Investment Styles and Monetary Policy Shocks: Evidence from Advanced and Emerging Economies

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Abstract

The paper investigates the impact of monetary policy shocks on investment styles in South Africa and the United States of America. The results indicate that monetary policy shocks significantly affect investment styles through transmission in the stock market. The findings show that value investing, and low volatility investing are the major safe havens for investors during monetary policy shocks or increasing interest rates. Results showed an inflation price puzzle in both countries, but inflation declined in the intermediary period. Our findings are robust in terms of investment styles' response to the monetary policy shock. The robust results showed consistency in how investment styles react to monetary policy shocks.

Key words: Monetary policy shock, investment styles and response.

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Chapter 1: Introduction

1.1. Background

Equity investment styles that use a systematic process to identify securities based on repeatable drivers of return have gained significant traction over the past few decades. This follows numerous studies showing that style-based anomalies exist across both the Capital Asset Pricing Model and arbitrage pricing model specifications (Van Rensburg, 2001; Cronqvist et al., 2015; Chan and Lakonishok, 2019). Fama and French's (1998) seminal three-factor augmentation of the Capital Asset Pricing Model was perhaps the most important inflection point in the evolution of factor investing. The authors proposed two factors in addition to CAPM to explain asset returns: small minus big, which represents the return spread between small- and large-cap stocks, and high minus low, which measures the return spread between high book-to-market and low book-to-market stocks.

Subsequently, several scholars supported Fama and French's (1998) findings (Chan et al., 1995; Auret and Cline, 2011). A few decades later, hundreds of styles, including momentum (Page et al., 2016), quality investing (Gallagher et al., 2013), and dividend yields, are equity investment styles widely followed and implemented by investors. Despite overwhelming evidence proving the robustness of style investing, individual styles have been found to perform better during certain economic cycles (Levis and Tessaromatis, 2004; Cronqvist et al., 2015). According to Walkshausl (2013), low volatility stocks have outperformed high volatility stocks. The low volatility stocks outperform high volatility stocks because of drawdowns that high volatility stocks endure during stock market stress. This study will investigate the impact of monetary policy shocks on investment styles.

1.2. Research Gap

Central banks in advanced and emerging economies use interest rates and money supply as monetary policy instruments. During the financial crisis, central banks had to implement unconventional monetary policy measures, such as reducing interest rates to almost zero percent, due to the housing market crash (Comunale and Striaukas, 2017). Similarly, in 2020, after the Covid-19 outbreak, many advanced economies purchased bonds to provide liquidity in the financial markets and reduced interest rates to stabilize the economy. Previous studies by Xu et al. (2010); Kontonikas et al. (2013) and Wang and Zhu (2013) have found that interest rates and monetary policy shifts affect stock returns. This paper aims to investigate and examine the effects of monetary policy on investment styles since their response to these

policies and their performance differ. Investment styles are derived from stock returns in an equity financial market, so if stock returns are affected, so are investment style returns.

Investment styles differ based on their distinct characteristics; some outperform while others lose during monetary policy shifts. Investors tend to hold on to their views of certain investment styles, even though they may later find themselves experiencing significant negative returns in the short run. This study aims to help asset managers understand how investment styles react to monetary policy shocks to avoid downside capture during economic turmoil and gain upside capture during economic growth. Investors and asset managers can adopt a style-agnostic approach and disinvest from expensive styles in terms of valuations, styles that are not supported by current economic conditions, and styles with less market sentiment.

According to Lucca and Moench (2014) "80 percent of the alpha generated on the stock market from 1994 until recent was conjured up by the Fed before the monetary policy announcement, and the returns do not revert back in days ahead after the announcement." This makes the US Federal Reserve Bank one of the most important drivers of stock market performance. Given this backdrop, it is imperative to understand how the investment styles respond to monetary policy shocks, which is the goal of this study. Fama and French (1998) suggested that value stocks outperform growth stocks in the financial equity market. Meanwhile Chan and Lakonishok (2019) found that value stocks typically earn higher returns than growth stocks on average. Therefore, the study will examine whether these findings hold true in the context of monetary policy shocks. According to Chan et al. (2015), mutual funds that invest in stocks follow investment styles centred on market benchmarks, with some portfolio managers taking extreme positions away from the index. The literature on how monetary policy affects investment styles is lacking, and this study aims to fill that gap.

1.3. Objectives of the study

This study examines the impact of monetary policy shocks on investment styles. Specifically, it investigates how changes in interest rates, which affect the discount rate used to compute stock prices, influence equity prices and subsequently affect the net wealth of consumers in the market through transmission mechanisms (Ioannidis and Kontonikas, 2008). The main objective of this study is to study the extent to which investment styles respond to monetary policy shocks (increase in interest rates). In addition, the study will robustly investigate the correlation between the monetary policy (interest rates), control variables (output, inflation, exchange rates), and investment styles to understand the relationship between the variables.

1.4. Research questions

In the modern-day, information about monetary policy shifts is readily available to investors, and expectations of how the central bank will adjust its policies are typically anticipated. As a result, the anticipated shift in monetary policy is already priced in by the market prior to the official announcement. However, unanticipated policy shifts can have varied impacts on stocks in different sectors (Wang and Zhu, 2013). Therefore, this study aims to answer the following research questions:

- What impact do monetary policy shocks have on equity investment styles?
- Which investment style experiences the largest decline after a contractionary monetary policy?

1.5. Contribution of the study

This study aims to contribute to the existing body of knowledge by examining the impact of monetary policy shocks on investment style performance, an area that has been under-studied. Numerous academic papers have examined how monetary policy affects stock prices in financial markets. For instance, Corallo (2006) used an event study method to evaluate the pre- and post-response of stock prices to monetary policy, while Rigobon and Sack (2004) employed event studies to investigate the impact of monetary policy on asset prices and found that such studies may have biases that underestimate the effect of monetary policy on stock prices. However, this study will investigate how monetary policy shocks impact investment styles.

Empirical studies on how monetary policy shifts affect stock returns have been conducted in advanced economies and emerging markets (Rigobon and Sack, 2004; Bernanke and Kuttner, 2005). The findings of these studies confirm that stock returns are indeed affected by monetary policy shocks. However, there is still a need to investigate how each investment style reacts during monetary policy easing or tightening in emerging and advanced economies, especially in South Africa. While previous studies have mainly focused on identifying which investment style performs better in the long term, there is a dearth of research on how each investment style performs during monetary policy shocks.

According to Johnson et al. (2000), returns during expansionary monetary policy periods are higher, and risk is lower, regardless of the investment strategy, compared to restrictive periods. This study will contribute to the empirical literature by investigating how different investment styles react during monetary policy shocks, providing insights that can be useful for investors

and policymakers. Knowing which investment styles experience maximum drawdowns during monetary policy shocks is imperative because it allows investors to be sober and vigilant in their investment decision making. During monetary policy shocks, some investment styles resist the pressures of high interest rates; therefore, they provide a haven for investors in the equity market.

1.6. Significance of the study

The concept of asset allocation has been the foundation that has helped investors over the past decades, based on the trade-offs investors face (Kaplan, 2012). Markowitz (1952) advised that investment decisions should be based on the portfolio's risk and return, not merely on one security. Central bank actions in the stock market create significant arbitrage opportunities. Understanding the performance cycles of investment styles is essential for investors as they can position their portfolios to better capture upside potential and protect against downside risk. Risk-averse investors can also learn which investment styles can preserve their capital and deliver performance during unconventional monetary policy. Allocating more capital to investment styles that resist the pressure of monetary policy shocks is imperative to avoid underperformance.

Asset managers specializing in listed equity investments will benefit from the guidance provided by this study, enabling them to switch to more advantageous investment styles amid a shift in monetary policy. Fund managers can capture potential upside when certain styles are performing well and protect on the downside by disinvesting from styles under pressure. The findings of this paper aim to provide useful insights for investors who use tactical asset allocation models to manage their portfolios during various economic conditions, particularly during economic difficulty. Additionally, quantitative modelling or machine learning techniques used by investors to predict potential risk and returns for different investment styles could benefit from incorporating the results of this study as a guideline or a rule within the modelling process.

This paper investigates how investment styles perform following conventional and unconventional monetary policy shocks in both advanced and emerging economies. Fama and French (1998) suggested that value stocks outperform growth stocks in the financial equity market. However, according to Bellone and Carvalho (2022), value stocks have endured a period of underperformance until recently, when they began to outperform. The findings from

the study will help investors switch investment styles when monetary policy shocks occur and determine which style is appropriate during monetary policy shocks.

1.7. The structure of the report.

The study is organized into different sections. Section 2 will present a literature review on investment styles and how monetary policy affects them. Section 3 will discuss the methodology used to analyse the relationship between interest rates and investment styles. In Section 4, the study will present and discuss the results obtained from the analysis using the Vector Autoregressive model. Finally, Section 5 will provide the conclusion of the study.

Chapter 2: Literature Review

2.1. Introduction

Asset allocation is an investment strategy that diversifies an investor's portfolio across various industries, geographic areas, and currencies to manage risk and return. This reduces market risk and prevents significant losses during times of economic hardship. Portfolios are vulnerable to company, country, currency rate, and financial risks. The Capital asset pricing model (CAPM) and Arbitrage pricing theory (APT) can optimize expected returns by taking on more systematic risk. Changes in monetary policy affect the risk-free rate, which affects the market premium and expected returns of stocks. This study will review the theoretical and empirical literature on how monetary policy shocks affect investment styles in South Africa and the United States of America. The theoretical literature review will employ the theoretical underpinnings of passive investing. The literature review will fully explore each investment style's characteristics. Scholars have documented how monetary policy impact stocks affect stock prices (Rigobon and Sack, 2004; Bernanke and Kuttner, 2005). However, this study will investigate how investment styles respond to monetary policy shocks.

2.2. Theoretical literature review

2.2.1. The capital asset pricing model

The Capital Asset Pricing Model has been imperative in determining the relationship between risk and returns, where risk is divided into systematic and unsystematic risk. The capital asset pricing model was then credited by (Treynor, 1962; Sharpe, 1964; Lintner, 1965; Mossin, 1966). The CAPM defined systematic risk as the beta, which is the market's sensitivity or volatility. Unsystematic risk refers to the risk that is not related to the market but the individual company. Some of the formerly efficient portfolios sitting on the (Markowitz, 1952) efficient frontier are no longer efficient in (Tobin, 1958)'s paradigm, where investors can borrow and lend at the risk-free rate because investors can earn better returns for the same degree of risk. The Capital Asset Pricing Model (CAPM) is the first model to show how a systematic risk factor affects the expected return on investment (Wei, 2021). The CAPM model is mathematically described this way:

$$E(R_i) = R_f + \left[E(R_m) - R_f\right]\beta_{iM},\ i = 1, \ldots., N.$$

When monetary policy changes and interest rates are increased or decreased, the risk-free rate is affected, which then affects the market premium, defined as $\left[E(R_m) - R_f\right]$. This, in turn, affects the expected return of stocks, which are an important factor in determining investment

style returns. The transmission mechanism of monetary policy shift affects investment style returns. However, Fama and French (1997) found that estimates of the cost of equity capital for certain industries using the CAPM were inaccurate, with standard errors exceeding 3 percent each year. They reiterated in 2004 that the CAPM is built around unrealistic assumptions that must be empirically tested. For example, the assumption that homogeneous expectations and the single-period nature of the model are realistic has been criticized.

In addition, the idea that any investor in the market can borrow or lend at a risk-free rate is not true since investors' borrowing rates are determined by their risk profiles (Black, 1972). Other researchers have empirically demonstrated that market risk is not the only factor the market rewards and that the CAPM's assumptions are flawed (Jensen et al., 1972). Lei (2021) conducted a study on the Shanghai stock market using the CAPM with the Black, Jensen, and Scholes theory. They found no statistically significant evidence in CAPM verification of Chinese stock portfolios, as well as a failure to demonstrate the viability of CAPM in 5G stocks on Chinese stock markets.

To anticipate the expected rate of return on their portfolios, stock market investors must test a valid and reliable model against a variety of pricing models to determine which one is the most accurate. However, the expected rate of return cannot be predicted using single-factor or multi-factor capital asset pricing models (Elshqirat, 2019). The study of Elshqirat (2019) used Ross's (1976) arbitrage pricing hypothesis theory, which found that stock returns were associated with factors other than market returns. Dempsey (2012) also found data that contradicted the CAPM's assertion that markets are fundamentally rational and worthy of scientific investigation. Bornholt (2012) discovered that the CAPM empirically fails when applied in certain industries. Bornholt's (2012) research found that value and momentum anomalies continue to dictate returns, whereas beta anomalies are fading. Past returns and beta have a linear relationship, indicating that reality matches what the model predicts, and the connection is positively sloping, indicating a favourable trade-off between the two.

2.2.2. Passive and active management

Investors often choose equity funds to include in their investment portfolios based on the portfolio's performance, asset management fees, and the holdings of that portfolio. Garleanu and Pedersen (2019) suggest that the optimal passive portfolio is related to the expected market portfolio, which typically exhibits low tracking errors. Malkiel (2003) advocates for passive investing across all markets and major asset classes, such as stocks and bonds, in various

countries. Sushko and Turner (2018) found that passive investing has expanded in index mutual funds and exchange-traded funds over time because it is less expensive and favoured by investors during stressful times, resulting in relatively constant cash flows. Using a rigorous index-based investment strategy avoids the key asymmetric information and agency issues that come with entrusting investment choices to a fund manager (Vayanos and Woolley, 2016).

The primary objective of passive and exchange-traded funds (ETFs) is to give investors benchmark returns with low tracking errors. Passive funds and ETFs must have a tracking error of less than 1 percent. Blitz (2014) hails passive investment as one of modern finance's most successful ideas, citing the capital asset pricing model and the efficient market hypothesis as a foundation. According to Krige (2005), active funds outperform the index benchmark when costs are omitted from the performance composition, but they underperform the index benchmark when upfront fees are added. Few active funds in US stock mutual funds have outperformed passive funds, according to Fama and French (2010), and the outperformance has been able to cover costs. Sushko and Turner (2018) demonstrated how a shift towards passive investing could impact securities in the financial market. Passive investing can result in high correlation of returns and aggregate investment fund flows and market prices. The study further showed that active mutual funds exhibit persistent outflows during stress periods. The fund flows in passive investing are much more volatile.

Garleanu and Pedersen (2020) showed that the optimal active portfolio has the characteristics of investment styles, which include value and quality investing. According to Chan et al. (2015), mutual funds that invest in stocks follow investment styles centred on market benchmarks, with some portfolio managers taking extreme positions away from the index. The study further suggests that portfolio managers who take extreme positions away from the benchmark are more likely to pursue growth and momentum investing (investing in recent winners and disinvesting from recent losers). Active investors frequently use investment styles to compare themselves to big indices, such as the MSCI World Index and S&P 500. Graham is considered the "Father of Value Investing," and Fama and French agree that value stocks outperform growth firms.

2.2.3. Factor investing

Factor investing is based on factors that have generated excessive returns or premiums over an extended period and indicate beta exposure. Mutual funds with a tilt toward qualities, including value, growth, small size, and momentum, have a history of generating excess long-term

returns, and these factors have solid theoretical underpinnings (Bender et al., 2013). In comparison to conventional actively managed mutual funds, factor investing strategies for mutual funds produce much larger alphas. These strategies are based on equity asset price anomalies such as the small-cap, value, and momentum impacts (Van Gelderen et al., 2019). For many years, mutual funds have benefited from the effectiveness of factor investing strategies, which has allowed them to generate above-average returns.

Institutional investors have accessed factor investing strategies through the active management of funds and sometimes through different factor investing indexation. With indexation through passive vehicles, mutual fund managers can mimic or replicate the factor indexes. Thus, investing in the MSCI Value index would allow institutional investors to earn similar returns as the index (Bender et al., 2013). MSCI has successfully created different factor indexes such as Value, Low Size, Low Volatility, High Yield, Quality, and Momentum. These indices have historically outperformed market capitalization-weighted indices in terms of returns and had stronger Sharpe Ratios (Bender et al., 2013). The study suggested that factor investing has produced strong returns over a long period with greater Sharpe ratios.

ESG ratings for passive and smart beta portfolios increase with environmental, social, and governance screening of specific stocks within a region without lowering risk-adjusted returns (Alessandrini and Jondeau, 2020). Smart beta strategy exhibits a similar tendency to exclude stocks with low ESG ratings, which results in higher scores without degrading risk-adjusted performance (Alessandrini and Jondeau, 2020). According to Hsu's (2014) study, smart beta strategies are more diversified than traditional value or growth investing, and they can acquire cheap stocks and sell expensive ones when a portfolio needs to be rebalanced. The study also discovered that smart beta strategies could enhance returns by using mean reversion in value premiums. The main goal of smart beta investment is to mix passive investing with active investing strategies, including value, momentum, growth, and quality, where appropriate, to produce alpha and boost diversity at a lower cost than traditional active investing.

2.3. Empirical Literature review

2.3.1. International Evidence of investment styles

2.3.1.1. Value investing

Graham and Dodd (1934) established value as an investment style in their book named Security Analysis. Academics have provided sufficient evidence that low price-to-earnings ratios generate great returns in the long term (Stattman, 1980; Rosenberg et al., 1985). Low price

earnings' ratios can only mean that the stock price is low, and the stock's earnings per share are high. Fama and French (1996) further studied the outperformance of low P/E stocks and found the risk premium in individual stocks in 2012. Stocks with low P/E ratios demonstrated superior returns in the long term compared to those with high P/E ratios (Basu, 1977). Lakonishok et al. (1994) explained value stocks as stocks that have consistently yielded negative returns, and investors expect the stocks to continue yielding inferior performance. Damodaran (2012) indicated that investing in stocks that have been out of luck is a form of contrarian value investing. Investors should be patient, invest in stocks with low price multiples, and gain superior returns in the future.

Lee (2014) defined value investing as the "buying or selling of stocks solely because there is a perceived gap between the current market price and the fundamental value of the stock that's found when expected cash flows are discounted to the current date." Lee (2014) further indicated that value investing is buying stocks that are cheap compared to their intrinsic value and selling stocks that are too expensive. The share prices of undervalued stocks will increase and return to fundamental value as soon as investors recognize the undervaluation (Lev and Srivastava, 2019). The study further documents those investments in low-value companies, sometimes known as "value stocks," should, therefore, produce higher returns than the market average due to their characteristics.

Damodaran (2012) found three strands of value investing. First, passive value investing is where investors buy stocks based on low multiples of earnings, book to value, and projected yield high returns at minimal risk. Second, contrarian investing involves investors buying stocks that have been yielding negative, consistent returns and short selling stocks that have been yielding positive, consistent returns. Third, activist value investing involves investors investing large capital in companies that were poorly managed previously and their values are exceptionally low, only to turn them around to ensure that they are well managed and are growing in value. The study of Damodaran alluded that although value investing appears good on paper, value investors' overall success is not much better than other investment philosophies and tactics used by less "intelligent" investors.

By buying low-priced ("value") stocks and selling highly priced ("glamour") equities, value investors can take advantage of companies whose stock prices are momentarily undervalued or overvalued by investors in comparison to fundamentals (Lev and Srivastava, 2019). The price reversals of these mispriced stocks mostly drive gains from value investing. For decades, the

value investment approach produced excessive (abnormal) returns, which encouraged the development of "value funds" and other investment techniques. However, starting in 2007, the strategy seems to have lost its allure (Lev and Srivastava, 2019). Lev and Srivastava's analysis demonstrated the inability of value investment in recent years to provide excessive returns, which also revealed value investing's recent failures.

Younger investors who began investing in the 21st century may still be thinking back to the value strategy's strong performance in the early 2000s, making it difficult to comprehend the "demise of value" since 2007 (Lev and Srivastava, 2019). Value investing has not provided investors with excessive returns since 2007, while other investment styles have provided excessive returns. Academics have recently documented the demise of value investing due to most value investing strategies have not produced adequate returns to outperform. However, other academics think it is premature to conclude that value investing is dead (Israel et al., 2021). Despite decades of value investing strategies showing exceptional returns in the equity market, value investment style, particularly in the United States of America, has been awful since the financial global crisis (Adra and Menassa, 2022). That may be an understatement given the extremely unpleasant years the investment style experienced in 2018, 2019, and 2020 (Israel et al., 2021).

2.3.1.2. Growth investing

Academics have defined growth stocks in several distinguished ways. Overall, Fama and French (1998) define growth stocks as stocks trading at higher price-to-earnings ratios or higher prices that exceed their true intrinsic value. Investors expect such stocks to continue trading at soaring prices. Growth stocks' prices are high, whereas their intrinsic value is much lower than that for which they are currently trading. Bodie (2009) defines overvalued stocks as stocks that are currently trading at a higher price that is not justified by their earnings. A stock price significantly higher than its current intrinsic worth results from investor sentiment toward the company.

Growth stocks have high price multiples that are caused by high stock prices compared to their earnings after tax, cash flows, and sales that the stock is expected to generate in the future (Pinto et al., 2015). Growth stocks are expensive in nature, and during market crises or market stress, such stocks are highly volatile and result in high drawdowns. Pinto et al. (2021) state that "investing in growth stocks is accompanied by elevated risk, and investors have to identify their risk tolerance and understand how much risk of losing their capital they are willing to

take." According to Lakonishok and Porta (1997), the popularity of these companies causes their stock prices to rise steadily, and they tend to pay smaller dividends. Growth stocks mainly have the characteristic of the growth stage in a company's life cycle.

2.3.1.3. Value stocks vs growth stocks

Empirical studies have established that value stocks outperform growth stocks on average in the long term. Chan and Lakonishok (2019) found that value stocks earn higher returns than growth stocks on average. Fama and French (1998) stated, “Value stocks outperform growth stocks in the financial equity market”. Pinto et al. (2021) discovered that pre-financial crisis value stocks outperformed growth stocks; however, growth stocks outperformed value stocks during the crisis. The study of Pinto et al. (2021) further demonstrated that growth stocks outperformed value stocks post-global financial crisis period. The empirical research above demonstrates that there are market conditions that favour value investing and there are market conditions that favour growth investing, which is why various academics have come to different conclusions.

The study of Pinto shows that growth stocks are also capable of outperforming value stocks at times. Garcia and Oliveira (2018) stated that “Warren Buffet, who was a scholar of value investing under Graham and Dodd, has managed to beat the market consistently from 1976 until 2011”. The study showed that Buffet was able to achieve such remarkable performance by buying cheap, high-quality stocks that no one expected to outperform the market. Cheap stocks are defined as stocks that have low price multiples like price-earnings ratio, price-to-book ratio, and price-to-sales ratio. According to Chan et al. (2015), growth-oriented mutual funds are more likely to surpass their style benchmarks than value-oriented managers. The study further alluded that, on a style-adjusted basis, growth managers outperform value managers.

Traditional and contrarian investors who choose to concentrate on value or growth portfolios rather than individual stocks have been shown to engage in style investing (value investing). These portfolios can be made in several ways, but the most popular is by employing price metrics. These measurements, which investors use to evaluate performance based on a group of stocks rather than one, include price-to-earnings, price-to-book, and price-to-cash flow ratios. Investors use these price multiples to construct their portfolios with the aim of generating larger, more reliable returns over an extended period. The primary objective is to offer investors

a high Sharpe ratio. Price multiples are used in selecting individual equities for portfolio creation in both growth investing and value investing strategies.

2.3.1.4. Momentum investing

Even after the academic discovery of momentum investing more than 20 years ago, there is still a lot of misunderstanding and disagreement about its effectiveness and suitability as a useful investment technique (Asness et al., 2014). Momentum investing involves buying stocks when they are rising and selling them when they appear to have peaked, intending to manage volatility by looking for purchasing opportunities during brief uptrends and then selling when the momentum of the stocks begins to wane (Moskowitz and Grinblatt, 2002). Jegadeesh and Titman (1993) explored different momentum strategies that buy consistently performing stocks with high returns in the past 3 to 12 months and sell the consistently underperforming stock with the lowest returns in the past 3 to 12 months.

Rouwenhorst (2002) found that diversified portfolios that invest in stocks that had higher returns than peer stocks in the past 3 to 12 months (winners) and sell stocks that had lower returns in the same period (losers) earn approximately 1 percent every month. The study further indicated that the outperformance lasts for approximately the next 12 months. Garg et al. (2020) reiterated Jegadeesh and Titman's (1993) finding that investors can earn abnormal returns if they purchase stocks that performed well in the past 3 to 12 months (recent winners) and take short positions in the recent stocks that had negative returns in the past 3 to 12 months (recent losers). Antonacci (2017) found that combining absolute and relative momentum, known as dual momentum, resulted in superior returns than when only one momentum strategy is applied.

To prevent collapses in momentum investing, Singh et al. (2020) researched three different types of momentum investing (absolute momentum, relative momentum, and dual momentum) to select the recent winners and losers. The study demonstrates how investors might use macro-momentum as an additional screening method for the dual momentum strategy. The study by Barroso and Santa-Clara (2015) shows that momentum investing has produced a superior Sharpe ratio compared to the market, value investing, and size factors. However, momentum investing also has had the worst crashes. According to the research by Barroso and Santa-Clara (2015), which investigated relative momentum strategy crashes, relative momentum fell by 91.59 percent in just two months in 1932 and by 73.42 percent in just three months in 2009. Such returns have a negative effect on the gains that the investing strategy has previously made.

To prevent momentum crashes while markets are rebounding from significant losses, Singh et al. (2020) studied how the three momentum investing strategies could be used.

2.3.1.5. Quality investing

Novy-Marx (2014) defines quality as companies that meet the requirements of low leverage, high profitability, and low earnings volatility. The author claims that stocks of such companies "have consistently outperformed over longer holding periods." According to Novy-Marx (2014), buying high-quality assets at fair prices is equally valuable as buying average-quality assets at a discount. Novy-Marx (2014) further states that quality and value strategies differ significantly in terms of the equities they hold. High-quality businesses tend to be more expensive, whereas low-cost businesses tend to be of lower quality. Therefore, quality strategies have a short value, while value strategies have a long quality, according to Novy-Marx (2014).

After controlling for market returns and common anomalies such as size, value, and momentum, Lalwani and Chakraborty (2018) found that the Grantham Quality indicator and Gross Profitability generated higher returns. Gross profitability produced significant excess returns as a standalone strategy and had the highest Fama and French (1993) three-factor alpha, especially among large-cap stocks. Gallagher et al. (2013) discovered that high-quality stocks outperformed low-quality stocks during market stress. According to the study, quality investments are better at preserving capital and offer notable downside protection amid market stress.

2.3.1.6. High dividend yield investing.

Visscher and Filbeck (2003) created high-yielding dividend portfolios utilizing the top ten highest-paying dividend corporations, with the portfolio rebalanced every year. The dividend yield strategy has existed for years, and according to Filbeck and Visscher (2010), it consists of investing equal capital amounts in each of the 10 stocks of a market index with the greatest dividend yield. The study of Filbeck and Visscher (2010) documented that high dividend yields have outperformed the Dow index in the United States. The study showed that the same results of outperformance in the USA were not applicable in Britain. The findings show that dividend yield outperformance has its moments in various geographic locations.

Filbeck and Visscher (2003) conducted a similar study in Canada by applying the high dividend yield strategy to the Toronto 35 Index. The study found the same results as that of the USA, because the Sharpe ratio and Treynor ratio were higher, and the strategy produced higher risk-

adjusted returns than Toronto 35. Brzescsynski and Gajdka (2007) applied the same strategy in Poland, where they constructed a portfolio of 10 stocks that pay the highest dividends. The portfolio's performance did outperform the Warsaw Stock Exchange, according to the analysis; however, the outperformance was not always consistent. Even after accounting for risk, the portfolio's Sharpe and Treynor ratios were higher than market returns, according to the analysis. To guarantee that scholars are projecting accurate, dependable results, more research on the strategy's outperformance in other geographic areas is required.

2.3.1.7. Size investing

According to Kang et al. (2014), Korean investment styles have outperformed passive benchmarks. The analysis revealed that consistent outperformance was achieved by investing in large-cap stocks and stocks that have consistently outperformed. Switzer's (2010) study found that small-cap stocks outperform large-cap stocks before the economy reaches a trough, while large-cap stocks outperform small-cap stocks in the years prior to reaching an economic peak in the USA. Switzer and Fan (2007) demonstrated that adding Canadian small caps to overseas investors' risk-return performance could be beneficial, as high returns on small caps may be country-dependent. Kim and Burnie (2002) suggested that the time-varying character of the company size effect could be due to the business cycle, with small businesses underperforming during economic downturns, likely due to poorer productivity and more financial leverage.

Rompotis (2018) studied the performance of small-cap stocks relative to large-cap stocks and found that small-cap ETFs perform better than large-cap ETFs, but this superiority is inconsistent over time. When looking at risk-adjusted returns, small-cap ETFs perform worse than large-cap stocks. Valadkhani's (2022) study also found that small-cap ETFs experience more losses during severe downturns than gains during severe upturns, and during the bull market, large-cap ETFs surge more than they fall in a downswing. Based on the empirical research mentioned above, small-cap stocks are more volatile than large-cap stocks, resulting in large-cap stocks having greater risk-adjusted returns than small-cap stocks.

2.3.1.8. Low volatility investing

The study by Hsu and Li (2013) found that equities with modest price swings outperformed stocks with big price fluctuations. According to the study, the inclusion of low volatility stocks in a portfolio can improve risk and returns and dramatically increase the efficient frontier. Zakamulin (2014) showed that unexpected volatility is negatively related to expected returns,

and using this predictive ability of unexpected volatility in dynamic asset allocation techniques can result in a significant improvement in risk-adjusted performance. Chong and Phillips (2012) found that developing a low-volatility portfolio with economic factors could improve the risk-reward ratio over a portfolio built only on return-based measures.

According to Zaher (2019), low volatility investing is one of the risk-return anomalies, with low volatility stocks outperforming high volatility stocks. The study by van Vilet (2018) highlights the concave relationship between trading volume and risk reduction when investing in low volatility portfolios. Bender et al. (2020) demonstrated that significant carbon reductions could be achieved across a variety of low-volatility-type portfolios without jeopardizing the portfolio's volatility reduction goals. Hsu and Chen (2017) investigated the impact of investor attention on low volatility investment strategies. They found that, in the presence of high investor attention, low volatility strategies see a rise in returns due to the stocks' poor returns on idiosyncratic volatility.

2.3.2. Evidence that monetary policy affects stock prices.

The provided evidence from various academic studies has demonstrated that changes in monetary policy have an impact on stock prices. The sensitivity of stock prices to monetary policy changes varies across different economies (Xu et al., 2010). The direction of stock price movements highly depends on whether the Federal Reserve is hawkish or dovish. Xu et al. (2010) found that during contractionary monetary policy shocks, the impact on the stock market is significant in the United States but relatively small in Canada due to the openness of the financial market. Corallo (2006) discovered that the heteroscedasticity-based approach provides a larger response of stock prices to interest rate shocks compared to the event study approach. The study also found that the relationship between stock prices and interest rate shocks was not significant in Germany but was significant in the UK.

Haitsma et al. (2016) found that the impact of unexpected conventional and unconventional monetary policy surprises on the EURO STOXX 50 index was significant, with the effect of unexpected unconventional monetary policy surprises being much larger. The study shows that unexpected monetary policy loosening led to an increase in stock returns, which was statistically significant. Fausch and Sigonius (2018) also found a significant effect of monetary policy surprises on the stock market, with an increase of 25 basis points in interest rates resulting in a 1.64 percent decline in the stock market. The study also confirms the negative relationship between unconventional monetary policy surprises and stock returns.

Ioannidis and Kontonikas (2008) found that during periods of monetary policy tightening, stock market values decline in major Organisational for Economic Co-operation and Development countries due to higher discount rates resulting from interest rate hikes. Suhaibu et al. (2017) documented a bidirectional relationship between monetary policy and stock markets in African countries. The study found that stock markets in Africa respond positively to surprise changes in interest rates, while interest rates respond negatively when the stock market decline comes as a shock. Further studies should investigate the causes of these anomalies in African countries, given their different monetary regimes from those in advanced economies. Durham (2003) discovered that the impact of monetary policy on stock prices has weakened over time, including in the United States of America.

2.3.2.1. VAR model studies

The study of Thorbecke (1997) applied the Vector Autoregressive model, where monetary policy innovations are identified by Cholesky decomposition, to investigate the association between monetary policy and asset prices in the USA. The study used various measures of monetary policy stance and found evidence that expansionary monetary policy increases ex-post returns. VAR was utilised in the study of Kontonikas and Zekaite (2018) to analyse how changes in monetary policy and stock prices at the market and portfolio levels are interdependent. They discovered that an unexpected 25-basis-point reduction in the federal funds rate objective causes broad stock indices to rise by 1 percentVAR in this study will be used to analyse how changes in monetary policy and investment styles are interdependent.

The study of Neri (2004) employed the structural VAR model to evaluate the effects of exogenous monetary policy shocks on stock market indices in the G7 countries and Spain. The researcher found that contractionary monetary policy has a negative impact on the stock market through the transmission mechanism by using an estimated model for each country. In addition, the researcher discovered evidence of significant cross-country variation in the response's amplitude, durability, and timing. According to the scholars mentioned above, the VAR model has been successful in examining the impact of monetary policy shocks on asset prices or stock returns in different regions. The study of Cepni and Gupta (2021) used the VAR model to investigate the time-varying impact of monetary policy shocks on US stock returns conditional on the states of investor sentiment. The study found that, even after accounting for time-varying model parameters, contractionary monetary policy shocks have a negative impact on stock returns and are more pronounced or stronger in areas with high investor sentiment.

2.3.2.2. Evidence that monetary policy tightening affects stock prices.

The research by Ehrmann and Fratzscher (2004) demonstrated how tightening monetary policy reduces demand for debt due to high borrowing costs. In addition, through a transmission mechanism, investment and consumption spending decrease, resulting in lower expected future cash flows, which lowers the price of current stocks. When determining a stock's current price, the discount factor rises due to the increased interest rate, which is inversely correlated to the stock price. The study of Chen et al. (2017) demonstrated that asset prices react differently when monetary policy tightening is implemented in China using the Qual VAR methodology. However, the study found that stock prices remained unaffected when the monetary policy tightening shock was implemented.

The study of Kontonikas and Zekaite (2018) added to the study of Bernanke and Kuttner (2005), which found that a monetary policy shift could fuel the risk premium. According to the research by Kontonikas and Zekaite (2018), as monetary policy is tightened, investors' perceptions of risk or their level of risk aversion increase, causing the equity risk premium on stock prices to rise. The study further documented that current stock prices decline because of the increased equity premium. Through different transmission mechanisms, monetary policy tightening reduces stock prices. Although there is a lagged response by small stocks compared to large stocks, Kontonikas and Zekaite (2018) found the data to confirm a substantial negative and considerable monetary policy tightening influence effect on stock prices.

The above scholars have shown that during monetary policy tightening, the interest rate is hiked, which through transmission mechanism reduces the stock prices. The reduction in the stock prices results in reduced stock returns. Risk-free rate is impacted by changes in monetary policy that result in rising or falling interest rates. When monetary policy is changed, it has an impact on the market premium, which is $E(R_m) - R_f$, which in turn has an impact on the expected return of the stocks. Returns on investment styles are influenced by stock performance. The returns on investment styles are impacted by changes in monetary policy through transmission mechanisms. Monetary policy tightening has a negative impact on stock returns, according to the scholars mentioned above and on the back of this notion, investment style returns are expected to decline as monetary policy is tightened.

2.3.2.3. Evidence that monetary policy easing affects stock prices.

The study by Chen et al. (2017) found that stock prices in China increased when monetary policy was eased, demonstrating a positive impact. As explained in the study by Al-Jassar and

Moosa (2018), quantitative easing is a central bank strategy that creates new money and supplies it to the financial market to purchase securities from financial institutions, with the primary goal of keeping interest rates low to encourage borrowing and spending. The study found that stock prices were significantly impacted by quantitative easing. However, the findings were not definitive due to the election of presidency of Donald Trump in 2016 and other factors at play.

Cao and Hygrell (2022) investigated the effects of US quantitative easing on the Chinese stock market using the vector autoregressive model (VAR). They found a positive and statistically significant correlation between the US central bank's supply of money and Chinese stock prices. Balatti et al. (2016) used VAR to examine how quantitative easing boosted stock prices in the US and the UK, and the study's results revealed a correlation between quantitative easing and the rise in share prices. Lower interest rates due to monetary policy easing reduce the equity risk premium, leading to increased household consumption and investment spending and, in turn, higher equity prices. The market premium return, which is equal to $E(R_m) - R_f$, also increases due to the lower interest rate, raising expected returns. Scholars have shown that monetary policy easing has a positive effect on stock returns, and as a result, investment style returns are expected to increase.

2.3.3. Evidence that monetary policy affects investment styles.

Compared to restrictive periods, returns during expansionary monetary policy are higher, and risk is lower, regardless of investment strategy (Johnson et al., 2000). The study by Johnson et al. (2000) indicates that alerting customers about the likelihood of lower returns during periods of tight monetary policy may lead to happier investors and allow money managers to focus on the job of developing and monitoring portfolios rather than explaining what happened. Page et al. (2021) discovered that momentum style rotation is the most effective across short and long periods. Investment styles perform differently during different economic cycles, with some performing better during monetary policy tightening and others yielding worse returns.

The effectiveness of value strategies has been undermined by central bank initiatives and the low-interest-rate environment during the past ten years, which have skewed asset prices by lowering discount rates (Israel et al., 2021). The absolute and risk-adjusted returns from value investment are significantly predicted by monetary policy shocks that deliver fresh macroeconomic information. Federal Reserve information shocks that are favourable result in higher future value returns (Adra and Menassa, 2022). The study also demonstrated that value

investment performs poorly if the Federal Reserve announces unfavourable adjustments to monetary policy. The study's authors Adra and Menassa (2022), discovered that the Fed's monetary policy adjustments have a sizable impact on value stock returns. The results demonstrate that monetary policy changes do impact investment style.

2.4. Conclusion

Markowitz (1954) emphasized the importance of efficient asset allocation in his modern portfolio theory, which aims to reduce a portfolio's idiosyncratic risk while optimizing returns within a specified level of risk. The Capital Asset Pricing Model established the relationship between risk and returns, where systematic and unsystematic risks are distinguished. Changes in monetary policy, such as interest rate adjustments, affect the risk-free rate and market premium $E(R_m) - R_f$, which subsequently affects expected stock returns. Blitz (2014) notes that passive investing, based on the efficient market hypothesis and capital asset pricing model, has gained popularity, while active investing attempts to outperform asset benchmarks.

Factor investing, which relies on identified factors that yield disproportionate returns over time, such as value investing, quality investing, momentum investing, growth investing, low volatility investing, high dividend yield investing, and firm size, has been well-researched. Investment style indices developed by MSCI have been beneficial to investors. The impact of monetary policy shocks on asset prices has been studied, with most researchers using the VAR methodology, finding that tighter monetary policy has a negative impact on asset prices. In contrast, monetary policy relaxation positively affects stock prices. Few studies have been conducted on the impact of monetary policy shocks on investment styles, with Adra and Menassa (2022) finding that value investment performs poorly when the Fed announces unfavourable monetary policy adjustments. This study aims to investigate how monetary policy shocks affect investment styles in advanced and emerging economies using vector autoregressive methodology.

Chapter 3: Data and Methodology

3.1. Introduction

This chapter of the study outlines the methodology employed to analyse the sample data and answer the research question presented in chapter 1. This chapter aims to establish the research's legitimacy and provide details on the variables used in the study. Specifically, data is presented, and the independent, dependent, and control variables are constructed and defined. The methodology also describes the control variables for emerging (South Africa) and advanced economies (United States of America). The methodology employed in this paper is like that of Bjornland and Leitemo (2009) and Kontonikas and Zekaite (2018), which identified the interdependence between US monetary policy, the stock market, and stock valuation using the VAR methodology. However, this paper focuses on the impact of monetary policy shocks on investment styles using the VAR methodology in both advanced and emerging economies.

3.2. Methodology

3.2.1. VAR Methodology

Numerous researchers in the empirical literature have shown that monetary policy shocks affect stock prices and investment styles react to monetary policy shocks, and the researchers applied VAR models in their research (Thorbecke, 1997; Neri, 2004; Kontonikas and Zekaite, 2018; Cepni and Gupta, 2021). Investment style returns are derived from stock prices, depending on their characteristics. This study will employ VAR methodology to investigate the impact of monetary policy shocks on investment styles. The VAR model will be used in this section of the study for both advanced and emerging economies. Appropriate VAR characteristics will be applied for South Africa and the United States of America to reduce variations in the models that apply to the various countries and maintain comparability in the results' estimates.

Many scholars in the empirical literature have reiterated that asset prices respond to monetary policy shocks (Ioannidis and Kontonikas, 2008; Bjornland and Leitemo, 2009; Kontonikas and Zekaite, 2018). Scholars have shown that monetary policy tightening has a negative impact on asset prices, and such a trend will be assessed to see if it applies to investment styles (Israel et al., 2021). The VAR methodology will help answer questions in Chapter 1, such as what happens to equity investment styles when there is a monetary policy shock, and the impulse responses will be able to show the magnitude at which investment styles respond to the monetary policy shocks. The VAR methodology is comprised of three main variables: the independent variable, the dependent variable, and the control variables. First, this paper takes

monetary policy (interest rates) published by the central banks as an exogenous or independent variable in the VAR system.

Second, the endogenous or dependent variables are the investment styles such as value investing, growth investing, quality investing, momentum investing, size investing, which includes large-cap stocks, medium-cap stocks, and small-cap stocks, low volatility investing, and high dividend yield investing. Morningstar uses the style box to determine different investment styles by studying the characteristics of stocks and mutual funds, market cap, and investment style benchmarks. Price-to-book, Price-to-sales, price-to-cash flow, dividends yield, historical earnings growth, sales growth, cash flow growth, and book value growth are the factors or ratings used in measuring or determining if the stock is value or growth or quality by Morningstar (Morningstar, 2022). Third, control variables include inflation, changes in commodity prices, industrial production (real output for South Africa and output gap for the USA), and exchange rates.

3.2.2. Emerging economy methodology

This paper uses a standard VAR model to analyse the response of investment styles to monetary policy shocks in South Africa. The model includes inflation, output, exchange rate, and commodity prices as control variables. To ensure the reliability of the results, the study employs Augmented Dickey-Fuller tests to check for stationarity at the level. If a variable is not stationary, it is first differenced before being included in the model. Bjornland and Leitemo (2009) noted that all variables in a VAR model must be stationary, hence the importance of conducting ADF tests and applying the first difference as needed. First, we include monetary policy (interest rates) as the independent variables, and it is first differenced in the ADF test to achieve stationarity, as it was not stationary at level. All variables' responses in the model are tested against the interest rates.

Real output is stationary at the level and complies with economic fundamentals. The study by Kontonikas and Zekaite (2018) demonstrated that inflation has a price puzzle, while the study by Bjornland and Leitemo (2009) discovered that inflation does not immediately react to monetary policy shocks in the short run. However, a response is evident in the intermediary period. Exchange rate volatility significantly impacts asset prices in emerging markets in the short and long term (Hajilee and Al Nasser, 2014), hence the inclusion of the exchange rate in the model. Commodity prices are one of the control variables. The real returns for the

investment styles are used in this paper, as in the paper by Bjornland and Leitemo (2009), but they are stationary at the level.

The matrices used are (*6 x 6*), representing (*n x n*) matrices. The exogenous variables include the independent variables, which are the interest rate (i_t), and the control variables, which are inflation (π_t) and change in commodity prices (ΔC_t), Y_t which represent the real output and the exchange rates (Er_t) (Kontonikas and Zekaite, 2018). The endogenous state vector contains the dependent variables, which include all the equity investment styles (IS_t), such as value investing (V_t), growth investing (G_t), momentum investing (Mom_t,), quality investing (Q_t), dividend yield (Hdy_t), size investing (SMB_t), and low volatility investing (Lv_t). If the F_t to be a (*6 x 1*) vector of macroeconomic variables discussed above is shown as:

$$F_t = [Y_t, \pi_t, Er, \Delta C_t, IS_t, i_t] \quad \textbf{(1)}$$

$$D_0 F_t = D\mathrm{F}_{t-1} + D2_t + F_{t-2} + \cdots DF_{t-p} + \mathcal{E}_t \quad \textbf{(2)}$$

$$F_t = \mathrm{C(S)} m_t \quad \textbf{(3)}$$

Where m_t is the (*n x 1*) vector containing n dependent variables D_0 is the (*n x n*) matrix of response coefficients occurring contemporaneously. D_i for integers =1, 2, 3, 4, … *p* is the (*n x n*) matrix of lag coefficients and F_t denotes the (*n x 1*) vector of the uncorrelated structural innovations of zero mean and variance covariance matrix (Kontonikas and Zekaite, 2018). Due to the dependent variables being contemporaneously correlated, the ordinary least squares method cannot be utilized to estimate the structural model (Kontonikas and Zekaite, 2018). The standard VAR model was used to achieve the results of the impulse.

$$F_t = \mathrm{C(S)}^{-1} \mathcal{E}_t = N(S) \mathcal{E}_t \quad \textbf{(4)}$$

Equation 4 emphasizes the (*n x n*) matrix polynomial lags $N(S)$. The system's dependent or endogenous variables are all expressed in terms of the recent and historical monetary policy shocks. The purpose is to identify the pattern of responses in relation to the shocks of monetary policy changes to investment styles. We can then write the $\mathcal{E}_t$ as a linear function or combinations of $m_t = D\mathcal{E}_t$ where the D is the (*n x n*) matrix of contemporaneous response coefficients. Equation 5 is now expressed in terms of monetary policy shocks as:

$$F_t = \mathrm{N(S)} \mathcal{E}_t \quad \textbf{(5)}$$

Where the $C(S)D = \mathrm{N}(\mathrm{S})$. The D is then identified, but first the $\mathcal{E}_t$ is then to be normalized with the unit variance. The sequence of uncorrelated monetary policy shocks is denoted as $\mathcal{E}_t = \mathcal{E}_t^i, \mathcal{E}_t^Y, \mathcal{E}_t^\pi, \mathcal{E}_t^{Er}, \mathcal{E}_t^C, \mathcal{E}_t^{IS}$. The $\mathcal{E}_t^i$ is the monetary policy shock represented by the interest rates, $\mathcal{E}_t^\pi$ is the inflation, $\mathcal{E}_t^{Er}$ is the exchange rate, $\mathcal{E}_t^C$ is the change in the commodity prices, $\mathcal{E}_t^Y$ is the real output, and $\mathcal{E}_t^{IS}$ is the investment styles. The study shows how monetary policy shocks impact macro-economic variables such as inflation, real output, exchange rate, and commodity prices. For example, if the interest rate increases, each country's inflation response is unique. In this study, the price puzzle is evident. The four macroeconomic variables are arranged well above the interest rate in the sequence, and four zero limitations are made on the corresponding coefficients in the sixth column of the D matrix, just like in the study of Bjornland and Leitemo, (2009), as follows:

$$\begin{pmatrix} Y_t \\ \pi_t \\ Er_t \\ \Delta C_t \\ IS_t \\ i_t \end{pmatrix} = C(S) \begin{pmatrix} D_{11} & 0 & 0 & 0 & 0 & 0 \\ D_{21} & D_{22} & 0 & 0 & 0 & 0 \\ D_{31} & D_{32} & D_{33} & 0 & 0 & 0 \\ D_{41} & D_{42} & D_{43} & D_{44} & 0 & 0 \\ D_{51} & D_{52} & D_{53} & D_{54} & D_{55} & D_{56} \\ D_{61} & D_{62} & D_{63} & D_{64} & D_{65} & D_{66} \end{pmatrix} \begin{pmatrix} \mathcal{E}_t^Y \\ \mathcal{E}_t^\pi \\ \mathcal{E}_t^{Er} \\ \mathcal{E}_t^C \\ \mathcal{E}_t^{IS} \\ \mathcal{E}_t^i \end{pmatrix} \quad \textbf{(6)}$$

The relationship between the shocks to investment style and the macroeconomic variables is subject to the same recursive limitations. Four zero limits cause macroeconomic variables to respond to the investment style shock with a lag while allowing investment style shocks to respond instantly to all variables (as there are no zeroes in the fifth row) (Bjornland and Leitemo, 2009). Macroeconomic factors are thought to be unaffected by monetary policy in the current. However, monetary policy is still able to react to shocks to these variables in the same timeframe, e.g., central banks may see the need to hike interest rates if the inflation is too high. Therefore, in the state vector F_t, real output, inflation, exchange rate movements, and commodity price changes are ranked higher than interest rates (Kontonikas and Zekaite, 2018).

Given that it is presumed that no other variable in the system is having an immediate impact on the lagged growth rate of industrial production, it is ranked first. Consumer prices can react to a shift in commodity prices through a transmission mechanism process thus, rising oil prices can impact consumer prices through a transmission mechanism. The variables in the VAR model will not respond immediately to the shock of monetary policy; also, the investment styles are not contemporaneously impacted by any other variable in the VAR model. The two final rows D imply that the short-run contemporaneous relationship between investment styles and monetary policy remains unrestricted. The study by Bjornland and Leitemo (2009) applied

final restrictions with respect to the long-run relationship between monetary policy shocks and investment style returns. However, this study uses the standard VAR model, which does not require restrictions.

3.2.3. Advanced economy methodology

The interest rate will enter the VAR system as an independent variable, while output gap, change in commodity prices, and inflation will enter the VAR system as the control variables. The output gap in the USA, just like in South Africa, has declined to the shocks of interest rates. The endogenous state vector contains the dependent variables, which include all the investment styles such as value investing (V_t), growth investing (G_t), momentum investing (Mom_t,), quality investing (Q_t), high dividend yield (Hdy_t), size investing (SMB_t), liquidity investing (L_t), and low volatility investing (Lv_t). Investment styles will enter the VAR system as the dependent variable, just like in the emerging economy methodology. If the F_t to be a (*5 x 1*) vector of macroeconomic variables discussed above is shown as:

$$F_t = [Y_t, \pi_t, \Delta C_t, IS_{t,} i_t] \quad \textbf{(7)}$$

Bjornland and Leitemo (2009) demonstrated that this equation is the (5 x 5) vector of macroeconomic variables in a VAR model. The equation below simplifies the above equation in terms of moving averages representation.

$$F_t = \mathrm{C(S)}m_t \quad \textbf{(8)}$$

Where m_t is the (*n x 1*) vector containing n dependent variables, D_0 is the (*n x n*) matrix of response coefficients occurring in the model. D_i for integers =1, 2, 3, 4, … *p* is the (*n x n*) matrix of lag coefficients and F_t denotes the (*n x 1*) vector of the uncorrelated structural innovations of zero mean and variance covariance matrix (Kontonikas and Zekaite, 2018). Due to the dependent variables being contemporaneously correlated, the ordinary least squares method cannot be utilized to estimate the structural model (Kontonikas and Zekaite, 2018). The standard VAR model was used to achieve the results of the impulse.

$$F_t = \mathrm{C(S)}\mathcal{E}_t \, , \quad \textbf{(9)}$$

Where the $C(S)D = \mathrm{N(S)}$. The *D* is then identified, but first the $\mathcal{E}_t$ is then to be normalized with the unit variance. The sequence of uncorrelated monetary policy shocks is denoted as $\mathcal{E}_t = \mathcal{E}_t^i, \mathcal{E}_t^Y, \mathcal{E}_t^\pi, \mathcal{E}_t^C, \mathcal{E}_t^{IS}$. The $\mathcal{E}_t^i$ is the monetary policy shock represented by the interest rates, $\mathcal{E}_t^\pi$ is the inflation, $\mathcal{E}_t^Y$ is the output gap, $\mathcal{E}_t^C$ is the change in the commodity prices, and $\mathcal{E}_t^{IS}$ is the investment styles. The study follows the study of Bjornland and Leiteno, (2009) by assuming

that other macro-economic variables do not simultaneously change to monetary policy shocks. The three macroeconomic variables are arranged well above the interest rate in the sequence, and three zero limitations are made on the corresponding coefficients in the fifth column of the D matrix, just like in the study of Bjornland and Leiteno, (2009), as follows. The matrix below is (5 x 5):

$$\begin{pmatrix} Y_t \\ \pi_t \\ \Delta C_t \\ IS_t \\ i_t \end{pmatrix} = C(S) \begin{pmatrix} D_{11} & 0 & 0 & 0 & 0 \\ D_{21} & D_{22} & 0 & 0 & 0 \\ D_{31} & D_{32} & D_{33} & 0 & 0 \\ D_{41} & D_{42} & D_{43} & D_{44} & D_{45} \\ D_{51} & D_{52} & D_{53} & D_{54} & D_{55} \end{pmatrix} \begin{pmatrix} \mathcal{E}_t^Y \\ \mathcal{E}_t^\pi \\ \mathcal{E}_t^C \\ \mathcal{E}_t^{IS} \\ \mathcal{E}_t^{it} \end{pmatrix} \quad \textbf{(10)}$$

According to research by Bjornland and Leitemo (2009) and Kontonikas and Zekaite (2018), monetary policy does not contemporaneously affect macroeconomic factors that are occurring at the time. However, there is a lag in reaction to the shocks in monetary policy changes. Three zero limitations allow the investment style to react quickly to monetary policy shocks (since there are no zeros in the fourth row) (Bjornland and Leiteno, 2009). The response of the macroeconomic factors to the investment styles is different with each variable. Each investment style response is independent of the other.

In the state vector F_t , output gap and inflation are therefore ranked higher than interest rates (Kontonikas and Zekaite, 2018) by assuming that commodities are affected by output and inflation. Only the latter allows for an immediate real investment-style return reaction to a shock in monetary policy. The lagged growth rate of the output is assumed to be unaffected by any other systemic variable; hence, it is ranked first. The response of inflation to the shocks of monetary policy is tested, and a price puzzle exists. According to the last two rows, D, there is still no restriction on the short-term contemporaneous relationship between investment styles and monetary policy.

3.3. Data and Sample

The monthly data from the USA is from January 1990, ending June 2022, and for South Africa, it is from December 1999 until June 2022. The interest rate used in this study is the 3-month Treasury bill for each country, set by the central banks of the nations under investigation will be used to identify changes in monetary policy. The goal is to have the central bank's interest rate reflect that of the nation itself. The investment styles data is sourced directly from MorningStar for each country using the currency of that particular country. Investment styles are measured by grouping of stocks based on their characteristics and their behaviour. Different

scholars have used different metrics on how to measure the investment styles and the literature review clearly explain how each investment style is measured and how it performs relative to other investment styles. MorningStar uses a style box to measure investment styles based on equities' behaviour, characteristics, and stock size.

MSCI FRED Economics and Bloomberg were used to gather information on interest rates, consumer prices, industrial production index, commodity prices, and exchange rates. The response of the different investment styles to monetary policy shocks, such as value investing, growth investing, quality investing, momentum investing, size investing, which includes large-cap stocks, medium-cap stocks, and small-cap stocks, low volatility investing, and high dividend yield investing, will be studied. In accordance with the available statistics, the study will concentrate on the United States of America and South Africa.

The paper by Bjornland and Leitemo (2009) and Kontonikas and Zekaite (2018) calculated inflation as the annual log of consumer prices, the change in commodity prices as the annual log of the commodity price index, and industrial production as the log of the industrial production index to obtain real output. A similar strategy is used in this paper to find the percentage change in the aforementioned control variables. The studies by Bjornland and Leitemo (2009) and Kontonikas and Zekaite (2018) used real returns in their analysis. Real returns of investment styles are computed by subtracting inflation from nominal returns. The study by Liu et al. (2021) found that the producer price index has no material impact on stock markets due to omitted variables and the counter-effect of price adjustment; hence, it is excluded in both countries. Table 1 below clearly shows the description of each variable and where the data was sourced from.

Table 1: Factors variables

Type of variable	**Name of the variable**	**Description of variables**	**Source**
Independent variable	Interest rates (risk free rate) - $\boldsymbol{i_t}$	The one-month rate of return on central banks or federal banks (Bjornland and Leitemo, 2009).	Bloomberg and FRED Economic Data.
Control variables	Inflation - $\boldsymbol{\pi_t}$,	The annualised log of consumer price index, (Bjornland and Leitemo, 2009).	FRED Economic Data.
	Exchange rates - $\boldsymbol{Er_t}$	The one-month log of currency prices.	FRED Economic data.

	Industrial Production index - $\boldsymbol{Y_t}$	Industrial Production Index is known as real output and is provided by the central banks. The one-month log of industrial production index, (Kontonikas and Zekaite, 2018).	FRED Economic Data.
	Changes in commodity prices - $\Delta \boldsymbol{C_t}$	The annualised log of commodity prices (Bjornland and Leitemo, 2009).	Bloomberg
Dependent variable	Growth investing - $\boldsymbol{G_t}$	The one-month return of growth investing benchmark measured by Morningstar for all countries investigated.	Morningstar.
	Quality investing - $\boldsymbol{Q_t}$	The one-month return of quality investing benchmark measured by Morningstar for all countries investigated.	Morningstar.
	Momentum Investing - $\boldsymbol{Mom_t}$	The one-month return of momentum investing benchmark measured by Morningstar for all countries investigated.	Morningstar.
	Low volatility investing - $\boldsymbol{Lv_t}$	The one-month return of low volatility investing benchmark measured by Morningstar for all countries investigated.	Morningstar.
	Size (small-cap, and large cap) - $\boldsymbol{SMB_t}$	The one-month return of small cap and large cap investing benchmark measured by Morningstar for all countries investigated.	Morningstar.
	High dividend yield investing - $\boldsymbol{Hdy_t}$	The one-month return of value investing benchmark measured by Morningstar for all countries investigated.	Morningstar.
	Value investing - $\boldsymbol{V_t}$	The one-month return of value investing benchmark measured by Morningstar for all countries investigated.	Morningstar.
	Investment styles - $\boldsymbol{IS_t}$	Represent all the investment styles.	Morningstar.

Chapter 4: Results and Analysis

4.1. Introduction

This chapter of the paper is dedicated to discussing and analysing the results by drawing from the existing literature. We will use the methodology as a means to analyse the results and available data for a comprehensive assessment of how investment styles respond to monetary policy shocks. The results presented below are influenced by the literature discussed earlier, where various scholars have demonstrated the impact of monetary policy on asset prices, both during monetary policy easing and tightening. The literature also sheds light on how monetary policy affects specific investment styles. This paper will extend this research by examining how all major investment styles respond to monetary policy tightening. Furthermore, this section of the paper addresses the problem statements posed in Chapter 1, aiming to provide insights into how monetary policy shocks affect investment styles.

The order of the results below begins with descriptive statistics, the Augmented Dickey Fuller test for stationarity, and lag length criteria, which determines the optimal number of lags to be employed by the model. The results will then show the impulse responses to measure the degree of responses by the investment styles and control variables to interest rates. The data used to estimate the models is monthly, as described in Chapter 3. The countries tested for are the United States of America, which represents advanced economies, and South Africa, which represents emerging markets. The output gap was computed using one sided Hodrick-Prescott Filter on the real output. CPI prices were used to calculate inflation (the annualized log difference of the consumer price index), and commodity prices were also calculated as the annual change in the log of commodity prices. Investment styles were converted to real returns, and T-bill rates represent the interest rate for each country.

4.2. USA results and analysis.

4.2.1. USA Descriptive statistic test and analysis

	Interest rates	Output gap	Inflation	commodity prices	Growth	High dividend yield	Large cap	Low volatility	Momentum	Quality	Small cap	Value
Mean	0.015	0.000	0.009	0.023	-0.003	-0.003	-0.004	-0.003	-0.003	-0.003	-0.001	-0.004
Median	0.009	0.000	0.009	0.030	0.000	0.000	0.001	-0.001	0.004	0.001	0.006	0.001
Maximum	0.062	0.021	0.035	0.271	0.152	0.108	0.128	0.091	0.115	0.116	0.221	0.126
Minimum	0.000	-0.065	-0.009	-0.332	-0.195	-0.146	-0.174	-0.158	-0.176	-0.164	-0.232	-0.173
Std. Dev.	0.017	0.011	0.007	0.111	0.051	0.040	0.045	0.036	0.047	0.043	0.060	0.045
Skewness	1.193	-2.011	0.844	-0.672	-0.522	-0.515	-0.457	-0.642	-0.674	-0.420	-0.252	-0.482
Kurtosis	3.304	11.990	5.795	3.450	4.025	4.830	3.806	4.522	3.860	3.753	4.684	4.264
Jarque-Bera	64.797	1087.22	119.478	22.534	23.984	49.445	16.645	44.453	28.684	14.274	34.623	28.322
Probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Sum	3.949	0.029	2.513	6.115	-0.899	-0.775	-1.057	-0.821	-0.828	-0.717	-0.157	-1.097
Sum Sq. Dev.	0.079	0.030	0.011	3.298	0.685	0.438	0.551	0.342	0.600	0.493	0.960	0.552
Observations	269.00	269.00	269.00	269.00	269.00	269.00	269.00	269.00	269.00	269.00	269.00	269.00

Small cap has the highest standard deviation, indicating that it is the most volatile among the investment styles and has the highest mean. The descriptive statistics above show the analogy of high risk and high return. The probability for all variables above is below 5 percent, which means that the variables are statistically significant. Commodity prices have the highest volatility among the control variables, and even the mean is the highest. The kurtosis for all the variables is above three, indicating that they are leptokurtic. The bell shape of the variables has thin tails on the back of the kurtosis, being above three. All the investment style variables have negative skewness, which shows that the bell shape is skewed to the left and the tail of the distribution curve is longer on the left side. Commodity and output gap also have negative skewness, indicating that the bell shape is skewed to the left and the tail of the distribution curve is longer on the left side. Only interest rates and inflation have positive skewness, meaning they are skewed to the right, and the tail of the distribution curve is longer on the right side.

4.2.2. USA correlation matrix results and analysis

	Output gap	Inflation	Commodity prices	Growth	High dividend yield	Large cap	Low volatility	Momentum	Quality	Small cap	Value	Interest rates
Output gap	1.000											
Inflation	-0.136	1.000										
Commodity prices	-0.480	0.736	1.000									
Growth	-0.083	-0.336	-0.130	1.000								
High dividend yield	-0.053	-0.267	-0.089	0.732	1.000							
Large cap	-0.075	-0.312	-0.101	0.964	0.858	1.000						
Low volatility	-0.070	-0.300	-0.109	0.845	0.920	0.912	1.000					
Momentum	-0.102	-0.335	-0.085	0.902	0.706	0.884	0.838	1.000				
Quality	-0.057	-0.333	-0.130	0.965	0.824	0.973	0.895	0.869	1.000			
Small cap	-0.035	-0.277	-0.058	0.800	0.666	0.834	0.735	0.780	0.782	1.000		
Value	-0.068	-0.264	-0.050	0.833	0.940	0.943	0.915	0.785	0.892	0.806	1.000	
Interest rates	0.088	0.286	0.225	-0.173	-0.092	-0.148	-0.112	-0.118	-0.147	-0.078	-0.097	1.000

The above table is the correlation matrix for the USA that shows all the investment styles being negatively correlated to the interest rates. There is somewhat a weak positive correlation between inflation and the interest rate, which shows that there are certain times when inflation is driving the interest rate up, which may be displayed by the price puzzle in the USA impulse response analysis. Central banks use interest rates to curb the inflation. Initially, inflation moved in the same direction as the interest rates but declined in the intermediary period. There is a weak positive correlation between output gap and inflation. Commodities are displaying a weak positive correlation with inflation. Investment styles are highly correlated to one another.

4.2.3. USA Augmented Dicky Fuller test results and analysis

Variables	Probability at level	Probability at first difference	T-statistic at level	T-statistic at first difference
Interest rates	0.037**	0.001***	2.987	4.276
Commodity prices	0.001***		4.307	
Inflation	0.123	0.001***	2.471	4.076
Output gap	0.000***		6.093	
Growth	0.000***		9.237	
High dividend yield	0.000***		5.879	
Large cap	0.000***		16.705	
Low volatility	0.000***		4.829	
Momentum	0.000***		9.537	
Quality	0.000***		5.520	
Small Cap	0.000***		15.868	
Value	0.000***		18.283	

The table above shows the results of the United States of America (USA) Augmented Dickey-Fuller (ADF) test run through Eviews. The purpose of the ADF test is to determine if the variables have a unit root and whether they are stationary. The null hypothesis for each variable tested is that it has a unit root. From the results presented above, the interest rate p-value is at 0.037, and the t-statistic is above critical values at 95 percent and 90 percent confidence intervals. We can now reject the null hypothesis and conclude that interest rates do not have a unit root, are stationary at 90 percent and 95 percent confidence intervals, and are statistically significant. The first difference was applied to obtain stationarity at all confidence intervals. Consequently, the p-value measured at 0.00 percent leads us to reject the null hypothesis on all confidence intervals, and we conclude that interest rates have no unit root at the first difference, are stationary at all confidence intervals, and are statistically significant.

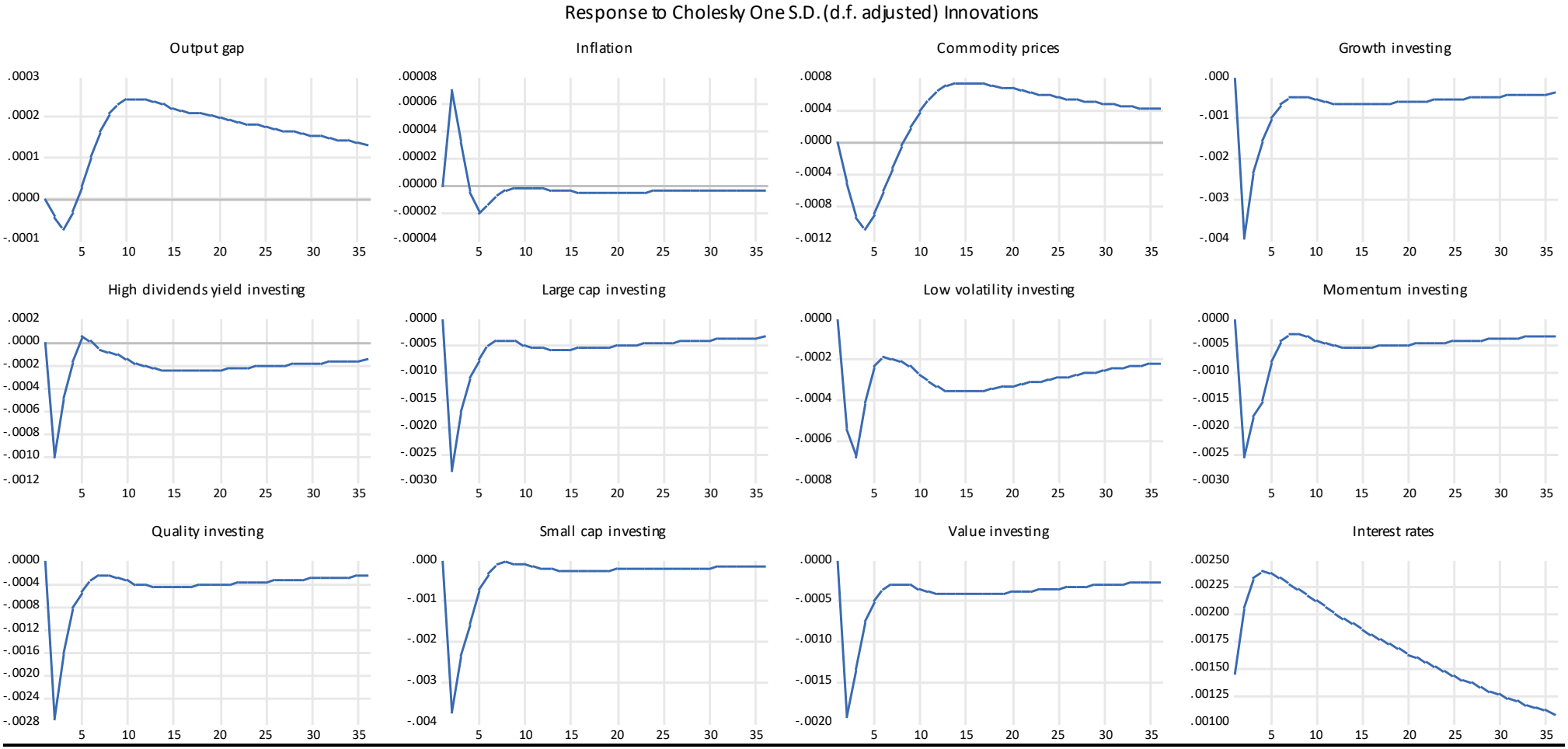
Commodity prices and output gap were tested at level and the results measured p-value of 0.00 percent and t-statistic above critical values on all confidence intervals, respectively. Such results force us to reject the null hypothesis and conclude that commodity prices and output gaps have no unit root, are stationary at all confidence intervals, and are statistically significant. All investment styles were tested with the null hypothesis that each variable has a unit root. The results indicate that none of the investment styles have a unit root and are stationary with statistical significance at all confidence intervals of 90 percent, 95 percent, and 99 percent. The p-values recorded for all investment style variables are 0.00 percent, which forces us to reject the null hypothesis. The t-statistics above all critical values in the appendix reinforce the conclusion that the investment style variables are without unit root and are stationary.

4.2.4. USA Lag length criteria test and analysis

Lag	LogL	LR	FPE	AIC	SC	HQ
1	10301.110	NA	2.56E-49	-77.832	-75.866*	-77.042*
2	10492.190	347.017	1.8E-49	-78.193	-74.260	-76.612
3	10656.890	283.965	1.56e-49*	-78.352*	-72.452	-75.980
4	10764.200	175.144	2.12E-49	-78.071	-70.204	-74.908
5	10877.490	174.500	2.82E-49	-77.835	-68.002	-73.883
6	10986.410	157.743	3.98E-49	-77.566	-65.767	-72.823
7	11129.690	194.331	4.46E-49	-77.561	-63.794	-72.027
8	11268.900	176.017*	5.38E-49	-77.524	-61.7911	-71.200

The above table is the lag length criteria. Eight lags were used to determine the optimal number of lags to use in a VAR model to best fit the model. Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion, and Schwarz Information Criterion (SIC) are used in this model to ensure that the model is capturing the right patterns and trends of variables in a dataset. Schwarz Information Criterion (SIC) and Hannan-Quinn Information Criterion are optimal at one lag. However, Akaike Information Criterion (AIC) is optimal at three lags, which are demonstrated by the stars above.

4.2.5. USA Impulse response results and analysis



Response of variables to monetary policy tightening.

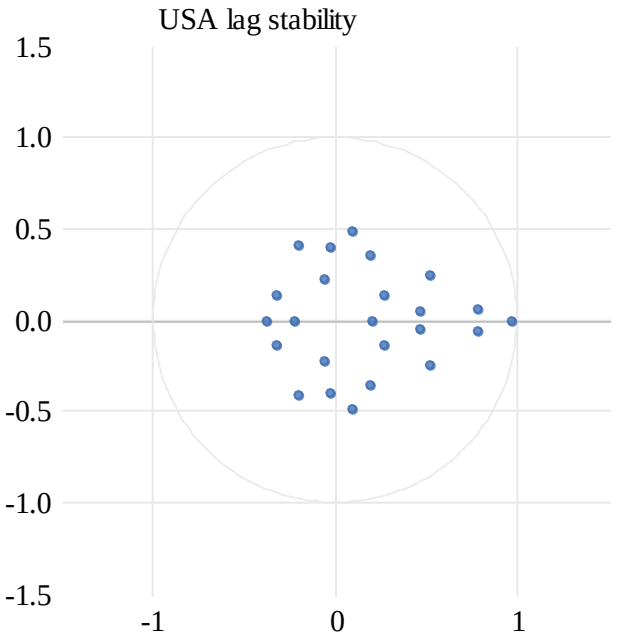
All variables except for inflation were stationary at level, and the first difference was applied to achieve stationarity. The USA impulse response was conducted on how the following variables, such as inflation (infl), output gap, commodity prices (CMPI), growth (G), high dividend yield (HDY), large cap (LC), low volatility (Lv), momentum (MOM), quality (Q), small cap (SC), and value (V), respond to the shock of interest rates. The results show that the output gap declined in the short term in response to the positive shock of interest rates. Interest rates are used to slow down the growing economy to stabilize it. Additionally, there is a price puzzle with inflation, where it does not immediately decline in response to the increase in interest rates. This result is consistent with Bjornland and Leitemo's (2009) findings, where they discovered that inflation increases in the short run before eventually declining in the intermediary term.

Commodity prices declined in the short term in response to the positive shock of interest rates. As interest rates increased, commodity prices declined accordingly. Investment styles declined because of the positive interest rate shock, but the magnitude is peculiar to each investment style. Growth investing declined more than all other investment styles (approximately -4 percent) in response to the positive shock of interest rates. Scholars have documented in the literature that growth stocks have a high price-to-earnings ratio. By increasing interest rates, the discount factor is increased, and the price of the stock dramatically declines, hence why growth investing declined more than others did. High dividend yield, value, and low volatility declined less than any other investment style at approximately -1 percent, -1.2 percent, and 0.2 percent, respectively, in response to the positive shock of interest rates. Investors can use high dividend yield, value, and especially low volatility investment styles in periods where central banks are hiking interest rates excessively as a haven.

Large cap and small cap declined differently in response to the positive shock of interest rates, with small cap declining more than large cap. The descriptive statistics have shown that a small cap is more volatile than a large cap. Large cap declined approximately -2.5 percent, and small cap declined below -3 percent. The response indicates that small cap has higher drawdowns than large caps. Momentum declined approximately -2 percent, and quality declined -2.4 percent in response to the positive shock of interest rates. Quality buys high-quality companies that are less volatile, while momentum is buying recent winners and selling recent losers; hence, they declined less than growth and small cap, which are highly cyclical and price sensitive.

Overall, low volatility, value, and high dividend yield investing should be the safe haven for investors during the central bank hiking cycle. Investors should sell growth and small cap due to large drawdowns that could be incurred. Investors should hold neutral positions in momentum and quality investment styles. These findings are consistent with the studies by Bjornland and Leitemo (2009) and Kontonikas and Zekaite (2018), which showed that a positive shock of interest rates results in a negative response in asset prices (stocks).

4.2.6. USA VAR stability conditions results and analysis



The purpose of the above is to check if VAR is stable, which implies that VAR is stationary if the AR polynomial has a modulus that falls inside the unit circle and is below one. The units in the above VAR stability conditions fall within the unit circle and are below one. Such results prove that the VAR model is stable and stationary.

4.3. South African results and analysis

4.3.1. South African descriptive Statistic results and analysis

	Interest rate	Inflation	Exchange rate	Commodity prices	Real output	Growth	High dividend yield	Large Cap	Low volatility	Momentum	Quality	Small cap	Value
Mean	0.071	0.020	0.991	0.032	2.016	-0.009	-0.005	-0.010	-0.009	-0.007	-0.009	-0.006	-0.011
Median	0.070	0.020	0.989	0.041	2.021	-0.008	0.001	-0.010	-0.008	-0.005	-0.007	-0.003	-0.008
Maximum	0.127	0.054	1.269	0.280	2.079	0.166	0.163	0.151	0.134	0.175	0.137	0.109	0.132
Minimum	0.035	-0.011	0.758	-0.266	1.712	-0.194	-0.224	-0.193	-0.205	-0.225	-0.198	-0.281	-0.310
Std. Dev.	0.021	0.010	0.139	0.090	0.032	0.056	0.058	0.051	0.049	0.058	0.052	0.048	0.056
Skewness	0.709	0.086	0.167	-0.559	-3.988	-0.128	-0.328	-0.194	-0.437	-0.228	-0.195	-0.939	-0.673
Kurtosis	3.181	4.671	1.602	3.846	36.541	3.404	3.665	3.881	4.102	4.037	3.469	7.187	6.466
Jarque-Bera	21.521	29.756	21.776	20.718	12530.0	2.416	9.195	9.772	20.870	13.525	3.923	221.964	145.794
Probability	0.000	0.000	0.000	0.000	0.000	0.299	0.010	0.008	0.000	0.001	0.141	0.000	0.000
Sum	18.062	5.036	250.682	8.178	509.978	-2.253	-1.206	-2.438	-2.285	-1.719	-2.295	-1.534	-2.729
Sum Sq. Dev.	0.113	0.027	4.890	2.053	0.252	0.778	0.861	0.647	0.608	0.852	0.689	0.582	0.796
Observations	253	253	253	253	253	253	253	253	253	253	253	253	253

The table above demonstrates the descriptive statistics for South African variables like the USA. High dividend yield has the highest mean amongst investment styles, implying high returns over the stated period, and has the highest standard deviation, implying high risk. High risk, high return analogy is evident in this descriptive statistic. Value has the lowest mean (-0.011) in the tested period, in line with the results of Pinto et al. (2021) where the study discovered that pre-financial crisis, value stocks outperformed growth stocks; however, during the crisis, growth stocks outperformed value stocks. The study by Pinto et al. (2021) further demonstrated that growth stocks outperformed value stocks post-global financial crisis period. The study by Bellone and Carvalho (2022) also discovered that value stocks went through underperformance in recent periods.

Growth and quality have the p-value above 5 percent, indicating that they are not statistically significant. Value, small cap, large cap, low volatility, high dividend yield, momentum, inflation, real output, interest rates, exchange rates, and commodity prices have a p-value below 5 percent, which means they are statistically significant. The kurtosis for all variables except that of exchange are above three, indicating that they are leptokurtic. The bell shape of these variables has thin tails on the back of the kurtosis, being above three. All the investment style variables have negative skewness, which shows that the bell shape is skewed to the left and the tail of the distribution curve is longer on the left side. Commodity prices and real output have negative skewness, which shows that the bell shape is skewed to the left and the tail of the distribution curve is longer on the left side.

4.3.2. South African correlation matrix results and analysis

	Real output	Inflation	Exchange rate	Commodity prices	Growth	High dividend yield	Large Cap	Low volatility	Momentum	Quality	Small cap	Value	Interest rate
Real output	1.000												
Inflation	0.172	1.000											
Exchange rate	-0.059	0.154	1.000										
Commodity prices	0.266	0.126	-0.104	1.000									
Growth	-0.132	-0.358	-0.056	-0.069	1.000								
High dividend yield	-0.223	-0.331	-0.116	0.006	0.640	1.000							
Large Cap	-0.162	-0.385	-0.126	-0.021	0.898	0.785	1.000						
Low volatility	-0.174	-0.388	-0.148	-0.005	0.820	0.801	0.964	1.000					
Momentum	-0.168	-0.392	-0.116	-0.014	0.908	0.686	0.934	0.895	1.000				
Quality	-0.109	-0.373	-0.168	0.011	0.844	0.786	0.938	0.923	0.889	1.000			
Small cap	-0.187	-0.364	-0.155	0.001	0.586	0.761	0.770	0.836	0.694	0.734	1.000		
Value	-0.149	-0.347	-0.169	0.023	0.682	0.782	0.928	0.922	0.817	0.875	0.786	1.000	
Interest rate	0.018	0.470	-0.325	-0.050	-0.196	-0.165	-0.203	-0.212	-0.198	-0.175	-0.195	-0.178	1.000

The above graph is the correlation matrix of all the variables. Interest rates and real output have close to zero correlation at 0.018, showing that they are somewhat uncorrelated. The positive correlation between inflation and interest rates at 0.47 shows that interest rates and inflation move in the same direction at times when central banks are still trying to curb inflation by increasing interest rates. The study by Bjornland and Leitemo (2009) discovered that inflation does not decline to the shock of monetary policy in the short run but in the intermediary. The impulse response on exercise 4.3.4 showed a price puzzle where interest rates were moving in the same direction as interest in the short run but declined in the intermediary period. Interest rate is negatively correlated to all investment styles. Interest rate is negatively correlated to the exchange rate, which clearly indicates that the rise of interest rate results in the appreciation of domestic currency. Interest rates and commodity prices have close to zero correlation at -0.05, showing that they are somewhat uncorrelated.

4.3.3. South African Augmented Dickey Fuller results and analysis

Variables	Probability at level	Probability at first difference	T-statistic at level	T-statistic at first difference
Interest rates	0.169	0.001***	2.312	4.320
Commodity prices	0.006***		3.630	
Exchange rate	0.736	0.000***	1.050	10.765
Inflation	0.071	0.000***	2.727	5.674
Real output	0.004***	0.000***	3.754	13.455
Growth	0.000***		15.500	
High dividend yield	0.000***		14.013	
Large cap	0.000***		8.081	
Low volatility	0.000***		8.968	
Momentum	0.000***		6.596	
Quality	0.000***		6.178	
Small Cap	0.000***		9.239	
Value	0.000***		7.860	

The table above shows the results of the South African Augmented Dickey-Fuller (ADF) test run through Eviews. The purpose of the ADF test is to determine if the variables have a unit

root and if they are stationary or not. The null hypothesis for each variable tested is that it has a unit root. The results above show that interest rate, exchange rate, and inflation have a p-value above 5 percent and t-statistics lower than critical values when tested at level. From such results, we fail to reject the null hypothesis and conclude that interest rate, exchange rate, and inflation have no unit root and are not stationary. The first difference is applied to three variables; p-values are below 5 percent at 0.00 percent. From these outcomes, after applying the first difference, we can now reject the null hypothesis and conclude that interest rate, exchange rate, and inflation have no unit root and are stationary at confidence intervals of 90 percent, 95 percent, and 99 percent and are statistically significant.

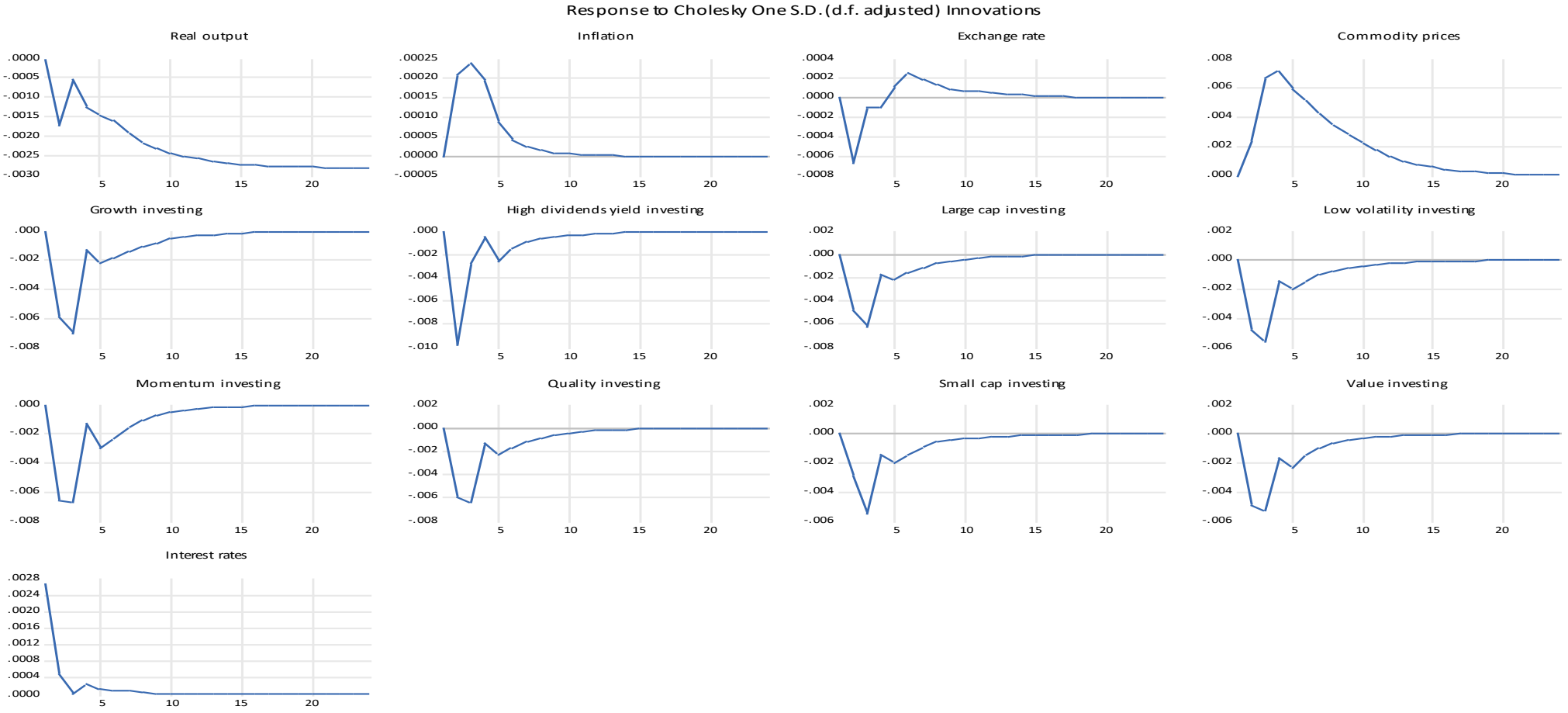
Real output and commodity prices were tested at level with the null hypothesis that each variable has a unit root. The p-value is below 5 percent, which forces us to reject the null hypothesis and conclude that real output and commodity prices are without a unit root and are stationary at a confidence interval of 90 percent, 95 percent, and 99 percent and are statistically significant. The t-statistic is greater than critical values of 90 percent, 95 percent, and 99 percent reiterating that variables are stationary without unit root. All investment styles were tested at level with the null hypothesis that each variable has a unit root. The p-values recorded for all investment style variables are 0.00 percent, which forces us to reject the null hypothesis. We can now conclude that all investment style variables have no unit root and are stationary at a confidence interval of 90 percent, 95 percent, and 99 percent and are statistically significant. The t-statistics above all critical values in the appendix reinforce the conclusion that the investment style variables are without unit root and are stationary.

4.3.4. South African lag length criteria results and analysis

Lag	LogL	LR	FPE	AIC	SC	HQ
1	9031.066	NA	3.63e-48*	-72.343*	-69.928*	-71.371*
2	9181.630	269.173	4.26E-48	-72.193	-67.363	-70.248
3	9332.639	253.940	5.06E-48	-72.046	-64.801	-69.128
4	9455.779	194.009	7.73E-48	-71.672	-62.011	-67.781
5	9614.330	232.972	9.16E-48	-71.586	-59.511	-66.723
6	9755.375	192.282	1.31E-47	-71.358	-56.867	-65.523
7	9923.151	210.919	1.59E-47	-71.348	-54.442	-64.540
8	10106.140	210.629*	1.84E-47	-71.462	-52.141	-63.682

The above table is the South African lag length criteria. Eight lags were used to determine the optimal number of lags to use in a VAR model to best fit the model. Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion, and Schwarz Information Criterion (SIC) are used in this model to ensure that the model is capturing the right patterns and trends of variables in a dataset. Schwarz Information Criterion (SIC), but Akaike Information Criterion (AIC) and Hannan-Quinn Information Criterion are optimal at one lag, as demonstrated by the stars above.

4.3.5. South African impulse response results and analysis



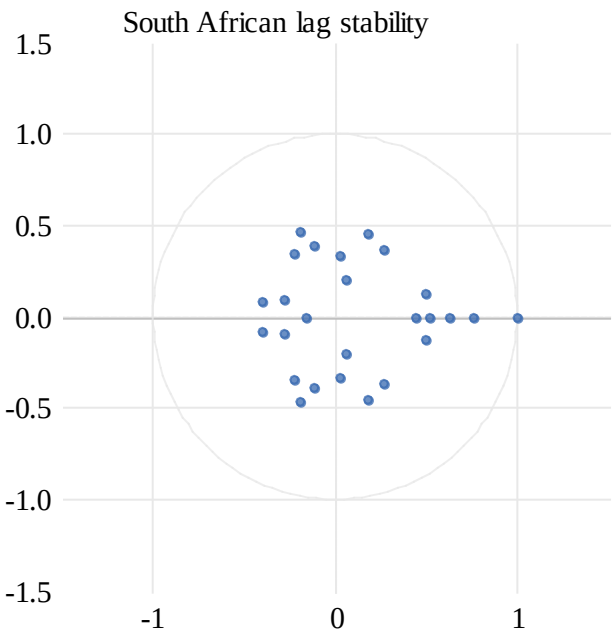
Response of variables to monetary policy tightening.

The diagram presented above illustrates the impulse response of various South African macroeconomic variables to a shock in interest rates. The top-left diagram shows the response of real output to a positive shock in interest rates, where there is an initial decline from the first month to the third month, followed by an increase in the fourth month and an immediate decline after that. This pattern suggests that the increase in interest rates has had a contractionary effect on the real economy in the short run, but this effect dissipates over time. The response of inflation to the same shock in interest rates is depicted in the following diagram. It shows that inflation initially increases in response to the shock but subsequently declines over time, indicating that the central bank has been successful in managing inflation. However, a price puzzle is observed, where inflation does not immediately decline in response to the increase in interest rates. This finding is in line with the results of Bjornland and Leitemo (2009), who also observed a similar pattern in their study.

The diagram between inflation and commodity price shocks illustrates the exchange rate response to a shock in interest rates. It shows that the domestic currency has appreciated because of the increase in interest rates, which has led to a decline in prices. This finding is consistent with the theoretical prediction that an increase in interest rates in a country leads to an appreciation of its currency. The remaining diagrams in the figure display the response of various investment styles to the shock in interest rates. It is observed that value stocks have outperformed growth stocks in response to the increase in interest rates, which is consistent with previous studies on the subject. Low volatility and quality investment styles have declined slightly in response to the shock, which is also in line with the results of studies conducted in the United States.

Large cap stocks have declined more than small cap stocks in response to the shock, which is in line with the higher volatility displayed by large cap stocks in the descriptive statistics. High dividend yield and momentum stocks have declined the most in response to the increase in interest rates, with high dividend yield declining by approximately 10 percent and momentum declining by approximately 7 percent. Overall, the results suggest that value, low volatility, and quality investment styles are relatively safe havens during periods of monetary policy tightening. These findings are consistent with previous research and provide useful insights for investors seeking to manage their portfolios during interest rate hikes.

4.3.6. South African VAR stability conditions results and analysis



The purpose of the above unit circle is to check if VAR is stable, which implies that VAR is stationary if the AR polynomial has a modulus that falls inside the unit circle and is below one. The units in the above VAR stability conditions fall within the unit circle and are below one. Such results prove that the VAR model is stable and stationary.

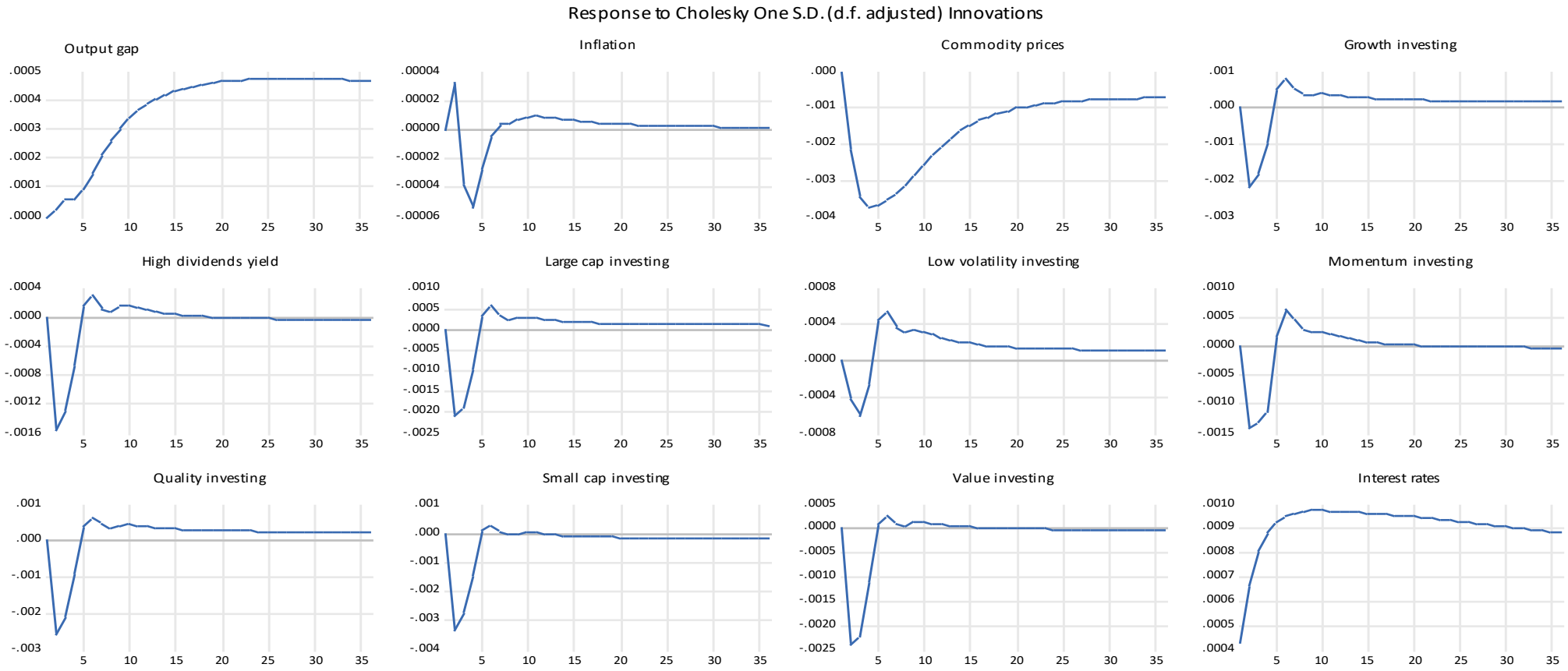
4.3.7. Similarity of the results between USA and South Africa

The control variables, including inflation, commodity prices, and output, respond similarly to monetary policy shocks. However, in the case of South Africa, commodity prices and inflation exhibited an unusual response by increasing in the wake of monetary policy shocks. The expectation of future inflation might drive investors to seek safe havens by purchasing commodities during monetary policy tightening. Another contributing factor to the spike in South African commodity prices could be the weakened currency, as it results in the purchase of commodities at higher or inflated prices. The results indicate the volatility in the response of the South African currency. Initially, it weakened and then stabilized after 8 to 15 months. In the South African case, inflation initially increased in response to the monetary policy shocks and then stabilized after approximately 10 months. The persistence of inflation could be one of the factors driving investors to seek safe havens in commodity prices, leading to their increase. To fully address this issue, further research is needed to delve into the causes of inflation and the rise in commodity prices in South Africa.

The USA and South Africa results demonstrate similarities in how investment styles respond to monetary policy shocks. However, there are differences in the magnitude of the effect on investment styles between the two countries. In the case of the USA, the results indicate that investment styles return to a steady state approximately five months after a monetary policy tightening. In contrast, for South Africa, it takes 10 to 15 months for investment styles to revert to a steady state following a monetary policy. The landscape for South Africa differs from that of the USA, as South Africa is an emerging market, and the recovery dynamics are distinct. More research is needed to investigate why South African investment styles take longer to recover from monetary policy shocks.

4.4. Robust results for both United States of America and South Africa

4.4.1. USA robust impulse response results and analysis

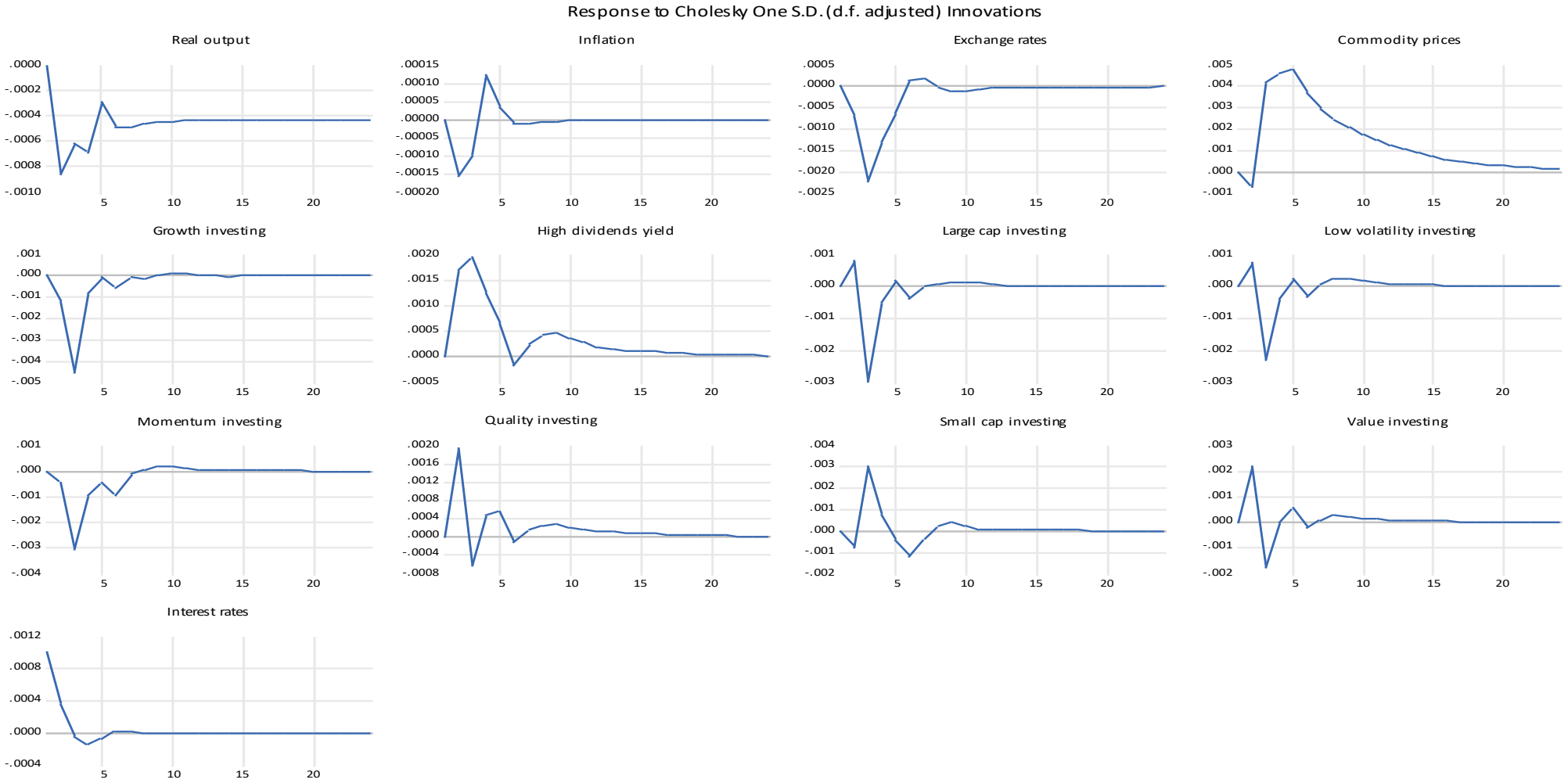


Response of variables to monetary policy tightening.

The above diagram shows the impulse response based on data from January 2010 to December 2019. This approach aims to examine whether the results remain consistent when excluding the effects of the 2008 global financial crisis and COVID-19 pandemic. Contrary to economic fundamentals, the output gap increased in response to the shock of higher interest rates. Inflation initially rose in the short term and then significantly declined due to the increased interest rates. There is still a price puzzle regarding inflation, which decreased in the short term in line with the main impulse response.

Commodity prices decreased due to reduced demand, as high interest rates exacerbated the cost of carrying inventory. The momentum (-1.5 percent), high dividend yield (-1.6 percent), and low volatility (-0.6 percent) investment styles were consistent with the main results, as they declined less than other styles, such as growth (-2.0 percent), large cap (-2 percent), small cap (-3 percent), and quality (-2.8 percent). The growth and small cap investment styles were consistent with the main results, as they both plummeted significantly because of increased interest rates. The value investment style declined more than the growth style at -2.5 percent versus -2.0 percent, in line with the study of Bellone and Carvalho (2022), which found that value stocks have underperformed in recent periods.

4.4.2. South Africa robust impulse response results and analysis



Response of variables to monetary policy tightening.

The diagram above illustrates the impulse response based on January 2010 to December 2019 data. We have chosen this timeframe to assess whether the results remain consistent when excluding the effects of the 2008 global financial crisis and the COVID-19 pandemic. The aim is to exclude major events that had a profound impact on the economy, financial markets, and livelihoods. During these significant events, central banks worldwide were compelled to react to economic conditions. For instance, during the financial crisis, central banks implemented conventional monetary policies, while during the COVID-19 pandemic, quantitative easing measures were applied. (Dahlhaus (2017) and Rebucci et al., (2021)). Real output declined in the short term but was more volatile because of increased interest rates, as many scholars have documented (Bjornland and Leitemo (2009) and Kontonikas and Zekaite (2018)). The increase in interest rates resulted in a decline in inflation, with no price puzzle observed as in the main results of exercise 4.2.4.

The exchange rate results were consistent with the main results, showing that the exchange rate appreciated because of increased interest rates. Commodity prices declined in the short run due to the shock of interest rates but quickly rebounded. This may be because investors perceive commodities such as gold and copper as a safe haven, leading to them becoming veblen goods where investors purchase them regardless of the price they have to pay. Investment styles were highly volatile in response to the increase in interest rates. Growth, large cap, low volatility, and momentum endured more than other investment styles because of interest rate shocks. However, value, high dividend yield, and quality were volatile but increased in the short term because of the increased unanticipated interest rates. Value and quality continue to outperform growth, as shown in exercise 4.3.4. In South Africa, small cap stocks are a safer haven than large cap.

4.4.3. Similarity between South Africa and USA robust results

The results demonstrate similarities in how investment styles respond to monetary policy shocks in both the USA and South Africa. On average, investment styles in both countries tend to decline in response to monetary policy tightening. However, there are differences in the recovery periods. In South Africa, investment styles take about 10 months on average to stabilize after the initial monetary policy shocks. At the same time, in the USA, recovery seems to occur within 10 to 15 months. Notably, the inclusion of major events like the financial crisis and COVID-19 appears to have a more prolonged impact on South Africa, as investment styles took longer to recover compared to the USA. In the absence of major crisis events, South Africa

has demonstrated a quicker recovery. This raises the need for further research to investigate the speed of the recovery of investment styles in response to monetary policy shocks.

4.5. Conclusion of results and analysis

Many scholars have employed the VAR methodology to test how asset prices respond to monetary policy shocks. A similar approach was adopted to test and analyse the impact on investment styles. The results presented above unequivocally confirm that investment styles respond to monetary policy shocks, particularly in the context of monetary policy tightening. Furthermore, although the control variables show different responses in the USA and South Africa, exhibit a notable reaction to monetary policy shocks. Thus, the problem statements concerning the impact of monetary policy shocks on equity investment styles and the identification of the investment style most affected by a contractionary monetary policy have been satisfactorily addressed in these results. In essence, the results align with the findings of numerous scholars discussed in the literature review, indicating that investment styles tend to decline in response to monetary policy shocks, supporting the existing body of knowledge in this field.

Chapter 5: Conclusion

This study aims to explain what investment styles are and how monetary policy affects asset prices, particularly stocks, in various countries. Adra and Menassa (2022) established a link between investment styles and monetary policy shocks and used their study, along with others, to investigate how monetary policy affects asset prices. Previous studies found that monetary policy tightening has a negative impact on asset prices, while monetary policy easing has a positive impact. The methodology of Bjornland and Leiteno (2009) and Kontonikas and Zekaite (2018), which used Vector Autoregressive (VAR) models to examine the effects of monetary policy shocks on asset prices, was used in this study to investigate how investment styles react to monetary policy shocks.

The VAR model was used to determine the reaction of control variables, such as inflation, output gap, exchange rates and commodity prices, and investment styles for both South Africa and the United States of America. The results show that all investment style and control variables respond negatively to a positive monetary policy shock (thus, interest rate increase). In South Africa and the USA, inflation showed a price puzzle where it resisted the increased interest rates in the short term but eventually declined, in line with the study of Bjornland and Leiteno (2009). This study found that value, low volatility, and quality are the safe haven investors should seek when central banks hike interest rates for both South Africa and the USA.

Growth and small cap in the USA have shown signs that when monetary policy shock is applied, the two styles tend to decline more than other investment styles, such as value, quality, momentum, and large cap. Even though Bellone and Carvalho (2022) discovered that value stocks have endured higher underperformance in recent times than glamour stocks, the results have shown that value has declined less than growth during the hiking of interest rates cycle. USA and South African results have shown that monetary policy shocks impact investment styles in opposite directions (an increase in interest rates results in a decline in investment styles). The USA's robust impulse results showed value underperforming growth in response to the shock of interest rates, which is in line with the study of Bellone and Carvalho (2022), who discovered that value stocks have endured high underperformance in recent times.

This study aligns with previous research conducted by scholars who have explored the impact of monetary policy on asset prices using the VAR model. It confirms that monetary policy shocks indeed affect investment styles in both South Africa and the USA. However, there are differences in the magnitude and speed of recovery to a steady state, which warrants further

investigation to understand these variations between countries. The study has effectively addressed the problem statement presented in Chapter 1, and robust evidence supports the findings. The paper also identifies investment styles that serve as safe havens during contractionary monetary policy and those that tend to recover more rapidly than others. Although control variables displayed varying responses to monetary policy shocks, many were consistent with previous research. In conclusion, this study affirms that contractionary monetary policy shocks negatively affect investment styles, and the speed of recovery varies from country to country and style to style.

Recommendations

This study has revealed that contractionary monetary policy shocks negatively affect investment styles in both the USA and South Africa. However, the magnitude and speed of recovery differ between the two countries. It is recommended that further research be conducted to delve into the factors influencing the speed of recovery of investment styles after monetary policy shocks. Additionally, more studies should explore how different investment styles not covered in this study respond to monetary policy shocks. The results of this study provide valuable insights for asset managers. They can utilize these findings to strategically position their equity portfolios during contractionary monetary policy periods and respond effectively to central bank decisions to implement expansionary monetary policy. One limitation of this study is that it focuses primarily on developed and emerging markets. Further research is needed in frontier markets and less developed emerging markets to investigate whether investment styles respond similarly to monetary policy shocks and to understand the speed of recovery to stable levels following such monetary policy shocks.

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