

The Effect of Monetary Policy on Inflation in Ghana

Emmanuel Kwakye Amoah^{1,*}, Foster Awindolla Asaki¹, Dominic Atogumsekiya Anarigide², Michael Osei¹

¹Department of Business Studies, Regentropfen College of Applied Sciences, Bolgatanga, Ghana

²Department of Economics, SD Dumbo University of Business and Integrated Development Studies, Wa, Ghana

Email address:

emmankwakye@gmail.com (Emmanuel Kwakye Amoah), asakifoster@gmail.com (Foster Awindolla Asaki),

danarigide@st.ubids.edu.gh (Dominic Atogumsekiya Anarigide), penvankmichaels47@gmail.com (Michael Osei)

*Corresponding author

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Abstract: Ghana is working to reduce the inflation rate, which has become a burden. This study especially focuses on the short- and long-term effects of monetary policy on inflation in order to determine how it affects inflation in Ghana. The scope of the study was expanded to look at how responsive inflation is to monetary policy shocks and the relationship between monetary policy and Ghana's inflation rate. The vector error correction model was utilized as an estimation technique in the study, which utilised secondary data spanning the years 1990 to 2018. The study found that monetary policy, economic growth, and oil prices have a favorable short-term impact on inflation. The findings also showed that while currency rates and oil prices have a negative impact on inflation, monetary policy has a beneficial impact. The study also found a one-way causal relationship between inflation and monetary policy, exchange rate, economic expansion, and oil prices. The empirical results lead to the conclusion that inflationary innovations have a beneficial impact on monetary policy and the currency rate, but a negative one on oil prices. As a monetary policy tool to stop the inflationary trend, the report advises stakeholders and policymakers to reduce the quantity of money.

Keywords: Monetary Policy, Inflation Rate, Vector Error Correction Model, Causality, Impulse Response Function

1. Introduction

The recent rise in inflation in Ghana is alarming and affecting investors, economic activities, and the growth of the economy [1]. However, the Bank of Ghana relies on macroeconomic policies to curb the continual rise of inflation in Ghana. Macroeconomic policy has three primary ultimate goals, which have been dubbed the "Holy Trinity" in the literature. These include low unemployment, price stability, and economic growth. In general, economists agree that "price stability must be the long-run objective of monetary policy" [2]. Because it hinders economic efficiency and growth, inflation is expensive [3]. In actuality, price stability has been understood to imply low and constant inflation [4].

The Central Bank of the country's monetary policy has a significant impact on the country's economic and financial status. It is widely acknowledged that monetary policy can

promote long-term growth by upholding price stability. Households and companies do not need to take inflation into account when making daily decisions when it is sufficiently low [5]. The government uses both monetary and fiscal policies to manage the economy. A noteworthy and evident part of fiscal policymaking that is directly influenced by both recurrent and investment expenditures is the government adjusting its spending levels to track and influence the nation's economy. A nation's monetary authority controls the money supply through a process known as monetary policy. This process frequently targets an interest rate to foster economic stability and growth. Its stated objectives typically include low unemployment and reasonably stable prices. The amount of base money in circulation is really adjusted as part of any monetary policy. Open market operations, which affect the base currency's liquidity, are the public sales and purchases of (government-issued) debt and credit

instruments. The continual market transactions of the monetary authority change the money supply, which has an impact on other market factors including short-term interest rates and the currency rate.

Since growing inflation will impede the country's economic growth and social welfare, controlling inflation is a major objective of public policy [6]. Inflation, which is defined as an increase in the quantity of money as productivity declines, is likely influenced by monetary policy [7]. Because of the low returns on investment, low salaries for labor, and decreased production and economic growth, all of which are crucial for any economy, inflation inhibits investment [8]. Monetarists concluded that while monetary policy expansion impacts nominal variables in the long run, it affects real variables in the short run [9]. Given that anticipated inflation increases will increase long-term interest rates and tightening monetary policy will slow down economic growth, the increase in inflation will result in a decline in financial stock prices [10]. Inflation, according to Amadeo [11], happens when the cost of things increases and stays elevated. One of the most crucial objectives for any state bank, government, or institution is price stability.

A high inflation rate can also have a variety of effects on how well a business performs. First of all, a greater inflation rate will reduce people's actual income (income before deducting inflation), which will lead to them spending less money on goods and services, decreasing demand and harming firms' sales. Additionally, when price levels climb sharply, people may get uncertain about the future and begin making speculative investments, which are bets on assets like gold, stocks, and real estate to generate quick money on the premise that the price will rise further. Speculative investments have the drawback that the market could collapse at any time, leaving investors with a substantially smaller amount of money than they had first put [12].

Additionally, over time, inflation raises interest rates. When the government expands the money supply, interest rates initially decline due to the increased money supply. Banks and other financial institutions, however, increase rates to make up for the decline in the purchasing power of their funds as a result of the higher equilibrium prices and lower money value brought on by the increasing money supply. Higher long-term rates make it difficult for businesses to obtain financing, which decreases investment in technology and capital goods [13].

Nevertheless, increasing prices result in higher taxes. In tandem with inflation, nominal (not real) incomes increase, placing income earners in higher tax categories. People give the government a larger percentage of their income, even though their purchasing power does not improve. Additionally, property taxes on buildings, lands, and other real properties rise. Tax rates will remain the same if the government modifies the brackets in line with the rate of inflation; however, frequently, the government does not adjust the brackets at all [14]. Increased tax rates result from this.

The Bank of Ghana Act 612 [15] established the autonomy of the central bank and gave it the primary mandate of

achieving price stability (low inflation) through the implementation of monetary policy. Despite the laws, the country has had and continues to experience price instability, with inflation beyond its targets. Except a brief spell in 2012, the nation experienced long-term high double-digit inflation. The financing associated with the fiscal deficit and monetary growth are two main causes of a rising price level [16]. Although it is obvious from the way economic theory operates that monetary policy reduces inflationary pressure, monetary policy continues to expand in the form of money supply, such as 122.6b, 123.6bn, 124.6bn, 129.2bn, 131.7bn, 135.6bn, 137.5bn, and 139.4bn from 2017 to 2022. This is coupled with fluctuating inflation rates of 12.34%, 7.81%, 7.14%, 9.89%, 9.9%, and 31%. From 2017 to August 2022 respectively [17]. This, however, conflicts with the theoretical establishment of the relationship between monetary policy and inflation.

Empirically, several studies have examined monetary policy and inflation interconnections. However, the previous studies focused on monetary policy on inflation [18], determinants of inflation [19] and [20], price stability and growth [21], financial and monetary policies [22], the effect of monetary policy and inflation on the exchange rate [23] and Inflation targeting and monetary policy [24]. However, these studies do not examine the long and short-term influence of monetary policy on inflation. This is vital for identifying policy instruments that can be reduced and keep inflation at the optimal level over time.

Additionally, there is contention in empirical studies about the link between monetary policy and inflation [25-28]. Therefore, in the instance of Ghana, there is a need for empirical validation.

In contrast with earlier research, this one contributes to the body of knowledge by exploring the relationship, both short- and long-term, between Ghana's monetary policy and swings in inflation. The research will be expanded to determine the causal relationship between Ghana's monetary policy and inflation. Moreover, the study will look at how monetary policy reacts in both the short and long term to inflationary shocks or innovation.

The remainder of the essay will concentrate on the evaluation of the literature, the technique used to analyze the data, and the presentation as well as the discussion of the findings. Finally, the last portion will include recommendations and conclusions.

2. Literature Review

Interest rates and the availability of financing have connections to monetary policy. Short-term interest rates and bank reserves through the monetary base are being used as monetary policy tools. Money printing to create credit and coinage decisions were the only two sorts of monetary policy that existed for many centuries. Even though interest rates are currently regarded as a part of the monetary authority, at this time they were typically not coordinated with other aspects of monetary policy. The authority holding seigniorage, or

coining power, was typically in charge of monetary policy because it was seen as an executive choice. Recent centuries have seen the continuation of monetary policy, which refers to the process by which a country's central bank oversees the amount of money in circulation, typically focusing on an interest rate to promote economic stability and growth. The stated objectives are typically low unemployment and generally steady prices. Therefore, the monetary policy controls how much money the central bank prints to meet the objectives of price stability (or a low rate of inflation), full employment, and an increase in the country's overall revenue. Since funds are a means of trade, variations in demand and supply affect how much is spent. For example, the monetary policies of Ghana and England, respectively, are notorious for having "long and variable lags."

The recapitalization of banks and other financial entities in Nigeria and somewhere else, among other recent initiatives at financial market liberalization and reform, is gradually allowing the relevant central banks the flexibility needed to implement monetary policy frameworks.

Monetary theory states that monetary policy modifies the money supply and interest rate to achieve preset goals [29].

Monetary theory allows the creation of the best monetary policy feasible. It falls into one of two categories: expansionary or contractionary. An expansionary policy increases the money supply more gradually than usual or even contracts it, whereas a contractionary policy does the exact reverse. As interest rates are reduced in an attempt to battle unemployment during a recession, businesses are projected to grow as a result of the easy access to credit. The Central Bank aims to boost the economy when it uses expansionary monetary policy. Usually, to increase the money supply, this entails decreasing the prime rate. Mortgage rates will decrease as a result, consumers will borrow money, and businesses will grow, hiring more workers who will spend more money [11]. To avoid the distortions and depreciation of asset values that would otherwise occur, the contractionary policy seeks to lower inflation. The monetary policy instruments used by the central bank are determined by the economy's state of development, notably in its financial sector.

The relationship between monetary aggregates and inflation has garnered a lot of interest in the field of monetary economics concerning whether monetary policies have a major impact on a country's level of inflation empirically. The findings from earlier investigations varied depending on the economy being analyzed, the period that was examined, and the monetary aggregates selected.

The money supply and inflation were found to be positively correlated in some research. The following reviews a few of these studies. Using the two-stage least squares (TSLS) technique of estimate, Angelina and Nugraha [25] examined the impact of Indonesia's monetary policy on the country's inflation rate and overall GDP. Data for time series were taken from the annual reports of Indonesian banks. The study's conclusions demonstrated that the money supply had an important and beneficial effect on inflation, as well as an

important and favorable impact on inflation during the period before it, while the SBI rate and exchange rate had important and unfavorable impacts, respectively. The national economy is having a minimally positive effect on inflation in the interim. The rate of inflation in Ghana has been continuously high notwithstanding the establishment of an inflation-targeting system in 2007. The proclaimed objective for inflation was exceeded from 2007 to 2017 by an average of 4%, despite the target never deviating from a reasonably cautious 8% annual growth rate. When we investigate whether this outcome is the product of bad monetary policy, we find that it is not. Interest rates react to inflation shocks as is theoretically recommended, and the reaction functions of monetary policy are similar to those predicted for countries with effective monetary policies [24]. If the money supply increases, inflation will increase. If the money supply had increased in the prior era, inflation would have risen. If the SBI interest rate rises, inflation will decline. A rising rate of exchange will result in higher inflation. As the level of the country's economic activity rises, inflation will rise as well. Abradu-Otto [30] examined Ghana's money growth (M2+), exchange rate, and inflation using an error correction methodology. They found a long-term link between real income, money supply, inflation, and exchange rates in their article. Their findings also suggest a seasonal pattern in Ghana's money supply. They recommended actions to halt the growth of the money supply.

To examine Ghana's inflationary tendencies, Sowah and Kwakye [31] separated the time into pre- and post-ERP (Economic Recovery Program) periods. In Ghana, real and monetary shocks to the economy both contributed to inflation, according to their research, which used M2 as the major monetary aggregate. However, the latter had a far lesser effect than supply-side effects. The results of a different analysis by Kovanen [26] to ascertain if money matters for inflation in Ghana supported those of Sowah and Kwakye [31], showing that the major drivers of inflation in Ghana are exchange rate depreciation and demand pressures. The report acknowledged Ghana's high expectations for inflation and pushed for enhancing the legitimacy of the central bank. Zhang [32] employed multivariate dynamic models to investigate the short- and long-term links between monetary growth and inflation in China. The study discovered a causal link between money growth and inflation in China. This causal relationship was found through the asset inflation channel. Based on evidence from UK and US data on the adjusted monetary base, M2, and Consumer Price Index (CPI), Batinni and Nelson [33] claim that regardless of the monetary policy framework in a country, the effects of monetary policies on inflation in an economy become fully-fledged or fully noticeable after a year. Their findings support the idea that monetary policies, like all other policies, have a lag effect, therefore policymakers must consider the long-term consequences of their short-run actions when adopting their present policies. Williams and Adedeji [34] considered the Dominican Republic's period of macroeconomic stability and expansion while modeling the elements that affect inflation using money demand as the key

monetary aggregate. They found that the short-term effects of inflation were influenced by the need for money, real income, exchange rates, and international prices. Furthermore, their analysis demonstrated that inflation is significantly impacted by the disequilibrium of the money market.

Similar to this, Duodu *et al.* [28] used the vector error correction model (VECM) using quarterly data from 1999 to 2019 to study the dynamics of Ghana's budget deficit, money supply, and inflation. The VECM results show that the budget deficit has a considerable positive impact on inflation while the money supply has a positive impact as well. In contrast, the money supply and the budget deficit are both affected by inflation in opposite directions. The responsiveness of monetary policy to inflationary pressure was not examined in this study.

Following a review, several researchers also discovered a link between the money supply and inflation that was negative. Akinbobola [27] researched Nigeria's money supply, currency rates, and inflation dynamics. The results of the analysis lend support to the idea that inflationary pressures are considerably inversely associated with both the money supply and the exchange rate over the long run. The paper goes on to suggest that the adverse effects of the money supply may be due to shocks in both the domestic and global markets for goods. Additionally, Su *et al.* [35] used the bootstrap Granger causality test to examine the connection between China's inflation and money supply. The findings demonstrate that inflation has the same effects on money supply growth for China as it does for other sub-periods, with both positive and negative effects on money supply growth. The dynamic causal link is then reviewed using a time-varying rolling-window technique. These findings largely agree with the current quantity theory of money in terms of money supply and price level.

Conclusively, it is noted that different studies have come to differing results about the connection between the money supply and inflation. By empirically investigating the short- and long-term link between monetary policy and inflation in Ghana, this study contributes to the body of literature. It is also observed from the literature that no empirical studies published in Ghana have examined the causal relationship between monetary policy and inflation in Ghana, especially in recent years when Ghana's economy has dwindled due to COVID-19 coupled with an economic crisis. Thus, filling this lacuna will be of great benefit to policymaking.

3. Methodology

3.1. Introduction

This section outlines the study's theoretical and methodological underpinnings, as well as the data collection and estimation methods used. There are three segments in this section. Model specifications and the theoretical foundation are presented in the first section. The estimation method is the main focus of the second section, and the data and variable descriptions are covered in the third.

3.2. Theoretical Specification

This study, following Abradu-Otto [30], expresses the general price level in Ghana's open economy as a weighted average of the prices of tradable goods (PT) and non-tradable items (PN), as indicated in equation 1 below, to investigate the impact of monetary policy on inflation in Ghana.

$$\log P_t = \rho(\log P_t^N) + (1 - \rho)(\log P_t^T) \quad (1)$$

Where $0 < \rho < 1$

The category of tradable products also includes goods that are sold or imported from overseas. The prices of marketable commodities are then determined on the global market and are based on the current exchange rate (e) and foreign prices (Pf). These prices for marketable products are displayed:

$$\log P_t^T = \log e_t + \log P_t^f \quad (2)$$

Theoretically, an increase in domestic prices will follow an increase in foreign prices and a decline in the value of the local currency. On the other hand, domestic prices will go down if the value of the local currency increases and overseas prices fall.

The model assumes that demand for non-tradable items moves in line with overall economic demand. The price of non-tradable products is thus determined by the real money balances. The equilibrium state of the money market, where the real money supply (M^s) equals the real money demand, determines the real money balances (M^d).

$$\log P_t^N = \phi(\log M^s - \log M^d) \quad (3)$$

Where ϕ is the scale factor, which represents the relationship between demand across the economy and demand for non-tradable commodities, is. According to theory, real income (y_t), interest rate (r_t), which gauges the opportunity cost of keeping money, and projected inflation (π^e) all affect demand for real money balances (M^d).

$$M^d = f(y_t, r_t, \pi^e) \quad (4)$$

If expected inflation is formed adaptively then:

$$\pi^e = \Delta \log P_{t-1} \quad (5)$$

Rearranging and substituting, we derive the inflation equation in the log-linear form below:

$$\log P_t = \log M_t^s + \log y_t + \log r_t + \log P_{t-1} + \log e_t + \log P_t^f \quad (6)$$

Where P_t , y_t , r_t , e_t , M_t^s , P_t^f , and P_{t-1} represents inflation rate, income (Proxy by GDP), exchange (Proxy real effective exchange rate) rate, interest rate, money supply (MS), foreign prices (proxy by domestic oil prices) and expected inflation.

Empirically, equation 6 is further specified as given in equation 7.

$$\log P_t = \beta_1 \log M_t^s + \beta_2 \log y_t + \beta_3 \log r_t + \beta_4 \log P_{t-1} + \beta_5 \log e_t + \beta_6 \log P_t^f + \varepsilon \quad (7)$$

Where β and ε are the coefficients to be estimated and the error term respectively.

3.3. Estimation Strategy

The vector error correction model (VECM) model estimation technique will be utilized to examine the short- and long-term relationships between the model's variables during empirical examination of the findings. The study used Enders' [36] and Feasel et al.'s [37] Vector correction model

(VECM) methods for cointegration. Additionally, the augmented Dickey-Fuller test, variance decomposition, and the Philips-Peron test were used to determine stationarity. The impulse response function will also be used to trace the effect of the current and future values of the endogenous variable of one standard deviation shock to one of its innovations. Using the Asumadu-Sarkodie and Owusu approach [38], equation (1) was translated into the following VECM model expression:

$$\Delta \ln P_t = \alpha + \sum_{i=1}^{k-1} \beta_i \Delta \ln P_{t-i} + \sum_{j=1}^{k-1} \gamma_j \Delta \ln r_{t-j} + \sum_{m=1}^{k-1} \delta_m \Delta \ln GDP_{t-m} + \sum_{h=1}^{k-1} \theta_h \Delta \ln e_{t-h} + \sum_{r=1}^{k-1} \phi_r \Delta \ln MS_{t-r} + \sum_{r=1}^{k-1} \phi_r \Delta \ln P^f_{t-r} + \lambda_1 ECT_{t-1} + u_{1t} \quad (8)$$

3.4. Data Source

The study's annual data, which covers the years 1990 through 2018, was taken from the World Development Indicators (WDI) [17]. The availability of data and complete information on the variables used in the investigation determined the length of the study. The data was used in

various empirical studies for analysis and is global information on specific measures for each country [39]. Complete information on the variables chosen for the study is contained in the data. To standardize the data and enable simple result interpretation, the logarithm of natural numbers was used. Tables 1 and 2 provide additional information on the variables' data.

Table 1. Variable Definition and Sources.

Variable	Series	Definition	Data source
Inflation	INInfl	Consumer price index	WDI
Monetary Policy	INM2	broad money (M2)	WDI
Gross domestic product	INGDP	gross domestic product	WDI
Exchange Rate	INEXR	Real effective exchange rate	WDI
Oil prices	INP ^f	Crude oil Price	OPEC data
INTEREST RATE	INT	Deposit interest rate	WDI

3.5. Descriptive Statistics

Table 2 presents the descriptive statistics of the study variables. The period of study is 50 years spanning from 1972 to 2021. The findings show that the mean inflation over the study period is 3.07 % with maximum and minimum inflation rates of 4.81% and 1.58% respectively. Furthermore, the average income over the study period is GHC20.471 billion with the minimum income as GHC12.548 billion and the maximum or highest income as GHC26.853 billion.

Also, the average rate of exchange is -2.81% over the

study period with its minimum and maximum rate of exchange as -9.07% and 1.76% respectively. The rate of exchange is negative because of the frequent depreciation of the Ghana currency resulting in making it perform worse over the study period. Moreover, the average oil prices over the study period are GHC3.812 billion with the minimum and maximum prices as GHC2.543 billion and GHC4.716 billion. Lastly, the mean rate of interest over the study period is 2.69 percent with corresponding minimum and maximum rate of interest rate as 2.18 percent and 3.58 percent respectively.

Table 2. Descriptive Statistics of the Variables.

Variables	N	Mean	Std. Dev.	Minimum	Maximum
LNINF	50	3.075	0.766	1.582	4.811
LNGDP	50	20.471	4.412	12.548	26.853
LNEXR	50	-2.812	3.766	-9.071	1.759
LNM2	50	18.984	4.553	11.109	25.717
LNPF	50	3.812	0.614	2.543	4.716
LnINT	50	2.694	0.369	2.184	3.577

4. Results and Discussion

4.1. Lag Selection Criteria

The optimal lag for the study was determined using the

available lag selection criteria such as FPE, AIC, HQIC, and SBIC. The result showed that the optimal lag as indicated by Akaike information criteria (AIC) is lag 4, as shown in Table 3. Thus, the unit root test is determined using this optimal lag of 4.

Table 3. Lag Selection Criteria.

lag	LL	LR	Df	FPE	AIC	HQIC	SBIC
0	-236.4			0.025	10.495	10.569	10.694
1	85.4	643.7	25	0.000	-2.411	-1.96384*	-1.218*
2	109.8	48.8	25	0.000	-2.384	-1.565	-0.197
3	142.8	65.9	25	5.2e-08*	-2.730	-1.539	0.450
4	171.1	56.547*	25	0.000	-2.872*	-1.309	1.301

4.2. Unit Root Test

The Augment, Dickey-Fuller, and Philips-Perron techniques of testing for stationarity were used to examine the data and determine whether the variables were stationary or not. In contrast to the alternative hypothesis, which argues that there is no unit root, the null hypothesis for these approaches states that the series is not stationary. The outcome of the unit root test is shown in Table 4. According

to the Augmented Dickey-Fuller results, every series was stationary at the first difference.

The Augmented Dickey-Fuller test findings and the Philips-Perron test results both showed that all of the series were stationary at first difference. The conclusion disproves the claim that the series is not stationary. The findings imply that there might be a long-term connection between the series.

Table 4. Unit Root Test.

Variables	Series	Augmented Dickey-Fuller		Phillips-Perron	
		I(0)	I(1)	I(0)	I(1)
Inflation	INInfl	-0.707	-5.466**	-3.887	-13.37***
Monetary Policy	INM2	-2.989	-5.091***	-2.816	-5.114**
Gross domestic product	INGDP	-2.912	-5.714***	-2.891	-5.787**
Exchange Rate	INEXR	-1.768	-4.196***	-1.354	-3.827***
Oil prices	INP ^F	-1.811	-5.244**	-1.539	-5.253***
Interest Rate	lnINT	-1.769	-5.842***	-1.849	-6.454***

*** p<0.01, ** p<0.05, * p<0.1

4.3. Johansson Cointegration Test

The Johansson cointegration technique was used to determine whether or not there is a long-term link. By comparing the trace statistic to the critical value, this is proven. In contrast to the alternative hypothesis, which states that there is a long-term link between the series, the null hypothesis states that there is no cointegration. The

Johansson cointegration test result is shown in Table 5 below.

The outcomes showed that the variables have one cointegration at rank one (1). This suggests that the study accepts the alternative hypothesis that there is cointegration by failing to reject the null hypothesis that there is no cointegration. The requirement that both short-run and long-run relationships among the series be calculated is satisfied if there is cointegration among the series.

Table 5. Johansen cointegration Test.

Rank	LL	Eigenvalue	trace statistic	5% critical value
0	98.711465	.	144.7236	68.52
1	125.8744	0.69303	90.3978	47.21
2	150.41537	0.65596	41.3158	29.68
3	162.24647	0.40214	17.6536	15.41
4	169.37023	0.26635	3.4061*	3.76
5	171.07328	0.07137		

4.4. Short-Run and Long-Run VECM Estimates

The study analyzed the short-term effect of monetary policy on inflation in Ghana using the Vector error correction model. The results of the model are presented in Table 6 below.

The findings show that monetary policy has a positive and significant relationship with the inflation rate in the short run on average but was not statistically significant. This implies

that a percentage increase in money supply in the short run leads to a 0.209 percent increase in inflation on average. Controlling the amount of money in the economy is a significant monetary way to combat inflation. The demand for goods will decline and prices will fall if the money supply declines. When the government removes particular coins or paper money from circulation, this is another way to reduce the amount of money in circulation. Contrary to the findings of Duodu *et al.* [28], the insignificant effect of monetary

policy on inflation may be a result of the period required for the policy to be implemented effectively. Monetary authorities may be unable to effectively implement policies to curtail rising inflation rates in shorter periods. Again, the empirical findings reveal that economic growth has a positive and significant relationship with the inflation rate. This implies that on average, a percentage increase in economic growth results in a 2.24 percent increase in inflation. In the short term, these results indicate that additional increases in GDP, which in turn causes additional price increases. In line with previous studies, rapid economic growth frequently results in upward pressure on wages and prices, which raises the inflation rate [40]. Moreover, oil prices and the inflation rate have a negative relationship in the short run at a 5% level of statistical significance. The resultant effect is that a percentage increase in oil prices results in a 1.26 percent reduction in inflation. Theoretically, there is a positive correlation between the price of oil and the rate of inflation. This supports empirical evidence showing a potential nonlinear relationship between the rise and decrease of oil prices, which also has a varied impact on inflation [41]. Because high oil prices lower purchasing power, which in turn lowers consumption and investment, they may have a modest deflationary effect [42]. Therefore, high oil costs may lessen inflation by reducing domestic demand. Therefore, oil prices may have a negative effect on inflation, supporting the results of this study.

Similar to oil prices, the exchange rate and inflation rate in the short run are negatively related. Resultantly, a percentage increase in the exchange rate leads to a 0.91 percent reduction in the inflation rate holding other things constant. Since inflation is synonymous with a decline in a currency's purchasing power, it is generally accepted that inflation devalues a currency. As a result, nations with high inflation typically see their currencies depreciate about other currencies. Also, the rise in the foreign exchange rate causes domestic goods to become more affordable for foreign consumers, increasing exports as well as overall demands and prices. The rate of inflation rises as the cost of currency

increases. Because these items are either consumer goods or intermediate goods, the price increase of imported goods raises the cost of production and inflation as a result of this increase [43], thus confirming the findings of this study.

The results of the study's additional analysis of the long-term impact of monetary policy on Ghana's inflation rate are shown in Table 6. The conclusion shows that long-term inflation has a positive and statistically significant link with monetary policy. At a 5% level of significance, an increase in the money supply causes a rise in the inflation rate of 0.50 percent while keeping all other factors constant. Thus, inflation rises in direct proportion to the money supply. These results support the monetarists' hypothesis that there is a causal relationship between the money supply and inflation [44]. Amadeo [11] also proposed a causal link between the money supply and inflation. This implies that when the money supply is expanded through an expansionary monetary policy, inflation will happen. These results also support the empirical findings of Duodu et al. [28], who proposed a long-term connection between the money supply and the rate of inflation. Once more, the results demonstrate that, at a 10% level of significance, the interest rate and the inflation rate are positively correlated. According to this, a percentage increase in the interest rate causes a 0.31 percent decrease in Ghana's inflation rate. Higher interest rates increase borrowing costs and reduce economic demand, which results in an oversupply of goods and services and reduced inflation.

Lastly, the empirical results revealed that economic growth and inflation are negatively related at a 1% level of significance. The resultant effect is that a percentage increase in economic growth results in a 0.49 percent reduction in the inflation rate, all other things constant. As economic growth accelerates, there are more goods available for money to "chase," which lowers inflation.

The speed of adjustment which is the error correction term was negative indicating that the short-run deviation will converge at a speed of 2.06 percent in the long run at a 1% level of significance.

Table 6. Short-Run and Long-Run VECM Estimates.

Dependent variable: inflation rate Selected model (1, 3, 3, 3, 3)				
Variable	Coefficient	Standard Error	Z	P-Value
Short Run Estimates				
lnM21(-1))	0.152	1.335	0.11	0.909
(lnM21(-2))	-0.154	1.198	-0.13	0.898
(lnM21(-3))	0.629	1.056	0.6	0.552
(lnEXR(-1))	0.229	0.497	0.46	0.645
(lnEXR(-2))	-0.914	0.547	-1.67	0.095
(lnEXR(-3))	0.398	0.506	0.79	0.431
(lnGDP(-1))	1.932	1.161	1.66	0.096
(lnGDP(-2))	1.892	0.988	1.91	0.055
(lnGDP(-3))	2.881	1.040	2.77	0.006
(lnPF(-1))	0.224	0.554	0.4	0.686
(lnPF(-2))	-0.903	0.571	-1.58	0.114
(lnPF(-3))	-1.259	0.648	-1.94	0.052
(lnINT(-1))	-0.363	0.708	-0.51	0.609
(lnINT(-2))	-0.448	0.702	-0.64	0.524
(lnINT(-3))	-0.481	0.573	-0.84	0.402
Constant	0.013	0.472	0.03	0.979

Dependent variable: inflation rate Selected model (1, 3, 3, 3, 3)				
Variable	Coefficient	Standard Error	Z	P-Value
ECM	-2.058	0.471	-4.37	0.0000
Long Run Estimates				
lnM2	-0.502	0.200	-2.51	0.012
lnGDP	0.491	0.233	2.11	0.035
lnEXR	0.116	0.092	1.27	0.206
lnPF	0.104	0.126	0.83	0.407
lnINT	-0.308	0.185	-1.67	0.095
Constant	-1.854			

4.5. Causal Link Between Monetary Policy and Inflation Rate in Ghana

Using the Granger causality test, the study further investigates the relationship between monetary policy and Ghana's inflation rate. The findings are shown in Table 7. The results are consistent with the null hypothesis, which holds that monetary policy does not drive inflation. At a 1% level, this conclusion is substantial. The findings, however, do not support the null hypothesis that monetary policy is not caused by inflation. This conclusion of the null hypothesis does not show that monetary policy generates inflation in a statistically meaningful way. The results thus demonstrate a single direction of causality between monetary policy and Ghana's inflation rate. This suggests that both in the short and

long terms, inflation affects or changes the supply of money or the total quantity of money in use. These findings support the empirical research of Sultana, Koli, and Firoj who found a one-way causal relationship between monetary policy and inflation [45]. According to these findings, price level influences money supply in the short term and promotes inflation in the long term.

Once more, the study demonstrates a one-way causal relationship between inflation and both economic growth and exchange rate. The empirical data shows a bidirectional causal relationship between inflation and both interest rates and oil prices. Overall, the study shows that there is a unit-directed causal relationship between monetary policy, inflation, and the other components.

Table 7. Causal Link between Monetary Policy and Inflation Rate in Ghana.

Null Hypothesis:	Observation	F-Statistic	Prob.
LNM2 does not Granger Cause LNINF	46	6.823	0.000
LNINF does not Granger Cause LNM2		2.097	0.101
LNGDP does not Granger Cause LNINF	46	6.755	0.000
LNINF does not Granger Cause LNGDP		0.246	0.910
LNEXR does not Granger Cause LNINF	46	6.938	0.000
LNINF does not Granger Cause LNEXR		1.770	0.156
LNPF does not Granger Cause LNINF	46	1.621	0.190
LNINF does not Granger Cause LNPF		0.211	0.931
LNINT does not Granger Cause LNINF	46	0.242	0.913
LNINF does not Granger Cause LNINT		1.485	0.227

4.6. The Response of Monetary Policy to Inflationary Shocks

The study examined the responsiveness of monetary policy to inflationary shocks or innovation (both positive and negative) in Ghana over the study period. The results are depicted in Figure 1 below.

The outcome demonstrates that there is an unequal relationship between monetary policy and the inflation rate over both the short and long terms. As a result, the monetary policy reacts to inflationary shocks or innovation by initially boosting inflation but does so while simultaneously decreasing the rate of inflation in the short term and positively influencing inflation in the long term. The empirical results of Duodu *et al.* [28] suggesting the money supply responds positively to inflation shocks in Ghana are at odds with this finding. The results also showed that although economic growth and inflation have a beneficial relationship,

they fluctuates and becomes less favorable as time goes on. This suggests that as time goes on, economic growth will respond to inflationary innovations by gradually diminishing inflation shocks.

Moreover, the study findings show that exchange rate and inflation have a positive relationship from the short run to the long run. Consequently, the exchange rate responds to inflation rate by showing a gradual increase from the short run to the long run. Lastly, interest rates response positively to inflationary shocks from the short run to the long run. However, the interest rate is unstable in its response to inflationary shocks.

Contrary to the above conclusion of a positive relationship between monetary policy, exchange rate, and economic growth, oil prices show a negative relationship with inflation. Oil prices however respond to inflationary innovation by showing a gradual reduction of inflation from the short run to the long run.

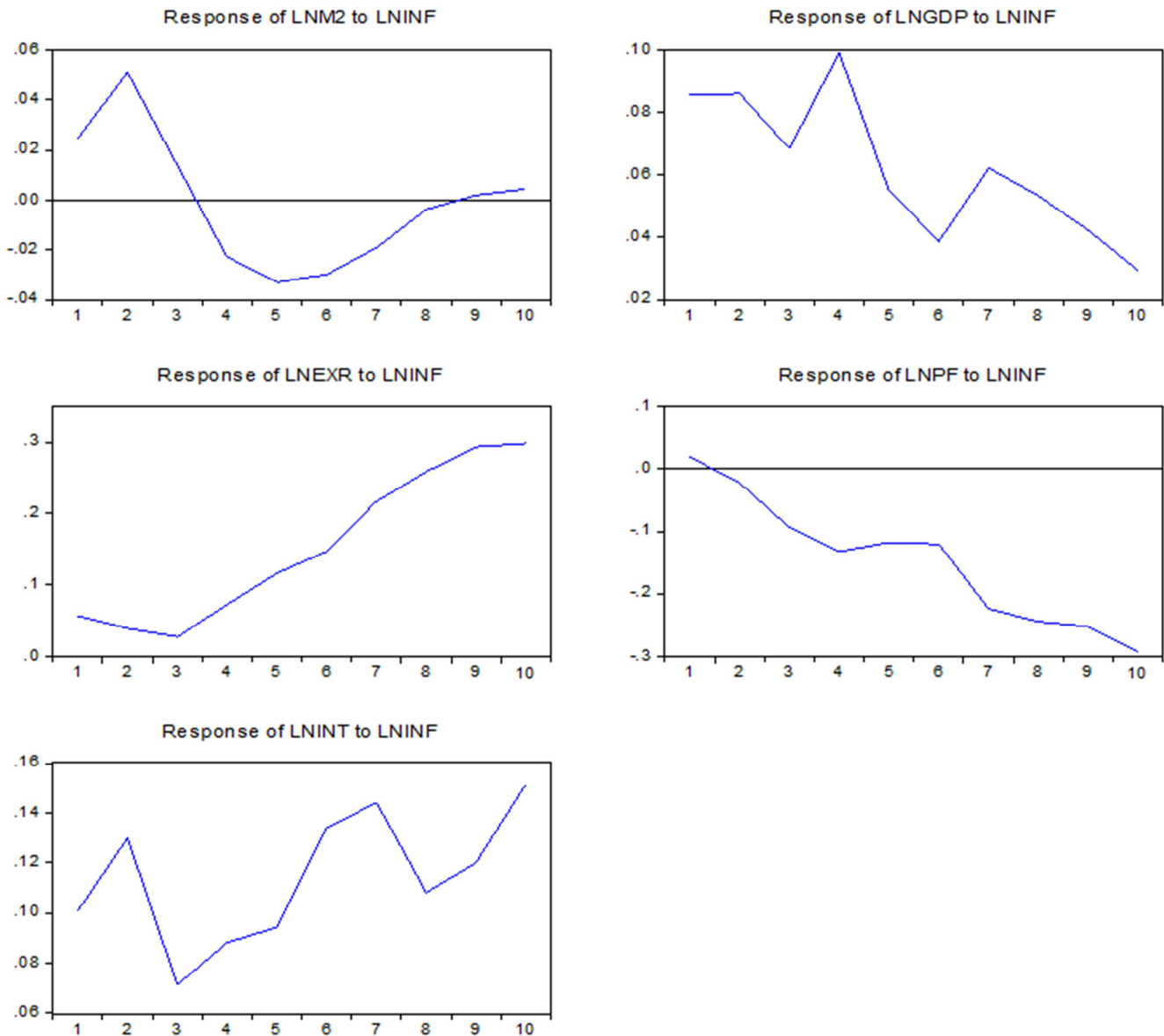


Figure 1. Monetary Policy to Inflation Shocks.

4.7. Diagnostics Test

The study conducted a diagnostic test to ascertain the reliability of the study results for making inferences or making decisions. They conducted serial correlation tests, stability tests, and Heteroskedasticity tests. The null hypothesis states that the model has serial correlation,

unstable, and suffers from Heteroskedasticity. However, based on the critical value (P-value), the study fails to accept the null hypothesis and concludes that there is no serial correlation, the model is normally distributed and stable, and no issue of Heteroskedasticity. Thus, the findings of the study are useful for making inferences or making decisions.

Table 8. Diagnostics test.

Test	Chi-square	Prob > chi2
Lagrange multiplier test (serial correlation test)	26.1586	0.88605
Jarque-Bera test (stability Test)	19.675	0.07348
Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)	584.7387	0.1219

5. Conclusion and Policy Implications

Based on the empirical findings, it can be concluded that

the short-term effect of monetary policy on inflation is positive but not significant. On the other hand, another conclusion that can be ascertained from the short-run estimates is that both economic growths showed a positive

effect on the inflation rate in Ghana. Contrary to the above findings, oil prices were found to have a negative effect on inflation. Furthermore, the long-term results of monetary policy support the short-run findings. Additionally, it may be inferred that over time, monetary policy and interest rates have a favorable impact on the inflation rate. In contrast to this conclusion, economic expansion eventually brings down inflation. The investigation into the relationship between monetary policy and the inflation rate led to the conclusion that monetary policy does not directly cause inflation, but that inflation indirectly causes monetary policy, establishing a one-way causal relationship between the two. The study also found a one-way causal relationship between the inflation rate and both economic growth and the exchange rate. The empirical findings also demonstrate a two-way causal relationship between inflation and both interest rates and oil prices.

Finally, it can be inferred from the empirical results that inflationary innovations have a beneficial impact on monetary policy, economic growth, interest rates, and currency rates but a negative impact on oil prices.

According to the study's long-run conclusions, stakeholders and policymakers should decrease the quantity of money as a monetary policy tool to stop the inflationary trend from continuing. This can be done by using open market operations, increasing the reserve ratio of banks to limit their ability to lend money, and purposefully increasing the lending rate to banks to limit the amount of money that can be in circulation at one time. Lastly, this study was unable to investigate the influence institutional quality played in reducing Ghana's inflation rate, particularly during the tough economic times brought on by the COVID-19 pandemic. Future research should explore the influence of institutional characteristics to see how they affect reducing Ghana's inflation rate.

Authors' Contributions

All other parts of the article, such as the concepts, writing, and proofreading, were jointly completed by the authors. The original idea came from the corresponding author. The final copy of the manuscript was read and approved by all of the authors.

Conflict of Interest

No authors have disclosed any conflict of interest.

Data Availability

The corresponding author will provide the dataset created and/or analysed during the current study upon reasonable request.

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