



The spillover effects of the US monetary policy on the South African economy

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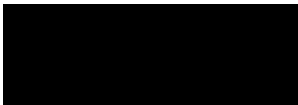
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ABSTRACT

The monetary policy actions of the United States have been identified to have a major spillover globally. Three channels explain this spillover effect: the trade flows, the exchange rate and the financial channel. This study examines how South Africa is impacted by the United States economic development. This spillover may be asymmetrical. Indeed, periods of low and high volatility may have different impacts. Thus, we examine the spillover from the United States to South Africa using a Bayesian regime switching structural vector autoregressive model. We use quarterly data from 1994Q1 to 2023Q1. The impulse response functions indicate that U.S. monetary tightening—reflected by an increase in the Federal Funds Rate—negatively affects the South African economy. Specifically, capital outflows triggered by higher U.S. interest rates result in a depreciation of the South African rand and a decline in real GDP. However, there is a rise in stock prices due to the possibility of capital outflows and domestic bonds becoming less attractive. In response, the South African Reserve Bank increases the repurchase rate to maintain price stability amid inflationary pressures and to halt capital outflows. The results indicate that the impact of the shocks on the domestic variables are heightened during periods of high volatility. Therefore, the empirical results support a substantial spillover from the United States economic developments and asymmetric effects that depend on the volatility regime.

Keywords: Fed, Spillover, conventional and unconventional monetary policy, emerging market economies.

JEL Classifications: E43, E52, E58, F42

Chapter 1 Introduction

The following chapter focuses on explaining the background of the study and its significance. The chapter presents the problem statement, layouts the research questions and objectives, including the significance of the study, the outline of the study.

1.1. Background

When the Federal Reserve Bank (Fed) coughs, do the other economies catch cold? This is the most asked question by researchers investigating the international spillover from the United States (U.S.). Therefore, the present study aims to investigate the US monetary policy's spillover effects on the South African economy. There were studies conducted that utilized methods that are time-invariant, the methods in this case have not accounted for the structural shock's dynamics. In that case, the study uses methods that are time variant and account for structural shocks, which in turn provides robust results on the spillover effects on the US monetary policy on the South African economy. The Fed is one of the most powerful and influential central banks globally, largely owing to the usage of the U.S. dollar (Caldara, Ferrante, and Queralto 2022). The advanced nations' monetary policies, particularly those of the U.S. have been determined to be a major source of international spillovers (Saxegaard, Firat, Furceri, and Verrier, 2022). However, which monetary policy actions of the U.S. are spilled over other economies is largely contingent on the measures of financial integration between the receiving nation and the U.S. (Nzimande and Ngalawa, 2019). This, therefore, implies that emerging market economies need to closely monitor the possible transmissions in the U.S. monetary policy, and adjust their policies accordingly.

The Global Financial Crisis (GFC) and the COVID-19 pandemic have significantly heightened uncertainty in financial markets (Altig et al., 2020). A major contributor to the 2007–2008 financial crisis was the failure of the U.S. Federal Reserve (Fed) to adequately regulate financial institutions, which facilitated the development of housing market bubbles (Tillman, Kim, & Park, 2019). Certain sub-markets within the U.S. mortgage sector extended loans to individuals with poor credit histories, often with minimal oversight or regard for repayment risk (Tillman et al., 2019). The resulting shock from the collapse of the U.S. mortgage market had widespread effects on international financial markets, leading to a sharp economic downturn and a surge in unemployment (Powell, 2013). In response to the crisis, the Federal Open Market Committee (FOMC)—the monetary policy-making body of the Fed—reduced the federal funds rate, reaching the zero lower bound (Williams, 2012). With policy rates constrained by the zero lower bound, the Fed was unable to further stimulate the economy through traditional interest rate policy. Consequently, the FOMC turned to a set of unconventional monetary policy tools, including

forward guidance and large-scale asset purchases, to restore financial stability and support economic recovery (Smaghi, 2009). The implementation of unconventional monetary policy tools was primarily aimed at stimulating economic recovery in the aftermath of the GFC. Initially, the central objective of these measures was to lower long-term interest rates to encourage investment and promote economic growth (Williams, 2012). In this context, the Fed undertook large-scale purchases of mortgage-backed securities (MBS) and long-term U.S. Treasury securities—a strategy commonly referred to as quantitative easing (QE). The purpose of these asset purchases was to reduce yields on risk-free assets, thereby exerting downward pressure on a broader range of interest rates and supporting overall financial conditions (Tillman, et.al 2019).

Moreover, in response to the economic disruptions caused by the COVID-19 pandemic, most central banks around the world adopted QE as of early 2020 (Cortes et al., 2022). According to Cortes et al., (2022), QE remained effective in advanced economies during this period, and the persistence of long-run uncovered interest rate parity, alongside a significant U.S. dollar liquidity shock, supports the widespread adoption of QE across both developed and emerging markets (Rebucci and Hartley, 2022). Consequently, the combined aftermath of the GFC and the COVID-19 pandemic provide a compelling context for this study to explore the spillover effects of U.S. monetary policy on the South African economy. Such an investigation is essential for understanding the extent to which U.S. monetary policy decisions influence macroeconomic outcomes in South Africa.

The Mundell-Fleming model (1963) provides a theoretical framework for understanding the transmission of monetary policy in an open economy setting. In the context of the U.S. monetary policy spillovers to South Africa, the model predicts that an announcement of monetary policy loosening by the Fed—such as a reduction in interest rates—will lead to a depreciation of the U.S. dollar. This outcome is primarily driven by capital outflows, as lower interest rate differentials reduce the attractiveness of U.S. dollar-denominated assets for foreign investors. Consequently, reduced capital inflows and declining demand for the dollar result in currency depreciation and may contribute to a deterioration in the U.S. trade balance. Conversely, emerging market economies with relatively higher interest rates, such as South Africa, tend to experience capital inflows under such conditions. These inflows increase demand for the domestic currency, leading to an accumulation of foreign exchange reserves by the central bank. The reserves are often used to purchase the local currency, resulting in an appreciation of the South African rand. This appreciation, while reflective of increased investor confidence, may also have implications for trade competitiveness and export performance. The opposite is true when the Fed implements a monetary policy tightening.

There are studies that investigated the U.S. monetary policy spillover transmission channels (Rey, 2016; Kabundi et al., 2022; Degaspero, Hong, and Ricco, 2021). The studies conclude that there are three significant channels that monetary policy spillovers to other countries. The channels include: the financial channel, exchange rate channels, and the interest rate channel. One key channel through which U.S. monetary policy spillovers affect emerging markets such as South Africa is via macroeconomic linkages. When the Federal Reserve adjusts interest rates, it conveys information about current and expected U.S. economic conditions. This leads investors and policymakers globally to revise their expectations accordingly. Through trade and investment ties, stronger U.S. growth can increase demand for South African exports, supporting domestic economic activity. Additionally, shared business cycles and inflation trends—transmitted through global confidence and information effects—further amplify these spillovers, prompting the South African Reserve Bank (SARB) to consider adjustments to its own policy stance (Kearns, Schimpf and Xia, 2023).

The exchange rate channel serves as a transmission mechanism through which U.S. monetary policy affects emerging markets such as South Africa. Following the Fed's abandonment of monetarism in the early 1980s, many developing countries adopted exchange rates targeting to stabilise inflation and currency volatility (Azad and Serletis, 2020). When the U.S. raises interest rates, capital tends to flow out of South Africa toward higher-yielding U.S. assets, causing rand depreciation. This raises import costs and fuels inflation but may simultaneously boost exports by improving trade competitiveness. Thus, through its influence on capital flows and trade balances, the exchange rate channel transmits U.S. monetary policy spillovers into South Africa's real economy (Zhang, Sensoy, Cheng, and Zhao, 2022; Kearns *et al.*, 2023). U.S. monetary policy also transmits globally through the financial channel, which includes credit and risk-taking effects. Due to strong financial integration, changes in U.S. interest rates influence borrowing costs and risk premiums in South Africa. Monetary tightening in the U.S. can lead to capital outflows, increased perceived risk, and reduced investor confidence in emerging markets (Kabundi et al., 2020; Zhang et al., 2022). These dynamics contribute to global financial cycles, prompting countries such as South Africa to adjust policy to preserve financial stability.

A growing body of literature has explored the spillover effects of U.S. monetary policy on emerging market economies, highlighting how changes in the Federal Reserve's policy stance can significantly influence global capital flows and financial conditions. Notably, studies by Tillmann et al. (2019), Kabundi et al. (2022), and Georgiadis (2016) have investigated the transmission of U.S. monetary policy to emerging markets, with particular emphasis on the effects of conventional contractionary policy. These studies generally conclude that when the U.S. adopts a tighter

monetary policy—through increases in the federal funds rate or other conventional tools—investors tend to reallocate their portfolios toward advanced economies that offer higher and relatively safer returns. This reallocation is driven by the interest rate differential, which makes investments in mature markets more attractive than in riskier emerging markets.

As a result, emerging economies experience capital outflows, currency depreciation, and higher risk premiums, which can dampen domestic investment and heighten financial market volatility. Furthermore, the increase in foreign capital directed toward the U.S. and other advanced economies can result in asset price inflation in those markets, while simultaneously exerting downward pressure on equity prices in emerging markets. The findings from these studies underscore the vulnerability of emerging economies to external monetary shocks, particularly those emanating from systemically important central banks such as the Fed. This context is crucial for understanding the relevance of the current study, which focuses specifically on the spillover effects of U.S. monetary policy on South Africa.

Most existing studies on U.S. monetary policy spillovers—such as those by Georgiadis (2016), Kabundi et al. (2020), and Tillmann et al. (2019)—have employed empirical models with time-invariant parameters. These approaches often divide the sample into pre- and post-GFC in 2008, limiting their ability to capture evolving dynamics in monetary policy transmission. Moreover, such methodologies typically do not account for potential structural breaks or changes in policy regimes over time, which are critical when analysing economies exposed to recurrent external shocks.

To address these limitations, the current study employs a Bayesian Vector Autoregressive (BVAR) model with Markov regime-switching. This time-varying parameter framework allows for shifts in the transmission mechanism across different regimes and better captures the volatility and structural changes that characterize the global economic environment. The model consists of the low and high volatile regimes; the low regime is defined as the regime that is stable with no shocks or economic crisis. Moreover, the high volatile regime is the regime that defines the forms of crisis in the economy. In doing so, this study contributes to the literature by providing a more flexible assessment of how U.S. monetary policy affects the South African economy over time.

1.2. Problem statement

The aggressive tightening of monetary policy from FOMC in the post-pandemic period has intensified the global co-movement in interest rates. Beginning in 2022, the U.S. Federal Reserve rapidly raised the federal funds rate from near zero in 2020 to 5.33% in 2023 (Liu and Mustapher, 2024). Therefore, prompting other advanced and emerging economies to follow the US monetary policy changes. South Africa mirrored this tightening cycle, with the SARB increasing the repo rate from 3.5% to 8.25% over the same period (Liu and Mustapher, 2024). Similar co-movement between U.S. and South African policy rates was observable during previous global episodes, including the GFC and the U.S. zero lower bound period.

Despite these policy responses, the South African rand has experienced a persistent depreciation against the U.S. dollar since the GFC, with sharp fluctuations during episodes of U.S. monetary tightening (Ncube et al., 2012). This combination of rising domestic interest rates and sustained currency depreciation highlights the vulnerability of South Africa to U.S. monetary shocks. Therefore, it raises renewed concerns about the transmission of U.S. policy decisions to South African economic conditions. Therefore, it is evident that tighter U.S. monetary policy has contributed to capital outflows, exchange-rate volatility, higher borrowing costs, and weakening asset markets in South Africa.

While a large body of empirical literature has examined U.S. monetary policy spillovers (Tillmann et al., 2019; Georgiadis, 2016; Kabundi et al., 2022), many studies rely on frameworks with time-invariant parameters or split the sample into pre- and post-crisis periods to infer regime-dependent effects. Such approaches are limited in their ability to capture structural policy regime changes and evolving external dynamics. To address these limitations, this study employs a Markov-Switching Bayesian Vector Autoregressive (MS-BVAR) model incorporating key South African macro-financial variables—Real gross domestic product, real effective exchange rate, stock prices, and the South African repo rate—together with the U.S. federal funds rate. This theoretical linkage also justifies the use of a Markov-Switching BVAR model, as the spillover dynamics may differ across low- and high-volatility regimes in South Africa. The low regime is defined as the regime that is stable with no shocks or economic crisis. Moreover, the high volatile regime is the regime that defines the forms of crisis in the economy. By allowing for endogenous structural changes without splitting the sample, the MS-BVAR framework provides a more robust means of identifying asymmetric spillover effects and understanding how U.S. monetary tightening spillover through the South African economy.

1.3. Research question and objectives

1.3.1. Research question

- i) What is the impact of the U.S. monetary policy on the South African economy

1.3.2. Research objectives

- ii) Examine how the endogenous variables (Gross Domestic Product, the Exchange rate, Stock Prices, South African repurchase rate) react to the U.S. monetary policy announcements.
- iii) Examine the possible asymmetric effect of the U.S. spillovers across the low volatile regime and high volatile regime.

1.4. Significance of the study

This study is primarily motivated by two major global disruptions of the past decade, the GFC and the COVID-19 pandemic. These events induced significant shocks to U.S. monetary policy, which subsequently spilled over into emerging markets. Given the U.S. dominance role in the global economy, announcements regarding its monetary policy exert a substantial influence on emerging economies such as South Africa. This research is therefore essential for investigating the transmission of U.S. monetary policy shocks to the South African economy. Specifically, it examines how key South African macro-financial variables respond to these external shocks. The findings of the study provide critical insights for South African policymakers, enabling them to better comprehend and mitigate associated risks to financial stability and economic growth by elucidating the channels through which the U.S. monetary developments affect the domestic economy.

1.5. Outline of the study

The dissertation is structured into five chapters. Chapter 1 introduces the study by providing the background, articulating the problem statement, outlining the research questions and objectives, and highlighting the significance of the research. Chapter 2 offers a comprehensive literature review, incorporating both the theoretical framework and the empirical evidence on the transmission mechanisms of U.S. monetary policy and its spillover effects on emerging economies, with a particular focus on South Africa. Chapter 3 details the methodological framework employed in the study, including econometric models, data sources, and estimation techniques. Chapter 4 presents the empirical results and provides an in-depth discussion of the findings in relation to the research objectives and existing literature. Chapter 5 concludes the study by summarizing the key insights and offering practical policy implications. As outlined, the next

chapter is the literature review, which expands on the theoretical channels through which U.S. monetary policy influences the South African economy and empirical studies that examine such spillover effects across emerging markets.

Chapter 2 Literature Review

In this chapter, the study discusses the nature of monetary policy in South Africa and in the U.S. The chapter reviews the monetary policies both in the US and in South Africa to give a comprehension on their mandate and the type of tools utilized to achieve their objectives. Furthermore, the chapter discusses the contagion and U.S. monetary policy spillover in emerging economies. This is mainly owing to understand the magnitude of the influence the US monetary shocks have on the global economy, more especially emerging economies such as South Africa. Lastly, there is a segment in the chapter on empirical review on previous studies on the same and identifying the gap in the body of literature.

2.1. Theoretical framework

2.1.1. The contagion and U.S. monetary policy spillover in emerging economies.

The U.S. remains the dominant global economic power, largely due to the U.S. dollar's role as the primary currency used in international banking and financial transactions (Caldara et al., 2022). Consequently, periods of economic instability or surging inflation in the U.S. typically prompt a monetary policy response from the Fed, often in the form of monetary tightening—raising interest rates—to stabilize domestic economic conditions and the value of the dollar (Saxegaard et al., 2022). Such actions by the central economy generate macroeconomic uncertainty, trigger asset repricing, and lead to heightened capital flow volatility in emerging market economies (Lastauskas & Nguyen, 2024). As a result, central banks in emerging markets often respond to these external shocks to safeguard domestic financial stability. U.S. monetary policy actions significantly influence global financial cycles by altering the cost of funding for globally active banks, thereby affecting financial conditions across economies (Agrrippino & Rey, 2020). Given the systemic importance of the U.S. in global finance, disturbances within its economy often have far-reaching implications—aptly captured by the adage that when the U.S. sneezes, the rest of the world catches a cold (Chen, Griffoli, & Sahay, 2014).

The influence of U.S. monetary policy on emerging market economies manifests through both contagion and spillover effects. The term contagion originates from the field of epidemiology, where it denotes the transmission of disease from one individual to another (Kolb, 2011). This concept has been adapted into economic literature, particularly within the context of international finance and emerging markets, to describe the transmission mechanisms through which financial distress in one economy propagates to others (Kolb, 2011). Concerns about financial contagion gained prominence following the Asian financial crisis of 1997, where financial instability in one

region rapidly spread across neighbouring economies (Hunter, Kaufman, & Krueger, 2012). These concerns were further validated during the 2008 GFC, wherein shocks originating in the U.S. financial system transmitted broadly across the global economy. Accordingly, contagion in this context refers to the transmission of financial or economic shocks across countries, particularly during periods of crisis, underscoring the vulnerability of globally interconnected markets.

In contrast to contagion, spillover effects do not necessarily entail the transmission of crisis-induced shocks between countries. Rather, spillovers refer more broadly to the transmission of financial or economic influences from one country's monetary policy to another (Xu, 2024). Such effects are particularly relevant in the context of the United States, given its deep financial and trade linkages with many emerging market economies (Nzimande and Ngalawa, 2019). The global prominence of the U.S. dollar as the dominant reserve and transaction currency further amplifies the reach of U.S. monetary policy decisions, influencing monetary policy choices in both advanced and emerging economies (Xu, 2024). Kearns et al. (2018) identify three primary channels through which these spillover effects occur in emerging markets: (1) macroeconomic linkages, particularly through trade integration with the U.S.; (2) foreign exchange rate mechanisms, especially when emerging economies peg their currencies to the U.S. dollar; and (3) financial linkages, wherein financial integration—such as exposure to U.S. bond markets—facilitates the transmission of monetary shocks. These channels highlight the multifaceted nature of U.S. monetary policy spillovers and their pervasive influence across global markets.

2.1.1.1 Macroeconomic links

When the FOMC announces changes to the Fed's interest rates, it provides new information about prevailing and expected economic conditions in the United States. As a result, investors adjust their expectations regarding global macroeconomic conditions and future policy decisions in other countries, including South Africa (Kearns et al., 2023). This is primarily due to two factors. First, there are macroeconomic linkages—such as trade flows—between the U.S. and South Africa. For instance, if U.S. economic growth strengthens due to an increase in exports, this can lead to higher demand for imports from trading partners such as South Africa, thereby supporting growth in the South African economy.

Second, the transmission of information through business channels results in co-movements in business cycles or changes in inflation (Kearns et al., 2023). As noted above, when the U.S. economy grows, business confidence in the recipient country, such as South Africa, tends to improve, potentially influencing domestic inflation. These linkages serve as channels through which U.S. monetary policy spillovers affect emerging economies. In response, the central bank of the recipient country is often expected to adjust its policy stance to mitigate adverse effects

or capitalize on favourable conditions, thereby supporting domestic economic stability.

2.1.1.2 The exchange rate channel

In the early 1980s the Fed abandoned the monetarism due to velocity shocks that caused unstable money demand (Azad and Serletis, 2020). Therefore, in mid-80s to early 90s many developing countries decided to adopt the exchange rate targeting as the monetary policy targeting to control inflation and currency stabilization (Azad and Serletis, 2020). The exchange rate targeting has been implemented whereby the value of the currency is fixed. This is implemented so that the value of the currency can be controlled when there is a tendency of the currency appreciating and tightening it when the currency depreciates (Azad and Serletis, 2020). Furthermore, the exchange rate channel serves as a transmission mechanism for the real economy via the trade channel. The trade channel magnifies the effect of exchange rate fluctuations on aggregate demand (Zhang et al., 2022).

As known from Mundell- Flemming model the exchange rate controls for the capital flows in an economy, between the U.S. and South Africa. Therefore, when the U.S. announces an increase in the Fed's interest rates investors will be interested in investing in U.S., mainly because of more returns in investment. Therefore, an emerging economy as South Africa will experience capital outflows, which in turn depreciates the South African rands. The cost of imports increases leading to inflation and affects the economic conditions. In contrast, focusing on the trade balance side, a depreciation in the rand can boost the exports of the country and a favourable trade balance. When the rand appreciates there will be less exports but more imports, which is not in favour of the trade balance. In conclusion, South Africa's economic circumstances can be impacted by U.S. monetary policy, altering trade balances and inflation, through the exchange rate (Kearns et al. 2023).

2.1.1.3 The financial channel

Another crucial channel of the U.S. monetary policy transmissions is the financial channel which includes the credit and risk-taking channels. Zhang et al., (2022) found that the degree of financial integration between emerging economies and the U.S. determines the magnitude of the spillover. This includes the credit, and the risk-taking channels as discussed. The U.S. has a large economy which results in the U.S. monetary policy transmissions affecting the global interest rates. Therefore, monetary policy transmissions that occur in the U.S. spillover to the South African credit market in terms of the costs of borrowing and lending. When the FOMC announces a monetary policy tightening, it will have an influence on the banks in South Africa and the costs of borrowing.

The U.S. monetary policy transmission imposes some risks to South Africa in terms of lending. When the U.S. increases the interest, South Africa will be perceived to be risky to lend because of the capital outflows, therefore it will increase the risk premiums. Therefore, South Africa will lose out on investors' confidence and economic growth activities associated with direct foreign investments. Kabundi et al. (2020) argues that since the U.S. dollar is essential to worldwide trade, and through the channels of international risk-taking and/or credit, the US monetary policy is transmitted to other nations' financial markets. The large co-movement in risky assets triggered by U.S. monetary policy transmission results in a global financial cycle (Zhang et al., 2022). Therefore, the monetary policy of the nations that are financially integrated with the U.S. will react in a way that will prevent financial instability.

The current study focuses on the channels mentioned to examine how financial and macroeconomic variable reacts to U.S. monetary policy shocks. If there is a monetary loosening, it lowers financing costs and results in an increase in U.S. asset prices, especially when the financial risk perception is higher in emerging countries. For example, during the COVID-19 pandemic and the 2008 GFC.

2.2. The South African monetary policy review

The primary objective of the study is to observe how the South African endogenous variables react to announcements of the U.S monetary policy. A comprehensive understanding of the nature of SARB monetary policy, and the U.S. Fed is imperative as it will be of aid in evaluating the U.S monetary policy spillover effects on the South African economy. The monetary policy mainly involves managing money supply, interest rate and exchange rate (Goyal, 2002). The spillovers effects of the U.S. policy are transmitted through the interaction with the SARB policy, macroeconomic and financial integration of South Africa and U.S (Nzimande and Ngalawa, 2019). The responses of the SARB to exogenous variables are crucial in determining the magnitude and the direction of the spillover effect on the economy. Therefore, reviewing the SARB's policy framework contributes to comprehending the U.S monetary policy transmissions impact the South African economy.

The South African monetary policy is formulated and implemented by the SARB; it is an independent institution that acts as the SA government banker (Saville, Shongwe, and Moore, 2023). The Governor of the SARB regularly meets with the Minister of Finance in ensuring policy coordination between the fiscal and the monetary policy, as mandate from the South African Constitution. Whereas the fiscal policy is concerned about the government's tax and expenditure (Goyal, 2002). The regular meetings are essentially to ensure that the macroeconomic objectives are aligning and to maintain economic stability. The primary mandate of the monetary policy is to

protect the value of the currency through maintaining price stability in the interest of sustainable economic growth (Vermeulen, 2020). The mandate is operationalized by the adoption of the inflation-targeting framework since 2000, to maintain inflation and price stability (Vermeulen, 2020). The secondary mandate is to ensure financial stability by protecting and enhancing the financial stability (Saville et al., 2023). The secondary mandate was implemented as a result of the 2008 GFC, the former Minister of Finance Pravin Gordien expanded this mandate to the SARB (Hollander and Van Lill, 2019).

2.2.1. The inflation-targeting framework

The adoption of the inflation targeting framework has been implemented for decades since 2000 by the Ministry of Finance largely to control the inflation to be within the 3-6% band and has a mid-point target of 4.5% (Vermeulen, 2020). By ensuring sustained low and stable inflation and aligning its inflation target with those of major trading partners, the SARB contributes to safeguarding the value of the national currency. This approach supports price stability domestically while also maintaining the currency's competitiveness and stability in international markets (Honohan and Orphanides 2022). SARB takes into consideration the inflation expectations from the economic agent when deciding on the adjustment of the repurchase (repo) rates. Honohan et al. (2022) states that by keeping inflation expectations firmly anchored and aligned with the objective of low and stable inflation, the SARB is better positioned to fulfil its mandate in two further respects. First, by promoting a stable monetary environment, it can support balanced and sustainable long-term economic growth. Second, by maintaining strong credibility in upholding price stability, it is better equipped to respond decisively to economic shocks and more effectively moderate fluctuations in the business cycle.

2.2.2. The South African monetary and fiscal policy coordination

The SARB is an independent institution in terms of having the autonomy of implementing the monetary policy instruments that it sees necessary to achieve their goals (Vermeulen, 2020). However, the government is responsible for setting monetary policy goals. Hence, the Governor of the SARB has regular meetings/discussions with the Ministry of Finance as per the monetary and fiscal policy integration in combating inflation and enhancing economic stability. The main reason for this coordination is to mainly to reinforce macroeconomic stability in South Africa (Vermeulen, 2020). The coordination between the fiscal and the monetary policies is crucial as both policies have an impact of the domestic outcome and the interest rate as well as the nation's global competitiveness with the rest of the world (Goyal, 2002). However, the aftermath of the GFC had rising debate on whether the coordination of the policies are able to account for the downward economic growth since 2011 and the accumulation of debt (Loate and Viegi, 2024).

Research has shown that the policies fail to account for the debts and decline in the economy's growth. However, Loate et.al (2024) found that global shocks and political uncertainty is more suitable for explaining the decline economic growth and increasing debts. Indeed, global shocks can result in negative impact on SA as a small open economy, also the ineffectiveness of the implementation of the coordinated policies for sustaining economic stability.

Since South Africa is an open small economy and U.S. economy being a dominate economy globally, also given that global shocks lead to slow growth in South Africa, it can be said any U.S. monetary policy shock can have a significant spillover effect in the South African economy. Thereafter, the SARB will be liable to implementing the efficient monetary policy phase – expansionary or contractionary- for them to maintain their mandate. The following segment will be reviewing the U.S. monetary policy, mainly to comprehend the nature of the policy and how its transmissions affect the SA economy.

2.3. The United States monetary policy review

Monetary policy is independently formulated by central banks to achieve macroeconomic objectives which is mainly sustaining low inflation, this excludes the need to finance the government (Mishra, Montiel, and Spilimbergo, 2012). Additionally, the Fed's objectives are to achieve maximum employment, economics growth and financial market stability (Mishra et al., 2012). According to the standard monetary policy theories, monetary policy has a long- term effect on controlling stable inflation (Mankiw, 2001). However, the objectives of the Fed's monetary policy have a transitory effect (Mankiw, 2001). Therefore, the transitory effect implies that the Fed's transitions have a temporary effect on the economy, thereafter the economic agents adjust to the effects (Mankiw, 2001). A while after that the effects will have less impact and the economy reverts to its normal trend. The way monetary policy operates to meet its objectives is by influencing short-term interest rates. The short-term interest rates in turn affect the cost and availability of credit in the economy. Furthermore, ultimately it affects the financial or economic decisions that households and businesses make (Ahmed, Akinci, and Queralto, 2024).

The Fed influences the short-term rates- maintained within the target range for Fed funds rates 0-2% - as a monetary policy tool for the stabilization of the economy (Hilton and Hrug, 2007). Hilton et al. (2007) further discuss that to maintain the Fed funds rates in the target range, the FOMC makes use of the monetary policy tools (open market operations, reserves requirement, and the discount rate). Therefore, the FOMC instructs the desk in the Fed reserve markets to operate open market activities. It includes buying and selling securities directly or through repurchase agreements with dealers and other trading counterparties (Ahmed et al.,2024).

Due to the monetary policy objectives, the central bank's policymakers must ensure that an optimal monetary policy is implemented within any state of the economy (Poole, 2006). For the monetary policy maker to successfully do so, they must understand the effect that the monetary policy has on the economy. Furthermore, policymakers need to comprehend the mechanisms of monetary policy that will affect economic activities and purchasing power (Boivin, Kiley, and Mishkin, 2010). It is mainly because monetary policy transmission decisions promote aggregate demand, optimal amount of money circulating in the economy, and more importantly for the performance of the economy (Boivin et al., 2010).

The transmission channels include the interest rate and the exchange rate channels that explains the spillover transmission of the U.S. monetary policy (Boivin et al., 2010; Endut, Morley, and Tien, 2018). The interest rate channel as the monetary policy transmission tool affects investments, spending, and consumption decisions (Endut et al. 2018). Due to price rigidities, theoretically, it is seen that the changes in the nominal interest rate affect the changes in the real interest rate (Kuttner and Mosser, 2018). This will automatically translate into affecting the economic agent's decision making such as their investments and spending. For example, if there is a contractionary monetary policy- an increase in the fed short interest rate- implemented by the Fed Reserve Bank, there will be a reduction in consumption and surge in capital flows. Therefore, for any shock that occurs in the economic system, the interest rate will adjust to the equilibrium in the markets by the application of the IS-LM model/framework (Bernanke and Gertler, 1995).

The other channel that is interconnected with the interest rate channel is the exchange rate channel. The transmission works as a chain whereby when the interest rate changes the exchange rate changes accordingly through the uncovered interest rate parity (UIP) condition. The UIP links interest rate differentials to anticipated changes in exchange rates (Kuttner and Mosser, 2018). This channel is derived from the Mundell (1963) and Flemming (1962) models. The channel applies to countries with open economies rather than closed economies, largely because exchange rates apply when there is international trading. Therefore, the exchange rate affects the monetary policy transmission to influence the net exports (Endut et al. 2018). Since the GFC there has been an implementation of an unconventional monetary policy, which has different transmissions than the conventional policy. The following explains the background of the policy and how the transmission mechanisms operate when implemented.

2.3.1. The formulation of the unconventional monetary policy

The financial institutions in U.S. were giving mortgages to people who subsequently proved to be bad credit (Tillmann et al. 2019). In response to the U.S. mortgage spread shock on the international financial markets, the economy experienced a free fall and a surge in the unemployment rate (Powell, 2013). The FOMC decided to cut the target federal funds rate to zero (commonly known as zero lower bounds). The Fed had to respond by cutting the policy rates to spur the growth rate because the economy was slowing down, and individuals receiving low incomes due to the loss of their employment (Tillmann et al. 2019). Therefore, the consumption of goods and services was reduced, which led to less demand for goods and services and a drastic fall in productivity.

Following cutting the target federal funds to zero, the Fed was unable to provide stimulus with interest rates (Williams, 2012). In result to the downfall of the economy and spillover to the global economy, the conventional monetary policy was not significant to stimulate in order gain control on the economy (Cecioni, Ferrero, and Secchi, 2019). The FOMC came to a consensus to implement the unconventional monetary policy, whereby the unconventional measures can be defined as policies that directly target the cost and availability of external funding for banks, individuals, and non-financial businesses (Smaghi, 2009). The fundings sources can take the form of central bank liquidity, loans, fixed-income securities, or equity (Smaghi, 2009).

The unconventional monetary policy tools include asset purchases, forward guidance, and negative interest rates (Smaghi, 2009). Similarly, the recent COVID-19 pandemic crisis, caused aggregate demand shock, aggregate supply shock, and financial shock in the U.S. economy (Bauer et al. 2020). Therefore, policymakers made use of unconventional monetary policy, (Yilmazkuday, 2022). The reason for the implementation of unconventional monetary policy tools was to stimulate economic recovery from the economic shocks experienced (Yilmazkuday, 2022). For example, the use of asset purchases by the Fed was to drive down longer-term interest rates to boost economic growth (Williams, 2012). The Fed then decided to purchase large mortgage-backed securities or long-term treasury securities (Tillman et.al, 2019).

The U.S. Fed Reserve Bank is well known as the most powerful and influential central bank globally, (Caldara et al., 2022). Therefore, Ahmed et al. (2024) states that the U.S. monetary policy can affect the financial conditions that are measured by the financial asset prices, including those of stocks and bonds, longer-term interest rates, and the exchange rate of the U.S. dollar against the currencies of foreign economies.

2.3.2. Introduction to unconventional monetary policy

To understand the emergence of unconventional monetary policy, it is important to examine its origins and the factors that led to its adoption. The U.S. experienced a recession in 1990–1991 and again in 2001, both of which led to increases in the unemployment rate (Rudebusch, 2018). However, between these recessions, the economy experienced a sustained expansion and declining unemployment (Rudebusch, 2018). Therefore, the Fed used the conventional monetary policy tool to respond to the slowdown to stay aligned with achieving its intended macroeconomic objectives. It was found that the Fed reduced its policy rate by 6% in the 1990 and the 2001 recession to stimulate economic growth (Rudebusch, 2018). This was done by following a monetary policy rule in the U.S. whereby if there is a 1 percent decline in inflation, they must decrease the policy rate to 1.5 percent. Moreover, if there is a 1 percent increase in unemployment the policy rate would have to decline by 2 percent to encourage consumption and economic recovery (Rudebusch, 2018).

The Fed's failure to regulate financial institutions, whereby the institutions were lending high risk loans to individuals without evaluating their ability of being a good debtor caused a global financial crisis 2008 (Carvalho, Hsu, and Nechio, 2016). Moreover, a further 5 percent decrease in policy rates that hit the zero lower bound (Carvalho et al., 2016). The further decrease in the policy rate did not significantly stimulate the economic recovery due to the worsened economic conditions at that time. Therefore, the Fed had to decrease more of the policy rate, however, it was going against the conventional monetary policy principles for decreasing further than the zero lower bounds. The Fed then introduced the unconventional monetary policy that contrasted with the conventional monetary policy, and it made use of different tools from the conventional policy (Kuttner, 2018). The unconventional monetary policy tools include forward guidance and quantitative easing (Smaghi, 2009).

2.3.3. Fed's monetary policy forward guidance tool.

The emergence of the 2008 GFC pressured the Federal Funds rate to decline till it reached the zero lower bound (Carvalho et al., 2016). The reason was to salvage the economy from collapsing and to sustain its ability to achieve its macroeconomic objectives. Therefore, the Fed resorted to additional policy tools such as the forward guidance tool which deals with communication about future changes in the federal funds rates and government's bond purchases (Rudebusch, 2018). The communications about the future federal funds rate are intended to directly affect the long-term yields and financial asset prices. The Fed's forward guidance includes two components to lowering the risks of financial instabilities, and well- sustained financial conditions.

The first component is the expectations; this component includes an average of future expectations

of the Fed funds rates on the maturity of the long-term bond yields. The second component is the term premium, which includes the compensation given to the investors for investing in long-term risky bonds (Rudebosch, 2018). The expectation component was found efficient for economic recovery after the financial crisis in 2008 (Kutter et al., 2018). Whereby it was used to lower expectations about the future Fed funds rates and to lower the long-term yield bond. Therefore, with lower expectations, it will be much easier to control better financial conditions. Furthermore, it will reduce the uncertainty or unanticipated shocks, and the short-term volatility (Kutter et al., 2018). For instance, when the mortgage-backed shock in the world economy started to wash out, investors had expectations that there will be an immediate lift-off of the Fed funds rate (Smaghi, 2009). However, the FOMC made use of the forward guidance tool by communicating to the public announcing that the economic conditions are warranted to low levels of federal funds rate at least until the end of 2014 (Smaghi, 2009). The announcement reduced the investors' expectations and furthermore pushed down the market expectations (Rudebusch, 2018). Therefore, the easing of the market expectations reduced the long-term yields and overall, the financial conditions were eased.

In contrast, Williams (2011) argues that there are some reasons why one can be skeptical about forward guidance being efficient for economic recovery. The reason found is that the optimal forward guidance policy tends to be time inconsistent. In the sense that theoretically, to get the desired effects of the policy, the central bank must commit to sustaining a lower short-term policy rate and higher inflation or otherwise it will happen in the future. When the time comes for the central bank to fulfil the commitment to allow inflation to rise, it becomes difficult for them to do so, hence they deviate from it (English, Lopez-Salido, and Tetlow, 2015). The main reason for this is that the Fed's initial objective is to lower inflation and low unemployment, therefore it is more difficult to allow a rise of inflation and end up not committing to the policy. With that said the policymakers try as much as possible to get away from policies that promise high inflation in the future, and effective in theory to combat the zero bound (Williams, 2012). The second reason for being septic about the forward guidance is the fact that the public may have different expectations on the future outcomes of the economy and not having a clear understanding on the central bank's intended monetary policy in the future, the policy may be inefficient to circumvent the zero bound (Reifschneider and Roberts 2006).

2.3.4. The Fed's quantitative easing

Quantitative easing (QE) is one of the unconventional monetary policy tools that is utilized by U.S. monetary policymakers. It is mainly implemented when the conventional policy rates are constrained by the lower bounds of the short-term interest rates, it was also found to be effective at

easing financial conditions (Bernanke, 2020). The Fed's QE involves the purchases of long-scale assets or bonds to improve economic conditions in periods of lower-bound Fed policy rates. The Fed announced its first QE program of purchasing mortgage-backed securities and government-sponsored enterprises (GSEs) in the events of the 2008 GFC. The first program well known as QE1 whereby the FOMC purchased US treasury securities that amounted to \$1.725 trillion in March 2009 (Bernanke, 2020). After the purchase, the long-scale assets of the first program followed two more programs. In November 2010 the Fed announced the second program of US treasury securities purchases that amounted to \$600 billion. Moreover, the Fed introduced the maturity extension of the program in September 2011 and extended it to June 2012 by selling short-term treasuries and purchase the longer-term treasury securities. The last program that was announced in September 2012 was mainly purchased to improve employment by purchasing both the treasury securities and the MBS (Bernanke, 2020).

In an economic intuition, an increase in the purchases of bonds in the bond market decreases the bond yields due to an increase in bond prices as they are inversely related. Therefore, in 2013 when the Fed slowed the assets purchases, the bond market yield started rising with a 10-year yield that rose by one percent from several months prior (Bernanke, 2020). The Fed's balance sheet increased to over 4 trillion after the overall purchase of the separated long-term assets (Rudebusch, 2018). In retrospect, QE is intrinsically a forward guidance policy in terms of announcing the time profile of the asset holdings that are purchased, Rudebusch (2018) mentioned that it reduces the expectation component. Umar, Bossman, Iqbal, and Teplova (2023) did a study on the patterns of unconventional monetary policy spillovers during a systemic crisis (Covid-19). They mentioned that there is no empirical evidence of monetary policy linkages in financial crises that are exogenously driven. Even though the 2008 GFC and the COVID-19 crisis occurred for different reasons, they still had some resemblance which led to the implementation of unconventional monetary policy. Whereby the Fed purchased a large-scale of assets for economic recovery from the damage caused by a sudden stop of global economic activities due to the spread of the virus. Simulations of Bernanke (2020), Papadamou, Siriopoulos, and Kyriazis (2020), Rudebusch (2018) studies, and the US FRB/macroeconomic model concluded by suggesting that the unconventional monetary policy must be considered the new policy that is implemented without any shocks in the economy as it has been significantly effective in stimulating the economy and being an aid in financial or economic conditions that occurs globally. Spillovers from US monetary policy to other emerging economies can be beneficial or negative. This depends on the relative strength of three channels of transmission: the exchange rate channel, the domestic demand channel, and the impact on international financial conditions. (Ammer et al, 2016).

2.4. The Mundell-Flemming theory

The Mundell (1963) and Flemming (1962) theory is a framework that provides a comprehension on how monetary policy from another country transits to another country's economy through capital mobility and exchange rate adjustments. In the context of the study, South African is a small open economy that has flexible exchange rate and capital mobility; therefore, the economic conditions in South Africa are susceptible to spillover effects of international monetary policy shocks. According to the Mundell-Flemming model when the U.S. announces to increase the interest rate, global investors will shift their investments towards the U.S. financial assets for higher return in investment. In turn, South Africa theoretically will experience capital outflows and puts downward pressure on the South African rand resulting to depreciation on the rand. The devaluation of the rand results in the currency being less competitive as investors demanding less of the South African currency and demanding more dollars. On the other hand, theoretically, depreciated rand increases the cost of importing and making the South African products cheaper globally. The model has a central explanation of the main spillover channels – which are, the exchange rate volatility, capital flows and the change of interest rates- through which the U.S. monetary policy shocks affect the South African economy. Building on the theoretical literature, the following section examines empirical studies that test these concepts in practice.

2.5. Empirical literature review

This study section will concentrate on relevant studies investigating the U.S. Monetary Policy spillover effect on emerging economies, narrowing it down to the impact on the South African economy. Secondly, the study will find papers that have relevant literature on the determinants of U.S. Monetary Policy spillover on emerging economies markets. Lastly, we look at literature that has estimated the asymmetric effects of conventional and unconventional Monetary Policies. Furthermore, we look at the estimators and findings they used.

The 2007/8 GFC and the aftermath are the main reasons most studies investigated the nature of the U.S. Monetary policy on emerging economies (Tillmann, 2019). The 2007/8 GFC pressured U.S. policy makers to implement a new policy regime- Unconventional monetary policy- also known as Quantitative easing. Moreover, years after the GFC, an anticipated shock in the economy occurred from the COVID-19 pandemic lockdowns that led to a sudden slowdown in economic activities.

2.5.1. Studies on emerging market economies

Several studies were conducted in the aftermath of the GFC, primarily focusing on the spillover effects of U.S. monetary policy on emerging market economies. To contextualize these developments, it is important to first consider the background of U.S. monetary policy prior to the adoption of unconventional measures. Maćkowiak (2007), for instance, estimated a structural vector autoregressive (SVAR) model to investigate whether external shocks to U.S. monetary policy were significant drivers of macroeconomic fluctuations in emerging markets. The study utilized a dataset comprising financial variables from eight emerging economies, including countries from both Asia and Latin America. The findings revealed that U.S. monetary policy shocks had a notable impact on financial variables in these economies. Short-term interest rates and exchange rates in emerging markets were found to respond both strongly and rapidly to such shocks, highlighting the extent of monetary policy spillovers from the United States (Maćkowiak, 2007).

To identify the direct effects of U.S. monetary policy shocks on emerging economies the study of Chen, Griffoli and Sahay (2014) employ an event study methodology. This approach enables researchers to isolate the immediate impact of specific policy announcements or actions on financial variables, such as asset prices and capital flows. By focusing on narrow time windows around monetary policy events, the methodology helps control for confounding factors and captures the causal influence of U.S. policy decisions on emerging market responses. Their findings show that the U.S. monetary policy has a significant effect on the financial markets. Chen et. al (2014) furthered their study to find out the effect of the policy in a different regime. Their results illustrate that in the unconventional monetary policy regime spillover was larger than in the conventional monetary policy regime. The unconventional monetary regime was found to have more spillover magnitude because of the newly implemented signaling instruments.

The study of Tillmann (2016) used low-frequency data to study advanced economies' unconventional monetary policy and its spillovers to emerging markets economies. The study estimated a Qual VAR that integrates binary information about QE announcements. Their results illustrate that the QE has a substantial effect on emerging economies' financial conditions. They concluded that QE is significant in explaining the response of emerging economies' financial conditions. This is in conjunction with the financial integration of the advanced and emerging economies as discussed above. Tillmann (2016) results indicated that emerging economies respond to QE by increasing their short-term interest rates and equity prices, capital inflows, and appreciated exchange rates.

Furthermore, another study of Tillmann et al (2019) investigated the spillover effects by estimating a series of Vector Autoregressive (VAR)-X models- vector autoregressions augmented with an exogenous variable- are estimated, with primary attention given to the effects of shocks to the exogenous variable, which constitute the focus of the analysis. The model estimated two sub-samples, the first sample was concentrating on the period before the 2008 GFC, and the second one was concentrating on the post-crisis. The variables used for their study include nominal domestic stock prices, exchange rates, and long-term domestic bond yields. They did this by observing 11 different emerging countries. Based on a prior discussion in their study, they stated that when the U.S. monetary policy tightening is implemented by increasing the short-term rate to 025 basis points, it will lead to a capital outflow from emerging markets economies.

The findings from the analysis revealed nuanced effects of U.S. monetary tightening on emerging market financial variables in the post-financial crisis period. After estimating the model, the authors observed that not all impulse response functions aligned with their initial expectations. Specifically, the results showed that U.S. monetary tightening was associated with a decline in domestic stock prices and a depreciation of the exchange rate in emerging economies—findings consistent with theoretical predictions. However, contrary to expectations, bond yields in these economies remained largely unchanged, suggesting a partial deviation from anticipated outcomes. Tillmann et al. (2019) further contributed to the literature by demonstrating that the magnitude of spillover effects from U.S. monetary policy varies across different regimes. Their analysis showed that spillovers were significantly more pronounced in the aftermath of GFC, indicating a regime- dependent and asymmetrically stronger transmission of U.S. monetary shocks to emerging markets during periods of financial stress.

Degasperi, Hong, and Ricco (2021) examine the international spillover effects of U.S. monetary policy transmission across advanced economies, emerging markets, and the Euro Area. Their analysis employs a high-frequency identification approach to policy shocks combined with large VAR techniques, incorporating both financial and macroeconomic variables. The study finds that U.S. monetary policy exerts a broadly homogeneous impact on nominal and real variables across all country groups. Notably, the results highlight the predominance of financial channels in the transmission process, with significant spillover effects observed irrespective of the recipient countries' monetary policy regimes. These findings suggest that the financial system serves as the primary conduit through which U.S. monetary policy influences emerging market economies. Accordingly, the dominance of financial transmission mechanisms underscores the pivotal role U.S. monetary policy plays in shaping financial conditions within emerging markets.

There are different sources of the policy's shocks, which in turn produce different outcomes of the spillover effects on emerging market economies (Ahmed, Akinci, and Queralto, 2021). Ahmed et. al (2021) conducted a study that explored how different sources of the shocks that cause a shift in interest rates, vulnerabilities of the countries, and how the central bank decisions affect the spillover effects of U.S. monetary policy on emerging economies markets. The model adopted is a two-country open-economy New Keynesian model to explore the transmission of U.S. monetary policy shocks to emerging markets (EMEs). The model incorporates features such as financial frictions, partially dollarized balance sheets, and imperfectly anchored inflation expectations to capture the heterogeneity among EMEs. By focusing on structural characteristics and vulnerabilities rather than specific countries, the study provides insights into how different types of U.S. monetary policy shocks—those driven by domestic demand versus a more hawkish policy stance—affect EMEs depending on their macroeconomic fundamentals and financial structures. The result from their estimations illustrates a positive spillover effect on emerging market economies when the source of the shock is aggregate demand in the United States of America. On the contrary, when the source is from a hawkish policy- increment of interest rate when the economy is overheating with high inflation- stance it has a negative spillover effect.

The COVID-19 pandemic serves as a key motivation for the present study, as it highlights the importance of understanding the nature of U.S. monetary policy spillover effects on emerging market economies. In this context, Wei and Han (2021) examine the impact of the pandemic on the transmission of monetary policy to financial markets, focusing on government bond yields, credit default swap spreads, exchange rates, and equity markets. They used an event- study methodology and their analysis include a sample of 37 countries. The countries are selected based on the severity of the pandemic's impact on the specific countries, and the countries' relevance to the global economy—many of which are members of the G20. The findings reveal that the onset of the COVID-19 crisis significantly weakened the international transmission of monetary policy to financial markets. Moreover, their regression analysis shows that this weakening effect was consistent across countries regardless of their level of industrialization. This uniformity is attributed to the sharp and simultaneous slowdown in the manufacturing sector observed across all countries in the sample. Lastaukas and Nguyen (2024), have conducted a study on the international spillover of U.S. monetary policy transmissions after COVID-19. They utilized the global VAR estimators; they study covered 32 countries. The results illustrate that an increase in the U.S. interest rate causes a persistent decline in the output in emerging markets and came to a consensus that is due to trade integrations.

The study of Yilmazkuday (2022) studied spillover effects of U.S. monetary policy in COVID- 19

pandemic precrisis and post-crisis. The study investigates the spillover effects of U.S. monetary policy on 11 emerging markets and 12 advanced economies pre- and post-COVID pandemic. They used the SVAR methods, the variables include the U.S. output, policy rate and the U.S exchange rate (constructed as the appreciation of the U.S dollar). Furthermore, they used the same variables for the emerging markets and the advanced markets. After estimation, the results found that after a negative shock in the U.S. interest rate the dollar depreciated which is evident to the Keynesian theory on demand-augmented effect. The findings indicate that the U.S monetary policy exhibited significant spillover across majority of the countries in the pre-COVID- 19 period. However, during the COVID-19 period, these effects were observed only in a subset of countries, a pattern that can be attributed to the influence of the pandemic-induced uncertainty (Iyke, 2020).

Bhattarai (2021) also investigated the international spillover effects of the U.S. QE policy on emerging market economies' financial data. The study estimated a Bayesian panel VAR model that observed emerging economies in Latin American countries, Asian countries, and South Africa. The study was motivated by the emergence of the pandemic. Bhattarai (2021) found that a U.S. expansionary QE shock shows a significant effect on emerging market economies' financial variables. The results of the study have shown that emerging economies' financial variables responded to the announcement of the QE shock. The exchange rates appreciated, there was a reduction in the long bond yields and stock market boom, and lastly, there was an increase in capital flows (Bhattarai, 2021). The results are consistent with the Mundell-Flemming model.

Overall, the findings discussed in the preceding literature consistently support the view that U.S. monetary policy exerts significant spillover effects on emerging market economies. A recurring theme across the studies is the dominant role of the financial channel in transmitting these effects, particularly in the context of increasingly interconnected global financial markets. Empirical evidence demonstrates that key endogenous variables in emerging markets—such as exchange rates, interest rates, and asset prices—respond notably to U.S. monetary policy shocks. The prominence of the financial channel reflects the sensitivity of capital flows and financial conditions in emerging markets to changes in U.S. policy. In line with the predictions of the Mundell-Fleming framework, monetary tightening in the United States often leads to capital outflows from emerging economies, resulting in contractions in real gross domestic product and rising unemployment due to reduced investment and liquidity (Dedola, Rivolta, and Stracca, 2017). These dynamics underscore the vulnerability of emerging markets to external monetary shocks and the importance of understanding the mechanisms of international policy transmission.

Central banks across the globe primarily aim to maintain price stability and preserve the value of their domestic currencies. Given the United States' status as the most influential economy in the world (Caldara et al., 2022), changes in U.S. monetary policy tend to have far-reaching global implications. This dynamic is often captured by the adage, "when the Fed coughs, the world catches a cold," a phrase used by Dedola et al., (2017) in their investigation of the international spillover effects of U.S. monetary policy on both advanced and emerging economies. Their study finds that unexpected U.S. monetary policy tightening leads to significant adverse effects in emerging markets, including currency depreciation, declines in industrial production and real GDP, and rising unemployment. Conversely, such tightening tends to improve the trade balance by increasing exports relative to imports. However, this improvement may come at the cost of higher inflation, driven by the increased price of imported goods resulting from currency depreciation. These findings underscore the complex and multifaceted nature of U.S. monetary policy spillovers on the global economy.

The present study extends the discussion by examining literature that explores potential asymmetries between the effects of conventional and unconventional U.S. monetary policy on emerging market economies. Tillmann et al. (2019) investigate whether the international spillover effects associated with the tapering of unconventional monetary policies—signalling a return to policy normalization—are more pronounced than those triggered by the announcement of quantitative easing measures. The authors estimated a series of VAR-X models, whereby VAR models augmented by an exogenous variable. They were interested in how the endogenous variables of 10 emerging economies responds to the U.S monetary policy rates. The endogenous variables include the stock prices, exchange rate and the domestic long- term bond yields. Their findings indicate a clear asymmetry between the impacts of conventional and unconventional monetary policy, aligning with the results of Georgiadis (2016). Specifically, the study concludes that expansionary unconventional monetary policy exerts a stronger influence on stock markets and capital inflows than conventional policy actions, highlighting the heightened sensitivity of global financial markets to nontraditional policy tools.

Georgiadis (2016) makes a significant contribution to the literature by examining the determinants of global spillovers from U.S. monetary policy. The study employs a Global Vector Autoregressive (GVAR) model, which integrates multiple country-specific VAR models to jointly capture the dynamic interlinkages among several advanced and emerging economies. This approach enables comprehensive analysis of international transmission mechanisms. By comparing the effects of conventional and unconventional U.S. monetary policy, the study finds that conventional policy tends to generate larger spillover effects. Importantly, Georgiadis (2016) emphasizes the substantial

cross-border impacts on real economic activity, particularly in emerging markets. Apart from a few regions—such as parts of Africa and Latin America— the findings indicate that spillovers in emerging economies are, in some cases, as large as the domestic effects observed within the United States. Moreover, the spillovers to advanced economies appear to be relatively smaller. The study also highlights that the degree of trade and financial integration plays a critical role in determining the magnitude of spillover effects (Georgiadis, 2016). These findings underscore the asymmetric nature of U.S. monetary policy spillovers across different economic contexts.

Williams (2012) investigates the differential spillover effects of U.S. conventional and unconventional monetary policies on emerging market economies. The study highlights that expansionary unconventional monetary policy in the U.S. had a more pronounced impact than conventional policy, particularly in lowering long-term interest rates and influencing global financial conditions. These findings align closely with those of Tillmann et al. (2019), who also report stronger spillover effects from unconventional policy measures. In contrast, Georgiadis (2016) presents a differing perspective, finding that conventional U.S. monetary policy generated larger spillover effects, particularly in emerging markets, relative to unconventional policy. Further insights are provided by Kearns et al. (2023), who employ a high-frequency identification approach to examine monetary policy spillovers from major central banks over the period 1999 to 2019. Their analysis reveals that spillover effects tend to be more substantial in advanced economies than in emerging markets. Collectively, these studies underscore the complexity and heterogeneity of international monetary transmission, shaped by the nature of the policy tools used and the structural characteristics of recipient economies.

This study also engages with the relevant literature that explores the potential channels through which U.S. monetary policy spillovers affect emerging market economies. Kearns et al. (2023) identify three primary transmission channels through which these spillovers occur. First, the macroeconomic channel operates through trade linkages, wherein countries with stronger trade integration with the United States are more exposed to policy-induced demand fluctuations. Second, the foreign exchange rate channel becomes relevant when emerging economies adopt fixed or tightly managed exchange rate regimes, particularly those pegged to the U.S. dollar, making them more susceptible to external monetary shocks. Third, the financial channel highlights the role of cross-border financial integration, the greater the financial exposure to U.S. markets, the more pronounced the spillover effects. For instance, changes in U.S. bond risk premia or capital flows can directly impact asset prices and borrowing costs in emerging markets. These channels underscore the multifaceted nature of international monetary transmission and the structural vulnerabilities that may amplify spillover effects in emerging economies.

Hofmann and Takas (2015) focus on economies highly integrated into global financial market. Their empirical evidence shows that emerging economies with greater financial openness are particularly vulnerable to sudden stops in capital flows and reversals in current accounts following U.S. monetary policy announcements. Additionally, trade openness or strong trade integration with the U.S. also increases a country's exposure to these spillovers. This heightened susceptibility is largely due to the dominant role of the U.S. dollar as the primary global reserve currency, with most international trade invoiced and settled in dollars (Caldara et al., 2022). Building on this, Hofmann and Takas (2015) employ panel regression analysis to examine spillover effects on short- and long-term interest rates as well as policy rates, focusing on economies closely linked to the global financial system. The economies include 30 emerging economies and small open advanced economies. Their results reveal economically and statistically significant spillovers from U.S. monetary policy to financially integrated emerging markets. Taken together, the empirical evidence suggests that the main channels through which U.S. monetary policy affects emerging market economies are financial integration, trade openness, and the exchange rate regime adopted by the recipient country (Georgiadis, 2015; Hofmann and Takas, 2015; Tillmann, 2019).

Moreover, the COVID-19 pandemic prompted 21 central banks to implement QE policies during March and April 2020 (Rebucci, Hartley, & Jiménez, 2022). The authors emphasize the continued effectiveness of QE in advanced economies despite ongoing challenges. They further note that the operation of long-run uncovered interest rate parity, and a significant dollar shortage shock during the pandemic align with the widespread global adoption of QE. Theoretically, according to the Mundell-Fleming model, investors adjust their portfolios in favour of higher-yielding assets when the United States and other advanced economies ease monetary policy in response to contractionary shocks. While some portfolio rebalancing occurs domestically, a portion of these investments flows internationally, particularly to emerging market economies (Powell, 2013). Consequently, currencies of emerging market economies tend to appreciate relative to those of advanced economies in response to these capital inflows.

In summary, the body of literature related to this study solidifies that there is evidently a significant spillover effects of the U.S. monetary policy on emerging market economies. There are heterogeneous spillover effects in most studies that focused on a panel of emerging economies. Furthermore, there are magnitudes of the spillovers that differ from both regimes of monetary policy. On the first part of the empirical literature of this study it was concentrating on the spillover effects in emerging market economies. The second part narrows it down to focus on the effects in the South African economy.

2.5.2. Studies on the South African economy

The onset of the Global Financial Crisis (GFC) in 2008 significantly heightened risks within global financial markets, generating widespread uncertainty among market participants, including those in South Africa (Mboweni, 2007). Given the United States' position as the world's most influential economy, South Africa remains particularly vulnerable to spillover effects stemming from U.S. monetary policy shocks. Despite these risks, the then-Governor of the South African Reserve Bank, Mr. Tito Mboweni (2007), addressed the nation regarding the unfolding global crisis and the monetary policy responses undertaken by the U.S. authorities. Notably, South Africa appeared to have weathered the global turbulence relatively unscathed. Mboweni (2007) reported that domestic financial markets remained stable, and the South African Reserve Bank did not find it necessary to inject additional liquidity to maintain market functioning.

This study moves on to discussing related literature on the U.S. monetary policy spillover effect on the South African economy. Meszaros and Olson (2019) investigated the impact of the U.S. monetary policy on the South African economy. The VAR model was conducted utilizing the macroeconomic variables including the South African inflation, Output, stock market index, exchange rate, and South African policy rate. Their study's primary objective is to examine the effects of the U.S. monetary policy on the South African economy. However, their sample includes the period during the QE during the GFC, and the aftermath from 2009 to 2018. They measure the U.S. policy in two ways: the adjusted St. Louis monetary base and Divisia M4. The findings indicate that the Federal Reserve's quantitative easing programs had only a limited impact on South Africa's economy. However, the choice of monetary policy indicator plays a crucial role in assessing international monetary spillovers, as the outcomes vary based on the specific measure of monetary policy employed.

Kabundi et al. (2022) examined the spillover effects of both conventional and unconventional U.S. monetary policy on South Africa. The study began by analyzing the relationship between South Africa's domestic financial cycle and the global financial cycle, revealing a strong co-movement between the two. This correlation suggests that developments in the global financial cycle inevitably transmit to South African financial markets. To empirically investigate these dynamics, the authors employed a medium-scale Bayesian Vector Autoregressive (BVAR) model with Minnesota priors, utilizing monthly data spanning from 1990 to 2018 and incorporating 20 financial variables from both the U.S. and South Africa.

The analysis was conducted over two sub-samples corresponding to the conventional and unconventional monetary policy regimes. In the first sub-sample, during the conventional policy

period, the results indicate that an expansionary U.S. monetary policy led to a decline in South African long-term interest rates and an increase in equity purchases by non-resident investors. This reflects capital inflows into South Africa, driven by a reallocation of global capital in response to lower yields in the U.S.

In the second sub-sample, covering the unconventional monetary policy period, the study found that an increase in the U.S. short-term interest rate during the quantitative easing regime contributed to reduced global financial market risk. Concurrently, the U.S. economy experienced rising output and inflation, which led to a depreciation of the U.S. dollar against major trading partners. As a result, capital outflows from the U.S. were observed, accompanied by capital inflows into South Africa. These findings underscore the significance of U.S. monetary policy, whether conventional or unconventional, in influencing financial conditions and capital flows in emerging market economies such as South Africa.

2.6. Conclusion

The chapter outlined the theoretical framework on conducting the study on the spillover effects of the US monetary policy on the South African economy. Moreover, the present study outlined empirical literature of the existing studies. The first segment of the theoretical framework discussed the contagion and the spillover effects of the US monetary policy on emerging economies, which in turn gave a background on why and how the US monetary policy shocks contagious and spillover to emerging economies such as South Africa. There are also monetary policy transmission channels mechanisms that gave clear description on channels used by US monetary policy to spillover their effect on emerging economies. Moreover, the Mundell-Flemming theory is included which is in harmony with the body of literature discussed in the study.

Although a growing body of research has examined the international transmission of U.S. monetary policy, most existing studies focus on broad emerging market groups or major developing economies, with limited country-specific analysis for South Africa. Much of the available literature concentrates on financial market reactions—such as exchange rate movements, capital flows, and sovereign bond spreads—while relatively fewer studies investigate the combined macroeconomic, financial, and sectoral channels through which these spillovers affect South Africa's real economy.

Furthermore, existing studies often encounter methodological limitations, particularly due to the division of their sample periods into pre- and post-2008 global financial crisis sub-samples. While this approach offers some insights, it may not fully capture the dynamic nature of spillover effects

across different policy regimes. Considering these limitations, the present study adopts a novel methodological framework to address the research question more comprehensively. Specifically, it utilizes a Markov- switching Bayesian Vector Autoregressive (MSBVAR) model—an approach that has not yet been applied in the context of U.S. monetary policy spillovers to South Africa. This model allows for the examination of regime-dependent dynamics in a more flexible and robust manner. The next chapter provides a detailed explanation of the methodology employed to achieve the objectives of the study.

Chapter 3 Empirical Framework

The previous chapter presented the theoretical framework and reviewed empirical evidence on the impact of U.S. monetary policy shocks on emerging economies, with a specific focus on South Africa. Literature highlights an important research gap, particularly relating to methodological limitations in existing studies. Many of the conventional econometric techniques employed in prior work rely on time-invariant parameters and therefore fail to account for structural breaks and evolving dynamics within the South African economy. These constraints limit the ability of earlier studies to capture how transmission mechanisms may shift in response to changes in global financial conditions, domestic policy regimes, or macroeconomic vulnerabilities. Considering these shortcomings, the present chapter outlines the methodological approach adopted to address this gap and achieve the study's research objectives. Specifically, it details the empirical strategy used to examine how key endogenous variables respond to U.S. monetary policy shocks in a framework that accommodates parameter instability and structural change over time.

The outline of the chapter is structured as follows: The first section explains the data used and the source of the data. The following sections explain the built up of the econometric framework utilized in the study-Markov switching Bayesian Vector Autoregressive (MSBVAR) model. The first one starts explaining the structural VAR and its applications, then followed by explanations of the Markov-regime switching model. Thereafter the Bayesian model includes the type of prior beliefs used in this study and the model estimations. Lastly, the model specification is explained and the econometric equation used in this study. The chapter further discusses the prior expectations.

3.1. Structural Vector Autoregressive

This study uses a Structural Vector Autoregressive (SVAR) model to answer the research question and achieve the research objectives, which is examining how the South African economy reacts to the U.S. monetary policy announcements. The SVAR model is an extension of the traditional VAR model which is a system that is set out to capture the linear relationship among variables (Enders, 2022). In a standard VAR, each variable in the system is expressed as a linear function of its own past values and the past values of all other variables in the system. The VAR is mainly known for forecasting the correlations between economic variables, moreover, it is utilized without an economic input on how the variables contemporaneous affect each other. Furthermore, the framework is unable to identify any underlying structural shocks, therefore this means that the estimated results do not account for structural shocks.

Therefore, this study adopts the SVAR as it can identify structural shocks (the U.S. monetary

policy shocks) and incorporates theoretical restrictions- derived from the economic theory- on the contemporaneous relationships among the economic variables. The notation of SVAR is as follows:

$$A_0 y_t = A_k y_{t-k} + \psi w_t + \varepsilon_t \quad (1)$$

Whereby, A_0 is a 5 X 5 matrix of coefficients, ε_t is a 5 x 1 vector of unobservable white noise processes. As noted by Enders (2022), the SVAR model cannot be directly estimated using Ordinary Least Squares (OLS) when contemporaneous relationships exist among endogenous variables. This is due to the simultaneity bias that arises when explanatory variables are correlated with the structural error terms, thereby violating the OLS assumption of exogeneity. To address this issue, a reduced-form VAR (RVAR) is first estimated using OLS, as it involves only lagged variables which are not contemporaneously correlated with the errors. Identification restrictions are then imposed on the reduced-form residuals to recover the structural shocks, allowing for causal interpretation of the dynamic interactions among variables.

The RVAR expresses each variable as a linear function of its past values, the past values of all other variables being considered, and a serially uncorrelated error term. The RVAR will be formed by pre-multiplying the VAR by the inverse of the A matrices A^{-1} and it results in:

$$\begin{aligned} A^{-1}A_0 y_t &= A^{-1}A_1 y_{t-1} + A^{-1}A_2 y_{t-2} + \dots + A^{-1}A_k y_{t-k} + A^{-1}\psi w_t + A^{-1}\varepsilon_t \\ y_t &= Fy_{t-1} + Fy_{t-2} + \dots + Fy_{t-k} + \mu_t \end{aligned} \quad (2)$$

While the Reduced-Form VAR effectively captures the dynamic interrelationships among variables, it lacks the ability to identify structural shocks. This creates an identification problem, as the model does not provide meaningful economic interpretation regarding the sources of the shocks. Therefore, it is necessary to return to Structural VAR by imposing restrictions - economic theory- to disentangle the structural shocks and recover causal relationships among variables (Enders, 2022). Moreover, to obtain impulse response functions or variance decompositions the structural shocks are necessary Enders (2022). SVAR models recovering the structural shocks (ε_t) from the reduced-form residuals (μ_t) involves expressing the variance-covariance matrix of the reduced-form errors as a function of the structural impact matrix (A^{-1}). Specifically, this is done by decomposing the reduced-form covariance matrix:

$$\Sigma \mu = A^{-1} (A^{-1})$$

However, the identification of this system is not straightforward. The number of unique elements

in $\Sigma\mu$ (due to its symmetry) is insufficient to recover all elements of A^{-1} , resulting in an underdetermined system. As such, the SVAR is not identified unless additional restrictions are imposed on the structural matrix.

To achieve identification, the study imposes structural restrictions based on economic theory. A common approach is to apply short-run zero restrictions, which assume that the A matrix is lower triangular—a method consistent with the Cholesky decomposition. Another approach is to impose sign restrictions, which involve drawing an orthonormal matrix (S') and verifying whether the resulting impulse responses align with theoretical expectations (e.g., expected positive or negative reactions to policy shocks). These restrictions are imposed by ordering the variables in a theoretically justified manner to determine the contemporaneous causal structure among them (Stock & Watson, 2001). This enables the structural identification necessary for meaningful economic interpretation.

3.1.1. Ordering of the variables

The first variable is the most endogenous variable with the most contemporaneous effect on the rest of the variables. Furthermore, the last variable is considered the most exogenous variable. This current paper adopts the imposition of restrictions from Abouwafia and Chambers (2015). The paper had imposed short-run restrictions. Therefore, in any U.S. monetary policy shocks, The GDP is the first common macroeconomic variable to respond to the shock. This implies that GDP affects contemporaneously all variables. The exchange rate and the stock prices were expected to react simultaneously to the U.S. monetary policy shocks. However, the exchange rates are restricted to react to stock prices. The South African repurchase rate will be the last variable in the ordering of the endogenous variables, and the Fed's interest rate will be the exogenous variable.

One of the key limitations of estimating a Reduced-Form VAR (RVAR) is its inability to adequately account for structural breaks, particularly in macroeconomic data following major global shocks such as the 2007/08 Global Financial Crisis. Standard VAR models assume that the underlying relationships among variables remain stable over time—a condition that is often violated in practice. As macroeconomic time series data frequently exhibit nonlinearities and regime shifts, relying solely on traditional VAR models estimated via Ordinary Least Squares (OLS) can yield biased or inefficient results due to parameter instability and overfitting, especially in the presence of many variables.

To address these challenges, this study incorporates Bayesian techniques in estimating the VAR. Bayesian methods are particularly useful in high-dimensional settings because they allow for shrinkage priors (such as Minnesota priors), which help stabilize parameter estimates by

incorporating prior beliefs about the structure of the model (Kabundi, 2020). This approach also facilitates the imposition of sign restrictions to identify structural shocks in SVAR frameworks. Furthermore, to account for potential structural breaks and time-varying dynamics, the study adopts a Markov regime-switching Bayesian VAR (MS-BVAR), following the methodology of Krolzig (1997). In this framework, model parameters are allowed to evolve across different regimes, which are determined probabilistically. This extension enables the model to capture shifts in the behaviour of macroeconomic variables that occur in response to structural changes in the economy—such as during periods of financial crisis or unconventional monetary policy.

3.2. The Markov-regime switching model

Markov regime-switching models are mainly utilized to allow changes of the dynamics in the time-series data estimates (Krolzig, 1997). Therefore, the data includes the transition of different regimes, the study will adopt the regime-switching models. The main reason is that the estimates from such a model will be more precise than those of a constant parameter estimation. Extending the model to the Markov regime-switching VARs model (MS-VAR) means that the parameters used will be time-varying. However, according to Krolzig (1997), the parameters can be time-invariant conditional to being unobservable regime variables.

If we let M denote the number of feasible regimes and s_t as the regime variable, then s_t can be $s_t \in \{1, \dots, M\}$. The conditional probability density of vector y_t is given as:

$$p(y_t | Y_{t-1}, s_t) = \begin{cases} f(y_t | Y_{t-1}, \theta_1) & \text{if } s_t = 1 \\ f(y_t | Y_{t-1}, \theta_M) & \text{if } s_t = M, \end{cases} \quad (3)$$

θ_m denotes the VAR parameter vector in observable regimes $m=1, \dots, M$. Therefore, it implies that for any observable regime in the time series vector y_t it will be generated by vector autoregressive process of order p (VAR(p)) model and gives:

$$E[y_t | Y_{t-1}, s_t] = v(s_t) + \sum_{j=1}^p A_j(s_t) y_{t-j}, \quad (4)$$

$$u_t = y_t - E[y_t | Y_{t-1}, s_t]$$

u_t is the innovation term (process) which is a zero mean white noise process and variance-covariance matrices sum $\text{sign}(s_t)$. u_t is normally distributed with a mean zero and standard variance sum $\text{sign}(s_t)$.

The MS-VAR model's main aim is to observe the volatility of the probability of moving from one regime to another (Krolzig, 1997). The Markov-switching model is a prominent regime-switching model that implies unobserved state variables to be governed by an underlying stochastic process

known as a Markov chain. The MS-VAR considers the p^{th} order of autoregression for the K -dimensional time series vector:

$$y_t = (y_{1t}, \dots, y_{kt}), t=1, \dots, T$$

$$y_t = v + A_1 Y_{t-1} + \dots + A_p Y_{t-p} + U_t$$

According to Krolzig (1997), the main idea behind the type of the model is that the parameters of the underlying data-generating process of the observed time series vector Y_t is dependent on the unobservable regime variable S_t . This indicates the probability of being in a different state of the world. This is according to the general principle behind the model.

The main assumption of the MS Model is the fact that the unobservable realization of the regime $S_t \in \{1; \dots; M\}$ is given by a discrete time. The discrete Markov stochastic process is described by transition probabilities (Krolzig, 1997):

$$P_{ij} = \Pr(s_{t+1} = j | s_t = i), \quad \sum_{j=1}^M p_{ij} = 1 \quad \forall i, j \in \{1; \dots; M\} \quad (5)$$

Therefore, it is assumed that the unobservable regime variable S_t follows an indissoluble ergodic M -state Markov process with the transition matrix P . In general, the model estimates the probability of the model changing from one state to another or staying in the same regime. The model will be able to capture the asymmetric spillover effect between the regimes of the U.S. monetary policy.

3.3. The Bayesian model

Furthermore, to extend the model we have decided to utilize the Bayesian methods. The Bayesian methods of estimation have been utilized for decades in economic research. Bayesian econometrics is fundamentally based on simple rules of probability (Koop, 2003). The Bayesian econometrics combines prior beliefs with information from data (likelihood) to form updated beliefs (posteriors) (Koop, 2003). Furthermore, the parameters in the study are treated as random variables with probability distributions. The priors will then be updated by uploading the data of interest. The Bayes theorem is used to update the distribution of parameters from the data. Koop (2003) compared the Bayesian methods to classical frequentist econometrics methods, whereby the frequentist econometrician interprets probability as the long-run frequency of events occurring in repeated experiments. The frequentist treats the parameters as fixed as unknown quantities from the randomness of data of interest. Furthermore, they create hypothesis tests and confidence intervals to conclude. The theory is that, over time, the employed technique will generate intervals with a specific frequency that contains the true parameter value.

The first step in Bayesian estimation is crucial, which involves selecting the parameters to be estimated (Keuschnigg, Maassen, & Kritzing, 2021). It is generally advisable to select parameters that are well-researched and commonly used in the existing body of economic literature. This selection process should be aligned with the research objectives and the specific econometric model employed. Once the relevant parameters are determined, the next stage is to specify the prior distributions for each parameter. According to Koop (2003), these distributions typically follow known forms such as the normal distribution for location parameters or the inverse gamma distribution for scale parameters. Each prior distribution is characterized by its own mean and variance, reflecting the researcher's prior beliefs or information drawn from previous studies. This process forms the basis of the Bayesian approach, where prior knowledge is formally integrated into the estimation procedure.

In a nutshell, Bayesian estimation methods allow for the flexibility of changing the prior distributions according to the economic structure with known quantities of data. Bayes' theorem is an element in Bayesian methods used to estimate the parameter values. To comprehend how the theorem is considered there is a given vector of model parameters θ , and the distributions of prior beliefs $p(\theta)$ (Herbst and Schorfheide, 2015). The Bayesian estimates will therefore generate the updated beliefs distributions depending on the observed data denoted as O . All in all, the theorem is given as (Koop,2003):

$$p(\theta|O) = \frac{p(O|\theta) p(\theta)}{p(O)} \quad (6)$$

Where $p(O|\theta)$ is the likelihood function, $p(O)$ is the marginal likelihood, and $p(\theta)$ as the prior density. The equation above represents Bayes' Theorem, which forms the foundation of Bayesian estimation. On the left-hand side is the posterior distribution $p(\theta|O)$, which reflects updated beliefs about the model parameters θ after observing the data O . The right-hand side of the equation consists of the likelihood function $p(O|\theta)$, which captures the probability of the observed data given the parameters, multiplied by the prior distribution $p(\theta)$, which encodes prior beliefs before observing the data. This product is normalized by the marginal likelihood $p(O)$, ensuring the posterior is a proper probability distribution.

In the context of estimating a Markov-Switching Vector Autoregressive (MS-VAR) model using Bayesian techniques, it is essential to define the prior distributions for the parameters and the likelihood function based on the data. The observed data in this study includes real GDP, real effective exchange rate, stock prices, and the U.S. short-term interest rate. Once these components are specified, the posterior distribution is obtained using computational methods such as Markov Chain Monte Carlo (MCMC) algorithms, which draw samples from the posterior by iteratively

simulating values based on the observed data (Keuschnigg et al., 2021).

3.3.1. Priors

The specification of prior distributions for the VAR coefficients is a critical step in achieving robust and reliable results, particularly when addressing the core research questions. This study adopts the prior specification framework developed by Sims and Zha (1998), whose work remains foundational in the field of Bayesian econometrics. Sims and Zha made a significant contribution by addressing two major issues commonly encountered in VAR models: identification challenges and high dimensionality, the latter often arising due to the large number of parameters involved, which can lead to overfitting. To mitigate these concerns, they proposed the use of the normal-inverse-Wishart (NiW) prior, a conjugate prior distribution well-suited for Bayesian estimation of VAR models. The NiW prior facilitates computational efficiency while simultaneously regulating the parameter estimates, thereby improving the precision and stability of the results.

Specifically, this approach assigns a normal prior distribution to the VAR coefficients and an inverse-Wishart distribution to the covariance matrix of the residuals. By incorporating this prior structure, the model gains the ability to better manage overparameterization and identification issues, ultimately producing more credible and interpretable estimates. Given the Bayesian framework, prior expectations regarding the signs and interactions among variables follow both theory and empirical literature. The priors assume that the U.S. interest rate shock exerts a negative effect on South African output and a depreciating effect on the REER, while also generating capital outflows that influence financial variables such as stock prices. Consistent with the literature, it is expected that these relationships exhibit asymmetry between high- and low-volatility regimes, with spillovers being stronger in periods of heightened global uncertainty.

3.3.2. Estimations

The model uses the Markov-Chain Monte Carlo (MCMC) method to estimate the parameters. The methods have an assumption that there is one sample path for the regimes and therefore not encountering the maximum likelihood (ML) and expectation maximum (EM) algorithm problems (Nain and Kamaiah, 2020). The type of estimation allows for regime-dependent impulse response functions and possible confidence intervals for the IRFs (Nain and Kamaiah, 2020). MCMC estimation approach is more robust than the other estimation methods such as ML and EM. The ML method may require intensive computation and is often characterized by a slow convergence rate. On the other hand, the EM algorithm is a widely used technique for MS model estimate. There are two steps in this process. The conditional expectation of the log-likelihood is initially calculated, conditioned on the given current parameter estimations and the E-step data. In the

second phase, referred to as the M-step, parameters are calculated based on the maximization of the log-likelihood of all the data. It is not possible to extract the standard errors of the parameters directly from the EM algorithm, though (Nain and Kamaiah, 2020).

Therefore, this study uses the Bayesian-Markov regime switching VAR to answer the research question of what the impact of the U.S. monetary policy on the South African economy is. Moreover, the methods will help to achieve the objectives by conducting the IRFs analysis in each regime to detect the dynamics of the South African variables from the U.S. monetary policy shocks.

3.4. Model specification

Therefore, the extension of the model by integrating BVAR and the regime-switching model is represented by the following notation (Nain and Kamaiah, 2020):

$$A_{0(st)} y_t = A_{(st)} y_{t-k} + \psi' w_t + \sum_{(st)} \varepsilon_t \quad (7)$$

Where A_{st} allows for every VAR model specification for every regime observed, s_t will follow the Markov process of transition probabilities. The study will use these methods to answer the research question and achieve the objectives. The BS-VAR combines Bayesian estimation with regime-switching to manage the parameter uncertainty and incorporate prior information about different regimes (Nain and Kamaiah, 2020). The MS-VAR Model with the endogenous variables Y_t will be represented by the following equation adopted from (Nain and Kamaiah, 2020):

$$Y_t = \begin{cases} \alpha_t + \beta_{11} Y_{t-1} + \dots + \beta_{p1} Y_{t-p} + A_t \mu_t & \text{if } st=1 \\ \alpha_t + \beta_{1m} Y_{t-m} + \dots + \beta_{pm} Y_{t-p} + A_m \mu_t & \text{if } st=m, \end{cases} \quad (8)$$

The residuals are normally distributed with a mean zero $\mu_t \sim N(0, I)$ and Y_t includes endogenous variables Real Gross Domestic Product (GDP), Real Effective Exchange Rate (REER), Stock Prices (SP), and the Repurchase Rate (SA_IR). As mentioned before the parameters are time variant, they switch according to the regime variable s_t reflecting a regime switch. Given the Markov process from the observations and the probability value P_{ij} from equation (5) will determine the state of the economy. In this study model, we assume that $m=2$ there are two regimes. The following explains the results the model produces to answer the research question and achieving the research objectives.

3.5. Impulse response functions

The model utilized produces regime-dependent impulse response function graphs that aid in achieving the primary research objective of assessing how the endogenous variables react to the US monetary policy shocks. To analyse the dynamic transmission of U.S. monetary policy shocks to the South African economy, the study employs impulse response functions (IRFs) generated within a MS-BVAR framework. Compared to the standard VAR models, IRFs in the MS-BVAR setting allow the responses of endogenous variables to vary across different economic regimes. Following Droumaguet (2012), the Markov-Switching structure enables the model parameters—such as autoregressive coefficients and shock variances—to shift between different states, typically interpreted as high- and low-volatility regimes. This feature allows the model to capture nonlinear and state-dependent spillover effects that a linear VAR would overlook. The Bayesian estimation procedure further enhances the analysis by producing posterior distributions of the IRFs rather than single-point estimates, allowing for a probabilistic assessment of uncertainty around the responses. This approach is particularly suitable for emerging market economies such as South Africa, where external shocks may propagate differently depending on macroeconomic conditions, market volatility, or policy credibility at a given time. The resulting regime-dependent IRFs therefore provide a deeper understanding of how South African endogenous variables react to U.S. monetary shocks under different economic states.

3.6. Variance Decomposition

In addition to impulse response analysis, the study employs forecast error variance decomposition (FEVD) within the MS-BVAR model to quantify the relative contribution of U.S. monetary policy shocks to fluctuations in South Africa's endogenous variables. Variance decomposition provides a percentage breakdown of how much of the forecast error variance in each endogenous variable is explained by its own innovations and shocks originating from other variables in the system. MS-BVAR decomposition is regime-dependent, meaning that the contribution of external monetary shocks may vary between high-volatility and low-volatility periods. According to Droumaguet (2012), the Markov-Switching structure allows the decomposition to incorporate structural break dynamics by permitting model parameters and shock variances to shift across unobserved states. The Bayesian estimation approach generates posterior distributions for each decomposition estimate, allowing uncertainty bands to be incorporated into the analysis rather than relying on point estimates. This approach is particularly important for an emerging market setting such as South Africa, where external monetary shocks may dominate during episodes of financial stress while domestic factors play a larger role in stable periods. The variance

decomposition results therefore aid in evaluating the extent to which U.S. monetary policy shocks drive fluctuations in variables over different horizons, and whether their influence intensifies under particular regimes.

3.7. Data sources and Discussion of variables

This study employs quarterly time series data spanning the period from 1994Q1 to 2023Q1 to address the research objectives and answer the research question. The dataset encompasses key global economic episodes. They include the pre- and post-2007/08 Global Financial Crisis as well as the onset of the COVID-19 pandemic, allowing for a comprehensive examination of the effects of these crises on U.S. monetary policy transmission. Moreover, the data facilitate an analysis of the spillover effects of U.S. monetary policy on the South African economy. The variables include South African real GDP, exchange rate, and stock prices—sourced from the Federal Reserve Bank of St. Louis—and the repurchase rate, obtained from the South African Reserve Bank. South Africa is selected as the focus of this study due to its classification as an emerging market economy, characterized by rapid economic growth, heightened volatility, and relatively low per capita income. As noted by Kabundi et al. (2022), South Africa is widely recognized by international institutions as one of Africa’s leading emerging economies, making it a suitable case for examining the transmission and spillover dynamics of U.S. monetary policy in an emerging market context.

The dataset used in this study includes endogenous variables representing the South African economy—Real Gross Domestic Product (GDP), Real Effective Exchange Rate (REER), Stock Prices (SP), and the Repurchase Rate (SA_IR) —as well as an exogenous variable, the Federal Reserve (US_IR) interest rate from the United States. The selection of these variables is primarily informed by the risk-taking channel of international monetary policy transmission. This channel posits that changes in U.S. monetary policy influence global risk perceptions, thereby affecting financial conditions in emerging markets. Consistent with this framework, Tillmann (2019), Georgiadis (2015), and Yildirim (2021) employed similar variables in studies examining the cross-border effects of U.S. monetary policy. Hence, this study assumes that the transmission of U.S. monetary policy through the risk-taking channel significantly impacts South Africa’s financial variables, justifying the inclusion of the selected indicators.

In time series analysis, variables such as Real GDP, REER, and SP are often transformed using natural logarithms to linearize exponential growth patterns, reduce skewness, and stabilize variance. Logging these variables also improves stationarity and allows for interpreting estimated coefficients in terms of percentage changes, which enhances the economic relevance and

comparability of the results.

The graph below shows how South Africa's Real GDP changed between the first quarter of 1994 and 2023. The graph's trend shows a continuously rising slope, suggesting that the economy grew steadily during that time. Real GDP increased from over R600,000 million in 1994 to over R1.1 million, indicating a thriving economy. Around 2008–2009, which coincides with the Global Financial Crisis (GFC), there is a noticeable flattening. Economic activity temporarily slows down during this time, then gradually picks back up, following worldwide trends of post-crisis stabilisation.

Around 2020Q2, when the COVID-19 pandemic started, there was a noticeable and severe contraction. The economic disruptions brought on by lockdowns, decreased international trade, and stifled domestic demand are reflected in this decline. During the observed period, the contraction is the biggest short-term shock to real GDP. Although the growth trajectory seems less steep than in previous years, the economy is showing indications of recovery after the pandemic shock. This points to a moderate recovery that might be hampered by persistent structural challenges, uncertainties in the world economy, or a sluggish domestic policy reaction. Overall, the graph shows how resilient and vulnerable the South African economy is to external shocks like pandemics and global financial instability, as well as how resilient it is in recovering from crises.

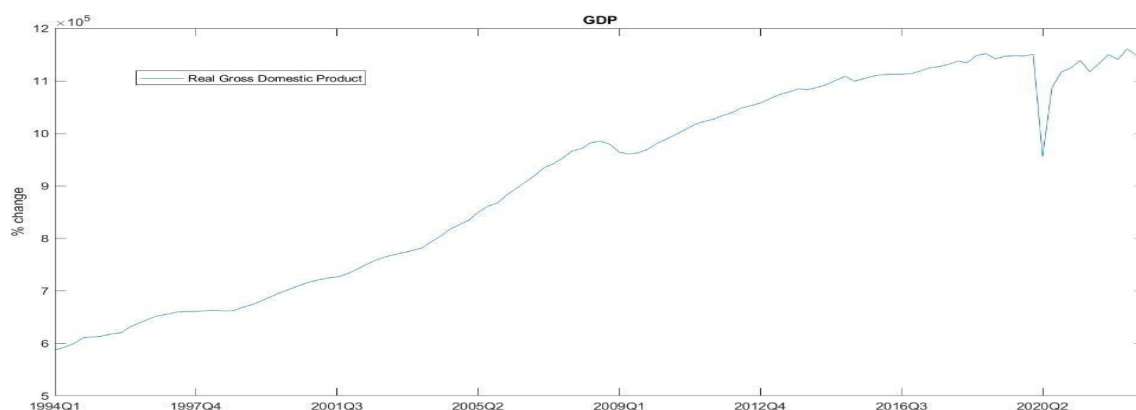


Figure 1. Real Gross Domestic Product

The REER for South Africa shows a typically negative trend from 1994Q1 to 2023, demonstrating a prolonged real depreciation of the rand against a basket of trading partner currencies. The early period from 1994 to the late 1990s was characterised by high volatility, which can be attributed to transitional macroeconomic conditions and global events such as the Asian Financial Crisis (1997-1998). A substantial devaluation occurs between 2001 and 2002, representing the local currency

crisis and investment uncertainty, which significantly devalued the rand. During the GFC (2008-2009), the REER again displayed significant volatility, indicating the rand's sensitivity to global shocks and capital flow reversals. Although the trend briefly improved, it remained volatile, particularly after 2012, when the REER persisted at relatively low levels.

This indicates prolonged structural weaknesses, global risk aversion, and South Africa's susceptibility to exogenous shocks, such as monetary policy adjustments by advanced nations. Furthermore, a further decline at the start of the COVID-19 pandemic in 2020 emphasises the rand's vulnerability to global financial volatility and economic uncertainty. The sustained depreciation trend of the REER implies that South Africa's currency has lost real external value over the long run. This may enhance export competitiveness but also reflects underlying structural weaknesses and vulnerability to external shocks. Periods of extreme REER volatility coincide with global financial turmoil and domestic macroeconomic disturbances, highlighting South Africa's exposure to both global and local risks.

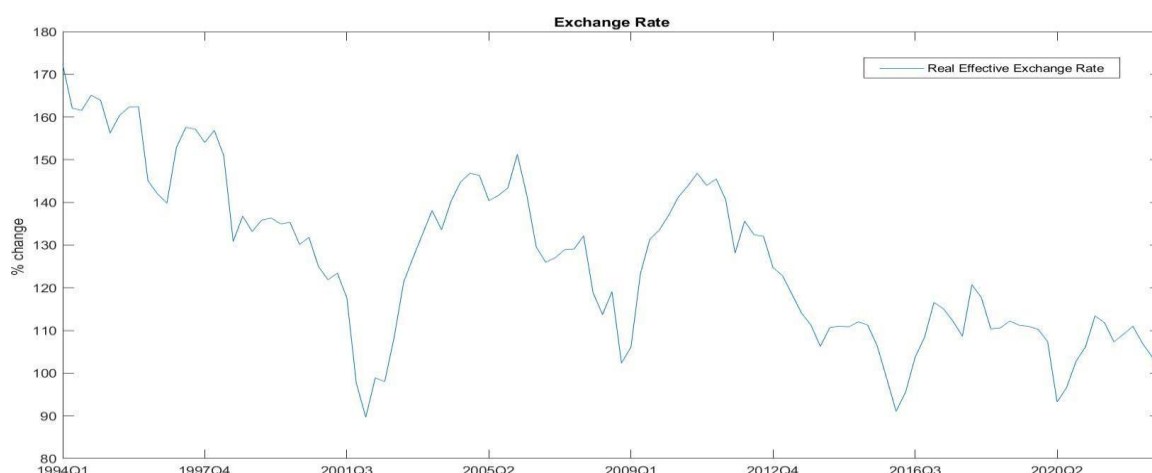


Figure 2 Real effective exchange rate

The time series graph of South African stock prices from 1994Q1 to 2023Q1 shows an overall increasing trend, demonstrating long-term expansion in equity markets. Stock prices rose substantially throughout the early years (1994-2003), reflecting a period of economic transformation and consolidation in the post-apartheid era. Stock prices began to rise quickly in 2004, driven by favourable global economic conditions, rising investor confidence, and robust commodity prices. A large reduction occurred between 2008 and 2009, coinciding with the GFC, which caused a significant drop in asset values worldwide due to increased risk aversion and capital flight. However, the South African stock market recovered quickly in the years after the

crisis, with stock values rising steadily throughout the 2010s. Another period of increasing volatility occurred around the commencement of the COVID-19 pandemic in 2020, although the market remained resilient and rebounded strongly thereafter. Stock prices have steadily risen over time, reflecting both domestic economic developments and the effect of global financial cycles, highlighting South Africa's incorporation into worldwide capital markets.

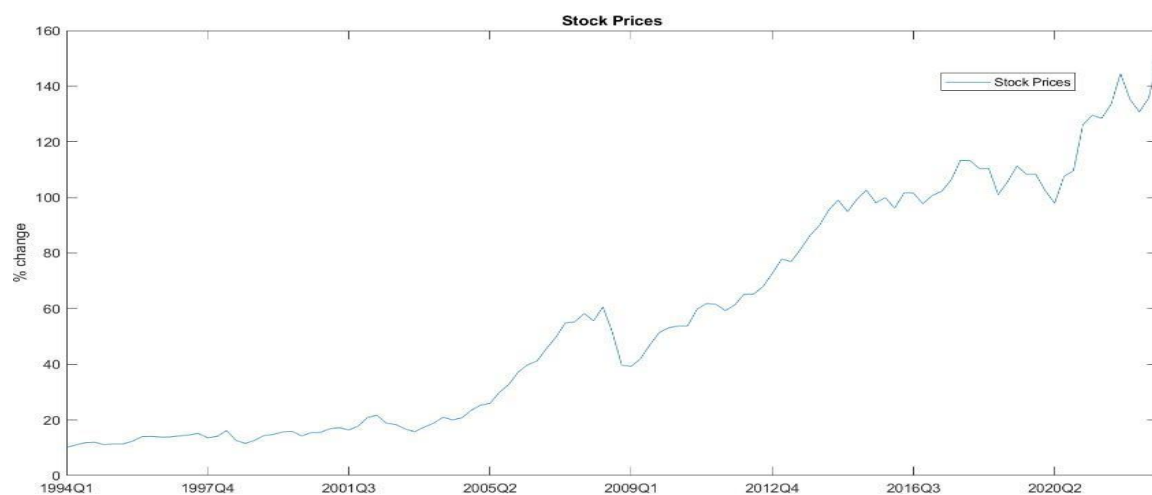


Figure 3. Stock Prices

Figure 4 shows the quarterly percentage change in the South African repurchase rate from 1994Q1 to 2023Q1. The repo rate, the South African Reserve Bank's essential monetary policy instrument, has fluctuated in reaction to domestic and global economic conditions. The graph shows a significant increase in the repo rate during the late 1990s. This spike can be attributed to the SARB's response to external shocks, particularly the Asian Financial Crisis, and domestic inflationary pressures. The early 2000s reflect a period of policy adjustment, with intermittent increases and decreases in the repo rate as the central bank sought to maintain price stability while supporting economic growth.

Leading up to the 2008 GFC, the repo rate increased as part of a tightening cycle, followed by a sharp decline post-crisis, reflecting a shift to an accommodative monetary policy stance. A prolonged low-interest-rate environment persisted from approximately 2012 to 2019, signalling efforts to stimulate economic activity amid subdued inflation and weak growth.

Notably, the repo rate reached historically low levels during the COVID-19 pandemic in 2020, as the SARB responded decisively to the severe contraction in economic activity. The recent upward trend post-2021 indicates a shift towards monetary policy normalization in response to global inflationary pressures and interest rate hikes in advanced economies such as the United States.

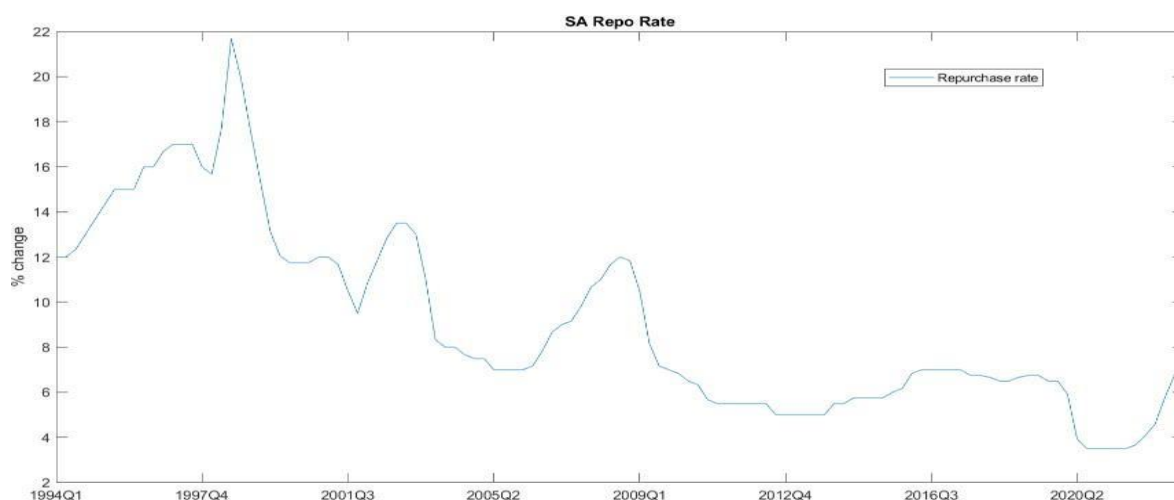


Figure 4. Repurchase rate

3.7.1. The Unit Root tests

This study employs a model that incorporates SVAR model to address the research questions. A key requirement for the reliable estimation of VAR-based models is that all variables included have be stationary. To assess the stationarity properties of the data, unit root tests are conducted. Initially, each variable is tested in levels; if non-stationarity is detected, the variables are different to achieve stationarity. The analysis incorporates three standard unit root tests: the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test, and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. These tests collectively ensure the robustness of the stationarity assessment. The null hypothesis for both the ADF and PP tests is the presence of a unit root (i.e., non-stationarity), while for the KPSS test, the null hypothesis is that the series is stationary. If the p-value obtained from the ADF or PP tests is less than the chosen significance level, the null hypothesis is rejected, indicating that the series is stationary. Ensuring stationarity is a necessary step to avoid spurious regression results and to facilitate meaningful structural interpretation of the SVAR model.

3.8. Framework Underpinning the study and Variable linkages

This study is guided by an open-economy macroeconomic transmission framework derived from the Mundell–Fleming model. The framework explains how monetary policy shocks in a dominant economy spillover into smaller open economies through interest rate differentials, capital flows, and exchange rate adjustments. In this framework, the U.S. Federal Funds Rate represents the external monetary policy shock. An increase in U.S. interest rates widens the interest rate differential between the United States and South Africa, triggering capital outflows and financial tightening. This transmission mechanism is captured through movements in the South African repo rate, which reflects the domestic monetary policy response, and changes in the REER, which captures real depreciation pressures.

The pass-through of exchange rate fluctuations influences domestic financial market conditions, observed through stock prices, and ultimately affects domestic output performance. Accordingly, the selected variables- U.S. Fed interest rate, South African repo rate, REER, stock prices, and output- jointly trace the theoretical spillover mechanism. This theoretical linkage also justifies the use of a Markov-Switching BVAR model, as the spillover dynamics may differ across low- and high-volatility regimes in South Africa, allowing the model to capture structural shifts in the transmission process over time.

3.9. Conclusion

This chapter presented the econometric methodology employed in the study and provided a justification for the selected techniques in relation to the research objectives. The chapter outlined the construction and integration of the various models used, highlighting how each component contributes to the overall empirical strategy. The core framework is based on a SVAR model, which enables the identification of linear relationships among the key macroeconomic variables and allows for the estimation of structural shocks. To address potential instability in the data-generating process, the model is extended to incorporate structural breaks, ensuring that variations in economic dynamics over time are adequately captured.

To enhance the robustness of the results, the study further adopts a Markov Regime-Switching model, which permits the parameters of the system to change across different volatility regimes. This approach is particularly relevant for emerging economies such as South Africa, where periods of heightened uncertainty are likely to influence the transmission of external monetary shocks. In addition, the use of Bayesian estimation techniques allows for time-varying parameters and probabilistic inference,

distinguishing it from traditional frequentist methods that rely on fixed-parameter estimations. The chapter also provided a detailed discussion of the variables included in the model, along with their respective data sources.

The subsequent chapter presents and interprets the empirical results derived from these methodological procedures, examining the responses of the selected endogenous variables to U.S. monetary policy shocks and assessing the consistency of the findings with existing theoretical and empirical literature.

Chapter 4 Empirical Results

This chapter presents the empirical findings derived from the estimated model discussed in the preceding section. The analysis begins with the presentation of descriptive statistics, which provide an overview of the key characteristics and distributional properties of the data used in the study. This is followed by the results of unit root tests conducted to determine the stationarity properties of the variables, ensuring the appropriateness of the econometric procedures applied. The chapter then introduces the smoothed state probabilities, which depict the likelihood of the South African economy transitioning between high- and low-volatility regimes over the sample period. The estimated probabilities reveal clearly defined regime shifts, indicating periods of heightened uncertainty relative to more stable macroeconomic conditions. Subsequent sections present and analyse the impulse response functions and variance decomposition results, which together illustrate the dynamic responses of domestic macroeconomic variables to U.S. monetary policy shocks and the relative contribution of these shocks to forecast error variance. Following the empirical estimations, the chapter offers a detailed interpretation of the results, linking the observed dynamics to theoretical expectations and existing literature. This structured approach ensures a comprehensive understanding of the spillover effects of U.S. monetary policy on the South African economy.

4.1. Descriptive statistics

Table 1. Descriptive Statistics

Descriptive Statistics	Observations	Mean	Standard deviation	Skewness	Kurtosis
RGDP	117	915577.2	191554.1	-0.28	1.54
REER	117	126.41	19.46	0.26	2.19
SP	117	57.42	41.56	0.44	1.82
SA_IR	117	9.12	4.14	0.80	2.78
US_IR	117	2,40	2.21	0.42	1.56

Table 1 presents the descriptive statistics of the variables that are included in the study, based on 117 observations. The GDP, which measures domestic economic activity, has the highest mean value (915577.2) and it exhibits substantial variability as reflected by the standard deviation (191,554.1). The slightly negative skewness (-0.28) indicates a left-tailed distribution, meaning that lower-than average growth episodes are more common than usual high-growth periods.

Moreover, the kurtosis value (1.54) that is below the benchmark of 3, suggests a distribution with thinner tails, reflecting the absence of extreme output shocks during most of the sample period. The REER which captures external competitiveness and serves as one of the key transmission channels of US monetary policy shocks. The variable has a mean of 126.41 and a standard deviation of 19.46 indicating moderate volatility. It is positively skewed (0.26) and kurtosis value (2.19) suggest that the currency experienced more periods of appreciation pressure than large depreciation extremes throughout the period of interest. The stock prices have a mean of 57.42 and a relatively large standard deviation of 41.56, This therefore highlights a high sensitivity of the South African financial market to both domestic and external conditions. The positive skewness (0.44) indicates that higher stock market returns were more frequent than sharp downturns. Whereby, the kurtosis value (1.82) points to a flatter distribution consistent with frequent but moderate fluctuations. Therefore, this is in support with the view that equity markets are an important financial channel through which US monetary policy shocks may transmit to South Africa.

The South African interest rate variable shows a mean value of 9.12 with a standard deviation of 4.14, reflecting significant variation in the SARB's monetary policy stance over time. It shows that it is positively skewed (0.80) which indicates that the series contains more observations of higher interest rate values, consistent with tightening episodes following external shocks. The kurtosis value suggests a moderate peaked distribution, this highlights periods of persistent policy intervention. The US Federal funds rate is the primary foreign policy variable of primary interest, it shows a mean of 2.40 with a lowest standard deviation (2.21) indicating periods of prolonged stability such as the zero lower bound period. Its right-skewed distribution (0.42) captures the sharp post-pandemic interest rate hiking cycle, while the kurtosis value (1.56) confirms a relatively thin-tailed distribution.

Overall, none of the variables follow a perfectly normal distribution, as indicated by the skewness and kurtosis statistics. This provides further justification for employing a Markov-Switching BVAR model, which accommodates nonlinear behaviour and potential regime shifts—consistent with the study's objective of assessing how U.S. monetary policy spillovers affect the South African economy under different volatility regimes

4.2. The Unit Root results

The following tables below depict the unit root test results mentioned in the chapter above.

Table 2. Augmented-dickey fuller Unit root test (Levels)

Variables	Trend and Intercept	Intercept	None
lnY	1.499	-1.917	-1.292***
Xr	-3.124	-2.318	0.434***
Insp	-1.772	-0.927	2.332***
SA_ir	-2.711	-1.262	-1.234***
US_ir	-2.750	-2.023	-1.866 ***

Note: *, **, *** denote rejection of the null hypothesis of unit root at 10%, 5%, and 1% respectively. Maximum number of lags: 4.

Table 3. Augmented-dickey fuller Unit root (First difference)

Variables	Trend and Intercept	Intercept	None
lnY	-1.847	-1.126	-1.410***
Xr	-5.285***	-5.313 ***	-5.272***
Insp	-4.321***	-4.312***	-3.572***
SA_ir	-5.038***	-5.064***	-4.990***
US_ir	-4.639***	-4.674 ***	-4.667***

Note: *, **, *** denote rejection of the null hypothesis of unit root at 10%, 5%, and 1% respectively. Maximum number of lags: 4.

Tables 1 and 2 present the results of the Augmented Dickey-Fuller (ADF) unit root tests. Table 2 indicates that the variables are non-stationary in levels when tested with both a trend and intercept, as well as with an intercept only, across all conventional significance levels. However, under the “None” testing specification, all variables appear stationary at the 1% significance level. To address the presence of unit roots, the variables were differenced. The differenced results, as shown in Table 2, reveal that most of the variables become stationary at the 1% significance level. Notably, Real Gross Domestic Product (RGDP) remains non-stationary under the trend and intercept specification even after differencing.

Table 4. Phillips Perron Unit root test (Levels)

Variables	Trend and Intercept	Intercept	None
lnY	-1.128	-1.946	3.912***
Xr	-3.133	-2.407	3.912***
Insp	-1.969	-0.908	2.640***
SA_ir	-3.024	-1.286	-0.993***
US_ir	-2.669	-1.478	-1.299 ***

Note: *, **, *** denote rejection of the null hypothesis of unit root at 10%, 5%, and 1% respectively. Maximum number of lags: 4.

Table 5. Phillips Perron Unit root test (First difference)

Variables	Trend and Intercept	Intercept	None
lnY	-15.963***	-14.993***	-12.963***
Xr	-8.388 ***	-8.432 ***	-8.452***
Insp	-8.306***	-8.344***	-7.884***
SA_ir	-7.660***	-7.675***	-0.993***
US_ir	-4.864**	-4.906***	-4.905***

Note: *, **, *** denote rejection of the null hypothesis of unit root at 10%, 5%, and 1% respectively. Maximum number of lags: 4.

Another widely recognized unit root test is the Phillips-Perron (PP) test. Similar to the Augmented Dickey-Fuller (ADF) test, the PP test results indicate that all variables are non-stationary in levels when trend and intercept are included. However, the null hypothesis of a unit root is rejected at the 1 percent significance level for the variables once they are first-differenced, suggesting stationarity. Notably, the U.S. interest rate becomes stationary at the 5 percent significance level, as shown in Tables 4 and 5.

Table 6. Kwiatkowski-Phillips-Schmidt-Shin test (levels)

Variables	Trend and Intercept	Intercept
lnY	0.523***	0.523***
Xr	0.118	0.118
Insp	0.227***	0.227***
SA_ir	0.211**	0.211**
US_ir	0.166**	0.166**

Note: *, **, *** denote rejection of the null hypothesis of stationarity at 10%, 5%, and 1% respectively. Number of lags: 3 as per lag selection criteria

Table 7. Kwiatkowski-Phillips-Schmidt-Shin test (First difference)

Variables	Trend and Intercept	Intercept
lnY	0.0755	0.0755
Xr	0.0346	0.0346
Insp	0.0731	0.0731
SA_ir	0.0598	0.0598
US_ir	0.0687	0.0687

Note: *, **, *** denote rejection of the null hypothesis of stationarity at 10%, 5%, and 1% respectively. Number of lags: 3 as per lag selection criteria

Furthermore, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, which differs in its null

hypothesis, provides additional confirmation. In contrast to the ADF and PP tests, the KPSS test assumes stationarity as the null hypothesis. The results indicate rejection of the null for most variables in levels—implying non-stationarity—except for the real effective exchange rate. After first-differencing, the null hypothesis is no longer rejected, confirming that the variables become stationary at this transformation.

To address the research question, this study employs a Markov regime-switching Bayesian Vector Autoregressive (MS-BVAR) model. The model is specified with time-varying parameters to capture potential shifts in policy regimes over the sample period. In addition, it accommodates changes in the volatility of structural shocks, thereby allowing for a more accurate representation of the dynamic economic environment. The analysis proceeds in three stages: first, by examining and interpreting the probabilities of regime switches; second, by analyzing the impulse response functions to assess the dynamic effects of monetary policy shocks; and finally, by conducting forecast error variance decomposition to identify the key sources of variation in the endogenous variables. The model is estimated using four lags, consistent with the quarterly frequency of the data. Furthermore, the regime-switching specification assumes the presence of two distinct regimes, denoted by $m=2$.

4.3. Smoothed state probabilities

Figure 5 presents the smoothed state probabilities, illustrating the likelihood of the economy being in a high-volatile regime over time. The figure reveals distinct regime shifts, with the sample alternating between high- and low-volatility periods. Notably, two prominent episodes of low volatility are identified. The first occurs between 1995 and 1997, a period associated with the onset of the Asian Financial Crisis, which began in Thailand with the collapse of the Thai baht and subsequently spread to other East Asian economies. This event triggered capital outflows as investors sought safer assets in economies with relatively higher interest rates. The second episode of low volatility aligns with the early 2000s, coinciding with the dot-com bubble. This period was marked by a significant increase in investment in technology-related assets during the late 1990s, culminating in a sharp correction in stock prices and ultimately leading to a recession. These shifts captured by the model reflect the macro-financial instability associated with major global financial disruptions.

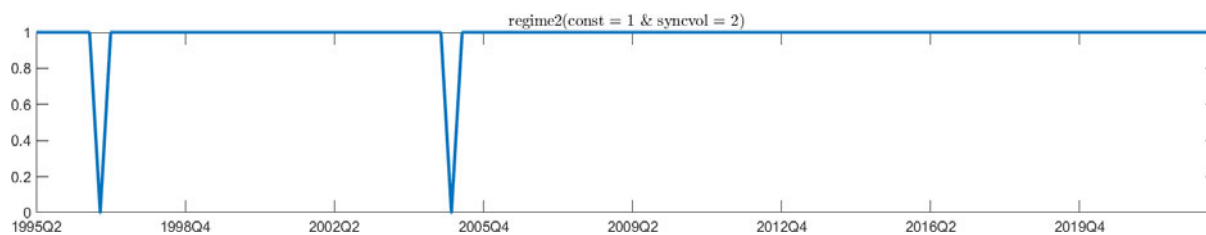


Figure 5. Smoothed probabilities of high volatility (Regime 2)

4.4. Impulse response functions

To address the primary objective of assessing how endogenous variables respond to changes in the U.S. interest rate, the study employs regime-dependent impulse response analysis using a Markov regime-switching Bayesian Vector Autoregressive (MSBVAR) model. This approach allows for the identification of differential responses across distinct volatility regimes. The impulse response functions (IRFs) capture the dynamic effects of a U.S. Federal Reserve interest rate shock under two regimes: Regime 1, characterized by low volatility, and Regime 2, marked by high volatility. As presented in Figure 6, the IRFs demonstrate how the endogenous variables react to monetary policy shocks across these regimes. The observed responses are broadly consistent with theoretical predictions from the Mundell-Fleming framework, which posits that monetary policy in a large open economy like the U.S. can transmit across borders, influencing macroeconomic conditions in smaller, open economies.

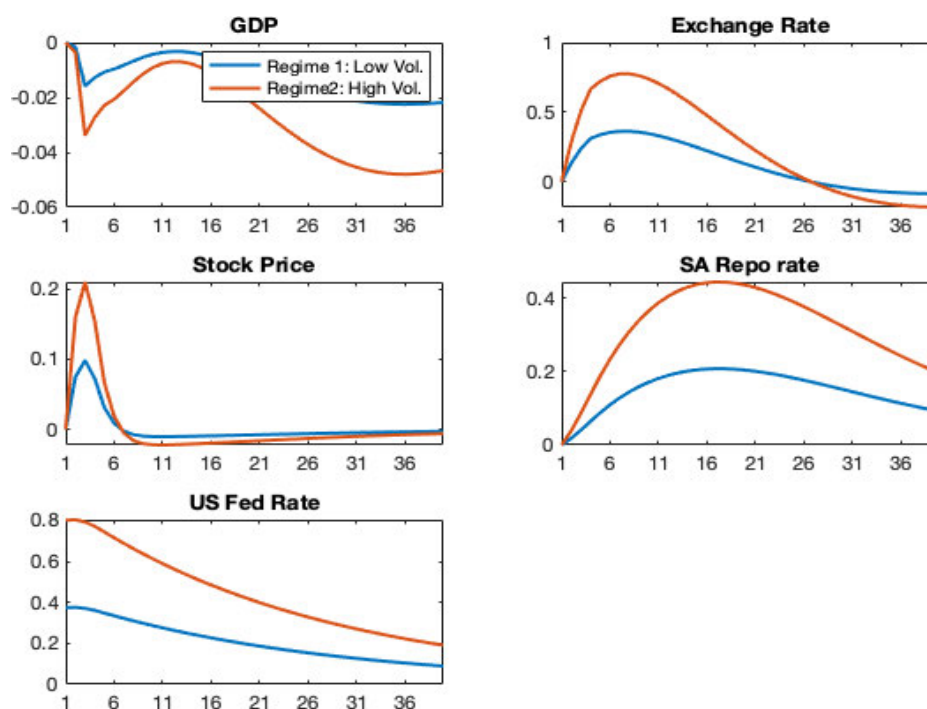


Figure 6. Impulse responses to US Fed Rate shock

Indeed, observing from the figures above, the endogenous variables react to the U.S. monetary policy shock. The figure shows the impact of a monetary tightening from the U.S. Fed; It is worth mentioning that policy is tightened strongly during periods of high volatility. The SARB responds by also tightening monetary policy to avoid capital outflows. There is a large fall in the Real GDP during periods of high volatility compared to periods of low volatility. In response, the exchange rate depreciation is also larger during periods of low volatility. According to Mundell-Flemming (1963) a Fed rate increase will lead to increased capital inflows in the U.S. In contrast, emerging economies such as South Africa will experience capital outflows as investors want higher returns in the U.S. dollar. A capital outflow in South Africa will lead to a depreciation of the exchange rate as it can be seen in the graph. Therefore, South Africa has to tighten monetary policy in response to a tightening in the U.S. to avoid capital outflows and a depreciation of the Rands.

A depreciated Rands increases the cost of borrowing. Furthermore, the cost of imported goods will rise, potentially leading to increased inflation and dampening economic activity. This may lead to a decline in the real GDP as illustrated in the figure above and reverts to initial point as a weaker rand boosting exports and offsetting the negative effects on the GDP. Moreover, an increase in the Fed's interest rate negatively impacts South African stock prices. An increased Fed rate makes holding U.S. dollar more sustainable for more returns in investments, making it less attractive to hold Rands which results to an increase in the stock prices.

All the endogenous variables respond more to a Fed interest rate shock in high volatile regime. It is evident from these IRFs, that there are asymmetric spillover effects as there is a difference in the magnitude of responsiveness. Overall, the U.S. monetary policy has an impact on the South African economy as it is evident that the South African endogenous variables are responsive to the U.S. monetary policy shock and the effects are asymmetric in both regimes.

4.5. Variance decompositions

The variance decompositions show the importance of the U.S. Fed interest rate in the variance of South African variables. Using this method, the prediction error variance of every variable in the model is broken down into parts that can be attributed to shocks in every variable. The breakdown will be different in a highly volatile regime and a low volatile regime. The results for variance decomposition are shown below.

In the low-volatility regime, the variance decomposition results indicate that approximately 90% of the variation in South Africa's output is explained by shocks originating from the output itself. In contrast, during periods of high volatility, the output is primarily influenced by innovations in the domestic policy rate, with the South African repo rate accounting for approximately 73.8% of the

forecast error variance. This outcome is expected, as the South African Reserve Bank employs the repo rate as a primary instrument to stabilize macroeconomic conditions. Consequently, fluctuations in the repo rate significantly influence economic output. Moreover, in the high-volatility regime, the U.S. federal funds rate emerges as the second most important contributor to the variation in South African output, suggesting that external monetary shocks, particularly those stemming from the Federal Reserve's short-term interest rate, play a notable role during turbulent periods.

The variance decomposition results for the exchange rate reveal that, in the low-volatility regime, most of the fluctuations are driven by its own shocks. However, during periods of high volatility, the exchange rate becomes more responsive to external and policy-driven shocks. Specifically, in the high-volatility regime, the South African repo rate emerges as the primary determinant of exchange rate fluctuations, closely followed by the U.S. federal funds rate. This suggests that monetary policy decisions, both domestic and foreign, exert a stronger influence on the exchange rate during periods of financial instability or heightened uncertainty. An increase in the South African repo rate, for instance, can enhance the return on rand-denominated assets, thereby attracting foreign capital inflows. These capital movements can lead to an appreciation of the domestic currency. Similarly, changes in the U.S. federal funds rate influence global capital flows and investor sentiment, affecting exchange rate dynamics in emerging markets such as South Africa. These findings underscore the exchange rate's sensitivity to monetary policy actions, particularly under conditions of financial stress.

In the case of South African stock prices, the results show that in the low-volatility regime, nearly 99.5% of the forecast error variance is self-explanatory—i.e., predominantly influenced by their own innovations. However, under high-volatility conditions, the U.S. federal funds rate becomes the dominant driver of the variance in stock prices. This finding reflects the heightened sensitivity of South Africa's financial markets to global monetary developments during periods of financial stress. Notably, such high-volatility periods—characteristic of unconventional monetary policy in the U.S. and other advanced economies during and following the GFC—exert substantial influence on emerging market financial indicators, including stock market performance.

In the low-volatility regime, the variance decomposition results indicate that the exchange rate accounts for a significant portion of the fluctuations in the South African repo rate. This can be attributed to the strong link between monetary policy and exchange rate dynamics. The SARB actively uses the repo rate as a monetary policy instrument to maintain price stability and support the value of the domestic currency. When the exchange rate depreciates, it often leads to increased

import prices, which in turn fuel inflationary pressures. In response, the SARB may adjust the repo rate to mitigate these effects, thereby stabilizing both inflation and the exchange rate. In this regime, the repo rate's own innovations also explain a substantial share of its variance, reflecting the persistence of domestic monetary policy dynamics. During periods of high volatility, however, the U.S. federal funds rate becomes a more influential driver of repo rate fluctuations in South Africa. This highlights the synchronization—or co- movement—of monetary policy between the Fed and the SARB. When the Fed raises interest rates, capital tends to flow out of emerging markets, exerting depreciation pressure on their currencies. To counter these pressures and maintain macroeconomic stability, the SARB may respond by raising the repo rate.

Table 8. Variance Decompositions

Shocks	Output	Exchange rate	Stock prices	Repo Rate	U.S. rate	Fed rate
Output						
Low volatile regime	90.787	7.358	0.684	1.014	0.157	
High volatile regime	10.791	0.014	0.000	73.809	15.386	
Exchange rate						
Low volatile regime	2.368	84.618	2.944	8.553	1.518	
High volatile regime	0.036	0.021	0.000	80.642	19.3	
Stock Prices						
Low volatile regime	0.456	0.016	99.483	0.002	0.044	
High volatile regime	1.205	0.001	0.000	3.262	95.532	
SA interest rate						
Low volatile regime	1.706	42.802	4.099	36.576	14.817	
High volatile regime	0.005	0.002	0.000	64.674	35.32	

Overall, the findings from the variance decomposition analysis indicate that the U.S. Federal Reserve's short-term interest rate plays a substantial role in explaining the fluctuations in South Africa's key macroeconomic and financial variables. This evidence supports the existence of asymmetric spillover effects from U.S. monetary policy, differentiated by the nature of the policy regime—conventional versus unconventional. Specifically, the spillover effects are more

pronounced during high-volatility periods, which are typically associated with economic turbulence and the implementation of unconventional monetary policies, such as quantitative easing. During such regimes, South Africa's economic and financial indicators appear significantly more responsive to changes in the Fed's policy stance, highlighting the increased vulnerability of emerging markets under conditions of global uncertainty.

Conversely, in low-volatility periods characterized by the conduct of conventional monetary policy, the spillover effects from the U.S. are notably weaker. In these regimes, the Fed's short-term interest rate contributes less to explaining the variation in South African variables, suggesting limited transmission of external shocks during more stable periods. These results are consistent with the existing literature, including the findings of Tillmann et al. (2019) and Kabundi et al. (2022), which also underscore the presence of asymmetric spillover effects based on the type and intensity of U.S. monetary policy. This asymmetry reinforces the importance of accounting for policy regimes and global financial conditions when assessing the external impacts of U.S. monetary actions on emerging economies such as South Africa.

4.6. Discussion

This study addresses the research question of the impact of the U.S. monetary policy on the South African economy. The research question is answered by setting two objectives. The primary objective is to examine how the endogenous variables react to the announcements from FOMC. Secondly, is to examine if there is any asymmetric effects between the two regimes. To answer the research question and meet the objectives, the study utilized the Markov regime switching-Bayesian VAR model. Implementing the Markov regime-switching, as depicted in figure 5, where it illustrates the smoothed state probability in high volatile regime. The figure illustrates the likelihood of the economy being in a high-volatility regime over time. There are two spikes from the smoothed state probabilities, indicating that the endogenous variables respond to the monetary policy transmission shocks. The spikes can be explained by the global crisis that occurred at the timeframe, which inevitably led to the U.S. monetary policy transmission shocks and therefore spilling over to integrated economies including South African output and financial variables.

Since the emergence of the 2008 GFC, the U.S. central banks were put in a tight position with a deteriorating economy, they had to resort to implementing the QE policy to stimulate the economy. Therefore, U.S. has a dominant economy that has a great potential of affecting the global economy and spilling over to largely to developing economies. Indeed South Africa as an emerging economy expected a negative impact from the U.S. monetary transmission shocks. However, the governor Mboweni (2007) of the South African central bank during the GFC gave a speech to assure the

public that South Africa's banking system was largely unscathed by the subprime crisis, with strong local liquidity and no need for assistance from the South African Reserve Bank. However, financial markets were volatile as the rand fell. Despite global financial turbulence, South Africa's strong macroeconomic position drew record non-resident investments in domestic bonds and more than R10 billion in stocks in August Mboweni (2007). The durability of these inflows is dependent on global liquidity and domestic growth prospects. Furthermore, the governor mentions that favourable conditions promoted the buildup of foreign exchange reserves, and the impact on domestic growth appears to be moderate, depending on US economic performance.

However, the endogenous variables did respond as illustrated from the impulse response functions in figure 6. The figure illustrates that the U.S. monetary policy tightening has a spillover effect on the South African variables, in alignment with the studies of Tillmann et al, 2019; Kabundi et al, 2022; Georgiadis, 2015 that studied spillover on emerging economies with South Africa included. The responses of the variables differ with the monetary policy regimes. The results show that the GDP in both regimes of the country response immediately by sharply declining for a short-term from a gradual decrease of the U.S. Fed rate. Shortly after the decline there is a gradual increase for a short while and reverting from the gradual decline. Furthermore, what is intriguing about the GDP is shown that is more responsive to a low volatile regime. Therefore, the GDP response lesser in a high volatile state of global crisis causing monetary policy spillovers.

Lastauskas and Nguyen (2024); Chen et.al (2014); Lavigne, Sarker, and Vasishtha (2014) are in alignment with my research and investigated the spillover effects on financial variables including exchange rates, short term interest rates, asset prices, their studies use both the sample in the conventional and unconventional monetary policy. It is evident that the U.S. monetary policy impacts the emerging economies, Indeed the spillover is contingent as there is a trade and financial integration of U.S. with majority of the emerging countries Lastauskas et al., (2024). Therefore, the countries will have to respond to U.S. monetary policy transmissions. For example, if the U.S. monetary policy increases the Fed's rate – monetary tightening- according to the Mundell-Flemming model theory, South Africa as an emerging economy may experience capital outflows depending on the economic state at that period. Capital outflows mean decrease in foreign direct investment which leads to depreciation to rands against the U.S. dollars then revert to a steady state. The depreciation will cause decline in exports leading to the initial decline in the impulse response functions, however, shows a recovery and stabilizing in the long run. Moreover, in the second regime, the variables show more persistent and high magnitude in responds to the U.S. monetary policy shocks. Therefore, due to high volatile regime, the Rand depreciation emerges as highly sensitive South African exchange rate to the U.S. monetary policy shocks.

Furthermore, the model computed the variance decomposition to observe whether the Fed's rate explains the variations on the endogenous variables. It is evident from the results that the Fed's rate has a significant percentage in explaining the endogenous variables variations, mostly in a state of high volatile regime. Overall, it can be said that there is a sufficient asymmetric spillover effects on the U.S. monetary policy on the South African economy. Therefore, the U.S. monetary policy has an impact on the South African economy evidently from the estimated results. The selected variables are economic indicators that indicate the health and the direction of the economy. Therefore, their reaction to the U.S. monetary policy transmission shocks indicates that the economy is impacted by the transmissions. In other words, the South African economy catches the cold when there is U.S. monetary policy transmission shocks.

The BVAR-MS model is a complex nonlinear model that can lead to an unreliable output. The model requires a large intensive data for estimating the spillover effects of the U.S. monetary policy on the South African economy. The data can include both South African and U.S. financial and macroeconomic observations to observe any possible structural breaks that influence both economies' dynamics. In that case, given that one of the SARB mandate's is to stabilize inflation the study continued to estimate a model which includes that inflation variable. The IRF's graphs are included in the appendix, this is to further illustrate how the inflation variable in South Africa reacts to the U.S. monetary policy shocks. Moreover, to detect sufficient any regime-switches throughout that has a spillover effect on the South African economy.

4.7. Conclusion

The chapter mainly focused on interpreting the results from the model's estimations and thereafter discussing the findings with existing studies to justify the US monetary policy shocks on the South African economy. The estimations utilized in the study were able to answer the research question of what the impact of the US monetary policy on the South African economy is. Moreover, to answer the question, the study sets out objectives to aid in answering the question. The primary objective to examine how the South African macro-financial variables react to the US monetary policy. The estimations did present the regime-dependent impulse response function graphs that aided in examining the reaction of the variables of interest to the US Fed rate. It is evident, that shocks in the US monetary policy spillover to the South African economy mainly by observing the IRF's. The IRF's do depicts a reaction from the US Fed rate changes, furthermore, the reactions show to be different with both regimes. Therefore, it can be concluded that the South African economy is impacted by the US monetary shocks in a regime of high volatility, which is defined as a regime where there is a form of crisis. Moreover, the variance decomposition results

show that the U.S. federal funds rate explains a significant share of the fluctuations in South Africa's macroeconomic and financial variables, confirming the presence of asymmetric spillover effects that differ across conventional and unconventional monetary policy regimes.

Chapter 5 Conclusion and Policy Implications

This study is mainly set out to investigate the impact of U.S. monetary policy transmissions on the South African economy. Specifically, the study observed how the South African endogenous variables react to the U.S. monetary policy transmissions. Furthermore, the study examined if there is an asymmetric spillover effect. The study utilised the Bayesian Markov regime switching structural VAR. The variables used are the real GDP, REER, SP, the South African repo rate, as the endogenous variables, and the U.S. Fed interest rate as exogenous.

The IRFs show that the U.S. monetary policy transmissions shocks have a spillover effect on the South African economy. The IRFs show that the different domestic variables respond to a shock on the U.S. Fed interest rate. The real GDP falls following the shock and the decline is more pronounced under the high volatility regime. The stock prices tend to rise following the shock. However, this is short-lived. In accordance with the Mundell-Flemming, the monetary tightening results in exchange rate depreciation which is also larger during periods of low volatility as shown by IRFs. The Fed rate increase will lead to increased capital inflows in the U.S. In contrast, South Africa will experience capital outflows as investors want higher returns in the U.S. dollar. Additionally, the monetary transmission shock resulted to the exchange rate to be more volatile in the high volatile regime.

The investors in short-term assets get attracted by economies with a slightly higher interest rate than other economies. Therefore, U.S. monetary tightening caused the investors to invest in U.S. stocks due to increased interest rates. Overall, these dynamics of the variables such as rand depreciating can cause inflationary pressures to the South African economy. Therefore, the SARB responded to the pressures by increasing the repurchase rate. Moreover, it's evident that the SARB responds drastically in the high volatile regime. Therefore, this aligns with studies from literature that there is an asymmetric effect of the between the low and high volatile regimes. Furthermore, the asymmetric effect was detected from the variance decomposition results. Table 7 shows that most variations of the endogenous variables are explained by changes in the U.S. Fed rates in the high volatile regime. In contrast, in a low volatile regime the variables variations are mostly explained by themselves. It can be concluded that the conventional and the unconventional monetary policy have asymmetric effects on the South African economy.

The empirical findings of this study have imperative policy implications for South Africa, particularly in the context of heightened exposure to external monetary shocks. The evidence of the asymmetric spillover effects, where US monetary policy shocks illustrated more influence on

the variables of interest during the high volatile regimes. This therefore highlights the need for proactive and state-dependent policy responses. Firstly, the Rand depreciation and capital outflows pressures observed following the US monetary policy tightening shocks underscore the importance of strengthening South Africa's foreign exchange and capital flow management frameworks. Enhancing reserves accumulation during stable global periods, moreover the use of targeted macroprudential instruments such as capital flow management measures would aid the economy against destabilizing shifts in global financial conditions.

The empirical findings suggest that the SARB responds more aggressively during high volatile periods. Therefore, this reinforces the need for a forward-looking monetary policy strategy that incorporates global financial conditions and anticipates US policy movements into interest rate decisions. A more proactive approach rather than a reactive strategy can be of help to reduce exchange rate overshooting, dampen inflationary pressures from rand depreciation, and improve credibility of monetary policy. Given that the US monetary policy tightening has recessionary implications for the South African output as shown in the results, relying solely on the SARB to stabilize the economy may be insufficient. Therefore, greater fiscal-monetary coordination is warranted as Mavundla et.al (2025) found that there is a weak level of fiscal-monetary policy coordination. A countercyclical fiscal policy could mitigate the contractionary effects of global tightening cycles without undermining the inflation-targeting framework.

Overall, the findings underscore that external monetary shocks do not affect South Africa uniformly. Policymakers should therefore adopt adaptive and state-contingent policy responses that account for shifts in global monetary regimes. Such measures would contribute to building macro-financial resilience and improving South Africa's ability to navigate global tightening cycles.

These results are insightful for decision making by South African policy makers in navigating through the U.S. monetary policy regimes. The implementation of quantitative easing due to the 2008 GFC intrigued researchers to understand the new nature of the US monetary policy spillover effects of the global economy. Therefore, understanding the nature of the spillovers in different regimes is imperative for South African policy makers to make well informed decisions on stimulating the economy. While the results found in this study are significant, the study is limited on a small sample by relying most on the financial variables in South Africa and not adding more U.S. variables. Future studies could investigate the spillover effects by enlarging the sample size by including more macroeconomic variables. Moreover, to investigate if there are more channels

that cause spillover effects on South Africa rather than the monetary policy.

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APPENDICES

A. FIGURES

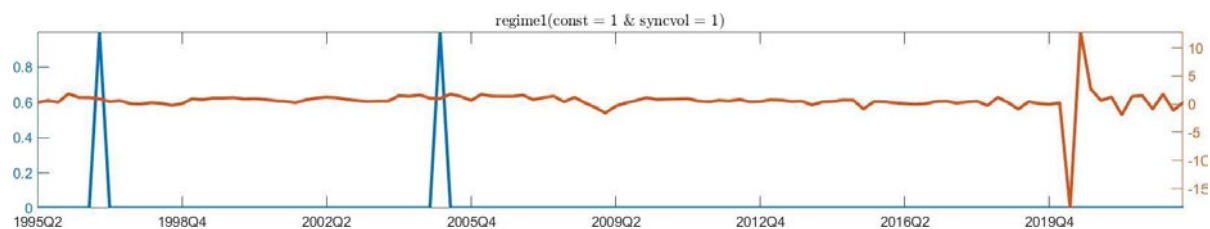


Figure 7. Smoothed probabilities of regime 1 against Output

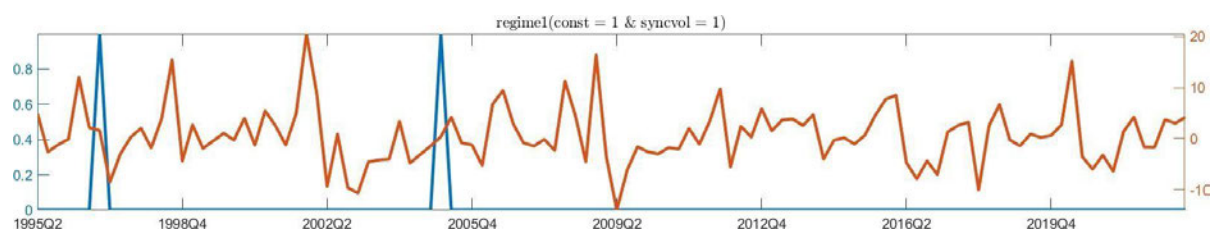


Figure 8. Smoothed probabilities of regime 1 against the Exchange rate

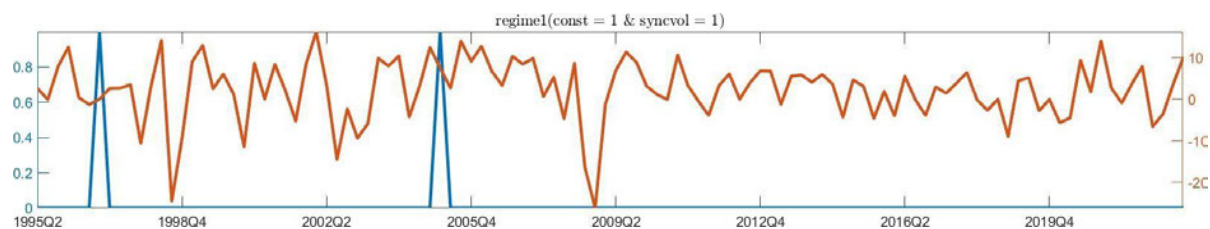


Figure 9. Smoothed probabilities of regime 1 against Stock prices

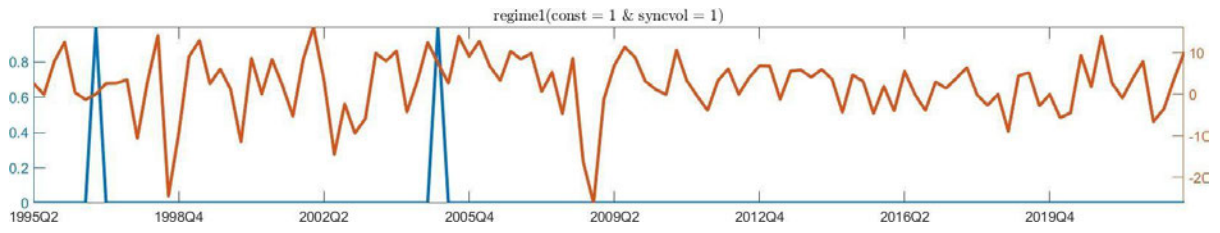


Figure 10. Smoothed probabilities of regime 1 against SA_IR

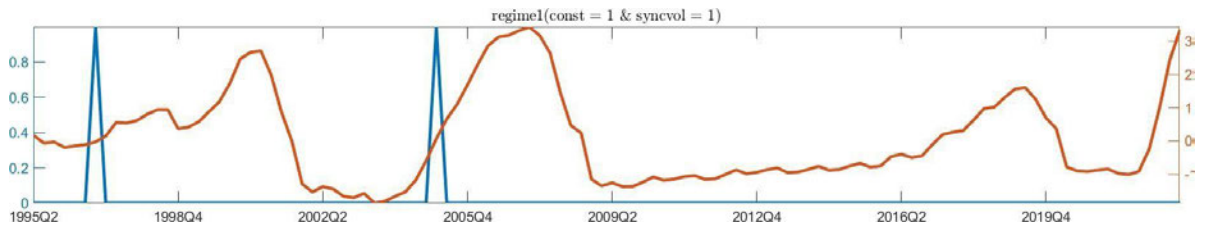


Figure 11. Smoothed probabilities of regime 1 against US_IR

B. IMPULSE RESPONSE FUNCTION FIGURES

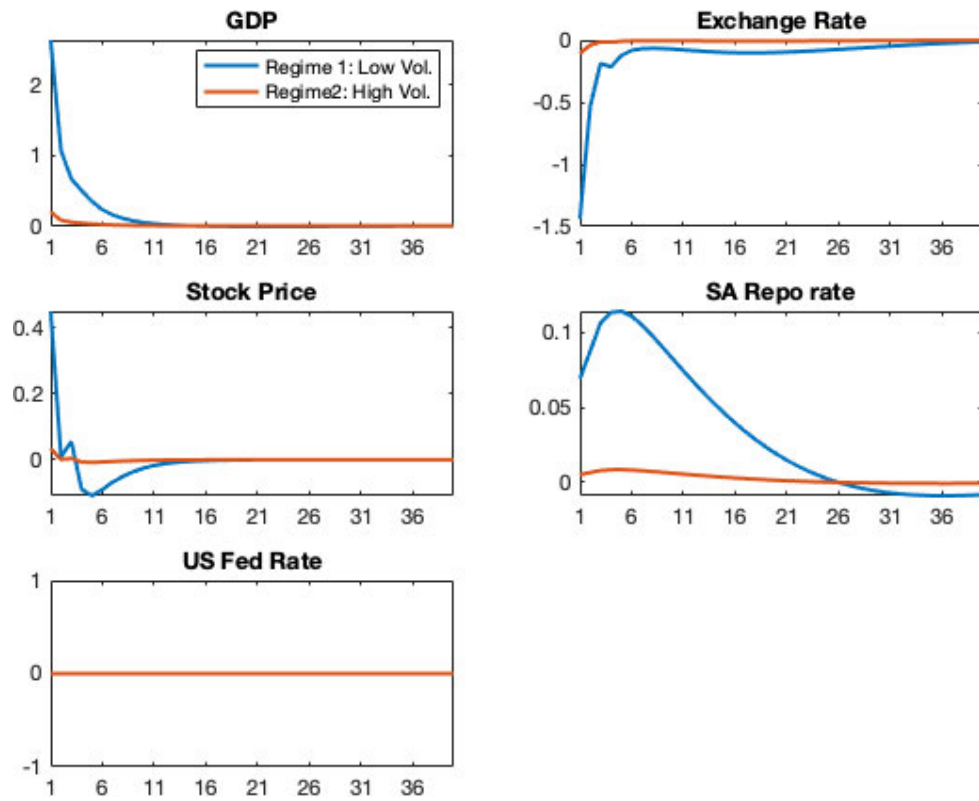


Figure 12. Impulse responses to Output shock

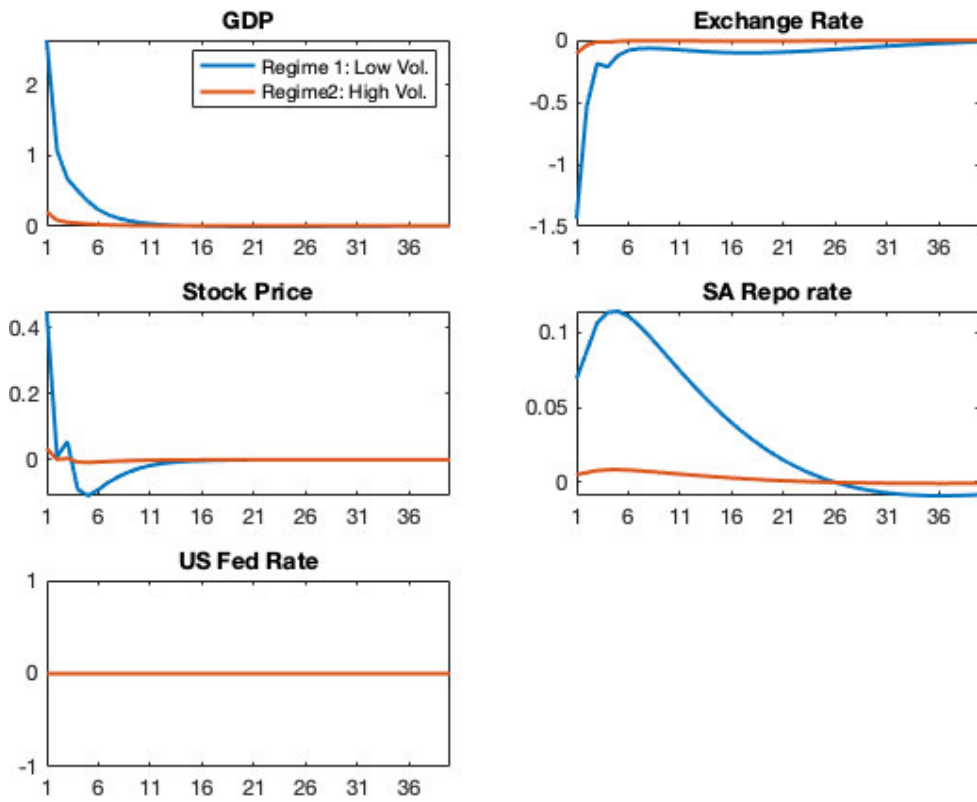


Figure 13. Impulse responses to exchange rate shock

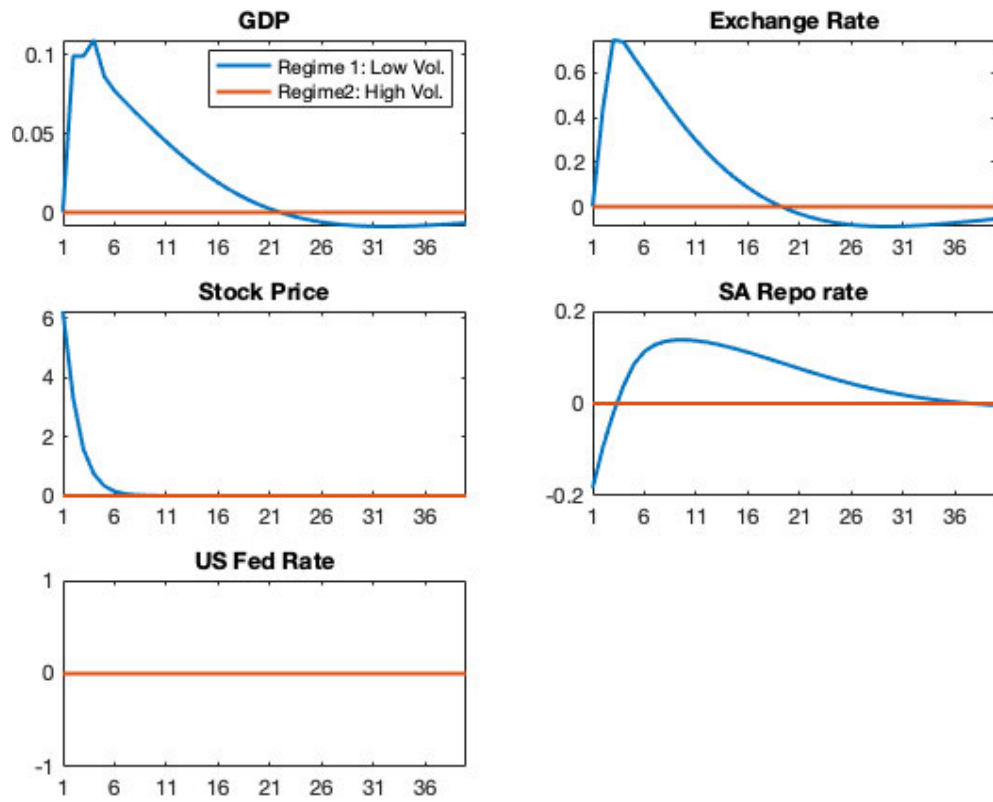


Figure 14. Impulse responses to Stock prices shock

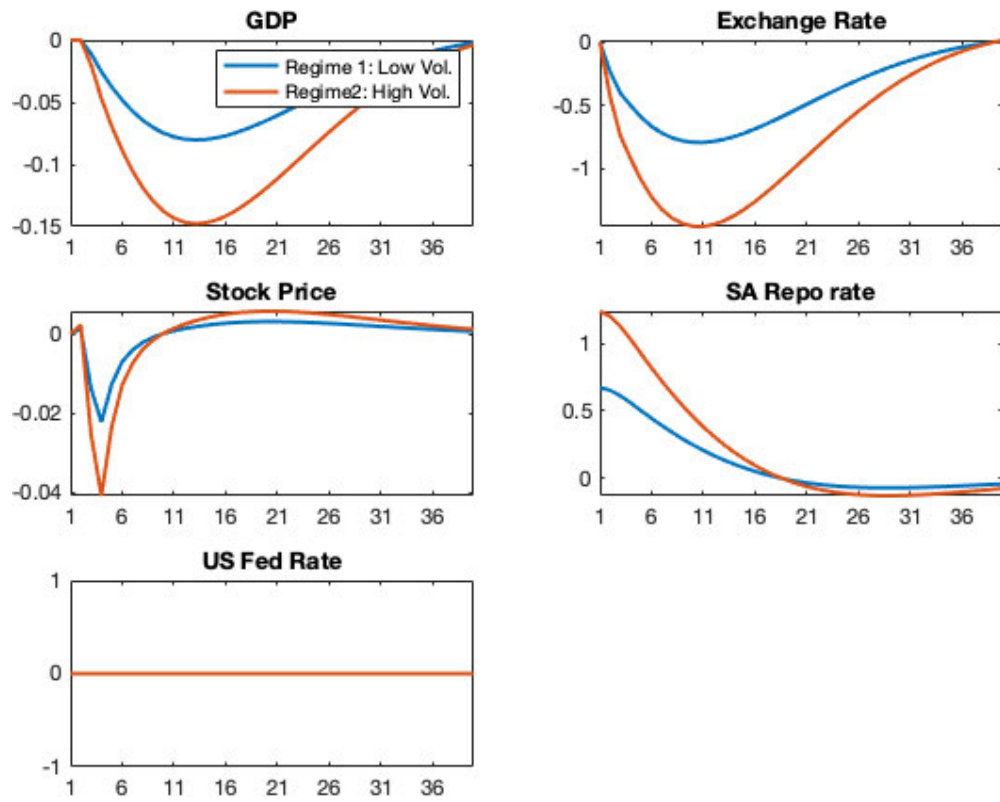


Figure 15. Impulse responses to SA repo rate shock

C. IMPULSE RESPONSE FUNCTION (INFLATION VARIABLE)

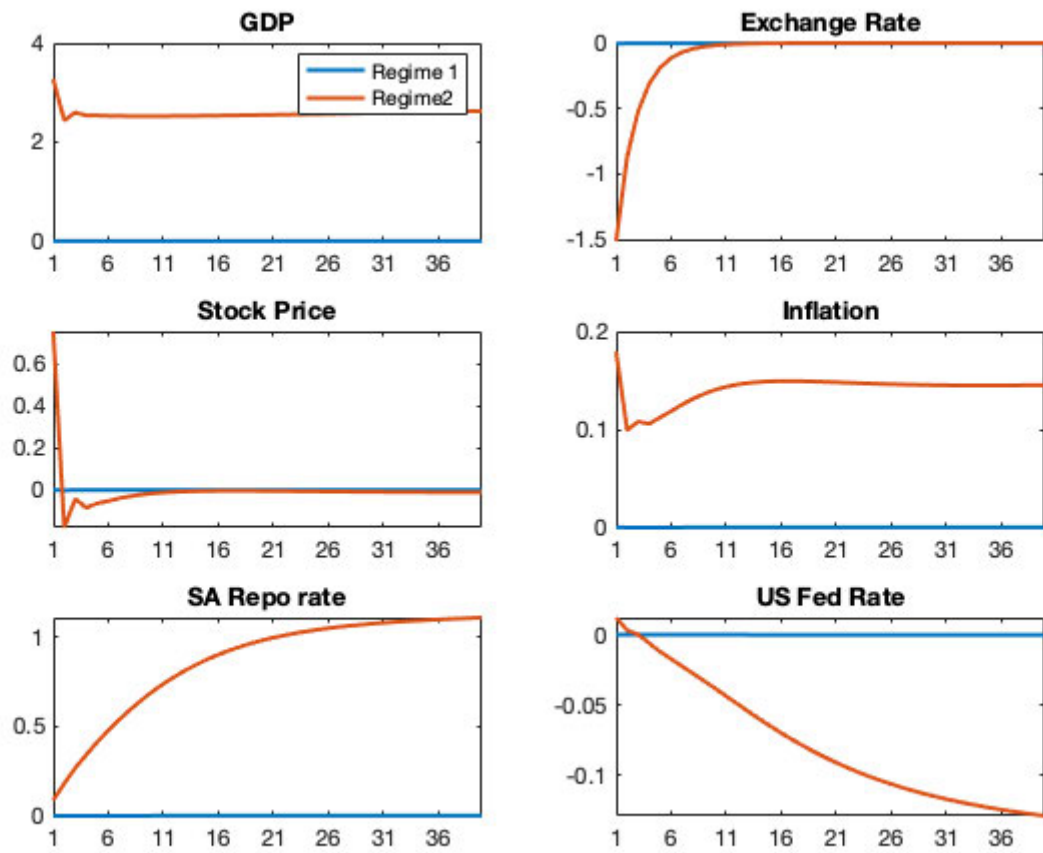


Figure 16. Impulse responses to Output shock

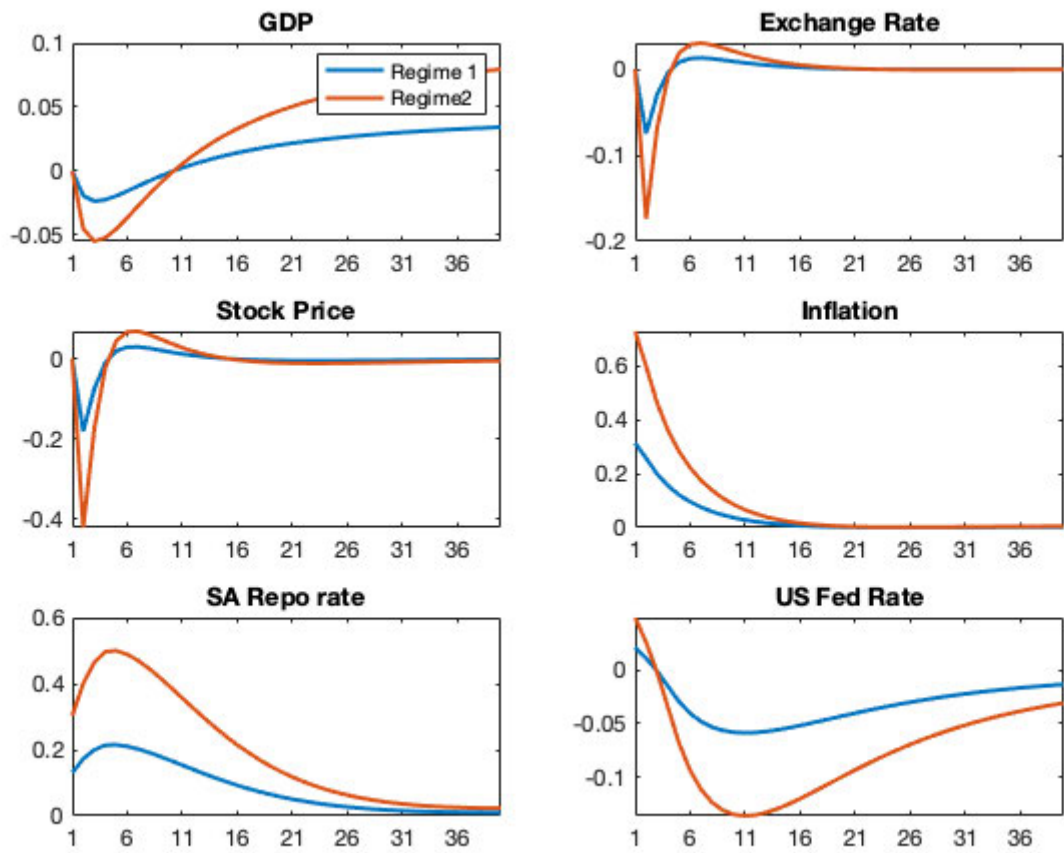


Figure 17. Impulse responses to Inflation shock

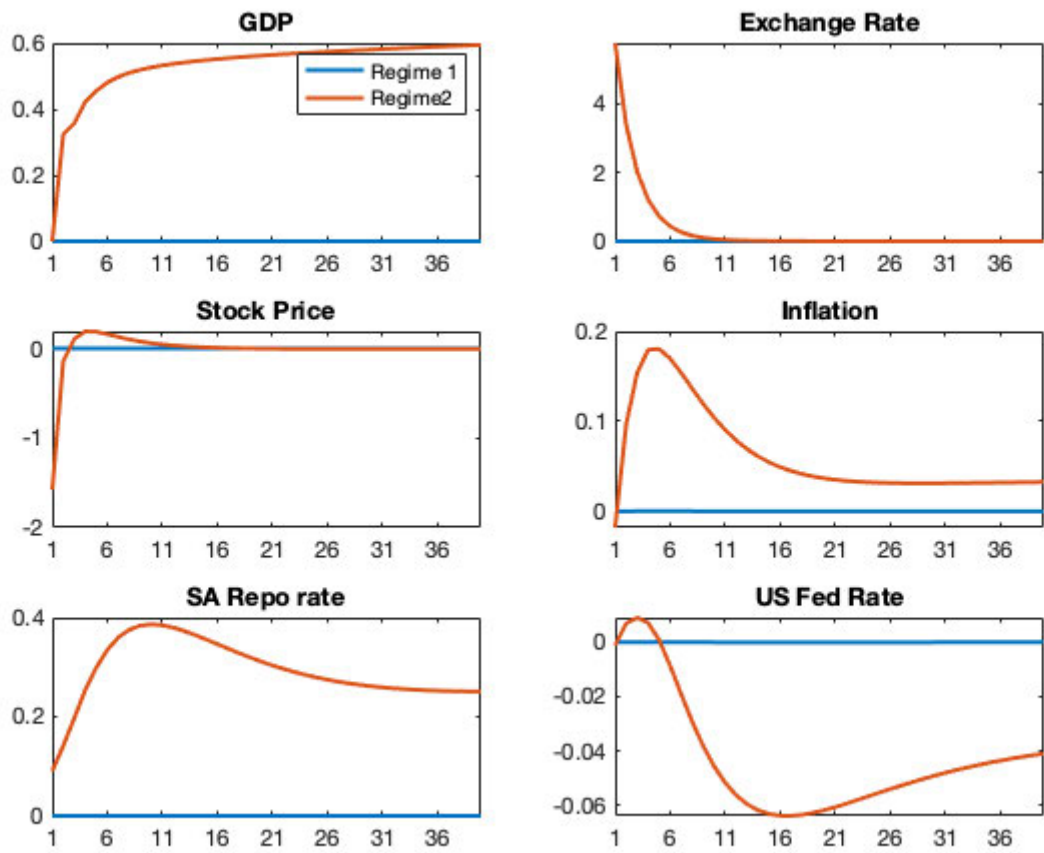


Figure 18. Impulse Response to exchange rate shock

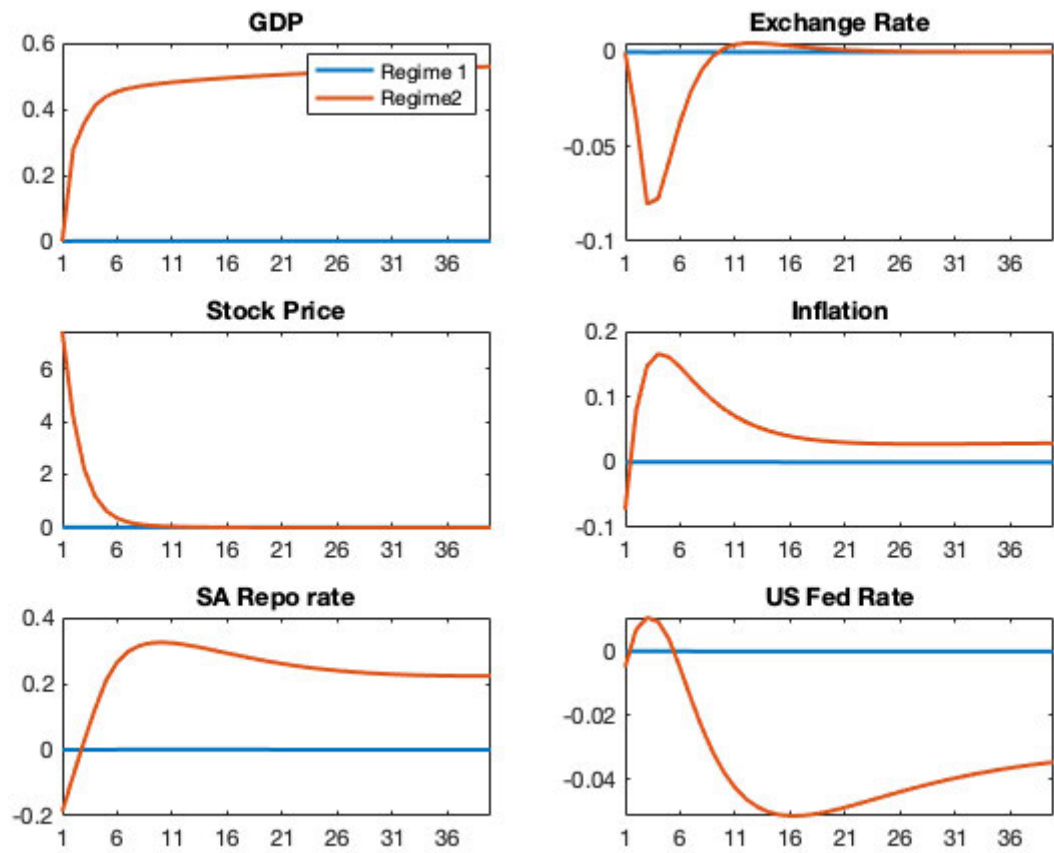


Figure 19. Impulse response to stock prices shock

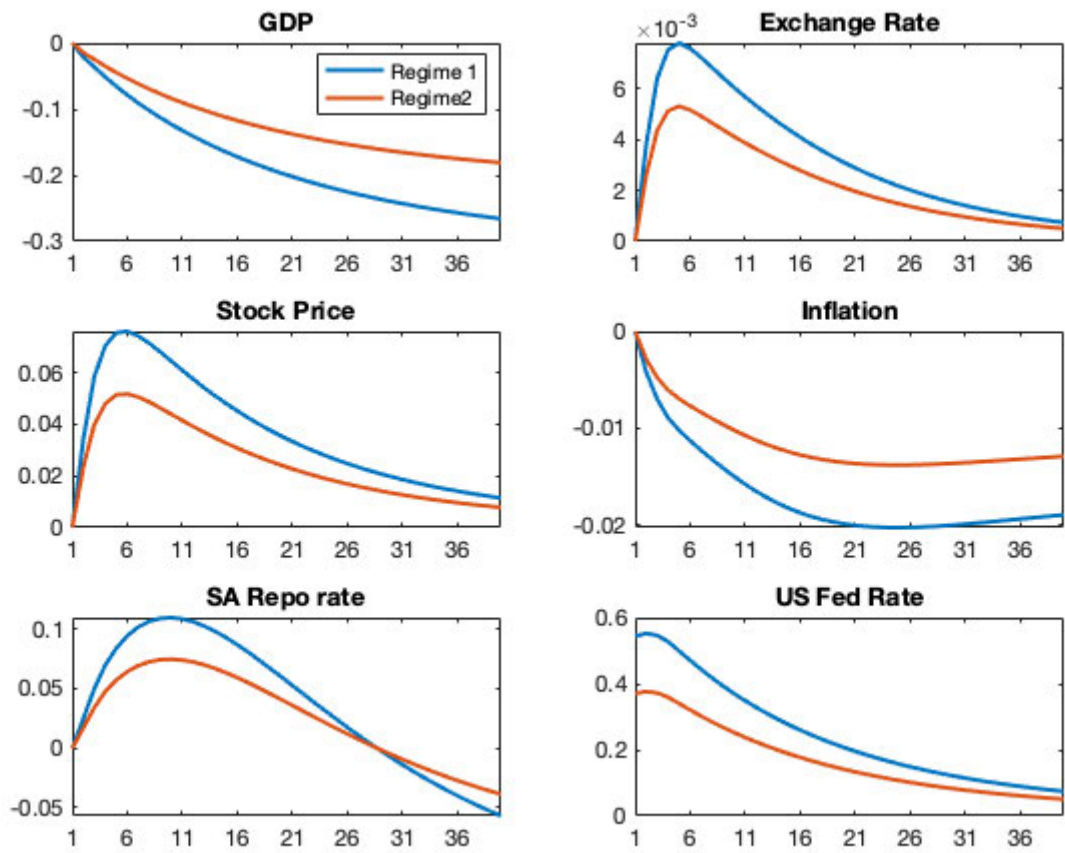


Figure 20. Impulse response of U.S. IR shock



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30-08-2024
Miss Bertinah Mabodiba Emily Mamabolo (223100803)
School Of Acc Economics&Fin
Westville

Dear Miss Bertinah Mabodiba Emily Mamabolo,

Original application number: 00024187
Project title: The spillover effects of the US monetary policy on the South African economy

Exemption from Ethics Review

In response to your application received on 26 August 2024, your school has indicated that the protocol has been granted **EXEMPTION FROM ETHICS REVIEW**.

Any alteration/s to the exempted research protocol, e.g., Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through an amendment/modification prior to its implementation. The original exemption number must be cited.

For any changes that could result in potential risk, an ethics application including the proposed amendments must be submitted to the relevant UKZN Research Ethics Committee. The original exemption number must be cited.

In case you have further queries, please quote the above reference number.

PLEASE NOTE:

Research data should be securely stored in the discipline/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours sincerely,

Prof Claire Lauren Vermaak
Academic Leader Research
School Of Acc Economics&Fin

UKZN Research Ethics Office
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Website: <http://research.ukzn.ac.za/Research-Ethics/>

Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

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