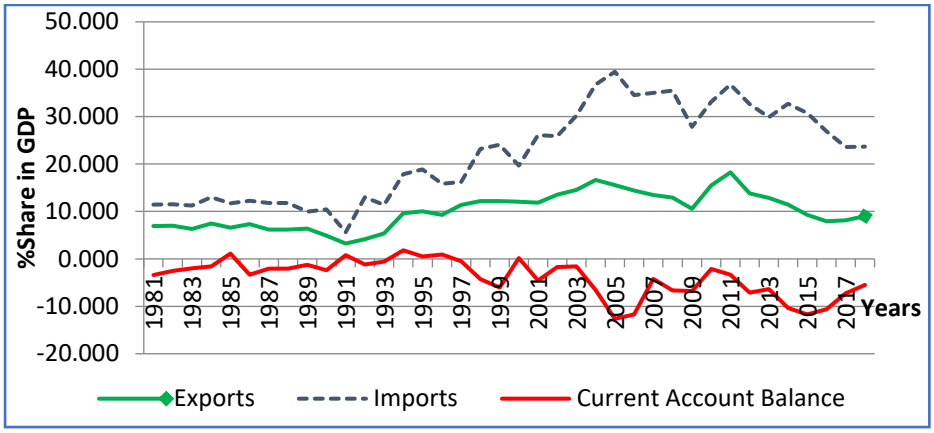
Note: Unit root estimations are with drift term. P-values are in parenthesis.

4. Empirical Results

4.1. Trade Performance of Ethiopia

The total exports of Ethiopia as a percentage of GDP have been incessantly deteriorated for the last decade. Such poor trade performance is partly explained by an overvalued exchange rate, poorly diversified export structure, low sector productivity, and high trade costs associated with poor logistics. The Ethiopian Birr remains overvalued as the exchange rate regime intended to facilitate the country's economic transformation process through infrastructural development, which requires affordable imports of raw materials and machinery (Deren & Motamed, 2020). But an overvalued currency could negatively affect international competitiveness and export growth as it may price export goods artificially high, which would ultimately hinder economic growth and worsen income inequality (Rodrik, 2008). Accordingly, due to a relative reduction in imports of goods and services as a share of GDP, the current account and trade balance have been incessantly in deficit for more than two decades despite some improvement in very recent years.

Figure 2: Total Exports and Imports of Goods and Services as a Share of GDP



Source: World Development Indicators Database, 2020

Regarding trade partners, the majority of Ethiopia's merchandise exports destined to Asia, mainly China and Saudi Arabia, over the last decade with a vast market share in the region accounting for about 43.45 percent of the country's total exports, followed by Europe with 22.92 percent in 2019. Historically, the leading trade partners for Ethiopia are the EU member countries and accounted even more than half of total exports in 1995. However, the share of exports to the Europe market dropped by 10.12 percent since the introduction of EBA scheme in 2001 while the share of exports to the Asian Market increased by about 5 percent over the same period. However, Ethiopia's trade with Africa has not showed any improvement for the last two decades (Table 4). The overall trends of share of exports to major destinations indicate that the EBA scheme seems failed to help Ethiopia to improve her exports to the EU market rather forging to developing markets particularly the emerging Asian economies.

Table 5: Total Exports of Ethiopia by Destination Regions (in % share)

No.	Regions	Years					
		2001	2005	2010	2015	2018	2019
1	Asia	38.51	41.36	43.42	39.82	43.95	43.45
2	Europe	33.04	36.75	33.80	30.30	23.24	22.92
3	Africa	22.27	15.56	15.88	21.17	20.85	21.01
4	America	5.90	6.08	6.00	7.80	11.10	11.80
5	Oceania	0.28	0.25	0.90	0.91	0.86	0.82
	Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: International Trade Center and UN Comtrade Database, 2020

Thus, the EBA, the most generous trade preference scheme, seems unhelpful in improving Ethiopia's export partly due to domestic supply-side constraints and structural problems. Ethiopia's export sector remains undiversified and remains highly dependent on few traditional commodities such as coffee, oilseeds, live plants and cut flowers, raw hides and skins, live animals, and meat and meat products (see Table 5). All these primary products are highly seasonal and vulnerable to domestic economic, political, social and environmental factors such as inflation, civil conflicts and internal displacements, weather conditions. The Ethiopia's export also depends on partner's economic conditions, commodity demand in the export market including the EU, and production capacity and institutional quality of other primary commodity supplying developing countries to the global market, the EU in particular. Moreover, the trade costs remain high due to poor logistics and infrastructure. According to the World Bank data, Ethiopia is still ranked 126th in the world with an overall logistics performance index (LPI) score of 2.38 in 2016, which even dropped from a LPI of 2.41 in 2010.

Table 6: Structure of exports of Ethiopia by major items (in % share)

No	Product Type	2001	2005	2010	2015	2018	2019
1	Coffee	38.13	38.93	29.81	29.74	25.26	31.80
2	Oil seeds and grains	9.61	20.32	18.40	16.73	21.18	18.50
3	Edible vegetables	6.98	4.06	10.27	18.40	18.26	4.53
4	Live trees, plants and Cut flowers	0.04	1.36	0.79	8.06	0.65	10.28
5	Articles of apparel, clothing accessories	0.20	0.26	0.85	2.41	3.06	11.54
6	Machinery & mechanical appliances	0.44	0.30	3.83	0.09	2.64	4.97
7	Pearls, precious stones, metals	1.18	4.86	13.29	5.79	3.03	3.00
8	Raw hides, skins and leather	18.80	7.45	4.86	3.24	3.26	2.66
9	Footwear, gaiters and parts	0.03	0.10	0.58	1.24	1.71	1.39
10	Meat and edible meat	0.39	2.03	3.58	3.53	6.57	1.14
11	Others	24.20	20.33	13.74	10.77	14.38	10.19
	All products	***100.00***	***100.00***	***100.00***	***100.00***	***100.00***	***100.00***

Source: International Trade Center Database, 2020

4.2 Regression Results

The traditional Ordinary Least Square (OLS) and Fixed Effect (FE) methods are commonly used in the existing empirical literature to estimate the effect of PTAs on export performance using the gravity model specification in log-linear form. However, the choice of the proper panel data model depends on the nature of data and characteristics of the models available for panel estimation. The panel model choice generally depends on the assumption about the likely correlation between the cross-section specific, error component and regressors.

The FE model would be a proper specification to make inferences restricted to the behaviour of cross-sectional units though it may not be feasible for very large units (too many dummies) due to large loss of degrees of freedom and possible multicollinearity among regressors (Baltagi, 2005; Gujarati & Porter, 2009). The random effect (RE) model would produce superior estimates of coefficients (β) if the dataset has few observations per unit and the correlation between the independent variable and unit effects are relatively low (Clark & Linzer, 2015). Despite its omitted variable bias, the RE method can offer what the FE method promises and even more by incorporating time-invariant variables with random coefficients and cross-level interactions. The RE approach is nearly preferable because the FE model, by effectively cut out the key time-invariant variables, provides overly simplistic and impoverished results that can lead to misleading interpretations (Bell & Jones, 2015). The assumption of normally distributed random intercepts, which may basically not, introduces only modest biases. The only reason to opt FE model is when higher-level variables are of no interest, the true data generating process (DGP) has no random slopes, and there are so few level-2 entities (that is, countries) in that random slope are unlikely to be estimable (Bell, Fairbrother, & Jones, 2018).

Although the FE approach cannot be undermined, the RE model should be considered if it is consistent and there is an interest of estimating the effect of time invariant variables such as EBA dummy. In fact, the estimated Hausman and BP Lagrangian Multiplier (LM) test results presented in Table (6) below confirms that the RE model is preferable against the FE and pooled OLS methods, respectively. Hence, the RE model is used to estimate the effect of EBA trade preference on the Ethiopia's exports based on the generalized gravity equation presented in equation (3). The RE with AR (1) remainder disturbance model (Baltagi & Liu, 2012) is also estimated for robustness.

Table 7: Hausman and BP-LM Tests for Random Effect

Test	Purpose	Chi-Sq. Statistic	Prob.
Hausman Test	Fixed vs. Random effect	2.01	0.7339
BP Lagrangian Multiplier test	Random vs. pooled OLS	2096.97	0.0000

Source: STATA Estimation Outputs

The RE regression results are presented in Table (7) below along with the RE with AR (1) remainder disturbance model results. The regression results, as expected, generally revealed that Ethiopia's export would increase for a higher domestic income and trade partner's income, but decrease for an increase in partners' population size and longer distance with trading partners. The estimation results also confirmed that trade partners' population size, the EBA scheme and sharing common language would have a negative effect on export performance for Ethiopia. The coefficients of the bilateral real exchange rate and border variable have the expected negative and positive signs, respectively, but statistically insignificant. The estimation results generally support the empirical findings, among others, of Persson and Wilhelmsson (2013) and (Gradeva and Martínez-Zarzoso (2009).

The positive impact of domestic income on the export value suggested that Ethiopia should improve the domestic productive capacity by altering the behind-border supply-side constraints such as improving trade infrastructure and logistics, strengthening bureaucratic quality and government effectiveness, and creating conducive investment climate for entrepreneurial growth and export diversification particularly in the value-added sectors. Similarly, the country should take advantage of the positive impact of high-income growth in her trade partners' economy through proper macroeconomic policies aligned with exchange rate regime. In addition, the negative effect of distance variable indicated that Ethiopia should better strengthen its beyond-border trade policies and relationships more with geographically proximate partners.

Table 8: Random Effect GLS Estimation Results

	Random Effect GLS			RE with AR (1) Disturbances		
Wald chi^2(8):		253.10			359.77	
Prob_chi^2 :		0.0000			0.0000	
$\boldsymbol{lnX}$	**Coefficients**	**Std. Error**	**p-value**	**Coefficients**	**Std. Error**	**p-value**
lnY_i	0.4132	0.1628	0.011	0.3618	0.1104	0.001
lnY_j	1.2549	0.2126	0.000	1.2765	0.1450	0.000
lnN_j	-0.2898	0.1278	0.023	-0.3051	0.1337	0.022
lnD	-1.8846	0.3105	0.000	-1.8838	0.3604	0.000
$lnRER$	-0.3386	0.3718	0.362	-0.1604	0.2551	0.529
EBA	-1.0197	0.3559	0.004	-1.0624	0.3452	0.002
$LANG$	-0.8718	0.3334	0.009	-0.8556	0.3490	0.014
BOR	1.3968	1.0825	0.197	1.4449	0.9056	0.111
$\_const$	-10.8946	3.2898	0.001	-10.8472	3.0573	0.000
Rho_ar				0.6365		
sigma_u	0.8868			0.7778		
sigma_e	0.6374			0.5073		
Rho	0.6593					
rho_fov				0.7016		
Theta				0.6462		

Source: STATA Estimation Outputs

Moreover, the EBA preferential access and common language variables have negative and statistically significant coefficients. In fact, LDCs could not be competitive enough in the global market despite comprehensive non-reciprocal preference schemes like EBA due to their weak domestic supply-side policies, poor trade infrastructures, and export concentration on few primary agricultural commodities. For countries with complex behind-border trade problems like Ethiopia, trade may be diverted to other countries for two reasons. First, Ethiopia still should compete with other LDCs to enter into the EU market, where the "Least developed" group is an official classification not a neutral measure of poverty. The EBA policy was actually adopted for essentially political, not development, motives (Page & Hewitt, 2002). Second, Ethiopia has significant trade with other developing and developed countries other than the EU.

Complying with EU product standards and quality practices may not be easy for Ethiopia's exporters.

Thus, the RE estimation results undeniably confirmed the argument that export growth and sustainable development in poor countries are largely determined by the countries themselves. Both financial aid and preferential access to the developed markets play limited role to trigger trade and economic growth particularly in LDCs (Birdsall, Rodrik, & Subramanian, 2005). In particular, the non-reciprocal preferential access programs of the OECD countries to the developing countries have not been very effective due to civil conflicts, supply side weaknesses, and inappropriate macroeconomic policies with overvalued currencies, corruption, governance problems, and institutional weaknesses that inhibit local businesses from taking advantage of market opportunities (Hoekman, 2011). Effective integration of the LDCs into the world trading system requires specific instruments aimed at improving the productive capacity and competitiveness of export producers in preference receiving countries.

5. Conclusions

The study examined the effect of the EBA trade preference on Ethiopia's exports. The empirical results using RE estimations generally revealed that the EBA scheme has a negative and significant effect of the export performance of Ethiopia. The country's export performance may improve for a higher domestic income and an increased partner's income, but deteriorate for a higher trade partners' population size, the EBA scheme, a longer distance and common language sharing with trading partners. The current account balance and total exports as a percentage of GDP of Ethiopia have been incessantly deteriorating for decades. The country's global competitiveness remains at stake due to unsatisfactory export diversification and immense dependence on traditional agricultural commodities. The share of Ethiopia's trade to the EU, the traditional leading trade partner, has been declining despite the extensive non-reciprocal preferential market access opportunities under EBA scheme since 2001. The market for major primary products shifted to the emerging Asia mainly China. The ineffectiveness of the EBA preference may be partially due to the existing poorly diversified export structure, domestic supply-side constraints and poor trade logistics. Thus, Ethiopia should enhance domestic production capacity, improve trade infrastructures and logistics, and diversify export items towards the

industrial or manufacturing sector with a favourable investment climate for export-oriented value-added economic activities. This would help the country to ensure long-run global competitiveness and to effectively reap the trade opportunities of NRTPs from developed economies, the EU in particular.

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Appendix-I: Average Exports of Ethiopia to Major Trade Partners (%share in 2018)

No.	Partner	%share	No.	Partner	%share
1	China	7.12	19	Switzerland	0.05
2	Saudi Arabia	6.77	20	Thailand	0.24
3	USA	10.21		**EU 15**	
4	United Arab Emirates	4.68	21	Netherlands	7.14
5	Djibouti	4.90	22	Germany	6.06
6	Israel	3.82	23	Belgium	2.56
7	Japan	3.72	24	Italy	2.16
8	India	2.43	25	United Kingdom	1.55
9	Korea, Republic of	1.71	26	France	1.02
10	Turkey	1.82	27	Spain	0.57
11	Indonesia	1.34	28	Sweden	0.27
12	Kenya	1.06	29	Portugal	0.29
13	Jordan	0.77	30	Greece	0.28
14	Australia	0.71	31	Finland	0.15
15	Canada	0.68	32	Denmark	0.04
16	Singapore	0.37	33	Ireland	0.02
17	South Africa	0.43	34	Austria	0.03
18	Egypt	0.51			

Source: International Trade Centere Database (2020)

Appendix-II: Regression and Diagnostic Tests Results using STATA

I. The Hausman Test Results

```
. hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+----------------------------------------------------------------
        lnYi |   .3593111     .4131865      -.0538755        .0633987
        lnYj |   1.307178     1.254948       .0522295        .0894971
        lnNj |  -.1961946    -.2898071       .0936125        .3427564
       lnRER |  -.2265693    -.3386094       .1120402        .1185673
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        2.01
                Prob>chi2 =      0.7339
```

II. The BP LM Test Results for Random Effects

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        lnX[country1,t] = Xb + u[country1] + e[country1,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                     lnX |   2.773423        1.66536
                       e |   .4063533       .6374585
                       u |   .7864289       .8868082

        Test:   Var(u) = 0
                             chibar2(01) =  2096.97
                          Prob > chibar2 =   0.0000
```

III. The Random Effect GLS Estimation Results

```
. xtreg lnX lnYi lnYj lnNj lnD lnRER EBA LANG BOR, re robust

Random-effects GLS regression                   Number of obs      =       646
Group variable: country1                        Number of groups   =        34

R-sq:                                           Obs per group:
     within  = 0.5830                                         min =        19
     between = 0.6428                                         avg =      19.0
     overall = 0.6227                                         max =        19

                                                Wald chi2(8)       =    253.10
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

                                 (Std. Err. adjusted for 34 clusters in country1)
------------------------------------------------------------------------------
             |               Robust
         lnX |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        lnYi |   .4131865   .1628183     2.54   0.011     .0940685    .7323046
        lnYj |   1.254948   .2126318     5.90   0.000     .8381977    1.671699
        lnNj |  -.2898071   .1278484    -2.27   0.023    -.5403854   -.0392289
         lnD |  -1.884608   .3104815    -6.07   0.000     -2.49314   -1.276075
       lnRER |  -.3386094   .3718445    -0.91   0.362    -1.067411    .3901924
         EBA |  -1.019695   .3559353    -2.86   0.004    -1.717315   -.3220741
        LANG |  -.8717805    .333435    -2.61   0.009    -1.525301   -.2182599
         BOR |   1.396844   1.082493     1.29   0.197    -.7248032     3.51849
       _cons |   -10.8946   3.289805    -3.31   0.001     -17.3425   -4.446697
-------------+----------------------------------------------------------------
     sigma_u |  .88680824
     sigma_e |  .63745846
         rho |  .65932313   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

IV. The Random Effect with AR(1) Remainder Disturbance Estimation Results

```
. xtregar lnX lnYi lnYj lnNj lnD lnRER EBA LANG BOR, re rhotype(dw)

RE GLS regression with AR(1) disturbances       Number of obs      =       646
Group variable: country1                        Number of groups   =        34

R-sq:                                           Obs per group:
     within  = 0.5829                                         min =        19
     between = 0.6399                                         avg =      19.0
     overall = 0.6204                                         max =        19

                                                Wald chi2(9)       =    359.77
corr(u_i, Xb)      = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
         lnX |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        lnYi |   .3618118   .1104421     3.28   0.001     .1453493    .5782744
        lnYj |    1.27647   .1450034     8.80   0.000     .9922682    1.560671
        lnNj |  -.3050869   .1336942    -2.28   0.022    -.5671228   -.0430511
         lnD |   -1.88379   .3603854    -5.23   0.000    -2.590133   -1.177448
       lnRER |  -.1604117   .2551161    -0.63   0.529    -.6604301    .3396067
         EBA |  -1.062407   .3452008    -3.08   0.002    -1.738988    -.385826
        LANG |  -.8556455   .3490259    -2.45   0.014    -1.539724   -.1715672
         BOR |   1.444953   .9055701     1.60   0.111    -.3299322    3.219837
       _cons |  -10.84718    3.05731    -3.55   0.000     -16.8394   -4.854965
-------------+----------------------------------------------------------------
      rho_ar |  .63655147   (estimated autocorrelation coefficient)
     sigma_u |  .77778647
     sigma_e |  .50727039
     rho_fov |  .70157637   (fraction of variance due to u_i)
       theta |  .64618544
------------------------------------------------------------------------------
```

Determinants of Commercial Bank Deposit Growth in Ethiopia

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Abstract

The study analysed the short and long-run impacts of endogenous and exogenous factors affecting deposit growth of the Commercial Bank of Ethiopia from 1974/75 - 2013/14. We employed the Vector Error Correction Model to establish the causal relationship among the variables of the study. Results show that exchange rate and branch expansion positively influence deposit growth contemporaneously both in the short-run and long-run while interest rate maintains positive but insignificant impact both in the long-run and short-run. Population and economic growth exhibit a positive relationship with deposit growth but significant only in the long-run. Moreover, inflation maintained a positive and significant impact in the long-run but negative in the short-run. Using the Granger causality test, it was found out a unidirectional causal flow from economic growth to deposit without any feedback while deposit growth has a bidirectional causality with branch expansion and economic growth implicating inflation affecting economic growth through investment. Finally, with error correction -0.0678, full adjustment from actual deposit to equilibrium would require about 15 years, implicating a slow speed of adjustment in every following year.

Keywords: deposit growth, VECM, short run, long run, bank
JEL Classification: G21

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1. Introduction

A sound, dynamic, and competitive financial sector is essential to promote economic growth and reduce poverty by mobilizing savings and allocating resources efficiently (Bayiley, 2013). Banks as financial intermediaries also provide savers a channel to diversify the risk of holding financial assets and permit investors to access financial resources that would otherwise be unavailable. In this process, banks most importantly in developing economies connect customers with capital deficits to customers with a capital surplus. In so doing, banks eventually facilitate the efficient use of this very scarce resource, ignite economic competition, integrate commodity markets, and above all spur economic growth (Phan et al., 2020).

Globally, the banking sector assumes the largest share of the financial system, and it plays an important role in all aspects of the national economy (Falkena et al., 2004; Phan et al., 2020). In Ethiopia, banks are the most dominant players in the country's financial system accounting for about 95% of the total financial sector assets (Babu et al., 2020; Alemu et al., 2021). More into these banks account for about 93 percent, 98 percent, and 92 percent of the total assets, deposits, and loans of the financial sector respectively in the year 2006 while microfinance companies hold 4 percent of assets, 2 of deposits, and 8 percent of loans, insurance companies hold only 3 percent of 2 total assets (Bayiley, 2013).

As of 2021, the number of commercial banks operating in the country reached 19 of which 17 are private the rest state-owned. During the year 2020/21, these banks opened 199 additional branches raising the total branch network of the country to 7096. As a result, the bank branch to population ratio becomes 1:14514.9 in 2013/14 (NBE Annual report, 2020/21). The total capital of the banking system amounted to Birr 125.1 billion, of which state-owned banks accounted for 46.4 percent and private banks 53.6 percent.

In a bid to improve the share of internal borrowing and reduce dependence on external sources in the financing of priority sector investments, the National Bank of Ethiopia, for example, has made it a requirement for private banks to buy federal government bonds amounting to 27% their loan portfolio. Accordingly, most private banks have identified deposit mobilization as the most important indicator of bank performance. In most private banks, for instance, meeting deposit targets by managers account 50% of the total branch performance. More into this, though CBE is waived from the 27% investment requirement in a federal government bond, as a state-owned bank expected of

promoting state interest it has set a meeting of deposit targets as 100% performance achievement.

Through relentless efforts are made to mobilize deposits and commendable results have been achieved, there is an unprecedented mismatch between demand and supply of financial resources in the Ethiopian banking sector. As a result, there have been many cases whereby private companies and small business firms complain about the inadequacy of credit facilities (World Bank Group, 2011) calling for efficient and coordinated deposit mobilization strategies.

Taking into consideration the fast growth of the Ethiopian economy and lower propensity to save (Fenta et al., 2017; Bekata, 2016), it has become increasingly difficult to satisfy the credit need of small businesses and the private sector. Hence, there is a need to understand the factors affecting deposit mobilization and develop an effective deposit mobilization strategy. Although, deposit mobilization strategies alone could not bring about long-term and sustainable deposit growth, deposit mobilization strategies should be complemented with quality service. Therefore, this study analyzed factors affecting deposit growth in Ethiopia for the country to sustain its growth in the foreseeable future.

There is a plethora of research output related to the current study. However, not only are the findings inconsistent but also, they are contradictory and thus, inconclusive (Jacobs, 2013). For example, a study by Almaqtari et al. (2018) by using a Panel data model from 2008 to 2017 for 69 Indian Commercial Banks found that the number of branches, bank size, and operational efficiency were the most important bank-specific determinants that affect the deposit and profitability of Indian commercial banks. A study by Muhindi and Ngaba (2018) found that the number of branches that a bank operates has a significant effect on financial performance of financial institutions because they are costly. They concluded with brick-and-mortar branches, banks must hire staff, pay for rent and provide security that increases the likelihood of loss than making a profit.

Inflation, interest rate, exchange rate, demographic composition, and branch expansion are some of the most important variables known to explain deposit growth though results are inconsistent. For example, some argued that branch expansion positively affects deposit mobilization; real interest rate has little or no impact on deposit mobilization when the spread between deposit rates and inflation is narrow; and interest rate and inflation rate do not affect deposit growth (Gemedu, 2012; Boyd et al., 2001). Others posit both branch expansion

and inflation negatively influence private saving in the short-run; and real per capita income and urbanization ratio have a positive effect (Gebeyehu, 2019; Menza, 2019). Deposit growth is positively related to bank income, loans, liability, and advance granted, and CPI (Tessema, 2019; Rashid, 2020).

Exchange rate negatively influenced bank deposits (Ngula, 2012; Hasanov et al., 2018; Tho'in and Prastiwi, 2019). A common phenomenon in developing economies where there exists a concern on currency volatility than the depreciation of the domestic currency. The rise in exchange rates might lead to lower levels of deposit as savers may withdraw their money deposited in banks to substitute domestic currency for foreign currency as a better means of saving. While inflation negatively influences deposits, interest rate has a positive but insignificant relationship with a deposit (Ngula, 2012; Bernard, 2019). On the other hand, a study by Ogbuabor and Nwosu (2017) by using Error Correction Model found that in the short-run, interest rate has no impact on deposit growth rate but it has a positive and significant impact in the long run.

The arguments presented in the previous paragraphs highlight lack of convergence in the claims of various researchers. The current research, therefore, attempted to examine the short and long-run impacts of endogenous and exogenous factors on deposit growth of Commercial Bank of Ethiopia for the period 1974/75 - 2019/20. The study also attempted to establish the causal relationships that exist between the antecedents and the consequent. In the empirical VECM model, parsimony was sought and the most commonly used control variables by various researchers including economic growth, inflation, interest rate, exchange rate, population growth, and branch expansion were used to establish the causal relationship and measure their impact on the outcome variable.

The rest of the article is structured as follows: section II reviews relevant extant theoretical and empirical literature. Section III presents the empirical approach. Section IV explains the research findings. Finally, section V summarizes the conclusions of the paper and highlights policy implications.

2. Empirical Review and Theoretical Framework

Financial systems play a central role in the capital formation endeavour of nations. Capital formation is also very much connected to economic growth through the efficient allocation of scarce resources. Banks as a crucial part of the financial system aid the mobilization of savings from saving-surplus economic

units and channel it to saving-deficit economic units. Such a process triggers capital formation and thereby economic growth.

The act of investing is usually limited to a particular class of innovative and growth-oriented entrepreneurs who have the acumen, technical skills, market-related information, and the predisposition to use them. However, saving is largely spread among the mass who lack these skills, resources, as well as attributes that make the role of financial institutions such as banks instrumental in capital formation, economic growth, and job creation.

History tells that the free market has existed in Ethiopia during the Imperial regime. Ethiopia has a market-led economic policy although the direct role of the government in the economy was not minimal. There is a general view that in Ethiopia, there exists monopolistic competition among banks in terms of price and investment opportunity although the competition in terms of price is relatively weak (Sime et al., 2013). Put in the order of their importance, Ethiopian banks compete in terms of service quality and efficiency including the use of technological advances, branch network expansions, advertising, and pricing (Tesfaye et al., 2019).

Deposits mobilization is one of the main functions of banks which they channel from those who have less economic opportunities to those who have higher economic opportunities contributing to the overall being of the economy. Deposit mobilization has a unique role for a developmental state economy as it helps to channel funds to priority sectors essential for long-term economic transformation. It has increasingly become difficult for developing economies to get adequate funds through aid and external borrowing as they are usually subjected to political conditions.

At the empirical front, research on what factors drive deposit growth is short, as most studies are researched towards explaining the determinants of savings behaviour. Whereas the microeconomic factors relate to bank-level variables, the macroeconomic level determinants reflect the overall macroeconomic fundamentals of a country. In general, the determining factors of bank deposits and savings are classified into microeconomic and macroeconomic factors.

The successful functioning of commercial banks depends on the extent of the funds they mobilize. Deposits constitute a reliable and low-cost source of funds for banks in financing their operations and asset portfolio. Financial resources of banking systems are naturally provided by public deposits (Namazi and Salehi, 2010; Bolarinawa, Obembe, and Olaniyi, 2019). Deposits play an

important role for both consumers and financial services providers (Stulz, 2019). For example, in Europe, deposits account for approximately 60% of bank funding (Global financial markets, 2012) and 87.7% in Africa (IMF Country Report 15/55).

Deposits are not only a crucial funding instruments for banks; they are one of the most important forms of investment for private individuals (Ahlswede et al., 2012). For commercial banks, they are the oldest, most stable, and significant source of funding. In the traditional banking model, deposits are the counterparts of loans. Moreover, deposit mobilization is the most important priority for developing economies whose growth performance is subject to domestic saving potential including financing of mega projects such as the Great Ethiopian Renaissance Dam (Roy, 2003; Duguma and Han, 2018; Ogechi, 2018).

Exchange rate and Total Deposit

Exchange rate plays an increasingly significant role in any economy as it directly affects domestic price level, the profitability of traded goods and services, allocation of resources, and investment decisions. These days, the stability of the exchange rate is a formidable bedrock of all economic activities. Since the adoption of the Structural Adjustment Programme (SAP) in 1996, the exchange rate regime of the Ethiopian government has been changed from fixed to a managed float. Before 1991, the Birr was pegged to the US Dollar at a fixed rate of $1= 2.07 Birr. The Ethiopian Birr was devalued by 58.6%, from 2.07 to 5.00 per dollar, by the Transitional Government of Ethiopia in 1992 (Geda, 1999; Kassie, 2015). Since a pegged exchange rate does not necessarily represent a currency's true market value, the EPRDF replaced the fixed exchange rate system with a floating exchange rate system (Amdework, 2021; Asratie, 2021; Yitayaw, 2021; Ayele, 2021).

Exchange rate negatively influenced bank deposits (Ngula, 2012; Alemayehu, 2015; Hasanov, 2018; Tho'in, 2019). Similar findings have been exhibited by Lu et al (2021), and Sitompul et al (2021). Moreover, Taiwo and Adesola (2013) found a negative relationship between the exchange rate and bank profitability. Such a relationship is a common phenomenon in developing economies where there exists a concern on currency volatility than the depreciation of the domestic currency. For instance, a poorly functioning monetary policy framework in a flexible exchange rate regime may hamper the country’s ability to maintain macroeconomic stability and insulate the real side of the economy from shocks. Following this, a rise in exchange rate might

potentially lead to lower levels of deposit as savers withdraw their money deposited in banks to substitute for foreign currency as a better means of saving. Based on these research findings, the research hypothesizes a negative relationship between exchange rate and the bank and performance.

Inflation rate and Total Deposit

The welfare cost of inflation is a longstanding concern of monetary economics, and the recent debate about raising the inflation target lends it renewed relevance (Kurlat, 2019). One reason that inflation is costly is that other thing being equal, higher inflation induces households to reduce their money balances, forgoing some of the convenience of carrying money to conduct transactions. Siegel (1981), Boyd et al (2001), Namazi and Salehi (2010), Abduh et al (2011), Asongu (2013), Chanthol (2021) found a significant, and economically important, negative relationship between inflation and both banking sector development and equity market activity. On the other hand, a study by Pasaribu and Fitrawaty (2021) found that inflation does not affect deposit growth. Also, Agarwa and Baron (2021) using a 47-country panel found that large inflation increases tend to be followed by aggregate lending contractions and reducing the bank's branch deposit. While inflation negatively influences deposits, the interest rate has a positive but insignificant relationship with deposit growth (Ngula, 2012; Bernand, 2019). On the other hand, a study by Ogbuabor et al. (2017) by using Error Correction Model found that in the short-run, interest rate has no impact on deposit growth rate but it has a positive and significant impact in the long run.

Branch expansion and Total Deposit

Unvan and Yakubu (2020) found bank-specific factors drive bank deposits in Ghana for the period 2008 to 2017 using the random effects technique. The results show that bank size is a significant determinant of bank deposit growth. The study by Yakubu and Abokor (2020) also identified branch expansion as a significant contributor to bank deposit mobilization.

Interest rate and Total Deposit

Regarding the elements of the bank's deposit policy of the Commercial Bank of Ethiopia, it should be noted that the formation of the deposit policy is closely related to the bank's interest rate policy and regulation guided by the National Bank of Ethiopia with a minimum deposit rate. Since the deposit rate is an effective tool for attracting resources (Yakubova, 2020), Andros et al. (2020), Owolabi and Fayemi (2017), Halaskova et al. (2021), and Ilugbemi (2020) examined the effect of interest rates on the profitability of Deposit Money Banks in Nigeria from 2004 to 2018 using time series data and found that interest rate was not significant to influence bank deposit growth. A study by Hossin (2020) using co-integration and error correction models proven that there was a positive effect of deposit rate of interest rate on financial depth in Bangladesh. Özen et al. (2018) based on McKinnon-Shaw's Theory, found that investors increase their deposit investments when interest rates rise.

Real GDP and Total Deposit

An increase in the real GDP can increase the money supply and hence, result in decreasing in interest rate as well as conversely decrease Commercial Bank's Total deposit (He, 2017). As predicted by theoretical models of the paradox of thrift (Ghiaie, 2018; Degorce and Monnet, 2021), found a negative relationship between RGDP and total deposit growth rate. In addition, Koroleva et al. (2021) examined the relationship between internal determinants, external determinants, and the profitability of state-owned commercial banks using pooled regression, fixed effect, and random effect models using selected top five Chinese state-owned commercial banks between 2007 and 2019 and proven that macroeconomic factor measured by the natural logarithm of GDP negatively influences banks' profitability. Puatwoe et al. (2017) in their study found that there exists a short-run negative relationship between bank deposits and economic growth equally. However, in the long-run, relationship between bank deposits and economic growth was found to be a positive and significant relationship.

3. Research Design and Methodology

The research followed a deductive approach, quantitative method and longitudinal time horizon, and used secondary data. The research also employed an explanatory research design to establish a relationship and claim causality between the explained and explanatory variables.

Data source and type

The research used secondary annual time series data published by different financial institutions. An annualized total deposit by category of ownership and type of deposit was collected from Commercial bank of Ethiopia along with lending rate, exchange rate, and the number of branches. Annualized data of population growth, inflation, and economic growth were sourced from the Central Statistical Agency of Ethiopia. Moreover, annual publication reports of the National Bank of Ethiopia and financial magazines such as Mudaye Neway and Biritu were also used as sources of secondary data.

Variable description and hypothesis

While deposit (D) was used as the explained variable interest rate on deposits (R), an exchange rate (E), economic growth (EG), inflation (I), and branch expansion (BR), and population growth (P) were used as explanatory variables of the study after a thorough review of extant literature. Moreover, the study used over 40-years annualized economic data spanning from 1974 to 2013.

Model specification

The empirical framework of this study focused on modelling the determinants of deposit of commercial banks in Ethiopia. A variant of the determinant model can be used to evaluate the determinants of deposit and the following empirical model was formulated as presented hereunder:

$$D = \mathrm{f}(\mathrm{R}, \mathrm{E}, \mathrm{I}, \mathrm{EG}, \mathrm{P}, \mathrm{BR}) \quad \textbf{(3.1)}$$

Thus, the equivalent equation in logarithmic form would be:

$$LD = \beta_0 + \beta_1 \mathrm{LR} + \beta_2 \mathrm{LE} + \beta_3 \mathrm{LI} + \beta_4 \mathrm{LGDP} + \beta_5 \mathrm{LP} + \beta_6 \mathrm{LBR} + \varepsilon t \quad \textbf{(3.2)}$$

Where ε_t is the error term and β_0 is the constant term, β_1, β_2, β3, β4and β5 are elasticity coefficients.

Estimation techniques

The study used recent techniques in time series econometrics to analyse the determinants of deposit growth for the selected organization including co-integration and error correction method carried out within the vector autoregression (VAR) framework. First, the unit root test was conducted using

Augmented Dickey-Fuller (ADF) test. Then, a test for co-integration among variables followed, and a vector error correction model (VECM) was constructed. Wherever there was a lack of evidence for co-integration, the analyses would be based on the first differences of the variables using a standard VAR model. In a VAR model, each variable is explained by its own lagged values and the lagged values of all other variables in the system. The variables of the form y_{t-I} indicate that variable's value *i* time periods earlier and they are known as the "i*th* lag" of y_t. Suppose that we have an n-variable VAR with lags up to order p. If the variables of the system are $y_1, y_2, \ldots, y_n$, then we can write the n equations of the VAR as:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{2-2} + \cdots + \beta_p y_{t-p} + e_t \qquad (\mathbf{3.3})$$

where β_0 is a $k \times 1$ vector of constants, B_i is a $k \times k$ matrix (for every $i = 0, ..., p$) and ε_t is a $k \times 1$ vector of error terms in another way a vector autoregressive process of order k or VAR (k) for a system of 'm' variables can thus, be written in the following matrix form:

$$Y = \delta + \sum_{j=1}^{k} AjYt - j + Vt \qquad \mathbf{(3.4)}$$

There are no exogenous variables in the model. In the VAR model, several endogenous variables were considered and each endogenous variable was explained by its lagged and the lagged values of all other endogenous variables in the model. In general, a VAR model expresses current values of the endogenous variables solely as a function of lagged values of all endogenous variables in the system.

VAR model is the extension of the univariate autoregressive model to dynamic multivariate time series. It has proven to be especially useful for describing the dynamic behaviour of economic and financial time series and important for forecasting. It often provides higher forecasts to those from univariate time series models as well as it elaborates theory-based simultaneous equations models. Thus, the researchers choose the VAR model by its ability to capture the intertwined dynamics of time series data, better, systematic, and flexible approach for capturing complex real-world behaviour.

Unit root tests

Many economic and financial time series exhibit trending behavior or non-stationarity in the mean. In time series analysis, the variables are expected to be stationary with a mean of zero and constant variance. Two common trend removal or de-trending procedures are first differencing and time-trend regression. First differencing is appropriate for I(1) time series and time-trend regression is appropriate for trend stationery I(0) time series. Unit root tests are used to determine if trending data should be first differenced or regressed on deterministic functions of time to render the data stationary (Kumar et al., 2020; Webb et al., 2020).

To examine the stationary nature of the variables, an ADF test was conducted. The logarithm values of the time series data were taken before Ordinary Least Square (OLS) techniques were used for estimating the model (Dickey and Fuller, 1981). Doing so is important to transform the nonlinear data into a linear form. As all variables in the system have to be stationary in the VAR model before estimation, it is necessary to test the stationary of each data series. Under the ADF test, the null hypothesis of a unit root, H0: b1 = 0 (unit root), is tested using the following specification:

$$\Delta Y = b_0 + b_1 Y t_{t-1} + \sum_{j=1}^{k} \theta j \Delta Y_{t-i} + \varepsilon t \qquad \mathbf{(3.5)}$$

Where y is the variable to be tested; Δ is the first difference operator; b_0 is a constant term; t represents the time trend; ε represents the Gaussian white noise; b and θj (for j=1, 2 …p) constant parameters; K is the optimal lag length to be chosen by the Akaike information criteria AIC or Schwartz/ Bayesian information criteria SBIC to ensure that εt is white noise.

The hypothesis to be tested is:
Ho: b_1 = 0, i.e.the variable has unit root (the series is non stationary)
H1: $b_1 \neq 0$, i.e.the variable has no unit root (the series is stationary)
The original level data and the first-differenced level data were both tested for unit roots. Where the test statistics (t-ratio) was greater than the critical values given in Fuller (1976), the null hypothesis was rejected and stationarity was claimed.

Cointegration tests

Economic theory recommends that many time series datasets will move together, fluctuating around a long-run equilibrium (Furno, 2021). In statistics and econometrics, this long-run equilibrium is measured and tested by using the concept of cointegration (Badshah and Bulut, 2020). A multivariate test for cointegration developed by Johansen (1988) and Johansen and Juselius (2009) was used in the study. The Johansen-Juselius (JJ) procedure of the co-integration test is based on the maximum likelihood estimation of the VAR model. The test was carried out through a VAR system such as follows:

$$Dt = B_1 D_{t-1} + B_2 D_{t-2} + B_1 D_{t-3} + \cdots + B_k D_{t-k} + \alpha + V_t \qquad \textbf{(3.6)}$$

t= 1, ----, T

Where D_t is an (n × 1) vector of I(1) variables; βi are (n × n) matrices of parameters; α is an (n × 1) vector of constant; υ_t is a vector of normal log distributed error with zero mean and constant variance, and k is the maximum number of lag length processing the white noise.

The trace and maximum eigenvalue statistics were calculated to test for the presence of r co-integrating vectors. The λtrace for the null hypothesis of at most r co-integrating vectors is:

$$\lambda_{trace}(r) = -T \sum_{j=r+1}^{n} \ln(1 - \lambda_j) \qquad \textbf{(3.7)}$$

The maximum eigenvalue statistic (λ_{max}) for the null hypothesis of r co-integrating vectors against the alternative of r + 1 co-integrating vectors is therefore:

$$\lambda_{max}(r, r+1) = -T \ln(1 - \lambda_{r+1}) \qquad \textbf{(3.8)}$$

Where, λ_j is the estimated values of the characteristic's roots obtained from the Π matrix and T is the number of usable observations.

The Vector Error Correction Model

This model is used to detect the presence of long-term relationships between the endogenous variables (Zhao and Palomar, 2017; Abusharbeh, 2020). Engle and Granger (1987) showed that co-integration implies, and is implied by, the existence of an error correction term. This means that changes in the

dependent variable are a function of the level of disequilibrium in the co-integrating relationship (captured by the error correction term) as well as changes in other explanatory variables. Once the variables are found to be co-integrated, a vector correction model (VECM) will be used to investigate the dynamic interactions among them in the system. The Granger representation states that for two co-integrated variables, an ECM can be found in the following form:

$$\Delta Yt = \mathrm{B}_{0+}B_1\Delta X_{\mathrm{t}} + B_2\varepsilon_{\mathrm{t}-1} + \cdots + V_{\mathrm{t}} \qquad \textbf{(3.9)}$$

Where ϵ_{t-1} represents the error correction term which captures the adjustment toward the long-run equilibrium and β_2 is the short-run adjustment coefficient.

A principal feature of co-integrated variables is that their time paths are influenced by the extent of any deviation from long-run equilibrium. ECM captures the dynamics of the system whilst incorporating the equilibrium suggested by economic theory (Newbold, 1983). The appeal of the ECM formulation is that it combines flexibility in dynamic specification with desirable long-run properties (Dolado et al., 1990).

Diagnostic tests

Diagnostic tests for multi-co-linearity, autocorrelation (serial correlation), normality, heteroscedasticity, and endogeneity test have been made. Under the ordinary least squares estimation (OLS) of regression models, the assumptions of no serial correlation of the error terms as well as a constant variance of the error terms are important. The Breusch-Godfrey test for serial correlation and the Breusch-Pagan /Cook-Weisberg were used to test for heteroskedasticity. If both tests fail, a robust estimator of the covariance shall be used to correct for the presence of serial correlation and heteroskedasticity. In this study, the diagnostic testing result for multi-co-linearity using Variance inflation factor (VIF), serial correlation test using Durbin-Watson (Durbin and Watson, 1950), normality using White-MacDonald test (White and MacDonald, 1980), and homoskedasticity using Bruesch-Pagan and Godfrey tests (Godfrey, 1978; Bruesch and Pagan, 1979) show that all are consistent to estimate the ECM mode.

4. Results and Discussion

In this section, the determinants of deposit growth in Ethiopia using annual data from 1974/75-2013/14 are thoroughly examined. Before the direct estimation of the model, the unit root was tested using ADF. After identifying the optimal lag length, the presence of the co-integrating vectors is tested using the Johansen procedure. Further, the granger causality test was employed to find the direction of causality between inflation, investment, and economic growth. The long-run and short-run relationships among variables were also captured.

The unit root test is a common practice in macro-level data analysis to accommodate non-stationary. If this behaviour of macro-variables is left uncorrected, it would lead to the problem of spurious regression when there is a need to model relationships among variables.

As explained in the methodology, formal testing for stationary and the order of integration of each variable are primarily undertaken using ADF. The tests with the ADF methods are performed with different trend assumptions (only intercept both linear trends and intercept, and no intercept and no trend). Performing the tests under all three alternatives will identify whether only the intercept or both the trend and intercept are significant. The results from the stationary test under the ADF (Table 8) demonstrate that both trend and intercept must be included in all variables (LnDeposit, LnRGDP, Lninflation, Lninterestrate, Lnexchangerate, and Lnbrexpanision) in testing for stationary, while Ln population is tested without the trend and intercept. A linear trend is found to be insignificant in all of the test equations. The results show that all of the variables included in the model are integrated of order 1, i.e., I (1) (see Tables1and 2)

The absolute values of the calculated test statistics for all variables are less than their critical value at a 5 percent level of significance. The result indicated that all variables are non-stationary at level 1. Thus, the null hypothesis that each variable has a unit root cannot be rejected by the ADF test. However, after applying the first difference, the null hypothesis was rejected, since the data appeared to be stationary at first difference. Therefore, all variables are integrated of order one I (1).

Table 1: ADF Unit Root Test at Level

Variable at Level	Test Statistic Under Different Assumptions		
	ADF test statistic	Critical Value at 5% Level of Significance	Order of Integration
LNDEPOSIT	-1.463756	-3.536601	The critical value is less than the test statistic. (In absolute terms)
LNRGDP	-0.658953	-3.529758	
LNINFLATION	-1.986868	-3.548490	
LNINTERESTRATE	-3.362962	-3.536601	
LNEXCHRATE	-2.274971	-3.533083	
BREXP	-0.451818	-3.533083	
LNPOP	-1.571379	-3.548490	

Table 2: ADF Unit Root Test at First Difference

Variable First difference	Test Statistic Under Different Assumptions		
	ADF test statistic	Critical Value at 5% Level of Significance	Order of Integration
LNDEPOSIT	-3.755235	-3.533083	I(1)
LNRGDP	-5.875910	-3.536601	I(1)
LNINFLATION	-5.339272	-3.533083	I(1)
LNINTERESTRATE	-6.617931	-3.536601	I(1)
LNEXCHRATE	-4.356993	-3.533083	I(1)
LNBREXPAN	-3.276611	-3.198312*	I(1)
LNPOP	-4.354315	-3.568379	I(1)

* Shows significance at 10%, others at 5%

Optimal lag selection

The lag length is selected according to Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC), and Schwarz Information Criterion (SIC). The more lags we include, the more initial values we lose. If we include too few lags, the size of the test will be incorrect (Wooldridge, 2000). VAR lag exclusion test is also applied to check the suitability of the lag included for estimation techniques (Table 3).

Table 3: Optimal Lag selection

VAR Lag Order Selection Criteria
Endogenous variables: LNDEPOSIT LNRGDP LNINFLATION LNINTERESTRATE LNEXCHRATE LNBREXP
Exogenous variables: C LNPOPULATION
Sample: 1974 - 2014
Included observations: 35

Lag	Log	LR	FPE	AIC	SC	HQ
0	161.2837	NA	3.43e-14	-8.301926	-7.590910	-8.056483
1	372.0987	301.1642*	8.87e-18*	-16.69135	-13.13627*	-15.46414*
2	440.3957	66.34570	1.45e-17	-16.93690*	-10.53775	-14.72791

* Indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)

All FPE, SIC, and HQ results indicated one lag length to be the optimum lag length. The lag exclusion tests confirmed the first lag to be the appropriate lag. Hence, this study used the optimal lag length of one for estimation techniques.

Co-integration test result

The next step in validating the VAR model is to test for the existence of a long-run relationship among the variables. Lack of co-integration between variables suggested the existence of no long-run relationship between the explanatory and explained variables. Hence, the Johansen co-integration method is applied. The result of testing the number of co-integrating vectors is shown in Tables 4 and 5.

Table 4: Unrestricted Cointegration Rank Test (Trace)

Sample (adjusted): 1976 - 2013
Included observations: 35 after adjustments
Trend assumption: Linear deterministic trend
Series: LNDEPOSIT LNRGDP LNINF LNINTERESTRATE LNEXCHRATE LNBREXP LNPOP
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.875713	211.4466	125.6154	0.0000
At most 1 *	0.806117	138.4660	95.75366	0.0000
At most 2 *	0.589826	81.04848	69.81889	0.0049
At most 3 *	0.458305	49.85738	47.85613	0.0320
At most 4	0.388743	28.40056	29.79707	0.0718
At most 5	0.268718	11.17226	15.49471	0.2011
At most 6	0.006232	0.218788	3.841466	0.6400

Trace test indicates 4 co-integratingeon(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 5: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.875713	72.98057	46.23142	0.0000
At most 1 *	0.806117	57.41753	40.07757	0.0002
At most 2	0.589826	31.19110	33.87687	0.1012
At most 3	0.458305	21.45682	27.58434	0.2496
At most 4	0.388743	17.22830	21.13162	0.1615
At most 5	0.268718	10.95347	14.26460	0.1566
At most 6	0.006232	0.218788	3.841466	0.6400

Max-eigenvalue test indicates 2 co-integratingeon(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

While the unrestricted co-integration rank test (Trace) in Table 4 shows four co-integrating vectors at the 5% critical value in the system, the unrestricted co-integration rank test (Maximum Eigenvalue) result presented in Table 5

indicates there are two co-integrating vectors in the system. Thus, based on the two statistics result, it was concluded that there exists a meaningful long-run relationship between the variables under consideration. Since the long-run co-integrated relationship was found at most in four variables, the Vector Error Correction Model (VECM) thus can be estimated.

The VECM also provides important information on the short-run relationship between any co-integrated variables through the error correction term which explains the short-run deviations from the long-run equilibrium. This study, therefore, analyzed the long-run co-integrating relationship and short-run dynamics between deposit growth rate and the control variables.

Error correction model (ECM)

After the co-integrated model is estimated, an optimal lag is chosen, the ECM was estimated by making use of the Johansen co-integration test result.

Long-run relationships

As shown in Johansen co-integration test, there are at most four co-integrating relationships. This part of the study examined the impact of independent variables on deposit growth. The first normalized coefficients of deposit growth from the co-integration equation are indicated in Table 6.

Table 6: The Estimated Long Run Model for LNDEPOSIT

Dependent Variable: LNDEPOSIT
Method: Least Squares
Sample (adjusted): 1974 – 2013
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRGDP	0.746919	0.013898	53.74468	0.0000
LNINFLATION	0.396015	0.081562	4.855358	0.0000
LNINTERESTRATE	0.008544	0.038916	0.219559	0.8276
LNEXCHRATE	0.739377	0.062018	11.92195	0.0000
LNBREXP	0.239927	0.104156	2.303539	0.0277
LNPOP	0.374507	0.085944	4.357563	0.0001
R-squared	0.994284	Mean dependent vary		22.96867
Adjusted R-squared	0.993418	S.D. dependent vary		1.438257

The co-integrated estimated result of the long-run model of LNDEPOSIT is shown in the following equation:

LN DEPOSIT =0.75 LNRGDP+0.40 LNINFLATION+0.73 LNEXCHRATE +0.24 LNBREXP +0.37 LNPOP

The result indicated that except for interest rate, all independent variables at a 5 percent level of significance have a long-run effect on deposit growth. The result also shows that in the long-run GDP, inflation, exchange rate, branch expansion, and population growth positively affect deposit growth while interest rate has a positive but insignificant effect on the outcome variable. The results of the long-run estimations are analyzed and discussed in the following paragraphs. A 10 percent increase in GDP improves deposit growth by 7.4 percent. What this implicates is a growing economy leads to increase earnings which in turn increases saving. The result is consistent with the findings of Gebeyehu (2019) and Gebrelibanos (2012). Moreover, the Chakravarty committee study in 1985 indicated the existence of deposit growth at times where there was real growth in the Indian economy (Chakravarty, 1985).

A positive relationship was observed between inflation and deposit in the long run. A 10 percent increase in inflation results in a 3.9 percent increase in deposit growth. This seams a reality on the ground; both private and government saving has been increasing year to year. Though the result supports the finding of Gemedu (2012) and Carroll (2006), it contradicts the findings of Gebeyehu (2019) who argued that households in developing countries facing inflationary pressure and macroeconomic uncertainty have income barely enough for subsistence but not for saving. It can be posited that the result may be related to the saving motive in Ethiopia which is mainly precautionary than investment as in most of the least developed countries. To this end, Deaton (1992) found that precautionary saving increases at times of inflation. Moreover, the result may also be due to the lack of entrepreneurial skill, availability of enough alternative investments, or risk-averse behaviour of most depositors in developing economies. For this reason, the null hypothesis was not rejected

The long-run relationship between deposit and exchange rate is positive and statistically significant. A 10 percent increase in exchange rate resulted in results in 7.3 percent increase in saving deposits. The result disagrees with the finding of Ngula (2012) who conducted the study in the Nigerian context. This may be due to the difference in foreign currency management policies of the two

countries. While individuals can buy and hold foreign currency in Nigeria to make earnings, this however is an illegal act in Ethiopia. Ethiopian depositors don't have the possibility of withdrawing their deposits and buying foreign currency though we know that Ethiopian local currency consistently depreciates against major foreign currencies which might have negatively affected deposit growth. Moreover, given that remittance and export of agricultural commodities are the two major sources of foreign currency for Ethiopia that have roots with the larger population of the country, local currency depreciation will predictably increase deposit growth. Therefore, the Null hypothesis was rejected

At priori it was expected that Branch expansion positively influences deposit growth in the long run. The result also confirmed the same. A ten percent increase in the number of branches increases deposit growth by 2.3 percent. Similar results were found by Gebeyehu (2019), Gemedu (2012), Rangarajan (1982), Sandhu and Goswami (1986). As a result, the Null hypothesis was rejected

The result also revealed that Population growth has a positive and significant impact on deposit growth. 1 percent increase in population growth increases deposit growth by 0.37 percent. The result is consistent with Modigliani (1986).

The long-run relationship between deposit and interest rate was positive but statistically insignificant. This is in support of the findings of Gebeyehu (2019) and Gebrelibanos (2012). Edmister and Merriken (1989) also found that interest rates could influence little in this regard. The finding could be the result of a negative real interest rate in the Ethiopian financial system. Owing to this, the Null hypothesis was rejected.

Short-run relationships

The other objective of this estimation was to investigate the short-run relationship between dependent and independent variables. If the cointegrating relationship, in the long run could be obtained, then the Vector Error Correction Model (VECM) can be estimated. This VECM is important to show the short-run relationship between any two co-integrated variables. Table 7 shows the result of the first short-run error correction model.

Table 7: Short-Run Coefficients when the dependent variable is D (LDEPOSIT)

Dependent Variable: D(LNDEPOSIT)
Method: Least Squares
Sample (adjusted): 1975 – 2013
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.071652	0.011248	6.369938	0.0000
D(LNRGDP)	0.214730	0.151483	1.417523	0.1666
D(LNINF)	-0.026112	0.018463	-1.414253	0.1676
D(LNINTERESTRATE)	0.011926	0.014553	0.819473	0.4190
D(LNEXCHRATE)	0.241443	0.076019	3.176066	0.0034
D(LNBREXP)	0.565349	0.075256	7.512329	0.0000
D(LNPOP)	0.001957	0.076373	0.025631	0.9797
CointEq1	-0.067835	0.039664	-0.85155	0.0444
R-squared	0.762707	Mean dependent var		0.130684
Adjusted R-squared	0.715249	S.D. dependent var		0.090587

The coefficient of the error correction term for the deposit growth equation has the expected negative sign, indicating that it is error-correcting. This guaranteed that although the actual real deposit may temporarily deviate from its long-run equilibrium value, it would gradually converge to its equilibrium. The error correction term of -0.0678 showed that 6.8 percent of the deviation of the actual deposit from its equilibrium value is eliminated every year. Hence, a full adjustment would require about 15 years. This showed that the speed of adjustment is slow in each subsequent year. The relatively low pace of adjustment may be attributed to structural rigidities in Ethiopia that is common in most developing countries that slow down the adjustment processes. In estimating the error-correction model, the population is introduced exogenously to capture the effect of the population on deposit growth.

In the short run, branch expansion and the exchange rate had positive and significant impacts on deposit growth while GDP, interest rate, and the population had a positive but insignificant relationship. However, inflation had an insignificant but negative relationship with deposits. The negative relationship, though insignificant, could be attributed to the recent dramatic increase of

inflation in the Ethiopian economy. For instance, in July 2008, inflation reached 64 % (UNDP, 2014).

Granger causality test result

At the most basic level of economic theory, the belief is that certain pairs of economic variables should not diverge too far from each other, at least in the long run (Granger, 2009). As indicated in the estimated causality test result reported in Table 8, the null hypothesis that RGDP does not granger cause Deposit and branch expansion (and vice versa) was rejected at a 5% level of significance. However, the null hypothesis that inflation and interest rate do not granger cause Deposit couldn't be rejected. The causality runs one way from deposit to inflation and interest rate, not the other way. Causality is unidirectional. Quite opposite to this, the null hypothesis that exchange rate and population growth do not granger cause Deposit was rejected at 5% level of significance. The causality runs one way from the exchange rate and population growth to deposit but not vice versa (Table 8).

Table 8: Pairwise Granger Causality Tests

Sample: 1974 - 2014

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LNRGDP does not Granger Cause LNDEPOSIT	38	1.33789	0.2763
K2 LNDEPOSIT does not Granger Cause LNRGDP		1.43079	0.2536
LNINF does not Granger Cause LNDEPOSIT	38	10.0375	0.0004
LNDEPOSIT does not Granger Cause LNINF		2.28005	0.1182
LNINTERESTRATE does not Granger Cause LNDEPOSIT	35	3.85044	0.0325
LNDEPOSIT does not Granger Cause LNINTERESTRATE		0.86499	0.4313
LNEXCHRATE does not Granger Cause LNDEPOSIT	38	2.06550	0.1428
LNDEPOSIT does not Granger Cause LNEXCHRATE		3.43419	0.0442
LNBREXP does not Granger Cause LNDEPOSIT	38	0.33089	0.7206
LNDEPOSIT does not Granger Cause LNBREXP		2.48934	0.0984
LNPOP does not Granger Cause LNDEPOSIT	38	0.07461	0.9283
LNDEPOSIT does not Granger Cause LNPOP		0.29426	0.0470

5. Conclusion and Policy Implications

5.1 Conclusions

Based on the findings of the study both from the descriptive and econometric analysis, the following conclusions are made.

In the long run, real GDP, inflation, branch expansion, exchange rate, and population growth have a positive and significant impact on the deposit growth of CBE. As the model result showed, economic growth has a more positive impact on deposit growth than other determinant factors. Even though interest rate has a positive sign, it was insignificant. Exchange rate has the second higher impact in the long run than other variables included in the model. The rate of inflation in Ethiopia is generally low except for the years 2008 and 2012. Whenever the level of inflation is below the threshold, it has a positive impact on the overall economy. Most studies suggest that the optimal level of inflation (threshold) for Ethiopia is 10% (Altasseb, 2013). For this reason, inflation has a positive impact on deposit growth in the Ethiopian context in the long run.

There is a short-run association between deposit and its determinants. In the short-run, there is a significant positive impact of exchange rate and branch expansion on the rate of deposit growth while real GDP growth rate, interest rate, inflation, and population growth are insignificant. Moreover, the estimated result of this model indicates that the deviation of the real deposit growth rate from its long-run equilibrium would require 15 years to adjust. There is a sluggish dynamic adjustment of deposits to equilibrium.

Deposit growth can predict movements of branch expansion and RGDP and vice-versa. Moreover, exchange rate and population growth can predict movements of deposit growth in Ethiopia but not vice versa.

5.2 Policy Implications

The macroeconomic event of Ethiopia could have a strong effect on deposit mobilization, which calls for a responsive policy to increase domestic saving for the sustainable financial liberty of the country.

Based on the analysis made and the major findings obtained, the following policy recommendations are forwarded;

- Improve infrastructure and incentives for banks to open branches in both remote (central) areas and reach the unbanked society. There should be also an investment in strengthening the operational capacity of the existing branches. Particularly those which are located in remote areas with limited

human and other resources. The empirical evidence indicated that deposits would increase as the number of branches increases.

- The government should continue to manage inflation below its threshold or optimal level as the research showed it negatively affects deposit growth in banks.
- There is a well-established positive relationship between economic growth and deposit mobilization. This calls for continued policy support and investment in enhancing economic growth that would not only increase the capacity of banks to mobilize resources but also trigger the overall growth of the economy both in the long and short run.
- Results also indicated an increase in population growth positively affecting the growth of deposits. While unmanaged population growth could hinder economic growth and social development, regulated population growth would mean an increase in the functional labor force that would attract investment and create wealth which would positively affect overall economic growth. As a result, the deposit will grow. The study recommends strengthening the current family planning initiatives allows regulated population growth. And then, enhance Human Resource development in the country. And finally, creating job opportunities for the existing labor force through developing investment-friendly policy instruments.
- Under the current financial and investment policy of the country, investment in the financial sector is allowed only for people with Ethiopian citizenship. This inhibits the possibility of foreign banks operating in the country. Since competition would remain low, the interest rate would not necessarily increase the total deposit. However, experiences from other countries, particularly where there is a liberalized economy, indicated that increasing interest rate commonly increases deposit mobilization. Therefore, banks should develop long-run strategies that will align with the policy shift of the country, if any. For example, if Ethiopia decides to be a member of the World Trade Organization (WTO), foreign banks would be allowed to operate in the country.

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