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Research Article

An Empirical Analysis of the Relationship Between Inflation and Unemployment in Ethiopia

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Abstract

In this study the empirical relationship between inflation rate and unemployment rate is investigated using annual time series data collected for the period 1991/92-2020/21 for Ethiopia. To accomplish this study, we employed a vector error correction econometric model, Granger causality, and variance decomposition tests. The findings reveal that the unemployment rate has a positive and statistically significant impact on the inflation rate in the long run, justifying that the Phillips Curve hypothesis does not hold for Ethiopia. Further results from the causality test confirms, the absence of causality running between the inflation rate and unemployment rate. To forecast error variance of inflation rate because of a unit shock of all variables included in the model—foreign aid, money supply, and unemployment rate—variance decomposition tests were undertaken. Thus, policies that are intended to boost the productive capacities of an economy by appropriate monetary and fiscal policy, and create job opportunities to bring the balance between the demand and supply of goods and services are better if implemented in a proper manner.

Keywords

Inflation Rate, Unemployment Rate, Vector Error Correction Model, Phillips Curve

1. Introduction

The two basic indicators of the performance of the market economy over time, inflation, and unemployment, have socio economic consequences for most people residing in the countries where the process took place. An increase in the unemployment rate can lead to terrible consequences such as a decrease in income and purchasing power, ultimately resulting in lower living standards. Inflation, characterized by a persistent rise in the overall cost of goods and services, is widely regarded as a catastrophic event that can significantly impair the functioning of the market economy [5].

The concept underlying the tradeoff between inflation and unemployment was first discussed by A. W. Phillips, who collected data on the wage rate (inflation) and unemployment for the economy of the United Kingdom in 1958 for more than 100 years, starting from 1861 to 1957 [18]. Phillips' empirical study reveals an inverse relationship between the rate of unemployment and inflation in an economy. In other words, the lower the unemployment rate in an economy, the higher the rate of inflation; the higher the unemployment rate, the lower the rate of inflation. However, later research revealed a disagreement over a negative relationship between the rate of inflation and unemployment. According to [13], in

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the long run there is no trade-off between inflation and unemployment. The structure of the economy, its growth rate, and other real factors, independent of monetary policy and the rate of inflation, determine the "natural rate" of unemployment. Although the natural rate may fluctuate over time, policies that generate inflation beyond the public's expectations are the only ways to achieve unemployment below the natural rate [22].

In recent years, inflation and unemployment have been the two basic macroeconomic problems for most of the population in Ethiopia. The general inflation rate in the country has increased from 19.1 percent during March 2020 to 19.3 percent during April 2020. In April 2020, Ethiopia's country-level overall inflation rate (annual change based on a 12-month moving average) increased by 19.1 percent compared to the same period in the previous year [7]. The labor market's imperfections are causing the unemployment problem, which is closely tracking Ethiopia's economy. For instance, there has been a consistent increase and decrease in the unemployment rate in Ethiopia since 1990/91. According to the [41] data, the unemployment rate for the year 2018 and 2019 were about 2.32 and 2.33 percentages respectively.

Barro has argued that, if sustained increase in prices is more than 15 percent, the inflationary situation in a country could have a negative structural break effect on economic growth [6]. Consequently, inflation reduces the real income earned by the society and their capacity to save in Ethiopia. The reduction in saving is due to increased demand for money to buy goods and services. This results in lower investment in both physical and human capital formation, which in turn results in lower economic growth [9]. Similarly, a longer period of unemployment can hinder economic growth by reducing the skill and productive capacity of workers. This, in turn, can increase the society's involvement in illegal activities as well as vulnerability to malnutrition, illness, and mental stress, which can lead to depression and social stigma [2]. The higher the inflation rate and the lower the employment creation capacity of an economy, the more the economy tends to be unstable.

Extant studies have found mixed results concerning the relationship between inflation rate and unemployment. For instance, the studies undertaken by [33], and [11] reveals negative relationship between inflation and unemployment rate. On the other hand, [20] have obtained the findings that reject the presence of the vertical Philips curve, and support the presence of the Phillips curve only in the short run. Since inflation rate and unemployment rate are largely influencing the economy of Ethiopia studying the relationship between the two variables is important to devise a sound macroeconomic policy that will bring a macroeconomic stability for the overall health of an economy. To investigate the relationship between inflation and unemployment in the scenario of Ethiopia, [25] collected time series data for the period 1984 to 2018. According to the findings from the Granger causality test, two-way causality exists between inflation and cyclical unemployment. However, the purpose of this study was only to identify the direction of causality between the two variables.

The study investigates the relationship between inflation and unemployment, which are two major economic issues that make Ethiopia's economy less stable. The study employs the vector error correction econometric model and variance decomposition with the following objectives:

1) Examining the relationship between inflation rate and unemployment rate in Ethiopia.
2) Identifying the direction of causality between inflation rate and unemployment rate.
3) Forecasting the error variance of the inflation rate due to a unit shock of variables such as the unemployment rate, money supply, and foreign aid.

2. Literature Review

2.1. Theoretical Literature Review

In most of the literatures of macroeconomics, the nexus between inflation and unemployment was examined with the aid of the Phillips Curve. This This curve claims that there exists an inverse relationship between inflation and unemployment. In other words, lower inflation can only be attained by increasing the unemployment rate and lower unemployment can be associated to high inflation rate. However, according to [35], the Phillips curve failed to predict stable inflation during the Global Financial Crisis of 2008-2009, leading to a significant drop in civilian unemployment during recovery and a stagnant core Personal Consumption Expenditure price index growth rate in the U. S. economy. Similarly, [8] evaluated the idea during the Great Recession and found the general explanations to be insufficient within the context of a standard Phillips curve. The two riddles imply that changes in wages and prices have been connected to changes in actual activity. Thus, as stated by Ratner and Sim, the Phillips curve is dead, according to a growing number of professionals from various backgrounds.

Inflation which is an increase in the general level of prices of goods and service represents how much expensive the good and services has become over a certain period, mostly in a certain year. Inflation can be measured by using the GDP deflator and Consumer price index. The GDP deflator enables us to measure the overall inflation with broader coverage by considering the price of goods and services domestically produced alone and assign varying weight to the cost of basket of goods and services. However, the most used method of measuring inflation is the Consumer Price Index (CPI). The CPI measures the cost of a basket of goods and services relative to the base year price, and it also includes both the imported and domestically produced goods [30]. According to many scholars, different factors and policies are responsible for the increase in the general level of prices of goods and services. For instance, when aggregate demand increases

faster than aggregate supply, there is upward pressure on wages and prices, resulting in demand-pull inflation. The increase in prices can also be associated with an increase in the cost of factor inputs such as labor, which results in the overall rise in the cost of production, which is then transferred to the consumers as an increase in prices, reflected as cost-push inflation [23].

The other factor for which a little emphasis is given by policymakers as a factor that influences the rate of inflation and the overall productivity of an economy, particularly in the developing countries like Ethiopia, is foreign aid. According to [28, 14], an increased flow of aid money leads to increased demand for both imported and locally produced goods and services. Continuously adding money can cause inflation if it is not backed by good economic and financial policies that can bring about a balance between the supply and demand of goods. This can happen when aggregate demand is higher than aggregate supply.

Money supply is another factor that results in an increase in the rate of inflation. According to monetarists, when money supply increases nominal income will rise, thus shifting out the aggregate demand curve, initially this may lead to an increase in real output above the natural rate level, but the resulting decline in unemployment below the natural rate will create upward pressure on wages and prices, thus leading to a continuing shift up in the short-run aggregate supply curve. Where the economy is again back at the natural rate level of output the price level has further increased. The net result of this process is that a continuing rise in the price level, that is, a sustained inflation, results from a growing money supply. In the monetarist model, the aggregate demand curve shifts only because of changes in the money supply and so, in the absence of a high rate of money growth, sustained inflation cannot develop. Most of a significant change in the price level has occurred due to the consistent change in the supply of money. Inflation is always and everywhere a monetary phenomenon resulting from and accompanied by a rise in the quantity of money relative to the output [21].

The Keynesian model agrees with Friedman that an excessive increase in the money supply can lead to price instability. It also comes to the same conclusion as the monetarist model: A continuing rise in the price level, that is, sustained inflation, will result from a rapid growth of the money supply. The Keynesian model, in contrast to the monetarist model, does allow other factors besides the money supply to affect the aggregate demand curve, specifically fiscal policy. At first glance, this means that sustained inflation could happen due to expansionary fiscal policy, like higher real government spending or lower taxes, which would show that Friedman's theory is wrong. However, this is not the case. Even in the Keynesian model, sustained inflation cannot result unless there is a rapid growth in the money supply. Even in a Keynesian model, fiscal policy cannot by itself be the source of sustained inflation. The Keynesian framework therefore supports the Friedman proposition [26].

Unemployment, which refers to a situation in which an individual who is actively searching for a job is unable to find one at the prevailing market wage rate, is another indicator of the performance of an economy. It indicates the total number of unemployed individuals in the labor force. There are many kinds of unemployment, such as cyclical and frictional unemployment. However, structural unemployment is the most prevalent in most developing economies [32]. On the other hand, structural inflation is also most prevalent in developing economies like Ethiopia due to the deficiencies in specific economic conditions, such as an inefficient and backward agriculture sector that cannot meet the rising demand for food from the public [1, 37]. Structural unemployment is the type of unemployment resulting from disparity between the skills that employees have and the skills that employers need [16]. Workers are unemployed because at the going wage, the supply of labor exceeds the demand. Frictional unemployment occurs when workers have different preferences and abilities, and jobs have different qualities. Employees' geographic mobility and employer-employee communication are incomplete. For all these reasons, searching for an appropriate job takes time and effort, and this tends to reduce the rate of job finding. Indeed, because different jobs require different skills and pay different wages, unemployed workers may not accept the first job offer they receive [24]**.** Cyclical unemployment, on the other hand, represents joblessness that is associated with the ups and downs, or fluctuations, in the economic system. To the Keynesians, frequent shifts in a business cycle and severe economic downturns like the Great Depression have led to a shortage of aggregate demand, which is not sufficient to provide employment for everyone who wants to be hired [19].

2.2. Empirical Literature Review

The nexus between inflation and unemployment from an empirical perspective has attracted the interest of many researchers in recent years to test the validity of the Phillips curve. Using data for the period of 1987–2016 in the Turkish economy, [31] employed an ARDL cointegration method for analysis and results shows that there is no long-term relationship between the variables in the model when inflation is the dependent variable. However, when the unemployment rate is a dependent variable, the long-run relationship exists between the variables under study.

To investigate the relationship between inflation and unemployment, [17] has employed an econometric model. In the model, the unemployment rate, money supply, and exchange rate were treated as independent variables, while inflation was treated as the dependent variable. The model showed that a negative relationship between inflation and unemployment rates exists, implying that higher unemployment rates lead to lower inflation rates and vice versa. The study also finds a negative relationship between the ex-

change rate and the inflation rate.

The study conducted by [36] by employing a descriptive method has indicated that unemployment has a negative impact on Ethiopia's economic growth where an increase in unemployment leads the decline of real GDP.

By using the Engle-Granger Error-Correction approach [40] has tried to determine whether higher inflation could contribute to employment creation for South African economy. The findings from the study shows a positive cointegrating long run relationship between employment and output, leading to the assertion that anything that negatively effects output like high inflation will by extension harm employment creation in the long run. Even though no relationship is found in the short run, in case where relatively low and constant inflationary pressure is attributed to inflation targeting regime, inflation is conducive to employment creation in South Africa.

According to [27], using data collected for the period 1996-2012 in Romania, it was found that there are six years when the unemployment rate change has the same trend as the change in the rate of inflation (direct relationship), which leads to the absence of negative relationship hypothesized by Phillips curve between unemployment and inflation. Furthermore, looking at the last period where there is an economic crisis, in one year (i.e., 2010) there is a direct relationship between the two indicators, and in another year (2012) there is evidence of a negative relationship.

Using quarterly data for the US from 1952 to 2010, [4] has examined the long-term relationship between inflation and unemployment. The band-pass filter method shows that there is strong evidence of a positive relationship. Specifically, inflation happens three to three and a half years before unemployment, and the cycles last from eight to twenty-five or fifty years. This study's theoretical statistical approach shows that there is a long-term positive relationship between inflation and unemployment. This is in line with what [13] and the more recent New Monetarist model of Berentsen, Menzio, and Wright predicted. Similarly, [3] tried to investigate the relationship between unemployment and inflation in Sudan using time series data for the period 1992-2015 to estimate the causal relationship between unemployment and inflation employing a Granger Causality test. The findings from the study reveal absence of causal relationship between inflation rates and unemployment rates.

By collecting annual time series data from 2003 to 2019 for Western Balkan, [10] has analyzed the relationship between macroeconomic variables that influence inflation. Through their research, they have analyzed the influence of GDP growth, remittances, level of exports on inflation rate. The research results reveal that in the short run, all variables influence the inflation rate, except for foreign direct investment, which has insignificant influence. Moreover, the analyses through the Arellano–Bover/Blundell—Bond estimation reveal that GDP growth, imports, and foreign direct investments have a positive influence on the inflation rate, while, working remittances and exports have a negative influence on the inflation rate.

In order to estimate the impact of economic growth and inflation on unemployment in Bhutan [38] have employed an Autoregressive Distributed Lag (ARDL) econometric model. According to the findings from the study economic growth had no impact on the reduction of unemployment rate both in the short and in the long run. On the other hand, inflation is found to have a negative relationship with unemployment in the short run and positive relationship in the long run. If inflation is not controlled, its uncertainty can lead to lower investment and economic growth resulting in rise in the unemployment in the long run.

By using a Vector Error Correction Model (VECM) and an impulse response function, [42] has examined how inflation and unemployment rates are related. The findings obtained from the study reveal that inflation has a one-way relationship with unemployment. However, results from the Impulse Response Function (IRF) show that the inflation rate is fluctuating in response to the shock of unemployment. Initially, the unemployment rate responded to inflation shocks by increasing, but it eventually decreased. This shows that the impact of inflation only induced shocks in the short run. Lastly, in the long run and short run, unemployment did not affect inflation rates.

The literature review shows mixed results concerning the relationship between inflation and unemployment rates. To fill in this research gap, this study investigates the nexus between inflation and the unemployment rate using annual time series data for Ethiopia from 1991/92 to 2020/21.

3. Methodology and Data

To undertake the study, the researchers have relied on secondary data sets. To make sure the data was consistent, we obtained yearly time series data from the World Development Indicators (WDI) database for variables such as the money supply (MS), the unemployment rate (UR), the foreign aid (FA), and the inflation rate (INF). We analyzed the collected data using Eviews 12 software. The reason for the selection of this software was its flexibility and comfort when dealing with time series data. For data analysis, we used a vector error correction econometric model, the Granger causality test, and the variance decomposition test.

Estimation Strategy

We conducted five separate econometric tests to estimate the model:

i) The test of stationarity of the individual series in the regression model was done to figure out the best way to combine the variables and the new data. The Dickey-Fuller (ADF) test is used for checking the stationarity of the variables included in the model with the following test equation:

$$\Delta Y_t = \alpha + \delta_t + \lambda Y_{t-1} + \beta_1 \Delta Y_{t-1} + \cdots \beta_{j-i} \Delta Y_{t-j+1} + \mu_t, \quad (1)$$

Where α is a constant term, δ is the coefficient of the time trend, j is the optimal lag length, Δ is the difference operator, t represents the time trend, and μ represents the Gaussian white noise. The test for stationarity is carried out under the null hypothesis λ = 0 as against the alternative hypothesis λ < 0. We then compare the computed test statistic with the critical values. So, if the test statistic is higher than the critical value, the null hypothesis that λ = 0 is not true, which means that there is no unit root (stationarity). In the same way, if the test statistic is less than the critical values, the null hypothesis is accepted. This means that the series has a unit root and is not stationary.

ii) We conducted the Johansen test of cointegration to examine the cointegrating relationship between the variables. The Johansen test of cointegration is the most important step in deciding whether to use the vector autoregressive model (VAR) or the vector error correction model (VECM). If the underlying variables of interest are not cointegrated after running the Johansen test of cointegration, the VAR model is the best way to figure out what the short-term relationship between the variables is. But if the variables in the model exhibit some sort of long run relationship among themselves, VECM model is more feasible for representing and estimating the sort of the relationship among the variables [39]. The test is based on a maximum likelihood estimation of the K-dimensional Vector Autoregressive (VAR) model of order p.

$$Z_t = \mu + A_1\Delta Z_{t-1} + A_2\Delta Z_{t-1} + \ldots\ldots + A_{k+1}\Delta Z_{t-p+1} + \varepsilon t, \quad (2)$$

Where Z_t is a vector of stochastic variables, μ is a vector of constants, A_t is a matrix of parameters, and e_t is a vector of the error terms. We could transform the model into an error correction form:

$$\Delta Z_t = \mu + \prod 1\Delta Z_{t-1} + \prod 2\,\Delta Z_{t-2} + \cdots\ldots\ldots\prod_{k+1}\Delta Z_{t-p+1} + \Gamma Z_{t-1} + \mathcal{E}_t, \quad (3)$$

Where Γ and $\prod \ldots \prod_{k+1}$ are the matrices of the parameters. On the other hand, if the coefficient matrix Γ has reduced rank $r < k$, then the matrix can be decomposed into $\Gamma = \alpha\beta.'$ The Johansen cointegration test involves testing for rank of the Γ matrix by examining whether the eigenvalue of Γ is significantly different from zero. There could be three conditions: (1) $r = k$, which means that Zt is stationary at levels, (2) $r=0$, which means that Zt is first differenced Vector Autoregressive, (3) $0<r<k$, which means that there exist r linear combinations of Zt that are cointegrated. In this study both trace statistics and maximum Eigen value statistics were used.

iii) Vector Error Correction model specification

After stationarity and tests of cointegration are made, the error correction model used for this study can be specified as follows:

$$\Delta\text{LNINF}_t = \mu + \sum_{i=0}^{n}\beta_1\Delta FA_{t-1} + \sum_{i=1}^{n}\beta_2\,\Delta UR_{t-1} + \sum_{i=2}^{n}\beta_3\,\Delta MS_{t-1} + \sum_{i=3}^{n}\beta_4\,\Delta LNINF_{t-1} + \beta_5 ECT_{t-1} + \varepsilon t, \quad (4)$$

Where $ECT_{t-1,}$ is the lagged value of the error correction term, the Wald test for joint significance of independent variables can be employed to examine the short-run impact of the change in the independent variables on the dependent variable. The t-test for the significance of the error correction term can be used to examine the long-run relationship among the underlying variables.

iv) Granger Causality Tests were undertaken to know the direction of causality.

To assess whether there is any potential predictability power of one indicator for the other a Granger-causality test is undertaken. According to [15] when dealing with different variables two assumptions are undertaken: a) the future cannot cause the past. The past causes the present or future. b) A cause contains unique information about an effect not available elsewhere. One of the reasons for conducting a Granger causality test is that, the knowledge of the past values of one variable can be best predicted by the value of another variable rather than only its past values. There are different types of causality like unidirectional Granger causality when A_t causes Bt (from A to B), and Bt causes A_t (from B to A), there is also a bi-directional (feedback) causality among the variables), and finally the two variables may be independent.

The causality test equation can be specified as follows:

$$lnINF_t = \beta_0 + \sum_{i=1}^{k}\beta 1\,\text{lnINF}_{t-1} + \sum_{j=1}^{k}\beta 1j\,\text{UR}_{t-j} + \varepsilon_{1t}, \quad (5)$$

$$UR_t = \alpha_0 + \sum_{i=1}^{k}\alpha_{1i}\,\text{UR}_{t-1} + \sum_{j=1}^{k}\alpha_{1j}\,\text{lnINF}_{t-j} + \varepsilon_{2t}, \quad (6)$$

HO: $\beta_{11}=\beta_{12}=\ldots\ldots$ $\beta_{1j}=0$ implying that UR does not Granger cause lnINF

H1: $\beta_{11}\neq\beta_{12}\neq\ldots\ldots\ldots$ $\beta_{1j}\neq 0$ implying that UR does Granger cause lnINF

For equation 3.6 the hypothesis can be formulated as:

HO: $\alpha_{11}=\alpha_{12}=\ldots\ldots\ldots\alpha_{1j}=0$ Implying lnINF does not Granger Cause UR

H1: $\alpha_{11}\neq\alpha_{12}\neq\ldots\ldots\ldots\alpha_{1j}\neq 0$ Implying lnINF does Granger Cause UR

If the null hypotheses for both Equations 5 and 6 are rejected, we can conclude that there exists a bi-directional causality running from the unemployment rate to the inflation rate and from the inflation rate to the unemployment rate at the same time. If the null hypothesis of equation 5 is rejected and that of equation 6 is not rejected, we can conclude that there is a unidirectional causality running from the unemployment rate to the inflation rate. But if we fail to reject the null hypothesis of equation 5 and reject that of equation 6, we can easily conclude that the direction of causality runs from

the rate of inflation to the unemployment rate.

v) Variance decomposition test

The last objective of this study is to look at the importance of the past values of the lagged dependent and independent variables, in explaining the error variance of the dependent variable.

4. Empirical Results and Discussions

4.1. Stationarity Test

For a stationarity test, we used the Augmented Dickey Fuller (ADF) test to make sure there is no spurious regression among the variables in the study's model (see Table 1).

Table 1. *Stationarity Test.*

Variables	ADF test at level	ADF test after first difference	Order of Integration
LNINF	-2.300793	-5.628295*	I (1)
FA	-0.448884	-4.870648*	I (1)
UR	-1.827456	-9.118896*	I (1)
MS	-1.698198	-4.901674*	I (1)
Test critical values:	1% level		-3.769597
	5% level		-3.004861
	10% level		-2.642242

*, denotes that the variables are significant at 1% level of Significance
Source: Own Computation by Eviews 12

The results in Table 1 indicate that all the variables included in the model were stationary at the first difference because the ADF test statistic values were greater than the ADF critical values.

4.2. Cointegration Test

Prior to running the VECM model, the Johansen test of cointegration was used to see if the underlying variables have a long-run relationship. Table 2 shows the results of the analysis.

Table 2. *Johansson Test of Cointegration.*

Unrestricted Cointegration Rank Test (Trace)			
No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**Critical Value 0.05**
None *	0.814158	52.55279	47.85613
At most 1	0.291317	15.52992	29.79707
At most 2	0.269382	7.954278	15.49471
At most 3	0.046574	1.049267	3.841465

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)			
No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**Critical Value 0.05**
None *	0.814158	37.02287	27.58434

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)			
No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**Critical Value 0.05**
At most 1	0.291317	7.575641	21.13162
At most 2	0.269382	6.905011	14.26460
At most 3	0.046574	1.049267	3.841465

*, denotes rejection of the hypothesis at the critical value of 0.05 level
Source: Own Computation by Eviews 12.

Based on the results in Table 2, since the trace statistic value of (52.55) is greater than 47.85 at 0.05 critical value and the Max-Eigen statistic (37.02) is greater than 27.58, the null hypothesis of no cointegration among the variables is rejected. Therefore, we have verified the existence of the long-run relationship. For a 0.05 probability level, both the trace statistics and the Max-Eigen value statistics show that there is at least one cointegrated equation. This means that all the variables in the study's model are linked together in the long run.

4.3. Results of the Vector Error Correction Model

After doing the stationarity test and the Johansen test of cointegration, the next step is to estimate the VECM for both the short-run and long-run. Table 3 presents and discusses the model's results.

Table 3. *Long run and short run Results of the Vector Error Correction Model (VECM).*

Long run results of the VECM Dependent variable LNINF			
Variables	**Coefficients**	**Standard errors**	**t-statistics**
FA	0.127942	(0.01887)	[6.77858] *
UR	1.449657	(0.44748)	[3.23960] *
MS	0.355424	(0.03444)	[10.3200] *
C -21.47698			

Short run results of the VEC model Dependent variable Δ (LNINF)			
Variables	**Coefficients**	**Standard errors**	**t-statistics**
ΔLNINF (-1)	-1.121996	(0.29458)	[-3.80874] *
ΔLNINF (-2)	-0.569190	(0.29792)	[-1.91055]
Δ (FA (-1)	-0.072831	(0.07127)	[-1.02196]
Δ (FA (-2)	-0.091164	(0.06654)	[-1.37004]
Δ (UR (-1)	-0.215465	(0.45636)	[-0.47214]
Δ (UR (-2)	-0.156582	(0.51487)	[-0.30412]
Δ (MS (-1)	-0.052121	(0.09227)	[-0.56487]
Δ (MS (-2)	-0.028931	(0.09066)	[-0.31910]

Short run results of the VEC model Dependent variable Δ (LNINF)			
Variables	**Coefficients**	**Standard errors**	**t-statistics**
C	0.231478	(0.22078)	[1.04847]
ECT (-1)	- 0.452218	(0.19636)	[-2.30302]

*, shows that the t-ratios of the variables are significant at 0.05 level of significance
R-squared= 0.626704, Adj. R-squared = 0.253409.
Source: Own Computation by Eviews 12.

The R-square of the model shows that 62 percent of the variation in the rate of inflation is explained by foreign aid, unemployment rate and money supply.

In the long run, all the independent variables included in the model have a statistically significant impact on the rate of inflation. An econometric model's results demonstrate a significant positive impact of foreign aid on Ethiopia's inflation rate. This could be attributed to the fact that an increase in aid inflows can trigger a surge in the demand for consumer goods and services. Since the total demand for goods and services exceeds its supply, an economy that is incapable of producing the desired level of goods and services will face the problem of inflation unless supported by sound economic and fiscal policy.

In reverse to the negative relationship hypothesized by the Phillips curve, the empirical result from this study shows the existence of a positive relationship between inflation and unemployment rate. The findings from this study are similar to those of [29], where inflation and unemployment are found to move in the same direction in the long run. The studies undertaken by [12] also found a positive relationship between cyclical unemployment and the inflation rate in Ethiopia. The model includes the money supply as another explanatory variable, which positively influences the rate of inflation. There are also similar findings by [34], where a one percent increase in money supply on average leads to an increase in inflation by 0.21 percent in Ethiopia. From this one can simply understand one of the factors contributing to the rise in the inflation rate in Ethiopia is the money supply, which is not regulated by appropriate monetary policy.

The error correction term from the VECM model also shows that, in an economy, 45 percent of the deviation from long-run equilibrium is corrected each year. The short-run VECM reveals that past values negatively influence inflation. The results also show that the past year's inflation influences the current rate of inflation. This shows how important inflation inertia is for explaining the rate of inflation in the short-run.

4.4. A Granger Causality Test

To identify the direction of causality between inflation rate and unemployment rate, a Granger causality test was performed, and the test results are reported in Table 4. The result from the causality test shows the absence of causality between the two variables. Since the null hypothesis of unemployment rate (UR) does not Granger Cause log of inflation (LNINF) and LNINF does not Granger Cause UR were not rejected, we can conclude that there is no causality running between inflation and unemployment in Ethiopia for the period for which the data were collected and analyzed. The findings were like those of [3], who collected time series data for the Sudanese economy from 1992-2015 and found no causal link between inflation rates and unemployment rates.

Table 4. *A granger Causality Test.*

Null Hypothesis	**Obs**	**F-Statistic**	**Prob.**
UR does not Granger Cause LNINF	22	0.53163	0.5971
LNINF does not Granger Cause UR		1.64980	0.2214

Source: Own Computation by Eviews 12.

4.5. Results for Variance Decomposition Function (VDF)

Since the study conducts the generalized VDF, the forecast error variances of one variable are explained by its own innovations

(shocks) or innovations in other variables, and traces the directional response of one variable to a one standard-deviation in shocks in other variables.

Table 5. Variance decomposition of LNINF.

Innovation (shocks) of LNINF					
Percentage of forecast variance explained by innovation in independent variables					
Period	**S.E.**	**LNINF**	**FA**	**UR**	**MS**
1	0.823944	100.0000	0.000000	0.000000	0.000000
2	0.910979	91.29925	1.174093	2.483780	5.042881
3	0.977321	81.75584	1.035886	3.245007	13.96326
4	1.265499	62.94022	12.09275	5.226379	19.74065
5	1.443926	54.21791	17.22259	6.218628	22.34088
6	1.565780	48.93898	18.11167	6.121116	26.82823
7	1.749672	46.53914	19.30643	7.059051	27.09538
8	1.838406	43.32769	19.19523	7.069314	30.40776
9	1.974297	40.42272	20.60559	7.549911	31.42178
10	2.073046	39.59454	20.69192	7.565704	32.14783
Cholesky Ordering: LNINF FA UR MS					

Source: Own Computation by Eviews 12.

In the short run, say for instance from period 1 to period 5 a shock to LNINF accounts for about 100%, 91.29%, 81.75%, 62.94%, and 54.21% variation of fluctuation in LNINF itself respectively. This is used to be referred as own shock. But in the long run say after period 5 the response of LNINF to its own shock has gradually declined having the values of 40.42% and 39.54 in period 9 and period 10 respectively. A shock to foreign aid on the other hand will cause about 0.00%, 1.17%, 1.03%, 12.09, and 17.22 variations in LNINF respectively starting from period 1 up to period 5. As the time passes and the economy reaches the long run position of say period 10, the shock to foreign aid will cause about 20.69 percent variation in LNINF.

When we observe the impact of the shock to unemployment rate on the rate of inflation, in both short- and long run, the magnitude of its causal effect is not as such strong, but it is increasing from period to period. For instance, an impulse to unemployment rate will account for about 3.24% 5.22%, 6.12%, 7.05% variations in rate of inflation in period 3, 4, 6 and 7 respectively.

In general, from the variance decomposition test undertaken, one can simply understand that in the long run more of the variations in the rate of inflation is predicted to be caused by money supply, inflation itself (LNINF), foreign aid and Unemployment rate respectively.

5. Conclusion and Policy Recommendations

This study employs a Vector Error Correction Model (VECM) to investigate the empirical relationship between inflation rate and unemployment rate. For undertaking an analysis, yearly time series data for inflation rate, money supply, unemployment rate, and foreign aid for the period 1991/92-2020/21 was obtained from the World Development Indicators (WDI) database. The finding reveals a positive relationship between the unemployment rate and the inflation rate in Ethiopia. This finding contradicts with the Phillips Curve, which asserts an inverse relationship between inflation and unemployment rate. We also found that foreign aid and money supply have a positive and statistically significant long-run impact on inflation. The results from the causality test confirm the absence of causality running between inflation and unemployment rate in Ethiopia. To forecast error variance of inflation rate because of a unit shock in the entire independent variables (foreign aid, money supply and unemployment rate) variance decomposition test were undertaken. The results from variance decomposition test shows that inflation rate itself, money supply, foreign aid and unemploy-

ment rate respectively have a significant impact in forecasting the long run error variance of the dependent variable (inflation rate).

To bring price stability and create employment for people, the government must be able to identify the actual capacity of an economy or the existence of a commodity whose worth is one birr before injecting one birr into an economy so that too much money does not chase too few goods, leading to an inflationary situation. One of the reasons for the unemployment rate being positively related to the inflation rate in Ethiopia is due to supply side constraints like an increase in cost of inputs used in production and lack of economic diversification. This rise in cost of production and absence of economic diversification will result in an economic instability. So, policies that will boost the productive capacities of an economy, like granting subsidies to the producers and creating job opportunities to bring the balance between the demand and supply of goods and services, must be given priority by stakeholders. The government must also develop strong policies by which it can regulate an economy so that commodity hoarding cannot exacerbate the existing inflation rate during a period of high unemployment. Additionally, the money received through aid must be diverted from non-productive to productive sectors for facilitating domestic investment, which results in job creation for most of the population.

This study is not without limitations, as the concern of this study is to investigate the relationship between inflation rate and unemployment rate by undertaking a variance decomposition test; future studies may examine the nexus between expected inflation rate and unemployment rate on economic growth by including more explanatory variables such as real exchange rate.

Abbreviations

CSA	Central Statistical Agency
GDP	Gross Domestic Product
CPI	Consumer Price Index
ADF	Augmented Dickey Fuller
ARDL	Autoregressive Distributed Lag
VECM	Vector Error Correction Model
WDI	World Development Indicators
VAR	Vector Autoregressive Model
MS	Money Supply
UR	Unemployment Rate
FA	Foreign Aid
INF	Inflation Rate
VDF	Variance Decomposition Function
ECT	Error Correction Term

Author Contributions

MW developed the original draft preparation, validation, and conceptualization; DT data collection and data management; and BM data analysis, interpretation, and report writing.

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Ethics Approval and Consent to Participate

Not applicable.

Consent for Publication

Not applicable.

Availability of Data and Materials

The data that support the findings of this study are available from the World Development Indicators (WDI) database for all variables (i.e., money supply, unemployment rate, foreign aid, and the inflation rate).

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Conflicts of Interest

The authors declare no conflicts of interest.

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