Inflation nexus Economic Growth: proof from Ethiopia

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Abstract: This paper examined the relationship between Growth Domestic Product Growth rate and Inflation for Ethiopia using time series data covering from 2000 to 2019. The study carried out Augmented Dickey Fuller test, Johansen cointegration test and Granger causality test to examine stationarity of time seriesdata, theexistenceoflongrunrelationshipandthedirectionofcausality respectively. The empirical results reveal that both variables under investigation are non-stationary at levels and stationery when differenced at first and inflation and economic growth are co-integrated thereby asserted the presence of a long-run relationship between the variables. The result of Granger causality test shows none of the variables is depicted as influential and therefore the result suggested that the influence iscontemporaneous.

Keywords: Inflation, Economic Growth, Ethiopia, Co-integration, Granger causality test.

I.   Introduction

Inflation is defined as a generalized increase in the level of price continued over an extended period in an economy (Lipsey and Chrystal, 1995), that is, a continues rise in the price levels of goods and services, leading to a fall in the money's purchasing power. Originally inflation rise from the prevalence of two conditions in the economy: the first one is happened when aggregate demand surpass aggregate supply which is known as Demand-pull inflation. The second category of inflation is appeared due to a persistent rise in the price levels of commodities and services. The latter one is emerged from some factors like salaries, low production, inaccurate fiscal policy, and imported risinginflation.

In the studies of macroeconomic examining the impact of inflation on economic growth is considered as one of the most perpetual issues that required to be fixed. That is why many economic literatures, in the last decades exerted their intention toward understanding the existing linkage between economic growth and inflation. As a result, many large debates have been embarked regarding the relationship between these two macroeconomic   variables   both   theoretically   and   empirically.   Even   though   a tinyunescapableargumenthostedregardingexistenceofthelinkagebetween inflation and economic growth, the debates sharpen and reach at its peak when scholars rise the issue of the sign of relationship between the two and the magnitude of the inflation that is optimal for better economicgrowth.

The source of debate was emanated from two major school of thought in the field namely, Structuralists and Monetarists. According to Structuralists inflation is considered as a fundamental element for economic growth of a country while for Monetarists inflation has a capability to govern economic progress (Malik and Chowdhry,2001). Each school of thought has an Evidence that underscore the signs of relationship either it is negative or positive. Surprisingly there is a third category that advocate the absence of relationship between inflation and economic development. For instance, Friedman (1973: 41) briefly summarized the inconclusive nature of the association between inflation and economic growth as follows: "historically, all possible combinations have occurred: inflation with and without development, no inflation with and without development". Earlier works (for example, Tun Wai, 1959) failed to found any meaningful relationship between inflation and economic growth.

In Ethiopia, formal macroeconomic regulation policies with various objective were implemented since the late 1950's. Given this, Geda and Tafere (2008), stated that, before the year 2002/03, inflation has not been considered as a serious topic among Ethiopian economic researchers and macroeconomic policy makers. This is due to stable macro-economic history of Ethiopia, especially the single digit inflation (apart from the periods of drought). When they explain the recent inflation, they mentioned that the rise of inflation is not due to decrease in crop production rather it is largely attributed to less conservative fiscal and monetary policies. Likewise, these authors explain the loose policies of government that involve ambitious infrastructural projects that led toward a budget deficit and hence the way of financing the deficit has led to higher inflation. Since inflation has not been considered as a problem in Ethiopia, there was no clear target level of inflation. Inflation is an indication for the developing of a given economy, nevertheless extreme economic growth can be destructive as it involves hyperinflation as experienced, on the other hand, an economy with no inflation implies dormanteconomy.

Therefore, the optimum level of economic growth, and thus the optimal level of inflation, is expected

somewhere at intermediate level. It is better to notice that, zero inflation is also very risky to the economy at its declining stage in prices, profits, andemployment. currently, following many developed and developing economies, the Ethiopian macro-economic Policy set the major objective that enable the country achieve rapid economic growth together with low and stable inflation (Erchafo 2001). specifically, from the year 2010 onwards following the five-year development plan of the Growth and transformation Plan (GTP), the monetary policy aims to keep inflation at 6%. However, limiting the level of inflation at some point may rise the question of how much this level of inflation provide guarantee for the economic growth not to be affected negatively. That is why we are coming across the number of contradictory studies suggesting the linkage between inflation and economic growth and the optimal inflation level for different countries. Thisstudy aims to scrutinize the relationships between inflation and economic growth based on the data obtained from Ethiopia from the period of 2000 to 2019.

1.1. Theoretical Perspective of Inflation and EconomicGrowth

Different conclusions have been reached by various economic theories concerning the responsiveness of economic growth to inflation. Classical theorists contributed a lot for establishment of a number of growth theories. Smith claimed that growth was self-reinforcing as it revealed increasing returns to scale. For smith, savings provide basic foundation for investment and investment thereby brings growth. In line with smith, Jean Baptiste Say also argued that economic growth, is determined by the level of saving. A decrease in saving led to an increase in interest rate and growth will be discouraged. Besides, smith postulated that an intensified rivalry of investors for labors will bid wage up led to the profit decline the relationship between the increase in price levels (inflation), and its "tax" effects on profit levels and growth were not definitely expressed in classical growth theories. However, the relationship between the inflation and economic growth is covertly proposed to be negative.

The empirical results (long run negative relationship between inflation and unemployment) discovered by Bill Phillips in 1958 was newly interpreted by the majority of Keynesian economists as a continuous negative long-run relationship between inflation and unemployment. Accordingly, Keynesians suggested a sustainable increase in the level of inflation is the solution to minimize unemployment and expand economic growth (Snowdon and Vane 200). Hence the policy maker has policy choice on every point on the Phillips curve. If the policy targeted to the reduction of the level of unemployment, the rate of inflation should rise and if objective of formulated policy is to achieve low and stable inflation, there should be some compromise of the economic growth (Leeson 1997). Holding this, New Keynesians asserted that high inflation has a negative impact on economic instability and hence growth. According to new Keynesians low and stable inflation is highly recommended to ensure rapid economic growth and to establish fair distribution of income. Therefore, limiting supply of money to diminish inflation leads to recession due to price rigidities (Ambler2008).

Milton Friedman, who coined the term "Monetarism" Established numerous main long-run features of the economy like the Quantity Theory of Money. The Quantity Theory of Money associated inflation and economic growth by simply equating the total amount of spending in the economy to the total amount of money in existence. Friedman challenged the concept of the Phillips Curve and argued that there is a positive linkage between inflation and economic growth in the short-run but in the long run an expansionary monetary policy causes an increase in general price increase (Friedman 1968). Monetarism in general advocates that in the long-run, the growth rate in money typically affect the price level, while prices having no real effect on Growth and inflation will prevail only if the growth in the money supply is higher than the economic growthrate

II. Literature Review

Many researchers have examined the relationship between inflation and economic development in many countries through applying various methods and revealed different findings with respect to the sign of relationship and direction of causality. Here below this paper attempts to review few literatures related to the relationship between inflation and growth domestic product. Barro (1995) who studied the relation between inflation and economic growth by using 100 countries data for the period of 1960 to1990. He found that there is a significant and negative relation between inflation and economic growth. Saaed (2007) investigate the association between inflation and economic growth in the context of Kuwait, using annual data set on real GDP and CPI for the period of 1985 to 2005. The estimated finding of the relationship indicates a long-run and strong inverse relationship between CPI and real GDP in Kuwait. By applying co- integration, and error correction models, Mallik and Chowdhury (2001) investigated the relationship between inflation and GDP growth for four South Asian countries namely, Bangladesh, India, Pakistan, and Sri Lanka and observed an evidence of a long-run relationship between GDP growth rate and inflation for all fourcountries. Erbaykal and Okuyan (2008) studied the relationship between the inflation and the economic growth in Turkey using data covering from 1987:1-2006:2 periods. The existence of the long run relationship and cointegration were tested. The result revealed statistically insignificant long-term relationship and negative and statistically significant short-term relationship. The causality relationship between the two series was examined in theframework of the causality

test developed by Toda Yamamoto (1995) and no causality relationship was found from economic growth to inflation, a causality relationship was found from inflation to economicgrowth.

Khan and Senhadji (2001) investigated the growth-inflation relationship of sample of 140 developing and industrialized countries using selected panel data covering a time period from 1960 to 1998.They found out a verging level of inflation rate beyond which inflation affects economic growth negatively. They contended that verging point of inflation is vary for developing and industrialized countries (e.g. for developing countries, it is 7-11 percent and for industrialized countries it is 1-3 percent). Ahmed and Mortaza (2005) also explored growth-inflation relationship using the data of real GDP and consumer price index of Bangladesh economy extended from a period of 1980 to 2005. Refined time series econometric methods have been employed by them for examining the relationship. They found that a significant and negative relationship between CPI and GDP has been evident for a long time period. So far as a threshold level is concerned for inflation rate of the Bangladesh, they observed it to be at level of 6 percent. Najid Ahmad (2012) finds negative relation between economic growth and inflation in Pakistan using time series data for the period of 1971 to2011.

Abbott and De Vita (2011) explored the relationship between inflation and growth in different exchange rate regimes using the panel data for the sample of 125 countries selected from developing and developed countries covering from the period 1980 – 2004. The findings of the study suggested that the cost of inflation on the economic growth becomes higher and significant for the case of developing countries that adopt flexible exchange rate regimes compared to the ones that use fixed or intermediate exchange rates. Gokal and Hanif (2004) analyzed the relationship between inflation and economic growth in Fiji using annual data covering from1970 to 2003 for variables of Real GDP, annual average CPI, and year on yearCPI inflation rate. The results of the analysis reveal that both inflation measures (annual average CPI and year on year CPI) have negative weak relationship with the GDP growth. The result of the Granger causality test shows that causality runs one way from economic growth to inflation.

Singh and Singh (2016) studied the link between economic growth and consumer price index (CPI) in Japan for the period of 1980-2014. The employed Johansen Co-integration Test and Granger Causality model in order to examine the long-run relationship among the variables and causal relation between two series respectively. The empirical results reveal that economic growth and CPI are co-integrated and thus exhibit a long-run relationship between the variables. The Granger causality test confirmed bi- directional causality between economic growth and CPI in Japan. Hussain and Malik (2011) explored the nexus between inflation and economic growth in the context of Pakistan economy by employing annual data for the period of 1960-2006. the results of the study revealed that inflation is positively related with economic growth in Pakistan and vice versa. concerning the result causality between two variables, it is found that causality run from inflation to growth not viceversa.

Similarly, Hossain (2012) examined the long run relationship between inflation and economic growth in Bangladesh over the period 1978 to 2010 using cointegration and causality test. The result of the Co-integration test exhibited that for the periods, 1978-2010, there was no co- integrating relationship between inflation and economic growth for Bangladesh data and that causality suggested a unidirectional causality running from inflation to economic growth. Pradana

M. and Rathnayaka M. (2013) investigates the short-run and the long-run relationship between the economic growth and the inflation of three Asian courtiers over the period 1980-2010. The methodology used in the study is cointegration and causality test. The results discovered that there is a long run negative and significant association between the economic growth and inflation in Sri Lanka. Whereas no statistically significant relationships were observed between the variables in China and in India, a negative and significant short run relationship was found for China. The causality results revealthatthereisaunidirectionalcausalitythatrunsfromtheeconomic growth to the inflation.

III.   Data description and modelspecifications

3.2 Source of thedata

In order to investigate the relationship between Inflation and Gross Domestic Product of Ethiopia, we used a time series data of twenty observations covering from the period of 2000-2019. The data on inflation and Real Gross Domestic Product Growth Rate (In %) has been collected from National Bank of Ethiopia report of 2018-2019, World Development Indicator (WDI) and International Financial Statistic (IFS).

1.2.   Unit roottest

In the case of dealing with the macroeconomic time series variables, due attention should be given to stationarity of the variables so as to escape the problem of spurious or nonsensical regression. The concern for stationarity of time series variables gives rise to analysis of unit roottests.

Unit root tests are statistical procedures that are designed to make judgment as to whether a given sample of time series data implies a unit root or the time series is found to be stationary. In most cases a time series that exhibits stationarity is denoted as $I(0)$ and a series that shows unit root is indicated as $I(1)$ (Wooldridge

2009: 192 – 5). Therefore, to deal with the issue of stationarity, we used Augmented Dickey Fuller test. The ADF test can be
estimatedusingthefollowingequation:

$$\Delta G_t = \alpha_1 + \alpha_{2t} + \mu G_t + \sum_{i=1}^{k} \tau_i \Delta G_t + \varepsilon_t$$

$$\Delta I_t = \beta_1 + \beta_{2t} + \delta I_{t-1} + \sum_{i=}^{k} \rho_i \Delta I_t + \varepsilon_t$$

where G is real GDP growth rate, I is inflation, k refers to the number of lags and ε_t are white noise. The null hypothesis that H_0: μ and δ = 0, alternative hypothesis that H_1=: μ and δ ≠ 0.

1.3. Johansen's cointegrationtest

After verifying the stationarity of the data series which is inflation and real gross domestic product growth rate usually using Augmented dickey-fuller test, the next procedure is to scrutinize the existence of a long-run equilibrium relationship among two variables which is to be tested by applying Johansen cointegration test. The Engle-Granger (1987) two-step cointegration procedure is used to test the existence of cointegration between the two variables. If both time series are integrated of the same order then it is possible to proceed with the estimation cointegration test. Therefore, we apply Johansen's methodology that begin from the Vector Auto regression (VAR) of order P given by:

$G_t = \alpha_1 G_{t-1} + \cdots + \alpha_p G_{t-p} + \beta I_t + \varepsilon$ whereGₜisak-vectorofI(1)variables, Itis a n- vector of deterministic trends, and ε is a vector of shocks. The above VAR model can be rewrittenas: $\Delta G_t = \varphi G_{t-1} + \sum_{i=1}^{p} \mu_i \Delta G_{t-1} + \beta I_t + \varepsilon_t$

Where $\varphi = \sum_{i=1}^{p} \alpha - 1$, $\mu_i = \sum_{j=t+1}^{j} \alpha_j$

To select the required number of lags to be used in the cointegration test, typically we employ the Akaie Information Criterion (AIC), Schwarz Criterion (SC) and the Likelihood Ratio (LR) test. In order to determine the number of co-integrating vectors, we can apply Johansen (1988) and Johansen and Juselius (1990) maximum-likelihood test procedure namely, the maximum eigen value test, which tests the null hypothesis that there are at least r cointegrations vectors, as against the alternative that there is r+1, and the trace-test, where the alternative hypothesis is that the number of cointegrating vectors is equal to or less than r+1. Their specifications are writtenasfollow: $\tau_{max} = -T \log(1-\lambda_{r+1})$ where λ_{r+1} isthe $(r+1)^{th}$ largest squared eigen value.
$\tau_{Trace} = -T \sum_{i=r+1}^{k} \log(1 - \lambda_i)$ where λ_i is the ith largest eigen value of matrix φ and T is number of series.

1.4. Granger causalitytest

By employing Granger test, we examine the causal relationship of growth and inflation. The variables can reveal bidirectional where the causality run from both sides, unidirectional (only from one direction not vice versa) and no causal relationship at all. When applying Granger causality test, we have a null hypothesis that go for the assumption that variables do not influence each other. The decision rule is that we reject the hypothesis if the calculated value of F statistics is greater than theoretical value. It can be said that one variable causes the other if coefficients that stand with variable are statistically significant (Granger 1969). If the two variables are co- integrated, an error correction term (ECT) is required to be included (Granger, 1988) and can be written as follow:

$$G_t = \alpha_0 + \sum_{t=1}^{i} \alpha_{1t} G_{t-1} + \sum_{t=1}^{j} \alpha_{2t} I_{t-1} + \gamma_1 ECT_{t-1} + \varepsilon_t$$

$$I_t = \alpha_0 + \sum_{t=1}^{i} \alpha_{1t} I_{t-1} + \sum_{t=1}^{j} \alpha_{2t} G_{t-1} + \gamma_2 ECT_{t-1} + \varepsilon_t$$

where γ_1 and γ_2 arespeedofadjustment, G_t and I_t areGDPandinflationattimet respectively. According to Johansen and Juselius (1990), the presence of cointegration indicates the existence of the causal relation between the two variables (Growth and Inflation) under the constraint /γ_1/ +/γ_2 / > 0. In case oftheabsenceofcointegrationbetweenthevariables, G_t and I_t ,theterm ECT_{t-1} whichisknownastheerrortermandcommonlyderivedfromthe long-run co-integration relationship will be removed from the above equation and we left with the following bivariate autoregression equation:

$$G_t = \alpha_0 + \sum_{t=1}^{i} \alpha_{1t} G_{t-1} + \sum_{t=1}^{j} \alpha_{2t} I_{t-1} + \varepsilon_t$$

$$I_t = \alpha_0 + \sum_{t=1}^{i} \alpha_{1t} G_{t-1} + \sum_{t=1}^{j} \alpha_{2t} I_{t-1} + \varepsilon_t$$

Regarding to the hypothesis, we have four hypotheses stated as follows:

1, if inflation causes growth not viceversa $\sum_{t=1}^{j} \alpha_{2t} \neq 0$ and $\sum_{t=1}^{i} \alpha_{1t} = 0$
2. if causality run from growth to inflation not viceversa,

$$\sum_{t=1}^{j} \alpha_{2t} = 0 \text{ and } \sum_{t=1}^{i} \alpha_{1t} \neq 0$$

3, if there is bidirectional causality i.e., both variables influence each
other, $\sum_{t=1}^{j} \alpha_{2t} \neq 0$ and $\sum_{t=1}^{i} \alpha_{1t} \neq 0$
4, if there is no causal relationship at all, $\sum_{t=1}^{j} \alpha_{2t} = 0$ and $\sum_{t=1}^{i} \alpha_{1t} = 0$

IV.   Result and discussion
4.1.   Unit roottest
The result of examining some statistical properties of the variables under consideration begin with testing stationarity using the Augmented Dickey Fuller (ADF) tests to check the presence of unit root in each of the time series. The results of the ADF tests are stated in Table 1 below

Variables	ADF at level			ADF at first difference		
	Test statistic	5% Criticalvalue	Decision	Test statistic	5% criticalvalue	Decision
GDP	2.796(0.0589)	3.00	Non-stationary	5.551(0.0000)	3.600	stationary
inflation	3.282(0.0693)	3.600	Non-stationary	3.325(0.0025)	1.761	stationary

N.B. The values in Brackets are MacKinnon p-values
Table 1: result of unit root test (at level and at first difference)
Table 1 presented the results of unit root test. It is visibly presented that time series are non- stationary at levels. However, the results indicate that economic growth and inflation are stationary when differenced. Augmented Dickey Fuller unit root test depicted that errors have constant variance and are statistically independent. These results enable us to proceed to employ co-integration test on inflation and growth.

4.2.   Johansen co-integrationtest
Next to the Augmented Dickey Fuller unit root testthe paper attempts to examine the cointegrating relationship between growth and inflation. Johansen co-integration test is used to determine whether there are any long- term co-integration relationships between growth and inflation in Ethiopia or not. To do so, we applied two likelihood ratio tests viz, the Trace Test and the Maximum Eigen Value test, to determine the number of co-integrating vectors. The result is reported in the tabular form below.

Johansen tests for cointegration				
Maximumrank	Trace statistic	5% critical value	Max statistic	5% critical value
0	25.6212	15.41	16.6133	14.07
1	9.0079	3.76	9.0079	3.76

Table 2: Johansen tests for cointegration
The above table vibrantly presented the results of the Johansen co- integration test. Accordingly, the results in the table confirmed the existence of long-term relationship among the variables under consideration. Therefore, the findings asserted that the series is co-integrated, as both the trace and the maximum eigenvalue tests able to reject the null hypothesis of no co-integration. Consequently, we can proceed to examine causal relationship between inflation and growth in Ethiopia.

4.3. Granger causalitytest

Granger Causality has been employed to observe the causal relationship between inflation and economic growth. Accordingly, summary of the Results is reported in table below.

Granger causality test	
Null hypothesis	Prob > chi2
Inflation does not Granger Cause GDP growth rate	0.421
GDP growth rate does not Granger Cause inflation	0.075

Table 3: Granger causality test

As it is clearly presented by the table above, the direction of influence between economic growth and inflation, none of the variables is depicted as influential. This implies that to increase the accuracy of the prediction of inflation with respect to a forecast, it is difficult to depend only on past values of GDP growth rate and vice versa. Consequently, the result suggested that the influence iscontemporaneous.

V.   Conclusion

Studying the causal relationship between inflation and growth has been get due attention among economic researchers in the last decades. However, the historically recorded stability of macroeconomic situation of the Ethiopian economy regarding inflation made economic researchers and policy makers not to engage in the study of the relationship between inflation and economic growth and cause for the limitation of the literature in this area. Therefore, this paper attempts to fill the observed literature gap and examine the relationship between inflation and GDP growth rate through employing the data extended from the period 2000 to 2019 extracted from report of National Bank of Ethiopia, World Development Indicator (WDI) and International Financial Statistic (IFS).

While studying, applied several tests starting from Augmented Dickey Fuller test to examine stationary property of the time series data understudy. The unit root test results assured that GDP growth rate and inflation are non- stationary at the level but stationary at their first differences. Hence, they are integrated of order one. This result enabled us to go far so as to conduct Johansen's co-integration test to investigate the existence co-integration between growth and inflation. The observed evidence succinctly exhibited the presence of long run relationship between the two variables under consideration. Moreover, we also carried out the Granger-causality test to explore the causal relationship between the two variables or to explore the extent to which the accurate prediction of one variable (inflation) with respect to a forecast, depend only on past values of the other (GDP growth rate) and vice versa. consequently, the result suggested that the influence is contemporaneous.

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