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Evaluating the impact of monetary policy on inflation in Sub-Saharan Africa

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ABSTRACT

This paper aims to assess the effect of monetary policy on inflation in Sub-Saharan Africa. The recent global economic crises have greatly brought about pervasive price distortions in many economies of Sub-Saharan Africa (SSA). However, a credible and sound monetary policy can provide a solution by influencing real economic outcomes. This paper employs the system General Method of Moment (GMM) technique based on a sample of 23 countries in SSA using a quarterly panel dataset for the period 2013-2022. According to the paper, contractionary monetary policy leads to a fall in inflation, and vice versa. Additionally, the inflation, interest rate, potential growth rate, and exchange rate negatively and significantly influence inflation in SSA. Further, inflation square, public debt, and oil prices positively and significantly influence inflation in SSA. Moreover, type of exchange rate regimes pursued by countries in SSA positively influences inflation. Monetary policy significantly influences inflation in SSA. This paper contributes to knowledge in terms of the monetary policy and inflation relationship and sheds more insight into how monetary policy brings probable changes in inflation in SSA, which informs policy decisions of monetary authorities.

Contribution/ Originality: This paper provides an in-depth analysis and understanding of how monetary policy interacts with inflation in SSA, which had a limited focus in the previous studies. Also, the panel data analysis technique provides a more nuanced understanding of the transmission mechanisms and effects of monetary policy on inflation in SSA.

1. INTRODUCTION

It can be indicated that monetary policy plays a pivotal role in the smooth functioning of an economy, of which economies in Sub-Saharan Africa (SSA) are no exception. Therefore, due to this fundamental role, monetary authorities and the various central banks in countries strive to formulate and implement efficient and effective monetary policies with the aim of ensuring a stable macroeconomic environment (Kallon, 2024). Despite the crucial role that monetary policy plays in ensuring macroeconomic stability, the effects of inflation have been felt profoundly by countries, especially those in SSA, during the recent global economic and financial crises (Mahmud & Akuoko-Konadu, 2023; Nguyen, Dridi, Unsal, & Williams, 2017).

As stressed by Kallon (2024) inflation brings about many undesirable consequences, such as economic instability, poverty, increased inequality and income distribution, and a decrease in the level of public welfare. It can be emphasised that inflation has consistently posed challenges to developing economies (Carrière-Swallow, Koumtingué, & Weber, 2024) thus impacting the daily lives of consumers as well as the decisions of firms. According to Nguyen

et al. (2017) headline inflation is considerably more volatile in SSA, compared to other regions. Thus, there has been a continuous rise in the general price levels of goods and services in SSA and this situation can be said to have been fuelled by the COVID-19 pandemic, high public debts, as well as rising energy prices (Mahmud & Akuoko-Konadu, 2023).

Further, many countries in Africa, especially those in SSA, according to the International Monetary Fund (IMF) (2022) report as cited by Mahmud and Akuoko-Konadu (2023) have recorded a median inflation of 9% since 2022, slightly above the 5% average pre-pandemic period. Therefore, investigating the nexus between monetary policy and inflation is critical in SSA as countries in the sub-region determine to achieve stable economic growth and sustainable development. In the recent years, many SSA countries have implemented monetary policy reforms to stabilise inflation and promote economic development (Agoba, Fiador, Sarpong-Kumankoma, & Sa-Aadu, 2022). Thus, some of the specific monetary policy instruments used by monetary authorities in the region include interest rate adjustments, open market operations, foreign exchange intervention, reserve requirements, liquidity management, and so on. These instruments are used by central banks to control inflation. In addition, the monetary policy transmission to inflation can be seen through various channels, such as the interest rate channel, exchange rate channel, credit channel and asset pricing channel (Mishkin, 2007b; Opolot & Nampewo, 2014; Setyawan & Anwar, 2023).

More specifically, the interest rate channel influences financial institutions' borrowing costs, whereas the exchange rate channel affects import prices as well as expectations of inflation (Mishkin, 2007a). Additionally, the credit channel operates through the availability of credit made to households and firms, while the asset price channel influences the wealth and spending decisions of households and firms (Bernanke & Gertler, 1995). Moreover, the effective implementation of monetary policy to tame inflation in the context of SSA is confronted with some challenges (Omolade & Mukolu, 2018). Thus, most of the countries in the sub-region have underdeveloped financial markets, which has the potential to hamper the smooth functioning of monetary policy.

Furthermore, there is also the issue of limited financial intermediation and weak transmission of monetary policy, which can decrease the potency of monetary policy tools. Additionally, countries in SSA can be said to often experience shocks from the supply side in the form of fluctuations in agricultural production and energy prices. Thus, these unexpected shocks can complicate the monetary and inflation nexus. It can be emphasised that some studies have been done on this subject matter in SSA (Asongu, 2014; Bonga-Bonga, 2017; Carrière-Swallow et al., 2024; Ezeanyeji, Obi, Imoagwu, & Ejefobihi, 2021; Mahmud & Akuoko-Konadu, 2023; Nguyen et al., 2017; Nyumuah, 2018).

It is worth emphasising that empirical studies conducted on the effect of monetary policy on inflation have yielded mixed results (Asongu, 2014; Bonga-Bonga, 2017; Carrière-Swallow et al., 2024; Cavoli, Gopalan, & Rajan, 2023; Doojav & Damdinjav, 2023; Ezeanyeji et al., 2021; Mahmud & Akuoko-Konadu, 2023; McNeil, 2023; Nguyen et al., 2017; Nyumuah, 2018; Saadatmehr, 2023). Some studies have found significant positive relationships (Carrière-Swallow et al., 2024; Doojav & Damdinjav, 2023; McNeil, 2023; Saadatmehr, 2023) some have also found significant negative relationships (Ezeanyeji et al., 2021; Kumar & Dash, 2020; McNeil, 2023; Saadatmehr, 2023) while others found no relationship (Sultana, Koli, & Firoj, 2019).

Additionally, there has been a limited focus on specific transmission channels of monetary policy and their relative importance in the region. While existing studies acknowledge the role of the monetary policy transmission channels, there is therefore a need for more in-depth analysis and understanding of how these channels operate and interact with inflation in SSA. Based on the aforementioned background, the main research question that this paper tries to answer is: How does monetary policy influence inflation in the context of SSA? This current research is therefore necessary. It can be indicated that the outcome of research stands to contribute to theory and practice by offering more insights into the policy decisions of policymakers. Thus, the outcome of the research can help monetary authorities and other stakeholders to have a deeper understanding of the factors influencing inflation in the context of SSA. Additionally, it provides a deeper understanding of how to apply monetary policy measures to effectively

manage and control inflation in the region. Additionally, monetary authorities and policymakers can use the research outcome to design more effective monetary policy frameworks and strategies aimed at promoting price stability. All these are important for fostering sustainable economic development as well as maintaining macroeconomic stability in the region. The main hypothesis underpinning this study is to test the relationship between monetary policy and inflation in SSA. The remaining sessions are organised into the following: The second section indicates the literature review on the subject matter. The third section deals with the research methodology, indicating the procedure carried out to achieve the study's objective. The fourth section presents the results. The fifth section focuses the discussion of the results. The conclusion, as well as policy recommendations, is stated in the last section.

2. LITERATURE REVIEW

This part of the paper presents some relevant literature that serves as a solid foundation for the current study. This helps to shape the focus of the study and properly integrate it into the existing body of literature. This comprises the theoretical underpinning and empirical studies conducted within this area of research.

2.1. Theoretical Background

This section explains the conceptual issues that the paper intends to study. This includes the explanation of monetary policy, inflation, monetary policy transmission mechanism in the case of SSA, and the relations between monetary policy and inflation in SSA.

2.1.1. Monetary Policy

Monetary policy is considered critical to a country's stability. This is the main focus and explanatory variable considered in the current study. As indicated by Gowland (1990) monetary policy is one of the tools that governments can use to control the economy in order to influence unemployment and inflation. Gameiro, Soares, and Sousa (2011) defined monetary policy as "the institutional arrangements and the use of the monetary authority instruments to maximise social welfare." In this context, open market operations and other processes within the central bank's operational framework determine a short-term interest rate, a monetary policy instrument. Bindseil (2014) also defined monetary policy as the "tools used by the central banks to reach their operational target." This underscores the importance of monetary policy instruments in the central bank's efforts to achieve its policy objectives, such as price stability and economic growth.

According to Bindseil, the three main tools central banks use are standing facilities, reserve requirements, and open market operations. Based on these definitions, this study characterizes monetary policy as a tool for shaping policy variables, particularly the financial aspects of an economy. This definition helps to examine how monetary policy responds to shocks in the financial markets. Khan (2011) asserts that the traditional monetary policy goals have been to achieve price stability, achieve full employment, promote growth, avert financial crises, smooth the business cycle, and stabilize the real exchange rate and long-term interest rates. Thus, central banks use instruments such as interest rates or money supply to influence the economy.

Moreover, according to Adam and O'Connell (1998) up until recently, monetary policy in countries in Africa had the primary objective of bringing inflation to (or near) single digits and stabilizing inflation expectations. Policy concentrated on aiming for intermediate variables like the exchange rate or monetary aggregates due to a lack of credibility and the requirement for a nominal anchor. With this, most African countries outside the CFA zone switched to targeting money, whereas the majority of the countries originally depended on de jure exchange rate pegs as a nominal anchor (Adam & O'Connell, 1998). It can be emphasised that any shocks from the monetary policy have implications for the macroeconomic stability and financial market operations of economies. Thus, the exercise of monetary policy may depend on the regime under which the country operates. Countries in SSA operate different

monetary frameworks and inflation anchor strategies, which are explained in the subsequent sections of this current study. Therefore, the effect of monetary policy also depends upon the inflation dynamics of the countries under study.

2.1.2. Inflation

Achieving macroeconomic stability has been the primary aim of both developed and developing economies. This has practically led these economies to pursue austerity measures to fulfill their purpose, particularly price stability. However, the recent global economic crisis has brought about systemic and pervasive price distortions or inflation in most economies, especially those in SSA (Miller et al., 2020). In Sub-Saharan Africa, inflation has historically been a significant challenge, with many countries experiencing high and volatile inflation rates. The increase in the general level of prices over a period of time is known as inflation. More precisely, inflation is defined as the general level of prices for goods and services in an economy rising steadily over a period of time (Gans et al., 2014).

Bolhuis, Kovacs, Jansen, and Van Der Velde (2022) claim that Africa is dealing with one of the most difficult economic climates in recent memory, as seen by the continent's sluggish epidemic recovery, rising food and energy costs, and high levels of governmental debt. It is evident that combating the region's ten-year high levels of inflation, which are wreaking havoc on earnings and food security, is one of the most pressing problems. The factors contributing to inflation in SSA are diverse and include both domestic and external factors such as fiscal imbalances, supply-side constraints, exchange rate fluctuations, and global commodity price shocks. Despite significant variations throughout SSA nations, the region's median inflation rate rose to about 9 in 2022 (Bolhuis et al., 2022).

Inflation is almost twice as high as it was before the pandemic, posing a risk to social and political stability and exacerbating food insecurity, even if the surge has been less pronounced than in other regions of the world and the sources are different. Compared to industrialised economies, domestic activity has had less of an impact on inflation in SSA. Rather, since the beginning of the pandemic, external events like increases in global commodity prices, fluctuations in exchange rates, interruptions in global supply chains, etc., have driven the trajectory of inflation (Bolhuis et al., 2022). Figure A1 in Appendix I illustrates the inflation trend.

2.1.3. Monetary Policy Transmission Mechanism in Sub-Saharan Africa

It is worth emphasising that central banks use their monetary tools to influence the broader economy through a channel or process, and this process is termed the monetary policy transmission mechanism. Thus, the ultimate aim of monetary policy is often to attain specific macroeconomic objectives, such as full employment, price stability, and economic growth. Moreover, the transmission mechanism outlines how adjustments in monetary policy influence various economic variables, impacting spending, investment, inflation, and employment. Although monetary policy potentially affects policy variables in an economy, its effectiveness depends on the transmission mechanism, central banks' understanding of this phenomenon, as well as the geographical context (Kasekende & Brownbridge, 2011).

Monetary policy transmission in Sub-Saharan African (SSA) economies tends not to work as smoothly compared to advanced economies, as indicated by Mishra, Montiel, and Spilimbergo (2012). According to their work, this situation is ascribed to factors such as the lack of a strong institutional environment, poorly functioning and illiquid interbank markets for reserves, lack of central bank independence, underdeveloped and illiquid secondary markets for government securities, low degree of international capital mobility, and shallow markets for equities and real estate.

However, it can be emphasised that the transmission mechanism of monetary policy in SSA operates through various channels, influenced by the unique economic, financial, and institutional characteristics of the region. These channels can include the interest rate channel, credit channel, exchange rate channel, and asset price channel, among others. For further reflection, we warrant a brief explanation of these monetary policy transmission channels in the context of SSA.

For instance, a key mechanism for transmitting monetary policy is the interest rate channel. Central banks in SSA often use policy rates to stimulate short-term interest rates in the financial system (Mahmud & Akuoko-Konadu,

2023; Nguyen et al., 2017). Here, policy rate changes impact the cost of borrowing for businesses and households, affecting consumption and investment (Mishkin, 2007a). In many SSA countries, exchange rates are fundamental in the monetary policy transmission mechanism. Thus, changes in policy rates can influence exchange rates, affecting trade balances and import prices (Nyumuah, 2018). A depreciating local currency can lead to inflationary pressures, thus raising the cost of imported goods (Mishra, Moriyama, N'Diaye, & Nguyen, 2014).

In addition, the credit channel of the monetary policy transmission is significant, particularly in economies where the financial sector is a key intermediary. For instance, changes in policy rates influence banks' lending behaviour, impacting credit supply to businesses and households. Note that the development of financial market and the health of banking systems can influence the strength of the credit channel (Ncube, Sibanda, & Matenda, 2023). Despite SSA's less developed financial markets compared to advanced economies, monetary policy changes can still influence asset prices, include real estate and agricultural commodities (Mishra et al., 2014). Changes in asset prices can have wealth effects, influencing consumption patterns. In conclusion, it can be indicated that the monetary policy has the potential of influencing the economic environment through its transmission mechanism, of which SSA is no exception.

2.1.4. Relations between Monetary Policy and Inflation in Sub-Saharan Africa

The relations between monetary policy and inflation have received much attention in the literature (Carrière-Swallow et al., 2024; Ezeanyeji et al., 2021; Mahmud & Akuoko-Konadu, 2023; Nguyen et al., 2017; Nyumuah, 2018). Inflation is widely considered a monetary phenomenon, with its behaviour explained by monetary factors (Friedman & Schwartz, 2008). Monetary policy refers to the steps taken by the central bank of a nation to control the money supply and interest rates in order to accomplish various economic goals. One of the key objectives of monetary policy is to achieve price stability as indicated early on, which includes keeping inflation under control within a target range. Moreover, according to the work of Friedman (1963), as cited by Batarseh (2021) an increase in the money supply can lead to inflation. This underscores the important role of monetary policy in managing inflation through the regulation of the money supply and other policy instruments.

According to Friedman, the money supply influences internal variables like output and prices, not the other way around (Batarseh, 2021). There has been a growing concern in recent times regarding monetary policy responses to high inflation in the case of SSA, especially during the COVID-19 pandemic. Figures A1, A2, and A3 in Appendices I, II, and III depict the behaviour of monetary policy proxied by shadow rate and inflation, as well as their relationship in the region. It can be indicated that, in Figure A1, inflation exhibited unstable behaviour, especially between 2015Q1 and 2018Q1, and the trend keeps on increasing from 2019Q1.

In terms of monetary policy, the trend is also similar. However, there are instances where monetary policy responses were felt lightly by the inflation path, as depicted in Figure A2. This is especially seen in 2016Q2-2018Q1. In addition, Figure A3 indicates the monetary policy responses to inflation dynamics from 2013Q. It can be seen that monetary policy responses were felt by inflation dynamics, especially between 2016Q3 and 2017Q2 as well as between 2020Q4 and 2021Q2. Moreover, in Sub-Saharan Africa, inflation has historically been a significant challenge, with many countries experiencing high and volatile inflation rates.

2.2. Theoretical Framework

The section attempts to integrate the study into the body of literature by focusing on the Quantity Theory of Money (QTM) and the New Keynesian Philips Curve Model (NKPCM). These models serve as a foundation to study how monetary policy transmission mechanisms affect inflation dynamics in the context of Sub-Saharan Africa. However, the paper focuses primarily on the NKPC model as the foundation.

2.2.1. Quantity Theory of Money (QTM)

The Fisher theory, developed by Fisher (1913) offers the basic theoretical explanation of the link between money and inflation. This theory provides an understanding of the relationship between the money supply and the general price level. According to the Fisher theory, changes in the money supply caused by monetary policy decisions have the potential to influence the general price level. As shown by Alexandrov, Valinurova, Kostromin, Zenkina, and Egorov (2021) and John and Udoye (2018) the Quantity Theory of Money (QTM) depicts a direct and proportional link between the supply of money and inflation, based on the supposition that the velocity of money is constant. In other words, the Fisher theory and the QTM suggest that increases in the money supply can lead to proportional increases in the general price level, all else being equal. This theoretical framework underscores the important role of monetary policy in managing inflation through the regulation of the money supply, where the product of the money supply and its velocity is equal to nominal income (Ononugbo, 2012) as cited by John and Udoye (2018). Thus, money is considered in this case as exogenous and controlled by central banks, which assumes that inflation correlates with the growth rate of money supply, making money the most suitable instrument for monetary policy as indicated by Fratianni, Gallegati, and Giri (2022) and Alexandrov et al. (2021) as well as Davidson (2006). According to monetarists, the money supply performs an important function in augmenting the output and the general price levels.

The depiction of the quantity theory of money which relates to money, output and prices is seen in Equation 1:

$$MV = PY \qquad (1)$$

Where M is the money stock, V is the velocity of money in circulation, P is the price level, and Y represents the real output level. The theory asserts that, despite the relative stability of both the income velocity of money (V) and the level of real output (Y), the assumption of full employment in the economy fixes the real output. Additionally, variations in the velocity of money are assumed to be inconsequential. This implies that the price level (P) is proportionate to the money stock (M) if both V and Y are fixed. As a result, the QTM provides a theory of inflation where changes in the money supply are the primary driver of changes in the general price level (Ezeanyeji et al., 2021).

People claim that developing economies like SSA can benefit greatly from the quantity theory of money. According to the theory, monetary policy actions can alter the money supply, which in turn can affect the rate of inflation. For example, an excess money supply in the economy may lead to price increases and inflationary pressures if the money supply grows more quickly than the actual output (Y). To control the money supply, central banks in emerging economies as well as in many other regions, generally employ monetary policy instruments like interest rates, open market operations, and reserve requirements. The goal of central banks' adjustments to these tools of policy is to stabilise the economy and rein in inflation. For instance, the economy receives an infusion of cash when central banks carry out expansionary monetary policy, which involves decreasing interest rates or raising the money supply. A rise in the money supply has the potential to boost spending and aggregate demand (Fisher, 1913).

Furthermore, the theory suggests that an increase in the money supply increases aggregate demand. More money allows consumers and businesses to spend more on goods and services. There may be demand-pull inflation as a result of this higher demand driving up prices. Increased money supply may exacerbate demand pressures and may raise prices in SSA, where countries may be experiencing strong levels of investment or rapid economic expansion. It is crucial to emphasise that the quantity theory of money is an oversimplification and does not fully account for the nuances of the dynamics of inflation, particularly in emerging economies.

2.2.2. New Keynesian Philips Curve Model (NKPCM)

Studies have emphasised the significance of NKPCM in analysing monetary policy and inflation interactions (Fuhrer, 1997; Mankiw & Reis, 2002; Woodford & Walsh, 2005). According to Clarida, Frisch, and Hochreiter (2001) as cited by Salunkhe and Patnaik (2019) a mainstay of theoretical monetary policy analysis is the NKPC, which was developed from the micro-founded price-setting mechanism. Using marginal costs or the output gap as a proxy for

real economic activity, this model links current inflation to anticipated future inflation (Salunkhe & Patnaik, 2019). Abbas and Sgro (2011) indicated that the NKPC deviates from the conventional Phillips curve due to its forward-looking nature, theory-based, and rigorous micro-foundations. The theoretical micro-foundations of the model help to explain the nominal rigidities and stickiness found in pricing and wages. This model is considered the main supplementary model that underpins the paper. Here, following Abbas and Sgro (2011); Patra and Kapur (2012); Goodhart and Hofmann* (2005) and Gertler, Gali, and Salido (2000) the basic mathematical representation of the model is stated as:

$$\pi_t = \pi_t^{\wedge e} + \alpha\,(Y_t - Y_t^{\wedge n}) + \beta_{i\_t} \qquad (2)$$

Where:

π_t indicates the rate of inflation at time t.

$\pi_t^{\wedge e}$ is the expected rate of inflation at time t.

Y_t indicates the output gap at time t.

$Y_t \wedge n$ represents the natural or potential level of output,

α represents the parameter determining the sensitivity of the rate of inflation to the output gap.

i_t represents the tools of monetary policy such as interest rate or money supply.

β represents the parameter that indicates how sensitive inflation is to changes in the monetary policy tools. Here, the application of the NKPC model to examine the monetary policy and inflation relationship is relevant in the case of SSA and this is done through the introduction of country-specific and time-specific effects. Equation 3 depicts this relationship.

$$\pi_{it} = \pi_{it}^{\wedge e} + \alpha\,(Y_{it} - Y_{it}^{\wedge n}) + \beta_{i\_t} + \gamma_i + \delta_t + \varepsilon_{it} \qquad (3)$$

Where:

π_{it} represents the inflation rate in the country i at time t.

$\pi_{it}^{\wedge e}$ represents the expected inflation rate in the country i at time t.

Y_{it} indicates the output gap in the country i at time t.

$Y_{it}^{\wedge n}$ represents the natural or potential output level in the country i.

i_t represents the monetary policy tools as seen above.

γ_i represents the country-specific effects.

δ_t represents the time specific-effects.

and ε_{it} represents the disturbance term capturing unobservable factors and measurement errors.

Here, the parameters α, β, γ_i and δ_t are estimated using econometric techniques. The estimated coefficients provide insights into the responsiveness of inflation to changes in the output gap and monetary policy tools, while also accounting for country-specific and time-specific effects. The NKPC model is chosen since its estimation allows for modelling the empirical specification involving the variables understudy and also allows for examining inflation dynamics across different countries in SSA.

2.3. Empirical Evidence

This study tries to have a clearer picture of the relationship between monetary policy and inflation by considering investigations conducted in this area of research, even though little is known in the context of SSA. It can be emphasised that studies conducted in this area have mixed results.

For instance, Carrière-Swallow et al. (2024) examined inflation and monetary policy relationships in low-income and fragile states with a specific focus on Guinea using the stylised log-linear model. According to the study's findings, monetary policy shocks to inflation have been moderate. Nevertheless, the study concluded that monetary policy has contributed to reducing inflationary pressures in the area.

In the same way, Mahmud and Akuoko-Konadu (2023) used annual data from Orbis for the period 2011 to 2018 to investigate the efficacy of the monetary policy rate as a tool for controlling inflation in Sub-Saharan Africa (SSA)

using the system GMM estimator. The study discovered that broad money supply, policy rate, exchange rate, unemployment, gross domestic product (GDP) growth rate, and predicted inflation all have a substantial impact on the inflation rate in Sub-Saharan Africa.

However, utilising monthly data from 2000 to 2019, Cavoli et al. (2023) developed a Taylor-like monetary policy rule in the case of Singapore, utilising nominal effective exchange rate (NEER) as the primary tool of monetary policy. According to the study, the country's monetary policy rule seems to respond asymmetrically to output and inflation beyond a specific level. However, this is mostly about inflation within the policy rule, providing proof of a consistent position of the policy with state-dependent strategy demand (SSD) by permitting a disproportionately bigger NEER during boom times. Additionally, the study showed that lower monetary policy rules apply in economies where a sizable portion of the population participates in banking operations.

Saadatmehr (2023) examined the effect of monetary policy on inflation in a panel of selected West Asian countries, including Iran, Jordan, Armenia, Azerbaijan, Pakistan, Saudi Arabia, Oman, Kyrgyzstan, Kazakhstan, Qatar, Georgia, and Kuwait. The study covered the period from 2000 to 2020, and the findings showed that monetary policy shocks had a symmetrical impact on the general price level in Iran, Pakistan, Kyrgyzstan, Georgia, and Kuwait. Conversely, Jordan, Azerbaijan, and Qatar experienced an asymmetric effect. Furthermore, the results indicated that monetary policy shocks had an asymmetrical effect on the general price level in Saudi Arabia, Kazakhstan, and Oman.

McNeil (2023) employing the unobserved components model, estimated the effect of monetary policy on inflation expectation over the period 1982-2019 in the United States. The study concluded that a contractionary monetary policy shock twists the term structure of inflation expectations, thus increasing the short-run expectations while decreasing the long-run expectations.

Doojav and Damdinjav (2023) using the Bayesian structural vector autoregression framework, examined the macroeconomic influence of unconventional monetary policies in the context of Mongolia. Based on monthly data from 2012 to 2020, the study found that an expansionary balance sheet stimulates M2 and bank lending, which tends to decrease interest rate spread, leading to increases in output and consumer prices.

Ezeanyeji et al. (2021) found that monetary policy has no significant effect on inflation control in Nigeria, neither in the short nor long run.

Hu and Zhang (2021) analysed the performance of China's core inflation measures for monetary policy by using the New Keynesian dynamic stochastic general equilibrium (DSGE) model with the quantity-based monetary rule. The study's outcome showed that inflation responds to monetary policy shocks.

Kumar and Dash (2020) investigated the effect of monetary policy on disaggregated inflation in India. They concluded that a contractionary monetary policy is more effective in reducing inflation in the manufacturing sector compared to the agricultural sector.

Gunduz (2021) also examined the stock market transmission channel of monetary policy in Turkey. The study determined that a tight monetary policy has a significant adverse influence on both output and inflation.

Bhattacharya and Jain (2020) examined how monetary policy can stabilise food inflation in emerging economies. They found that an unexpected monetary policy tightening has a significant positive effect on food inflation in both advanced and emerging economies.

Zulfa and Suseno (2019) used a VECM to examine the effectiveness of monetary policy transmission to inflation in Indonesia. They found that the interest rate channel and interbank call money interest rate have a significant effect on inflation in both the short and long run.

Sultana et al. (2019) investigated the relationship between money supply and inflation in Bangladesh using a VECM approach. They found that in the short run, money supply had no effect on inflation and vice versa, but there was a bidirectional causal relationship between the two variables.

In a different situation, Nyumuah (2018) used structural and recursive VAR techniques to analyse the effect of policy rate on output and inflation in Ghana. The study's findings revealed that an increase in policy rate had no effect

on output or price level. The study also examined the impact of money supply shock, the currency rate, and credit to the private sector. It was discovered that these factors had no bearing on price levels or output until the 70th quarter, the point at which they started to have a very minor impact.

Tran (2018) however, analysed the effectiveness of monetary policy transmission in curbing inflation in the context of Vietnam using the vector error correction model (VECM) for the period 2001-2015. The study found that the interest rate channel of monetary policy has an adverse influence on inflation in the long run.

Sheefeni (2017) used a Bayesian VAR technique to look at how output and inflation responded to positive shocks from interest rates, loans to the private sector, exchange rates, and asset prices between 2000 and 2016. The study concluded that an increase in the rate of interest can slow prices and GDP growth for up to eight quarters before losing its impact.

Bonga-Bonga (2017) used the structural vector error correction model (SVECM) to evaluate how South Africa's inflation reacted to shocks in monetary policy during the inflation-targeting period from 2000 to 2016. The study found that, while not statistically significant, a positive monetary policy shock lowered inflation somewhat. Moreover, the shock had a statistically significant negative impact on output.

In a different study, Nguyen et al. (2017) employed a global vector autoregressive (GVAR) model to examine the dynamics of inflation in Sub-Saharan Africa (SSA). The study concluded that while supply shocks, exchange rate shocks, and monetary variable shocks have been the main drivers of inflation in SSA over the past 25 years, the contribution of these variables has fallen in more recent periods.

Asongu (2014) also used the vector autoregressive model and the vector error correction model (VECM) to investigate the impact of monetary policy on inflation in Africa for the period 1987 to 2010 based on a cross-country evaluation. As a proxy for monetary policy, the study employed financial activity, financial scale, financial depth, and allocation efficiency. The study revealed that these variables impacted price variability over the long term. Nevertheless, the findings also showed that size and depth had a cointegrating relationship with inflation and served as adjustors in cases of distortions. Furthermore, it was discovered that monetary policy variables had no significant short-term impact on inflation. In conclusion, it can be said that, even though some studies have been conducted in this area of research, the empirical outcomes have been mixed, and there is a limited focus in the context of Sub-Saharan Africa. Thus, further research needs to be conducted to examine the effect of monetary policy on inflation, and that is what the current study attempts to do.

2.4. Theoretical Model

This aspect of the study presents the empirical econometric model, which dwells on the New Keynesian Philips Curve Model, the works of Carrière-Swallow et al. (2024); Mahmud and Akuoko-Konadu (2023); Doojav and Damdinjav (2023); Gunduz (2021) and Nguyen et al. (2017) to depict the relationship that inflation has with the exogenous variables under study. Thus, the following model illustrates the relationship:

$$INFL_{it} = \alpha_i + \varphi INFL_{t-1} + \beta_1 SDR_{it} + \beta_2 PDT_{it} + \beta_3 INTR_{it} + \beta_4 INFL\hat{}2_{it} + \beta_5 OP_{it} + \beta_6 EXR_{it} + \beta_7 PFS_{it} + \beta_8 PGR_{it} + \beta_9 GOVEFF_{it} + \beta_{10} Dummy\_FR/MR_{it} + \beta_{11} Dummy\_IMF_{it} + \beta_{12} Dummy\_COVID19_{it} + \varepsilon_{it} \quad (4)$$

Where i represents specified countries, NFL is inflation at the current period, $INFL_{t-1}$ represents the lag of the inflation rate, SDR represents shadow rate proxy for monetary policy, PDT is the public debt, $INTR$ is the interest rate differential, $INFL\hat{}2$ is the square of the inflation rate, OP is the oil price, EXR is the exchange rate, PFS is portfolio spread, PGR is the potential growth rate, $GOVEFF$ represents government effectiveness, $Dummy\_FR/MR$ is a dummy variable indicating if the country is practicing a fixed or managed/floating exchange rate regime and this takes the value 1 for the fixed regime; otherwise, 0. $Dummy\_IMF$ is also a dummy variable indicating whether the country receives aid from the IMF or not. This also takes value 1 for aid from IMF, otherwise 0. $Dummy\_COVID19$ is a dummy variable for *COVID-19*, and it takes value 1 for countries that experienced it and otherwise 0.

ε_{it} represents residual term for each country at time t, α_i represents the unobserved country-specific effect, φ is the coefficient of the dependent lag one, β_1 to β_{11} represent vector of coefficients, and t represents time period.

The following are the apriori (i.e., the assumed outcomes the study anticipates for the variables understudy) expected signs of the variables:

$$\beta_1<0;\ \beta_2>0;\ \beta_3<0;\ \beta_4>0;\ \beta_5>0;\ \beta_6<0;\ \beta_7>0;\ \beta_8>0;\ \beta_9<0;\ \beta_{10}<0,>0;\ \beta_{11}>0;\ \beta_{12}>0$$

3. MATERIALS AND METHODS

The study used a dynamic panel methodology by considering 23 countries in Sub-Saharan Africa (SSA). This was due to data unavailability for some of the 48 countries in the region. Secondary source data was used for the analysis. The data on the dependent variable (inflation rate) and the focus independent variable (shadow rate as a proxy for monetary policy) were obtained from the World Bank's World Development Indicators (WDI) and the databases of the countries' central banks, covering the period from 2013 to 2022. The study also controlled for various variables, including public debt, interest rate, oil price, exchange rate, portfolio spread, potential growth rate, and government effectiveness, as well as dummy variables. The selection of these control variables was based on the existing literature (Asongu, 2014; Bonga-Bonga, 2017; Carrière-Swallow et al., 2024; Ezeanyeji et al., 2021; Mahmud & Akuoko-Konadu, 2023; Nyumuah, 2018). Data on these control variables were extracted from the World Bank's Development Indicators, Global Financial Development Indicators, Sustainable Development Goals Indicators, and governance indicators, using the criterion-based sampling technique. The study constructed a quarterly panel data set covering a ten-year period from 2013Q1 to 2022Q4. Table 1 presents the measurement of the variables.

Table 1. Description of variables and data source.

Variable	Explanation	Data source
Exchange rate	This is measured as using the bilateral rate against the US dollar.	World development indicators and central banks' 2013-2022
Inflation	The consumer price index is used for measurement.	World development indicators 2013-2022
Oil price	This is measured in USD per barrel.	Organization of the petroleum exporting countries (OPEC) dataset 2013-2022
Interest rate	This measures the difference between domestic and foreign interest rates	World development indicators and central banks' databases 2013-2022
Shadow rate	This is the monetary policy instrument used by central banks. This is measured using the central banks' shadow rate (Wu & Xia, 2016).	World development indicators and central banks' databases 2013-2022
Public debt	This is measured as the public debt as a percentage of GDP.	World development indicators 2013 to 2022
Portfolio spread	This is portfolio investment, net of balance of payments.	Sustainable development goals and world development indicators 2013-2022
Potential growth rate	This is the potential growth rate measured as the rate of increase of potential output.	World development indicators 2013-2022
Government effectiveness	Capturing perceptions of the extent to which citizens of a country are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.	The world bank governance indicators 2013-2022

Moreover, the study analysed the data through the following means: First the study used Levin, Lin, and Chu (2002) and Im, Pesaran, and Shin (2003) unit root tests to check if the variables were stationary or had a unit root. The study employed the dynamic panel methodology as indicated earlier. The dynamic panel model was estimated by employing the System Generalized Method of Moments (Sys GMM) estimation technique. This estimation technique was initially developed by Arellano and Bond (1991) and later, Arellano and Bover (1995); Blundell and Bond (1998) and Arellano and Honoré (2001) furthered the development of this estimating technique. The study addressed simultaneity bias and country-specific effects by utilising the dynamic panel data estimator. This will assist in mitigating the effects of simultaneity bias and country-specific factors (Arellano & Bond, 1991). As a safety measure, the study used the Arellano and Bond test of second-order autocorrelation with the disturbance component (Arellano & Bond, 1991).

Furthermore, the study's inability to reject the null of the Arellano and Bond tests determined how useful the instruments were in determining whether or not the model was accurately stated. The very nature of disturbance terms allows for serial coupling at the first order.

The second-level serial association, however, indicates misspecification. As previously mentioned, the selection of the methodology stems from its ability to address simultaneity bias and economy-specific effects, particularly given the potential for heterogeneity within the SSA. Another aspect of the methodology is that every group of moments from the data can be applied to identify a GMM estimate as long as there are at least as many moments as there are parameters to estimate and the moments are sufficiently independent to do so. The system GMM estimator is strongly consistent and asymptotically normal. It can be pointed out that most of the previous studies, in their quest to examine monetary policy and inflation relationship, employed different models such as VAR, VECM, GVAR, SVAR, DSGE, and SVECM.

However, in the exceptional case, Mahmud and Akuoko-Konadu (2023) employed the system GMM in their study. Even though Mahmud and Akuoko-Konadu (2023) used the System GMM, nevertheless, their data coverage was different and choice of variables was quite different from the current study. This makes the decision to System GMM more appropriate and useful for this study. Nevertheless, the model has some limitations. Thus, System GMM estimates are sensitive to normalizations of the model or parameters and can also have bias and insufficiency in small samples. Based on the reviewed body of literature, the following hypothesis guides the study:

H_1: *There is a positive or negative significant relationship between monetary policy and inflation rate in SSA.*

4. RESULTS

This section of the study presents the findings related to study's focus. This consists of the unit root test results, panel regression results, and their explanations. It is to be noted that the results are discussed in detail in the discussion section of the paper.

4.1. Unit Root Tests

This section presents the results based on the objective and hypothesis stated. The results are presented in the following manner: First, the series properties were tested using the Im et al. (2003) and Levin et al. (2002) unit root tests, followed by the System GMM results. The LLC unit root test is based on an assumption that the panel cross sections are homogeneous, while the IPS assumes that the panel cross sections are heterogeneous. As indicated in Table 2, the series was nonstationary at levels, indicating that the series has a unit root, i.e. I(1), I(1); however, at their first difference, they became stationary. The LLC and IPS tests are based on the following hypothesis:

H_0: *Series has a unit root.*

H_1: *Series has no unit root.*

Table 2. Panel unit root tests.

Test	DINFL	DSDR	DPDT	DINTR	DINFL^2	DOP	DEXR	DPFS	DPGR	DGOVEFF
LLC	-6.181 (0.000) *	-7.332 (0.000) *	-7.127 (0.000) *	-3.610 (0.002) *	-6.302 (0.000) *	-10.561 (0.000) *	-27.767 (0.000) *	-3240.84 (0.000) **	-6.485 (0.000) **	-3.386 (0.004) *
IPS	-2.133 (0.016) **	-12.848 (0.000) *	-2.000 (0.000) *	-1.668 (0.048) **	-2.000 (0.022) **	-1.793 (0.036) **	-7.020 (0.000) *	-329.212 (0.000) *	-3.441 (0.000) *	-3.147 (0.008) *

Note: *, ** represent 1% and 5% significance levels. Also, DINFL = First difference of inflation; DSDR = First difference of shadow rate; DPDT= First difference of public debt; DINTR = First difference of interest rate; DINFL^2 = First difference of inflation square; DOP = First difference of oil price; DEXR = First difference of exchange rate; DPFS = First difference of portfolio spread; DPGR = First difference of potential growth rate; and DGOVEFF = First difference of government effectiveness.

4.2. Panel Regression Results

This section presents the dynamic panel results, which are depicted in Table 3. The model passed all the post-estimation tests, as seen in Table 3. Here, the variables obtained their theorised signs except for the potential growth rate and the one lag of the inflation rate. In addition, it can be seen that all the variables are significant in influencing inflation except portfolio spread, government effectiveness, IMF inflows (dummy variable), and COVID-19 variable, which is also a dummy variable. The coefficient of the one lag of inflation is positive and statistically significant at a 1 percent significance level, indicating that, a unit increase in the previous inflation will lead to a 10.2 percent increase in the current in the first quarter in the region, holding all other factors constant. The coefficient of inflation square (INFLSQ) is positive and statistically significant at a 1 percent significance level, indicating that, a unit increase in inflation square will increase the current inflation by 3.1 percent in the region, holding all other factors constant.

Moreover, the coefficient of interest rate is negative and statistically significant at a 1 percent significance level, suggesting that, a unit increase in interest rate will lead to a 27.8 percent decrease in inflation in the region, holding all other factors constant. In the case of public debt, the coefficient is positive and statistically significant at a 10 percent significance level, indicating that a unit increase in public debt will lead to a 1.8 percent increase in the current inflation, holding all other factors constant. However, even though the portfolio spread is positive, it is insignificant. Further, the potential growth rate is negative and statistically significant at a 10 percent significance level, showing that a unit increase in potential growth rate will lead to a 4.4 percent decrease in inflation in the region, holding all other factors constant.

Table 3. Panel regression results.

Variable	Coefficient	Std. error	z-stat.	P-value
C	0.135	0.080	1.688	0.089*
D(INFLSQ)	0.031	0.008	3.875	0.000***
D(INTR)	-0.278	-0.054	-5.148	0.000***
D(PDT)	0.018	0.010	1.800	0.076*
D(PFS)	3.510	2.808	1.250	0.211
D(PGR)	-0.044	-0.025	-1.760	0.081*
D(OP)	0.012	0.007	1.714	0.096*
D(SDR)	-0.052	-0.020	-2.600	0.001***
D(EXR)	-0.006	-0.001	-6.000	0.000***
D(GOV_EFFEC)	-0.352	-2.941	-0.120	0.906
DUMMY_FR_MR	0.039	0.020	1.950	0.063*
DUMMY_IMF	1.009	3.467	0.291	0.771
DUMMY_COVID19	0.383	1.006	0.381	0.704
DINFL(-1)	-0.102	-0.036	-2.833	0.005***

Note: Test for AR (1) errors: z = -2.715 [0.007]
Test for AR (2) errors: z = -1.951 [0.510]
Sargan over-identification test: Chi-square (32) = 11.802[0.999]
Wald (joint) test: Chi-square (8) = 4972.38 [0.000]
Number of countries 23
Number of observations 40
*, *** represent 10% and 1% significance levels.

Additionally, the coefficient of oil price is positive and statistically significant at a 10 percent significance level, showing that, a unit increase in oil price at the world market will increase inflation in the region by 1.2 percent, holding all other factors constant. Regarding shadow rate, a proxy for monetary policy, the coefficient is negative and statistically significant at a 1 percent significance level, depicting that, a unit increase in the central bank's shadow rate will lead to a 5.2 percent decrease in inflation rate, holding all other factors constant. The exchange rate is also negative and statistically significant at a 1 percent significance level, suggesting that a unit decrease in the exchange will lead to a 0.6 percent increase in the inflation rate in the region, holding all other factors constant.

Furthermore, the dummy for the exchange rate regime within the SSA economies is positive and statistically significant at a 10 percent significance level, showing that, a unit increase in exchange rate in countries practicing

fixed regimes will have their inflation rates increased by 3.9 percent, holding all other factors constant. Albeit, dummies for IMF inflows and COVID-19 are positive, they are insignificant within the chosen period of the study. Moreover, a detailed discussion of the results is done in the next section of the study, which helps to situate the study in the existing literature and validate the results for policy implications and development.

5. DISCUSSION

Here, we present a discussion of a the study's results, comparing them to the existing literature to validate the findings. The one lag of inflation was negative and significant in influencing the current inflation rate within the sub-region. This implies that an increase in the previous year's inflation rather decreases the prevailing inflationary pressure in the region in the first quarter. This can be attributed to the type of monetary policy frameworks, exchange rate regimes, or the macroeconomic environment prevailing in the countries in SSA. Additionally, the inflation square happened to be positive and significant, implying that, as the inflation rate increases up to a certain point, it aggravates the inflationary pressure and does not come down to an appreciable level. Thus, this situation seems to be happening in some of the SSA countries, especially in recent times, due to some economic challenges faced by the region, as indicated by the International Monetary Fund in 2022 (Bolhuis et al., 2022). This is why some SSA countries continue to have high inflation rates.

Furthermore, the interest rate was negative and statistically significant. This implies that increases in the domestic interest rate tend to decrease inflation. This is in the sense that rising interest rates tend to increase the borrowing cost, albeit encouraging deposits, and aggregate demand decreases as well, hence a fall in the inflation rate. In SSA, some central banks intervene to stabilise the financial markets through this means. The results confirm the findings by Doojav and Damdinjav (2023); Zulfa and Suseno (2019) and Tran (2018) who indicated that interest rates have a potential impact on inflation. The result also confirms the findings by Sheefeni (2017). Public debt was found to be negative and statistically significant in influencing inflation within the region. Thus, this indicates that excessive borrowing from both domestic and external means has potential consequences for inflation. This seems to be a characteristic of most of the governments in SSA, and this has resulted in high levels of inflation in the region. This situation is supported by the study undertaken by Nguyen et al. (2017) and Sheefeni (2017) who concluded that internal and external government debts affect macroeconomic stability.

In addition, the potential growth rate had a negative and significant effect on inflation, which contradicts the apriori expected sign by the study. However, the result implies that, in SSA, productivity growth is lower than the potential output level, which creates a negative output gap, and this has the potential of reducing inflation in the region. This suggests that the potential growth rate may have an impact on the dynamics of inflation in the region. However, the result here contradicts the findings by Mahmud and Akuoko-Konadu (2023) in SSA, who had a positive outcome. Oil prices were positive and significantly influenced inflation, implying that increases in oil prices at the world market have the potential of increasing inflationary pressures in SSA countries. Thus, this is expected since many countries in SSA import more than they export, especially energy resources from other trading partners in the world. Therefore, increases in the prices of these energy resources will bring about increases in the general price level within the region. This result confirms the findings of Nguyen et al. (2017) and Sheefeni (2017).

Furthermore, the shadow rate coefficient was negative and statistically significant in influencing inflation in SSA. The outcome implies that a contractionary monetary policy pursued by central banks in the region leads to price stability, and vice versa. Even though countries in the region pursue different monetary policy frames, to some extent taming inflation is core among them since inflationary pressures affect the macroeconomic environment. Thus, monetary policy has a potential influence on inflation dynamics in the region. This assertion supports the findings by Carrière-Swallow et al. (2024); Saadatmehr (2023); Mahmud and Akuoko-Konadu (2023); Gunduz (2021); Kumar and Dash (2020) and Sheefeni (2017).

The result contradicts the findings by Nyumuah (2018) who found no relationship, and Bonga-Bonga (2017) in Africa. The exchange rate was negative and statistically significant, implying that the depreciation of the local currency increases inflationary pressure within the region. Thus, exchange rate fluctuation tends to increase inflation, and this tendency has been found in the region in recent times, largely due to the global economic crisis. This assertion is supported by the studies by Mahmud and Akuoko-Konadu (2023) and Nyumuah (2018). Finally, the coefficient of the dummy depicting the type of regime pursued by the countries in SSA was significant, implying that countries pursuing fixed exchange rate regimes, are prone to high inflationary pressures compared to those with floating regime.

6. CONCLUSION AND POLICY RECOMMENDATIONS

It can be emphasised that the operations of the central bank influence the macroeconomic environment of a country, and for that reason, the conduct of monetary policy has implications, especially on the inflation rate of countries of which countries in SSA are no exception. Specifically, the transmission mechanism of monetary policy in place reflects the dynamics of inflation in an economy. This study thus assessed the effect of monetary policy on inflation in SSA by employing the system GMM technique based on quarterly panel dataset for the period 2013 to 2022 with 23 countries. The findings of the study revealed that monetary policy has a potential effect on inflation in the context of SSA. Specifically, a contractionary monetary policy (increase in shadow rate) leads to a fall in inflationary pressure in SSA and vice versa. It was also found that the one lag of inflation, interest rate, potential growth rate, and exchange rate negatively and significantly influence inflation in SSA. Furthermore, the study revealed that inflation square, public debt, and oil prices positively and significantly influence inflation in SSA.

Finally, it became clear that the SSA countries exchange rate regimes positively influence inflation in the sub-region. However, government effectiveness and the dummies for IMF inflows to these countries and COVID-19 were insignificant.

6.1. Implications of the Study

This study has some practical implications. First, the study has shed more insights into how monetary policy transmission mechanisms can bring about credible changes in inflation in SSA, thereby informing monetary policy authorities and policymakers. Second, governments and central banks in SSA countries with different exchange rate regimes could benefit by properly conducting monetary policy to avoid high inflation tendencies. Additionally, excessive domestic and external borrowing, upward interest rate adjustments, and exchange rate fluctuations have consequences for inflation. It is recommended that authorities in SSA pursue credible monetary policy to ensure price as well as sound macroeconomic stability in the sub-region.

6.2. Limitations

The main limitation of the study has to do with the unavailability of data for some countries, which led to the analysis of only 23 countries. This kind of study is limited in the case of SSA, since, to the best of the authors' knowledge, a specific study examining the relationship between monetary policy and inflation is limited.

6.3. Future Research Suggestions

This paper examined the effect of monetary policy on inflation in the context of SSA; hence, future studies could consider examining these variables using country-specific time series data to know what pertains to each country for policy development.

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Appendix I

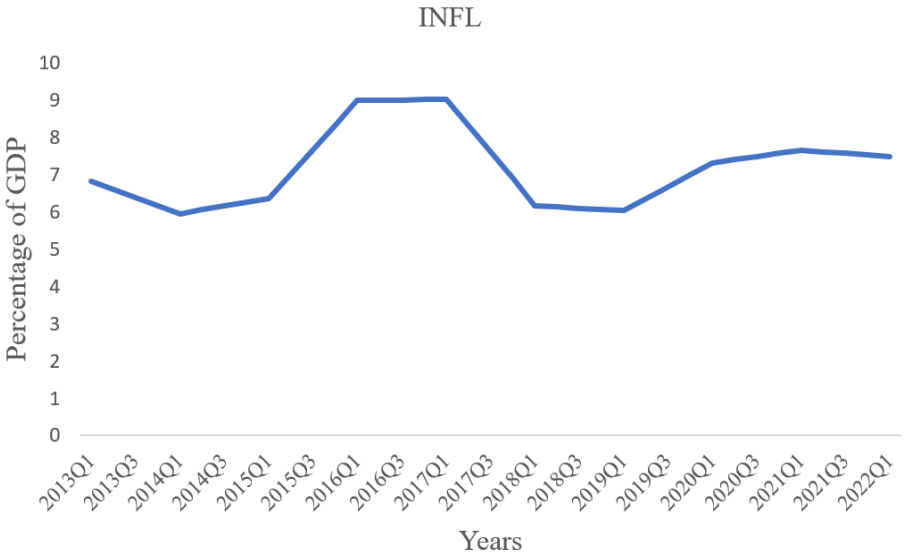

Figure A1. Inflation trend from 2013Q1-2022Q1.

Appendix II

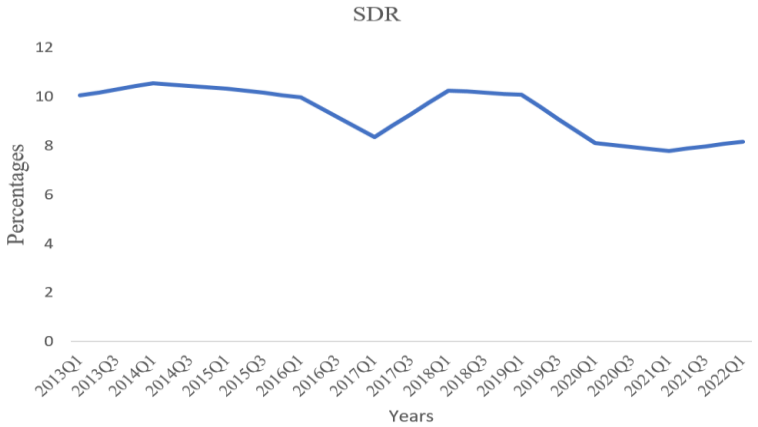

Figure A2. Monetary policy trend from 2013Q1-2022Q1.

Appendix III

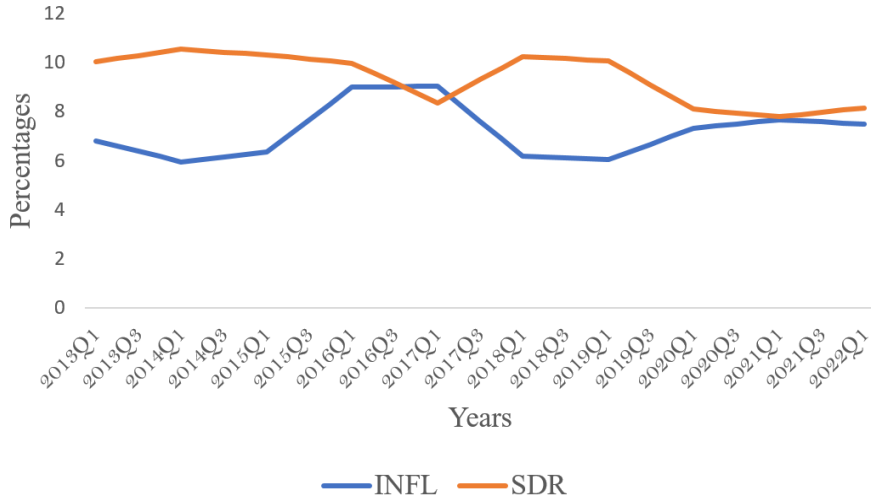

Figure A3. Monetary policy and inflation relationship from 2013Q1-2022Q1.