

Research Article

The Short-Run and Long-Run Relationships between Economic Growth and Inflation in Ethiopia

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Abstract

The relationship between inflation and economic growth is one of the debatable issue and the most important macroeconomic discussions among macro economists, policy-makers and monetary authorities in all countries. The dilemma of inflation and economic growth is one of the most important macro-economic policy problems. This study addresses the short run and long run relationship between inflation and economic growth. This study used yearly time series data that was taken from World Bank database year ranged from 1982 to 2021. Before analysing the data Augmented Dickey fuller test and Phillips curve were conducted to check the stationarity of data series. The co-integration test for long run relationship is check with Johnson co-integration and the econometric models like vector autoregressive and Vector Error Correction Model were applied. Descriptive Statistics results show that the average of inflation rate is more than the average of output growth and rate of economic growth and rate of inflation moves with the similar trend but inflation more fluctuation. The joint hypothesis test results of a VAR model show that both lagged value of inflation does not have any effect on economic growth. The result of a Granger causality test shows that economic growth cause inflation at 1% significance level but inflation rate does not causes economic growth. The result of co-integration test Vector Error Correction Estimation using Johansen trace statistic and maximum eigenvalue statistic show exhibit long run relationship between the two variable policy makers should exert effort to made stabilize the relationship between inflation and economic growth in the long-run.

Keywords: Economic growth; inflation; relationship; vector autoregressive

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Date Received: 9 November 2023

Date Accepted: 1 February 2023

1. Introduction

1.1 Backgrounds the study

The relationship between inflation and economic growth is one of the debatable issues and the most important macroeconomic discussions among macro economists, policy-makers and monetary authorities in all countries. Particularly, whether inflation is necessary or harmful form economic growth constitutes the basis of the matter in question (Eden, 2012). The relationship between price stability and economic growth has gained importance as a fundamental reason for the monetary policies based on the inflation-targeting regime. Nevertheless, there is no theoretical evidence as to which inflation level is considered high or low for economic decision-making units. Therefore, empirical findings are required to determine which inflation level is a threshold for the economic growth (Ekinci *et al*, 2020). Ethiopia has registered remarkable economic performance with annual growth averaging 10.9% over the past ten years this led to Ethiopia being rated as one of the fastest growing economies in the world. Since the experience of sustained inflation rate in Ethiopia had begun since 2003 (UNDP, 2014).

Now a day, developing countries like Ethiopia have a strong objective to achieve and maintain sustainable economic growth. To realize and maintain continuous economic growth macro-economic stability is significant. Unemployment, business cycle, output growth and inflation are the major indicators of macro-economic stability.

Macro-economic stability requires knowing and creating a smooth relationship between these variables in a country. Thus, one of the most relevant debatable issues in macro-economists is the relationship between inflation and economic growth. The relationship between inflation and economic growth is debatable both in the world and specifically to Ethiopia. In this regard, there exists controversy between inflation and economic growth, which implies some, believes positive while the others negative and the remaining latest economists and researchers also believe non-linear relationship between these two variables. Despite its rich and varied endowment of natural resource base, Ethiopia is one of the least developed countries of the world (World Bank, 2004). According to African Development Bank, the main driving force for the recent growth of the country is improvement in agricultural sector due to favourable climatic condition and improved supply of fertilizers. The growth base is also broadening with increasing contributions of service and manufacturing sector to GDP.

1.2 Statement of the problems

Despite the rapid economic growth and poverty reduction progress, sustained fiscal imbalances and macroeconomic instabilities mainly inflation, had been constantly limiting the bouncing economy (Desta 2008). The dilemma of inflation and economic growth is one of the most important macro-economic policy problems that take the attention of researchers, policy makers and different scholars. As far as we see in different areas and places of study on the relationship between inflation and economic growth, there major problems is no single clear cut theory which shows fixed relationship between inflation and economic growth to implement in the country to achieve its objective of sustainable development. In addition, even if moderate inflation is an inevitable consequence of economic growth, determining and maintaining inflation on its moderate level is a headache for countries like Ethiopia. In Ethiopia needs to have sustainable growth and estimating threshold level of inflation is also significant to implement policies properly.

There are different empirical studies on the possible show cause of this inflationary situation in the country. The major sources of inflation discussed in the literature are increase in money supply unwarranted by the level of output growth, the nature of investment in the country, the widening of the national deficit and ways of financing it, the inefficiency within government controlled organizations, soaring of oil prices and others (Geda et al, 2008). In contrast, the government argues that the inflation is due to rapid economic expansion that has happened in country but at present time in Ethiopia inflation is the main in issue in every part of the country this indicate the country's economic progress is accompanied by sustained inflationary problems. In this context, it is interesting to know the relationship between economic growth and inflation in the country. According to the above idea the following objective are constructed.

1.3 Objective of the study

1.3.1 The general objective

The general objective of the study is to identify the relationship between inflation and economic growth based on 39-year time series data.

1.3.2 The specific objective

To identify the short run and long run relationship between inflation and economic growth by using GDP growth as a reference as well as to determine causality relationship between two variables in the economy.

2. Review of literature

2.1. Theoretical reviews

Macro-economists try to see the relationship between inflation and economic growth starting from classical economist. The following are some of the theories related to the literature.

Classical growth theory: According to classical theory, economic growth is an increase in per capita real GDP over time. Economic growth occurs when the aggregate supply curve shifts to the right over time. Therefore, even if the relationship between inflation and economic growth is not clearly stated in classical model, it is expected to be negative.

Keynesian theory: Keynesians widely believe that the government can promote economic growth while avoiding inflation through skill full macroeconomic policies Keynesian model advocates that there exists a positive relationship between inflation and output. The positive relationship between inflation and growth shown in the short-run dynamics is differing in long-run Phillips curve that turns to be negative with high rate of inflation.

Monetary theory: According to Quantity theory of Money, the relation between inflation and economic growth showed simply by equating the total amount of spending in the economy to the total amount of money in the economy. Monetarism suggests that the long-run prices are mainly affected by the growth rate of money but has no real effect on economic growth. If the growth in the money supply is higher than the economic growth rate, it will result inflation.

Neo-classical growth theory: According to this theory, argue that having rational expectation there exist positive relationship between price changes (inflation) and output changes.

Endogenous growth theory (*new growth theory*): One important implication of endogenous growth theory is that a country's long-run economic growth rate depends on its rate of saving and investment. This theory describe economic theory as being generated by factors within the production process, for instance, economies of scale, increasing returns or induced technological change. According to this theory, the economic growth rate depends on one variable: the rate of return on capital. Variables like inflation decreases the rate of return and this in turn reduces capital accumulation and hence reduces the growth rate. New Classical say that anticipated inflation has neither long run nor short-run effect on growth. However, if inflation is unanticipated it has a negative impact on the growth of the economy. While to new growth, inflation act as tax and reduce growth rate. Thus, theories do not tell us fixed relationship between these variables.

2.3 Empirical reviews

When we come to empirical part of the literature, different researchers come up with different results on the relationship between inflation and economic growth and up to now, there is still no conclusive argument about the nature of the inflation – economic growth relationship.

As empirical result of Ekinici Ramazan.et al, (2020) indicated, the relationship between price stability and economic growth has gained importance as a fundamental reason for the monetary policies based on the inflation-targeting regime. As the study output of Murad & Beyan, (2021) showed, inflation rate had significant and negative effect on economic growth in short run and a system speeding up to achieve its long run equilibrium with an adjustment of 5.8%. According to FS.Denbel, (2016) investigated the causal relationship between inflation and economic growth using a broad cross-country data from 140 countries over the period 1970-2005. The results indicated that, inflation retards growth, whereas the effect from growth to inflation is beneficial. Fekadu, (2012) reported the relationship between inflation and economic growth in Ethiopia for the year 1980-2011 the result showed that, an increase in economic growth decreases inflation whereas inflation does not have significant effect on economic growth in the short run. It was revealed in the paper by RG. Adugna, (2021), the results of VECM indicated that there was a positive and significant relationship between inflation, budget deficit and national debt and there by implied government has reduce its extra expenditure to make price stable.

Tewodros (2015) was investigated the determinants of economic growth in Ethiopia from the period of 1974-2013. The result showed that inflation was not significantly harming the economic growth of Ethiopia during the study time. This implies studies in the country had not shown a fixed relationship between inflation and growth in Ethiopia.

3. Methodology

3.1 Types of data

This study used yearly time series data which was taken from world Bank database to World Economic Outlook (WEO) covering the year ranged from 1982 to 2021 that means 40 years data. The data set includes Gross Domestic Product growth and Consumer Price Index The database contains selected macroeconomic data series from the statistical appendix of the World Economic Outlook report. The WEO database reflects information from both national source agencies and international organizations

3.2 Methods of data collection

The study used annual time series data for the period of forty-one years, 1982 – 2021 obtained from various international and domestic sources like World Bank World Development Indicator (WDI) for real GDP and inflation.

3.3 Methods of data analysis

In order to analyse the data, descriptive and inferential statistics as well as econometrics model were used. Before making any statistical inference and estimation, the time series data has primary pass through stationarity test and its order of integration determined for those series used for study. If the time series y_t is stationary, its probability distribution remains constant over a period of series. The Augmented Dickey Fuller (ADF) test and Phillips curve (PC) were conducted to check the stationarity of data series. Other test statistics also conducted in order to show whether there is a long run relationship between economic growth and inflation and their causality. The co-integration test for long run relationship is checked with Johnson co-integration and causality. Impact was checked through Granger causality test. The econometric models like VAR and VECM were applied. According to VEC model, past values of the error correction term help to predict future values of ΔY_T and ΔX_T , it represents how two or more variables consistent in the short run behave similarly with the long run co-integration relationship. The generalized VEC model of two variables is specified as:

3.4 Model specification

In econometric analysis when time series data are used the preliminary statistical step is to determine the order of integration of each time series used. A time series Y_t is stationary if its probability distribution does not change over time, that is, if the joint distribution of $(Y_{s+1}, Y_{s+2}, \dots, Y_{s+T})$ does not depend on s ; otherwise, Y_t is said to be non-stationary. To check the stationarity of the data the Augmented Dickey-Fuller (ADF) test is applied. The Augmented Dickey-Fuller (ADF) test for autoregressive unit root tests the null hypothesis $H_0: \mu=0$ against the one sided alternative $H_1: \mu < 0$ in the regression.

$$\Delta Y_t = \alpha_0 + \mu Y_{t-1} + \beta_1 \Delta Y_{t-1} + \beta_2 \Delta Y_{t-2} + \dots + \beta_p \Delta Y_{t-p} + \mu_t$$

Where α is an unknown coefficient and the ADF statistic is the OLS statistic testing $\mu=0$ in the above equation.

4. RESULT AND DISSCTION

4.1 Descriptive Statistics of the Variables

The table below shows that output grows at an average rate 5.8 percent from 1982-2021 and inflation rate grew at 9.9 percent on average. However, the average of inflation rate in Ethiopia is more than the average of output growth with a maximum value of up to 44 percent. The standard deviation shows that the spread of inflation from its mean is higher than the spread of economic growth this indicate increase inflation faster than economic growth.

Table1: Descriptive Statistics results

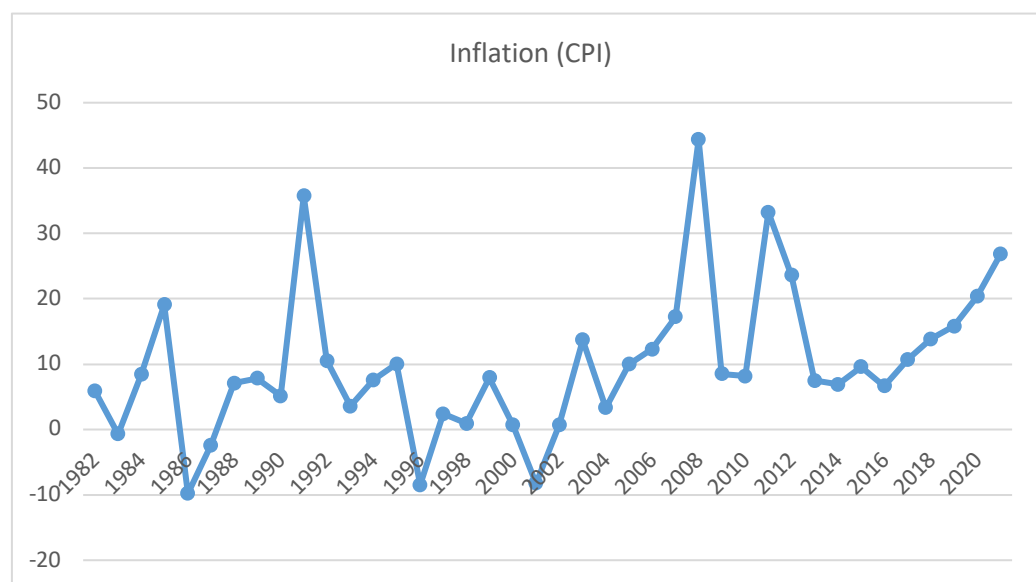
Variable	Obs	Mean	Std. Dev.	Min	Max
GDP growth (RGDP)	40	5.898	6.363	-11.144	13.859
Inflation CPI	40	9.905	11.319	-9.809	44.357

Source: Own effort data and from World Bank

4.1.1 Trend result of inflation rate with respect to CPI (1981-2021)

Trends of inflation show moderate up and downs from 1982 to 2021 and according to (Fekadu 2012) since the country depends on rain fed agriculture as a main source of income, the drought diminished output growth, which in turn has a significant influence on the increment of inflation by around 18 percent due to devastating drought and other cause.

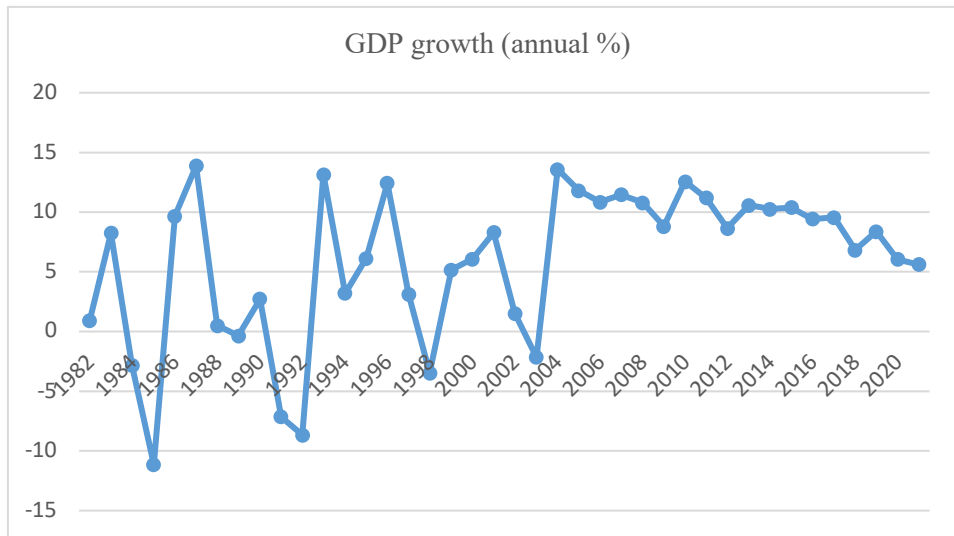
Figure.1-The trends of inflation rate (1982-2021)



4.1.2 Trend effect of GDP growth rate of Ethiopia (1982-2021)

Trends of GDP growth look like with trends of inflation rate. The rate of change of the economy declines four times from 1982 to 2021, which is 1986, 1992, 1998, and 2004 due to the effect internal conflict, war and drought weather condition.

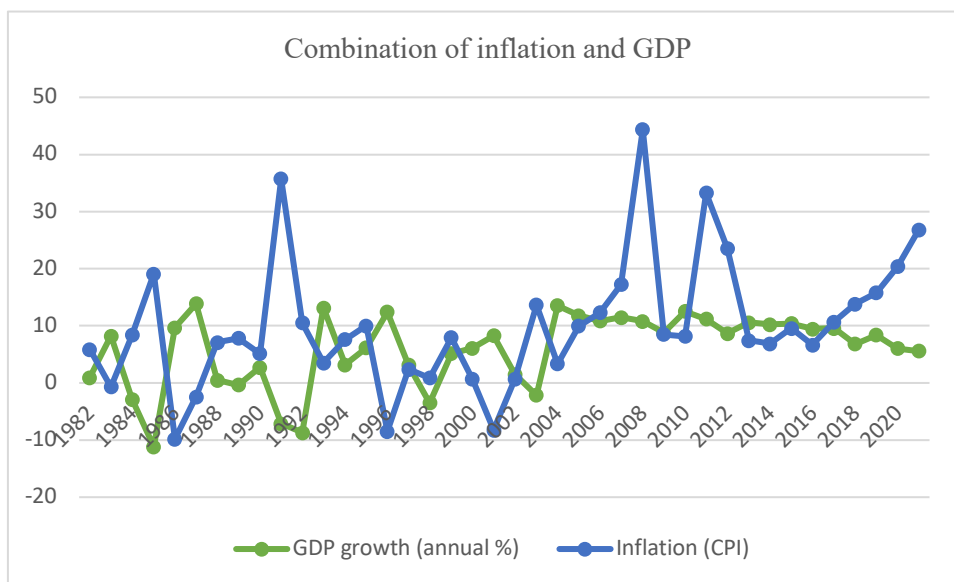
Figure.2-The trends of GDP growth (1982-2021)



4.1.3 The combined effect inflation and GDP growth

In general, rate of economic growth and rate of inflation moves with the same trend as shown.

Figure-3 the combined effect inflation and GDP growth



4.2 Econometrics model results

4.2.1 Unit Root Test for stationary

Stationarity of the data is checked by using the Augmented Dickey-Fuller (ADF) test. The null hypotheses of a random walk ($H_0: \mu=0$) against the alternate hypothesis of a stationary process ($H_1: \mu<0$) is tested by using Dickey and Fuller critical value.

Augmented Dickey-Fuller (ADF) Unit Root Test in Level

Table:-2 Dickey-Fuller test for unit root

level	Trend and constant			
Variable	Test Statistic	Lag	5% Critical value	p-value for Z(t)
GDP growth	-5.283***	0	-3.544	0.0001
Inflation (CPI)	-4.977***	0	-3.544	0.0002

Note: ***, ** indicates rejection of null hypothesis at significance level of 1% &5% respectively.

Source: Own effort data and from World Bank

The first task this work is to check for the existence of stationarity property in the series of growth rate and inflation rate. To check the stationarity of the data the Augmented Dickey-Fuller (ADF) test is applied. According to the test result GDP growth and inflation that found data from 1982 - 2021 show that both are stationary at a level with 1% significance level. Therefore, it is possible to reject null hypothesis of data that has non- stationarity.

4.2.2 Phillips-Perron-Unit Root tests (PP tests)

Table: 3 Phillips-Perron test for unit root

level	Trend and constant			
Variable	Test Statistic	Lag	5% Critical value	p-value for Z(t)
GDP growth	-5.197***	3	-3.544	0.0001
Inflation 9CPI)	-4.966***	3	-3.544	0.0002

Source: Own effort data and from World Bank

Perron performs the Phillips–Perron (1988) test that a variable has a unit root. The null hypothesis is that the variable contains a unit root, and the alternative is that a stationary process generated the variable because the data exhibit a clear upward trend over time, according to the test result, it is able to reject the null hypothesis of a unit root at all common significance levels. The interpolated critical values for Zt differ slightly from those shown in the example in dfuller because the sample sizes are different: With the augmented Dickey–Fuller regression, we lose observations because of the inclusion of lagged difference terms as repressors. Finally conclude that both GDP growth and inflation were integrated and remain

stationary. Results show that the choice of lag-order selection criterion has quantitatively important implications for the accuracy of VAR impulse response estimates.

4.2.3 Selection of Optimal Lag length many selection

Before estimating the VAR model, the first task is to choose the number of lags that should be included in the model. Order statistics have been developed to assist researchers in fitting a VAR of the correct order in case of the reports shows final prediction error (FPE), Akaike’s information criterion (AIC), Schwarz’s Bayesian information criterion (BIC), and the Hannan and Quinn information criterion (HQIC) lag-order selection statistics for a series of vector auto-regressions of order 1 through a requested maximum lag. A sequence of likelihood-ratio test statistics for all the full VARs of order less than or equal to the highest lag order is also reported. Johansen co-integration test and vector error correction model is usually preceded by a test of determining optimal lag length due to the estimated results are affected by the number of lags included. By applying these information criteria, the empirical issue is somewhat resolved since the information criteria with the minimum value are the ones preferred Basabose, (2020). In the table result show that the likelihood-ratio tests selected a model with two lags. AIC, HQIC and FPE have also both chosen a model with two lags, whereas BIC have selected a model with zero lags.

Table: 4 Optimal Lag length selected

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-252.42				4715.080	14.134	14.165	14.2222*
1	-245.93	12.973	4	0.011	4109.79	13.996	14.08	14.26
2	-239.7	12.477*	4	0.014	3639.47*	13.8717*	14.0253*	14.3
3	-236.7	5.954	4	0.203	3877.090	13.929	14.144	14.544
4	-232.4	8.681	4	0.070	3848.880	13.910	14.186	14.701

** indicates the optimal lag length for co-integration test*

Source: Own effort data and from World Bank

4.2.4 Vector Autoregressive Model (VAR)

Estimation results of a VAR model for inflation and economic growth with two lags are shown below in this case Chi-Square test cannot reject the claim that at least one of the predictors' regression coefficient is not equal to zero in the model. The first equation indicates that inflation has positive short run effect on economic growth during the sample period of 1982-2021. The result is statistically significant at 5 percent

significance level. Nevertheless, the second equation shows that effects of economic growth on inflation in Ethiopia are statistically insignificant at 5 percent significance level. The joint hypothesis test that lagged value of inflation does not have any effect on economic growth supports the finding. We cannot reject the null hypothesis states the coefficients of both lagged values of inflation are not significantly different from zero.

$$\text{GDPg}_T = 1.724 + 0.292\text{GDPg}_{T-1} - 0.058\text{GDPg}_{T-2} + 0.027I_{T-1} + 0.28I_{T-2} + \varepsilon_{t1}$$

$$(\text{Z-value}) = 1.12 \quad 1.99^{**} \quad -0.38 \quad 0.31 \quad 3.36^{***}$$

$$\text{inflation(CPI)} = 3.6 + 0.43\text{GDPg}_{T-1} + 0.32\text{GDPg}_{T-2} + 0.27I_{T-1} - 0.04I_{T-2} + \varepsilon_{t2}$$

$$(\text{Z-value}) = 1.18 \quad 1.47 \quad 1.05 \quad 1.58 \quad -0.24$$

Table:-5 Vector Autoregressive Model

	Coef.	Std.Err.	z	P>z	Interval] [95%Conf.	
GDPgr						
GDPgr						
L1.	0.292	0.147	1.990	0.047	0.004	0.579
L2.	-0.058	0.152	-0.380	0.702	-0.356	0.240
Inflation(CPI)						
L1.	0.027	0.086	0.310	0.756	-0.143	0.196
L2.	0.279	0.083	3.360	0.001	0.116	0.443
_cons	1.724	1.544	1.120	0.264	-1.301	4.750
InflationCPI						
RGDPgr						
L1.	0.427	0.291	1.470	0.142	-0.143	0.997
L2.	0.317	0.301	1.050	0.293	-0.274	0.907
InflationCPI						
L1.	0.272	0.172	1.580	0.113	-0.065	0.608
L2.	-0.040	0.165	-0.240	0.810	-0.363	0.284
_cons	3.610	3.061	1.180	0.238	-2.390	9.610

Source: Own effort data and from World Bank

After estimation of a VAR model, it is advisable to check if the disturbances of the model are not auto-correlated. If the disturbances are auto-correlated, it shows that there are some misspecification of the VAR model. The LM test for autocorrelation in the residuals of a VAR model discussed in Johansen (1995) is implemented. The null hypothesis of the test is that there is no autocorrelation at lag j.

LM Test of Residual Autocorrelation of VAR

Lagrange-multiplier test

H0: no autocorrelation at lag order

Lag	chi2	df	Prob > chi2
1	8.3344	4	0.08
2	5.8216	4	0.213

Source: Own effort data and from World Bank

From the above table show that it cannot reject the null hypothesis that there is no autocorrelation in the residuals up to a maximum of two lags, this test gives no suggestions of model misspecification because of the acceptance of null hypothesis.

Normally distributed test

Equation	Skewness test			Kurtosis test		
	chi2	df	Prob > chi2	Chi2	df	Prob > chi2
GDPg	1.315	1	0.25149	0.199	1	0.65514
Inflation (CPI)	7.282	1	0.0696	3.439	1	0.06368
All	8.597	2	0.1359	3.638	2	0.16215

Source: Own data and from World Bank

The skewness and kurtosis test statistic are used to check the normality of the disturbances. The null hypothesis of the test is that the disturbances in the VAR are normally distributed. Both results of the skewness and kurtosis test statistic show that the disturbances in the VAR model are normally distributed for the single and joint equations because the null hypothesis cannot be rejected at 5 percent significance level. This shows that there is no misspecification in the model.

Stability conditions of the VAR

Eigenvalue stability condition

Eigenvalue	Modulus
0.7838141	0.783814
0.04116677 + .6012835i	0.602691
0.04116677 - .6012835i	0.602691
-0.3026281	0.302628

Source: Own data and from World Bank

In the last, the stability conditions of the VAR model estimated checked by using the eigenvalue stability condition. If the VAR is stable, impulse response functions and forecast error variance decompositions have interpretations. Hamilton (1994) shows that if the modulus of each eigenvalue of companion matrix is strictly less than one, the estimated VAR is stable. So according to the idea of Hamilton this analysis fulfill the stability condition that is all value of the modulus are less one and all the eigenvalues lie inside the unit circle and VAR satisfies stability condition in the above table.

4.2.5 Granger Causality Test Results

Test of causality can identify if the lagged value of one variable helps to predict other variable in the model. The granger test state that:

H₀: GDP growth does not granger cause of inflation (CPI)

H₁: GDP growth does granger cause of inflation (CPI)

Table:-6 Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
GDP growth	Inflation CPI	13.911	2	0.001***
GDP growth	ALL	13.911	2	0.001
Inflation CPI	RGDP	5.5096	2	0.064
Inflation CPI	ALL	5.5096	2	0.064

Source: Own data and from World Bank

The result of a Granger causality test shows that economic growth Granger-cause inflation at 1% significance level in a sense that lagged values of economic growth have an incremental forecasting power when added inflation rate to equation in univariate autoregressive model but inflation rate does not Granger-causes economic growth at 5% significance level. This means that inflation rate does not predict anything about the short run properties of economic growth in Ethiopia during the study period of 1982-2021.

4.2.6 Co-Integration tests

The hypothesis is state as H₀: no co-integration equation H₁: co-integration equation

Before proceeding to estimate vector error correction model, the first task is to check whether the two variables are co-integrated. If the two variables are co-integrated of the same order, then there is a long run relationship between the two variables. The table below shows the result of co-integration test using Johansen trace statistic and maximum eigenvalue statistic. The maximum eigenvalue and trace statistic indicated the rejection of the null hypothesis at zero co-integration relationship respectively. The alternative hypothesis of the eigenvalue test statistic assume that given r in null hypothesis, it is likely that the alternative would be r+1 co-integrating equations/relationship in the long run.

Table:-7 Johansen tests for co-integration

Max rank	parms	LL	Eigenvalue	Trace statistic	5%critical value
0	4	-271.5		30.7241	19.96
1	8	-258.15	0.50523	3.9850*	9.42
2	10	-256.16	0.09956		

Source: Own data and from World Bank

In the above table, the trace statistic assumes that there is greater number of co-integrating equations than the r represented in null hypothesis. Because Johansen's method for estimating r is to accept the first rank, estimating a VEC model for two variables in which the maximum possible rank is only one. Therefore, one rank is select and the two variables was said to be co-integrated this indicate exhibit long run relationship. Implies the series are related and it can combined in linear fashion because of the presence of co-integration the estimation required the use of Vector Error Correction mode (VEC) or vector autoregressive (VAR) possible.

4.2.7 Vector Error Correction (VEC) Estimation

Co-integration implies that time series might be connecting through an error correction model.

According to the table below show the following the model achieves its long run co-integration relationship with (p-value =0.000) given as:

$$ECT_{t-1} = -0.27 + GDP_{g,t-1} - 0.548I_{t-1} + Vi$$

This equation shows the long run relationship between inflation and economic growth in Ethiopia as the rule of interpretations in the long run the sign of the coefficient are reversed so according to this rule the result show in the long run inflation has positive impact on economic growth at coefficient are statistically significant at 1% levels. conclusion inflation have asymmetric effect on GDP growth in the long run on average and from estimation results of the VEC model GDP growth as a target variable, the generalized form of the relationship between economic growth and inflations with effect of their lag value minus one interpreted as:

$$\Delta GDP_{g_t} = 0.402 + 0.017\Delta GDP_{g_t} - 0.312\Delta I_{t-1} - 0.672\Delta ECT_{t-1}$$

As the vector Error Correction model showed, Since the coefficient of the ECT is significantly negative affect it show the GDP growth adjustment value (-.672) suggests that the deviation of previous year error from long run equilibrium at 1% significance was corrected with the speed of 67.2% to attain the current steady state. Similarly, from the coefficients (1.044) of lagged value of inflation, the speed of disequilibrium correction was 104.4% satisfy long run relationship at yearly terms to convergence into current year stability. The results of model showed that, in short run the economic growth is negatively affected by the first lag of inflation rate but the last year GDP does not affect the current GDP growth this result is agree with results obtained by (Murad & Beyan, 2021). Accordingly in short run, the last year GDP does not affect the current GDP growth and conversely the past value of inflation affects economic growth negatively. The VEC model estimation shows that the error correction terms in both equations are statistically significant at 5 percent significance level. This means if the two series are out of equilibrium, growth rate will adjust to reduce the equilibrium error in the long run.

Log likelihood = -258.0361

Det (Sigma_ml) = 2711.052

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_RGDP	4	5.47939	0.5190	36.68463	0.0000
D_InflationCPI	4	11.0356	0.4095	23.57744	0.0001

Table: 8 Result of Vector error-correction model

	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]	
D RGDP						
_ce1	-0.672***	.129	-5.23	0	[-0.923, -0.42]	
L1.						
RGDP	.017	.154	0.11	.915	[-0.286, 0.319]	
LD.						
Inflation CPI	-0.312***	.079	-3.93	0	[-0.468, -0.157]	
LD.						
Constant	.402	.892	0.45	.653	[-1.347, 2.151]	
D_Inflation CPI	1.044***	.259	4.03	0	[0.537, 1.552]	
RGDP						
_ce1						
L1.						
RGDP	-0.449	.311	-1.44	.149	[-1.058, 0.16]	
LD.						
Inflation CPI	-0.065	.16	-0.40	.686	[-0.378, 0.249]	
LD.						
Constant	.258	1.797	0.14	.886	[-3.264, 3.781]	

source from own effort data from world bank, 2023

Co-integrating equations

Equation	Parms	chi2	P>chi2
Constant	1	16.33445	0.0001

Identification: beta was exactly identify and Johansen normalization restriction imposed

Beta	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
_ce1					
RGDP	1				
Inflation CPI	-0.548	0.136	-4.04	0.000	[-0.8135659, -0.2821836]
_cons	-0.27				

4.2.8 Diagnostic test of the vector correction error

Autocorrelation at lag order

Lagrange-multiplier test H0: no autocorrelation at lag order

Lag	chi2	df	Prob > chi2
1	9.2732	4	0.05462
2	7.9736	4	0.09255

In the last the LM test for residual autocorrelation is perform and the result below shows that we cannot reject the null hypothesis of no autocorrelation in the residuals of the VEC model at 5% significant level.

Normality distribution test

Jarque-Bera test H_0 : normal distribution of the equation

Equation	chi2	df	Prob > chi2
D_RGDP	0.360	2	0.83543
D_InflationCPI	4.047	2	0.13220
ALL	4.407	4	0.35378

The Jarque-Bera test show that the VEC model disturbances are normally distributed at 5 percent significance level.

Stability condition test of VEC model

Eigenvalue stability condition

Eigenvalue	Modulus
1	1
0.04480738 + 0.6066868i	0.608339
0.04480738 - 0.6066868i	0.608339
-0.3815205	0.381521

The Eigenvalue stability condition test show that the disturbances of the VEC are stable because all value of the model are less than one.

5. Conclusion and Recommendation

The relationship between inflation and economic growth is one of the debatable issue and the most important macroeconomic discussions among macro economists, policy-makers and monetary authorities in Ethiopia. In this study analyses the relationship between economic growth and inflation in Ethiopia using yearly data obtained from the world economic outlook database of Macroeconomics data trend for the period 1982 to 2021. To analyse the relationship between these two variables both in the long run and shot-run use an estimation technique of co-integrated vector error correction model (VECM) with pair-wise granger causality test were used before estimation stationarity test was applied by using Augmented Dickey fuller and Phillips curve test. The result show that both growth domestic product an inflation grow at an average rate on average in Ethiopia. However, the average of inflation rate is more than the average of output growth so the concerned body like government body effort to be made to balance the relation between inflation and gross domestic product. The result of a Granger causality test shows that economic growth Granger-cause inflation but inflation rate does not Granger-causes economic growth this means that inflation rate does not predict anything about the short run properties of economic growth. And the result of Vector Error Correction Estimation show in the long run inflation has positive impact on economic

growth so it should be need that the policy maker effort to be made to stabilize the relationship between inflation and economic growth in the long run.

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