The Impact of Commodity Price Fluctuations on Investment Styles

By

Vutomi Maluleke

Thesis submitted in fulfilment of the requirements for the degree of

Master of Management in Finance and Investments

in the

FACULTY OF COMMERCE LAW AND MANAGEMENT

WITS BUSINESS SCHOOL

at the

UNIVERSITY OF THE WITWATERSRAND

Supervisor: Dr. Sedjro Alovokpinhou

20 September 2024

ABSTRACT

This thesis aims to investigate the impact of fluctuations in commodity prices on the returns of various investment styles and identify the specific commodity classes that exhibit strong predictive power. The study focuses on three commodity classes, food, energy, and precious metals, applied to the value, growth, and momentum investment styles, which exhibit dominance and consistency across all the countries examined. Through empirical analysis, the study seeks to contribute to the existing literature by estimating the predictive power of commodity prices on investment style returns. A deeper understanding of the relationship between investment styles and commodity prices may provide investors with more effective strategies for achieving their investment objectives and navigating the challenges posed by volatility in commodity markets.

Drawing upon the research conducted by Dladla and Malikane (2019), our study builds upon the foundational framework of the linear asset pricing model. We extend the stock returns model with commodity prices. We use the real domestic and decomposed prices of commodities, reflecting the real exchange rate and the US dollar denominated international price. In addition to commodity prices, we introduce three macroeconomic variables: interest rates, the output gap, and the real exchange rate.

We estimate the baseline models for six countries: the United States, the United Kingdom, Australia, Canada, South Africa, and Brazil. The findings of this investigation indicate that fluctuations in commodity prices, interest rates, and the output gap play an important role in explaining the returns on investment styles. We find that food and energy prices, real interest rates, and the output gap significantly explain returns on investment styles. Real interest rates exert a positive impact on returns on investment styles. This effect has been statistically significant in all the countries. The output gap displays a negative impact on returns on investment styles. Furthermore, we find that commodities have a negative effect on returns on investment styles.

Food prices negatively impact returns on investment styles across all the countries. This effect holds statistical significance in the United States, United Kingdom, Australia, and South Africa. We further note that energy prices exert a similar impact as food prices. The effect of energy prices is statistically significant in the United States, United Kingdom, Australia, Canada, and Brazil. Notably, the impact of energy prices on returns appears consistent across the three investment styles. However, we note that the impact of precious metals is not statistically significant in any of the countries, except in Canada, where we note a positive effect on returns on momentum styles.

The effect of food and energy prices on returns on investment styles is in line with Gorton and Rouwenhorst (2006), who argue that this is primarily due to the distinct behavior exhibited by commodities across different phases of the business cycle. They suggest that commodities typically demonstrate a positive association with inflation and are influenced by a combination of demand-side fundamentals and supply-side dynamics. This divergence in the behavior of commodities implies that their relationships with equity markets vary inherently. On the other hand, precious metals exhibit a different pattern compared to food and energy prices, as they are often perceived as safe-haven assets.

DECLARATION

I, Vutomi Maluleke, declare that the research work reported in this dissertation is my own, except as indicated in the references and acknowledgements. It is submitted for the degree of Master of Management in Finance and Investment at the University of the Witwatersrand, Johannesburg. This thesis has not, either in whole or in part, been submitted for a degree or examination in this or any other university.

Signature of candidate: ____________________ Date: 20 September 2024

ACKNOWLEDGEMENT

Firstly, I would like to thank God for the grace of studying and completing this degree. I gratefully acknowledge the financial assistance provided by the Public Investment Corporation.

I would like to express my deepest gratitude to my supervisor, Dr. Sedjro Alovokpinhou, whose guidance and prompt feedback have been invaluable throughout this journey. His insightful suggestions and patience in explaining complex concepts have greatly enhanced the quality of this empirical study. I am sincerely grateful for his constructive critiques and useful insights, which have enriched my understanding of the research process.

Finally, I express heartfelt thanks to my husband, Musa, for his enduring patience and unwavering support during this study. To my daughter, Vun'we, I extend my appreciation for your understanding of my absence during this academic journey. I love you both.

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1. Introduction

1.1 Background

In recent decades, investors have shown a growing interest in discovering strategies to achieve excess returns on their investments. In this pursuit, various investment styles have garnered considerable attention in both academic and investment circles, owing to their potential to deliver enhanced risk-adjusted returns. Early research conducted by Basu (1977), Fama and French (1992), and Lakonishok et al. (1994), in conjunction with subsequent investigations by Hsu (2014), has yielded insights into investment styles and their impact on portfolio performance. These studies have consistently demonstrated that firms exhibiting specific fundamental characteristics, such as low market capitalization or low price-to-earnings ratios, consistently outperform the broader market. These characteristics, known as anomalies, highlight the possibility of achieving superior returns by capitalizing on the mispricing and inherent inefficiencies they manifest (Asness et al., 2013). Consequently, investors and fund managers have shown a growing interest in integrating these anomalies into their investment strategies, aiming to improve risk-adjusted returns.

According to Chen and Wermers (2005) and Muller and Ward (2013), investors and fund managers engage in the portfolio allocation process by grouping available assets into a limited number of broad categories. This approach, termed style investing (Barberis and Shleifer, 2003), allows for the allocation of funds based on these categorized classes. Furthermore, Wahal and Yavuz (2013) define investment styles as investment inclinations adopted by fund managers who believe pursuing a particular style will lead to improved returns. Barberis and Shleifer (2003) assert that there are at least two reasons why investors might opt for style investing. Firstly, categorization simplifies the decision-making process and facilitates handling vast volumes of information more effectively. Secondly, given the extensive array of asset classes, investment styles create a benchmark that allows investors to evaluate the performance of each investment style.

Various external factors can influence the performance of investment styles, and among these factors, commodities play a significant role in generating returns. According to Bekaert, Hoerova, and Lo Duca (2013), commodity prices, an essential component of the global economy, play a critical role in influencing the performance of investment styles, especially those with exposure to commodity-related sectors and assets. The findings of Fama and French (1988), through the three-factor model encompassing market risk, size, and the value factor, reveal that changes in commodity prices can affect the value factor. This effect arises from price fluctuations experienced by commodity-intensive industries, subsequently influencing the valuation of their assets.

In line with Fama and French (1988), the work of Bekaert et al. (2013) highlights that investment styles can be influenced by common factors arising from fluctuations in commodity prices. Substantial price changes in commodities, attributed to supply-demand imbalances or geopolitical events, can alter market sentiment toward commodities. Consequently, the performance of stocks and other assets linked to commodity-intensive industries may be significantly impacted. Therefore, fund managers need to possess a profound understanding of the interplay of commodity price fluctuations, as the dynamics significantly influence their choice of investment styles.

1.2 Research gap

Previous studies have extensively explored the crucial role of commodities in hedging inflation and enhancing portfolio returns (Gorton and Rouwenhorst, 2006; Cheuing and Miu, 2010; Daskalakis and Skiadopoulos, 2011). However, little empirical evidence is available to elucidate the impact of commodity price changes on investment returns and how individual commodity classes may possess unique predictive power for investment-style returns. Iyke and Ho (2021) conducted a study that built upon the findings of Gorton and Rouwenhorst (2006), exploring the relationship between commodities and stock return predictability. Their research revealed a negative correlation between commodities and stock returns, underscoring the significance of commodities in predicting investment returns.

Therefore, this research gap presents a significant area for investigation, providing an opportunity to contribute new empirical evidence on the potential predictive ability of distinct commodity classes for value, growth, and momentum portfolios. The predictive power of individual commodity classes holds significant importance for investors and portfolio managers, as it provides a mechanism for strategic asset allocation and risk mitigation. Addressing this gap will enable investors and fund managers to make more informed decisions when optimizing their investment strategies and strategically allocating funds during different commodity cycles.

1.3 Objectives of the Study

This study is motivated by the lack of consensus in international academic literature regarding the relationship between commodity price fluctuations and investment styles. Furthermore, there is limited literature investigating the role of commodities in stock return predictability, specifically with respect to returns associated with distinct investment styles.

The objective of this research thereof is to:

i. Examine the influence of changes in commodity prices on investment style.

ii. Determine the commodity classes that exhibit superior predictability for investment style returns.

1.4 Research questions

The primary research question that this study seeks to investigate is:

What is the influence of commodity price movements on the investors' choice of investment style in commodity markets and, subsequently, returns thereof?

To answer these questions, the following sub-questions will be explored.

i. How do fluctuations in commodity prices impact investment styles?

ii. Which commodity classes provide valuable information for predicting stock returns?

1.5 Contribution of the Study

The contribution of this study lies in its examination of the dynamics between commodity price fluctuations and the choice of investment styles. According to Gorton and Rouwenhorst (2006), commodities display an inconsistent pattern and are characteristic of a low correlation with stock returns during a business cycle. Additionally, Ali et al. (2020) further suggest that commodities tend to have stable prices compared to stocks and usually display a distribution that is skewed to the right. This indicates that commodities are more likely to experience upward trends, such as price booms. Conversely, stocks are inclined to face downward fluctuations, as evidenced by their left-skewed distribution. They argue that commodities can be used to predict returns if this relationship leads to causation. Jacobsen et al. (2019) also highlight that commodities can offer valuable information for predicting stock returns.

The study seeks to provide empirical evidence on the influence of commodity prices on investment style returns. We use three commodities classes across six countries: food, energy, and precious metals, on value, growth, and momentum investment styles. By analyzing the relationship between commodity price fluctuations and investment choices in these markets, the research seeks to develop a deeper understanding of the performance of the different investment styles over a commodity cycle. Through the empirical investigation, the study intends to contribute to the literature by estimating the effect of commodity price fluctuations on investment style returns. Based on a comprehensive understanding of the relationship between investment styles and commodity prices, these strategies may help investors achieve their investment objectives more effectively and navigate the challenges posed by commodity market volatility.

1.6 Significance of the Study

This research addresses a knowledge gap regarding the influence of commodity price fluctuations on investment styles. The study's significance lies in its potential to contribute to existing literature while offering valuable insights to guide investors in making informed decisions. Previous studies, including the works of Gorton and Rouwenhorst (2006), Bekaert et al. (2013), and Ali et al. (2020), have underscored the significance of the correlation between commodity prices and investment styles. This correlation is important for portfolio managers and investors because risk aversion or market sentiment changes can exert a considerable influence on investment returns.

The findings from this research can offer valuable insights and direction to investors, especially institutional investors seeking to diversify their portfolios and safeguard against macroeconomic challenges. Additionally, by uncovering the predictive power of commodity prices on investment returns, the research can offer practical implications for portfolio management and risk mitigation strategies, potentially improving investment performance and resilience against market fluctuations. According to Tang and Xiong (2012), to generate higher returns, it is necessary to comprehend the fluctuations in commodity prices and develop an investment strategy that mitigates the impact of these fluctuations on investment returns.

2. Literature Review

2.1 Introduction

The literature review delves into theoretical and empirical studies examining the connection between commodity prices and investment style returns. This review is structured into two sub-sections, each focusing on different aspects. The first sub-section explores the relationship between commodity prices and returns, encompassing discussions on the impact of commodity price volatility on investment outcomes. The second sub-section concentrates on investment styles, examining various approaches and empirical studies that investigate the interplay between commodity price fluctuations and investment style performance. Analyzing these studies gives a comprehensive understanding of the link between commodity prices and investment style returns.

It is essential to cover the modern portfolio theory literature because it provides a solid theoretical framework for understanding the principles underlying portfolio diversification, returns, and asset allocation.

2.1.1 Defining Investment Styles

Sharpe (1992) introduced the concept of style investing, which has emerged as a significant and influential notion in finance. Chou et al. (2019) define an investment style as a specific group of risky assets characterized by similar attributes, providing a framework for understanding these styles. Chen and De Bondt (2004) suggest that investment style plays a pivotal role in the success of active equity portfolio management, with the investment community acknowledging and appreciating its importance. This recognition has given rise to style investing, where funds are allocated based on the relative performance of different investment styles, facilitating investment decision-making and allowing for straightforward comparison of portfolio performance. In portfolio management, assets are classified into various categories, such as value and growth stocks, size, and government bonds (Chen et al., 2013). These classifications enable portfolio managers to allocate funds across different asset classes based on their investment styles (Barberis and Shleifer, 2003; Chen et al., 2013). Managers can diversify risk and optimize portfolio returns by grouping assets into classes.

Barberis and Shleifer (2003) established a connection between investment styles and the predictability of returns, highlighting that assets or stocks of the same style exhibit similar behavior influenced by fundamentals. Charlot et al. (2016) extend this notion to commodity markets, where different investment styles can have distinct implications. For instance, Markwat et al. (2020) assert that value investing focuses on identifying undervalued commodities based on production costs, supply-demand dynamics, and market sentiment. In contrast, momentum investing aims to capitalize on short-term price trends in commodities. These different styles represent various strategies for investing in commodities and have implications for portfolio performance and risk management in this asset class.

2.1.2 Modern Portfolio Theory

In 1952, Harry Markowitz introduced the Modern Portfolio Theory (MPT), which serves as a valuable framework for constructing optimal portfolios by effectively diversifying investments across assets with varying levels of risk (Markowitz, 1952). MPT emphasizes that the individual returns of assets are less important than their overall contribution to the portfolio's performance. The primary objective of MPT is to achieve portfolios that offer the highest expected return while minimizing risk (Ricciardi and Simon, 2000). However, it is worth noting that in the context of style investing, attaining a fully efficient portfolio becomes challenging due to the notable influence exerted by external investors on the stock selection decisions made by portfolio managers (Pástor and Stambaugh, 2002).

2.1.3 Risk-Adjusted Performance

There are several risk-adjusted return measures for evaluating portfolio performance in academic literature. The most widely used risk-adjusted ratio is the Sharpe ratio, initially developed by William Sharpe in 1966. The Sharpe ratio calculates the excess return of the portfolio, defined as the difference between the expected portfolio return and the risk-free rate, divided by the standard deviation as a measure of volatility. Another commonly employed metric, proposed by Treynor in 1965, employs the beta coefficient as a risk measure instead of standard deviation. The beta coefficient assesses the sensitivity of a security to overall market movements. Jensen's Alpha, introduced in 1968, measures the performance of an expected portfolio return against the returns predicted by the capital asset pricing model (CAPM).

Furthermore, Sortino's ratio (1994) and the Modigliani-Modigliani ratio (1997) are popular risk-adjusted measures. Sortino's ratio modifies the Sharpe ratio by considering downside risk and penalizing returns that fall below a predetermined target. The Modigliani-Modigliani ratio is an extended version of the Sharpe ratio. It calculates the portfolio's risk-adjusted return by multiplying the Sharpe ratio by the standard deviation concerning a benchmark index and adding the risk-free return. Additionally, the information ratio is a well-known risk-adjusted performance measure. It divides alpha, the excess return of the portfolio, by the non-systematic risk, also known as "tracking error" (Bodie et al., 2014, pp. 274-276). The information ratio quantifies the excess return per unit of risk that can be diversified away by holding a market portfolio.

2.1.4 The Nature of Commodities and Impact on investor returns.

Investor interest in commodities has long been substantial, particularly among institutional investors who perceive them as a potentially lucrative avenue for investment. Charlot et al. (2016) emphasize that institutional investors, particularly pension funds, started incorporating alternative assets, including commodities, into their strategic portfolio allocation process as a response to the underperformance of equities following the bursting of the Internet bubble in 2000. Ali et al. (2020) further assert that this strategic shift aimed to diversify investment portfolios and explore additional sources of returns beyond traditional equities.

Commodities are widely recognized for their speculative nature and high volatility, which entail various inherent risks (Sakkas and Tessaromatis, 2020). These risks primarily stem from the classification of commodities as real assets, which lack consistent income streams and often involve negative cashflows due to storage costs (Narayan et al., 2016). Commodity price fluctuations exert a significant influence on investor returns, as these fluctuations directly impact the performance and value of commodities-related investments (Ali et al., 2020).

Notwithstanding the inherent risks and volatility, several scholars argue that commodities can provide satisfactory annual returns comparable to those observed in equity markets (Daskalakis and Skiadopoulus, 2011; Bhardwaj et al., 2015). Moreover, commodities exhibit distinctive characteristics, including low to negative correlations with more traditional asset classes such as equities and fixed-income instruments (Gorton and Rouwenhorst, 2006). This recognition has led to the acknowledgment of commodities as fundamental components of well-diversified investment portfolios (Gorton and Rouwenhorst, 2006; Ali et al., 2020). By incorporating commodities into their portfolios, investors have the potential to achieve superior returns or mitigate risk levels compared to portfolios that lack exposure to commodities. In addition to their role in diversified portfolios, commodity price cycles impact investment styles and strategies (Sakkas and Tessaromatis, 2020). The unique characteristics of commodities, such as their speculative nature and high volatility, provide opportunities for various investment approaches.

2.1.5 Commodity Price Fluctuations and Choice of Investment Style

The volatility of commodity prices is a crucial factor influencing investment style selection. Extensive research has examined the effects of commodity price fluctuations on investment choices, revealing that such fluctuations notably impact investment styles like value, momentum, and indexing. Studies conducted by Balvers et al. (2017) and Tang et al. (2020) have provided evidence supporting the significant influence of commodity price fluctuation on these investment styles.

2.2 Value Investing

2.2.1 Definition

The value investing anomaly, initially observed by Basu (1977), represents a significant factor in investment analysis. In academia, value investing is commonly defined as acquiring assets with low price-to-earnings (P/E) or price-to-book (P/B) ratios relative to the broader market (Hanson & Fraser, 2013). According to Betermier (2016), value investors direct their attention toward identifying companies that exhibit favorable potential and fundamental characteristics, indicating the likelihood of high prices. These stocks are often undervalued in the current market due to negative investor sentiment surrounding the company. According to Du Toit's (2012) assertions, value investors adopt contrarian strategies to pinpoint overlooked stocks, considering factors such as high dividend yields and low-price multiples investment prospects due to their potential for future price appreciation as market conditions stabilize (Greenwald, 2010).

2.2.2 Theory and Evidence on Value Investing

The principles of value investing can be traced back to Graham and Dodd (1934), who emphasized a fundamental approach to investing and advocated purchasing undervalued securities based on their intrinsic worth. Bassu (1970) further expanded on this concept, highlighting the importance of investing in undervalued "value firms" and selling overvalued ones. These undervaluation signals are often derived from accounting ratios, including book-to-market (B/M), earnings-to-price (E/P), cashflow-to-price (CF/P), enterprise value to EBITDA (EV/EBITDA), dividends-to-price (D/P), or sales-to-price (S/P) ratios (Bodie et al., 2014). Among these ratios, the book-to-market ratio is widely used, comparing a firm's book value of equity to its market value of equity.

Empirical research conducted by Koijen et al. (2017) and Zhang (2005) indicates that the value effect, characterized by the outperformance of value stocks compared to growth stocks, tends to weaken during economic downturns. While the value premium is typically prominent before the onset of a downturn, it tends to diminish or even become negative during recessions. In contrast, growth stocks exhibit lower sensitivity to downturns, resulting in superior performance during such periods. Conversely, value stocks have demonstrated stronger performance during growth cycles (Gulen et al., 2010). The subprime credit crisis that emerged in the US market in early 2007 has been examined by Lee et al. (2014) in the context of the value premium. Their findings indicate that value stocks exhibited lower returns than growth stocks during this crisis despite t a positive value premium before its occurrence.

The implications of fluctuating commodity prices on invested industries' profitability and financial stability of must be considered. Kolb and Overdahl (2010) argue that as commodity prices rise, companies engaged in producing or consuming these commodities face escalated costs, resulting in diminished profitability and potential declines in stock value. In response, value investors may perceive such stocks as enticing. Conversely, drawing from Farma and French (1992), declining commodity prices can prove advantageous for companies operating in commodity-dependent sectors, as lower input costs contribute to improved profitability. Value investors may identify these companies, leveraging their strong fundamentals and favorable risk-reward profiles, expecting their stock prices to eventually align with their intrinsic value as market sentiment improves (Markwat et al., 2020). However, it is essential to note that the impact of commodity price fluctuations extends beyond companies directly affected by these changes. Industries reliant on commodities often experience supply chain disruptions and secondary effects that permeate various sectors (Bodie et al., 2014).

2.3 Growth Investing

2.3.1 Definition

Growth investors exhibit a willingness to pay premium valuations for stocks based on their conviction that the associated companies possess the potential for rapid growth, thereby anticipating future increases in stock prices (Chou et al., 2019). Growth stocks can be defined as stocks with significantly higher earnings expectations and growth rates compared to the market averages, and these expectations continue to increase over time (Bourguignon and De Jong, 2003). Conversely, growth investors concentrate on more fundamental shifts within companies and consider longer-term factors in their investment decisions. Bourguignon and De Jong (2003) posit that growth investors adopt a long-term perspective when selecting companies, driven by the anticipation that these companies will undergo structural changes over time. In contrast, value investors focus on short-term opportunities to capitalize on potential price momentum.

2.2.2 Theory and Evidence on Growth Investing

Betermier et al. (2016) posit that conventional investment approaches typically commence with a focus on growth investing. Growth investing entails identifying stocks with the potential for future growth and subsequent profitability. Distinct from value stocks, growth stocks are characterized by higher prices relative to their current yield and book value. Betermier et al. (2016) show this by constructing the local value, size, and momentum factors; they adopt the methodologies established by Fama and French (1993) as well as Carhart (1997). In order to arrange the stocks traded on prominent exchanges, they employ a sorting process based on their book-to-market values, market size, and historical returns.

Conversely, growth companies are perceived by investors as having the capacity to generate earnings that are anticipated to exceed the average rate of growth within their respective industries (Chou et al., 2019)). This projected earnings growth is already reflected in the stock's price. Similarly, according to Petkovha and Zhang (2005) and other researchers, growth investing is commonly regarded as riskier in comparison to value investing. This perception stems from the fact that growth investors make decisions based on the assumption that the company will sustain its growth trajectory without encountering significant obstacles. The profitability of growth stocks heavily relies on future market expectations regarding the return on those shares.

Fluctuations in commodity prices can directly influence the financial performance and cost structure of companies, especially those operating in industries reliant on commodities as inputs. Elevated commodity prices can escalate costs for these firms, potentially squeezing profit margins and impeding their growth prospects (Banz, 1981; Bodie et al. 1995). Conversely, declining commodity prices can reduce input costs, potentially bolstering profitability and fostering growth opportunities (Chen et al., 2011). Indirectly, changes in commodity prices can have ripple effects on consumer demand and overall market sentiment. The movements of commodity prices, particularly in essential commodities like oil or agricultural products, can impact inflation levels and consumer purchasing power (Hassan et al., 2017). Consequently, these shifts in consumer behavior can reverberate throughout the market, influencing the revenue growth and market outlook for growth-oriented companies, particularly those operating in sectors closely linked to discretionary consumer spending (Krauss et al., 2017).

2.4 Momentum Investing

2.4.1 Definition

Momentum investing has been the subject of extensive research in finance. Jegadeesh and Titman (1993) describe the concept of momentum in investing as the persistence or positive serial correlation observed in asset returns, which suggests that commodities with the highest historical returns tend to outperform the market in the future, while those with the worst returns underperform (Gorton et al., 2013; Fuertes et al., 2010). Investors in commodity markets can capitalize on the momentum effect by taking long positions on the top-performing commodities and short positions on the underperforming ones.

2.4.2 Theory and Evidence on Momentum Investing

To validate the existence of momentum in financial markets, Chan et al. (1996) built upon the work of Jegadeesh and Titman (1993) and conducted an extensive investigation. By utilizing a momentum measure based on the preceding six-month return and examining various holding periods ranging from six months to three years, they confirmed the presence of a momentum effect. This effect indicated that assets with favorable past performance tended to exhibit positive future returns. Moreover, Chan et al. (1996) observed that the momentum effect displayed a diminishing pattern beyond the initial twelve-month period, with returns generated by different deciles of assets becoming increasingly similar. These findings shed light on the limited duration and convergence of performance associated with momentum strategies.

Although momentum has traditionally been associated with stock returns, empirical evidence supports momentum effects in various other asset classes. Asness et al. (2013) provided evidence of momentum premiums across equities, bonds, currencies, and commodities on a global scale. Examining specifically the realm of commodities, Erb and Harvey (2006) focused their study on the presence of momentum in commodity futures. Analyzing the GSCI index and term structure of commodity futures from 1982 to 2004, their research demonstrated momentum effects in commodity futures, indicating that assets with favorable past performance tend to sustain their strong performance in the future.

The relationship between commodity price fluctuations and momentum investment strategies has been the subject of further investigation. Balvers et al. (2017) explored the impact of commodity prices on momentum strategies and found that changes in commodity prices significantly influenced the performance of momentum portfolios. Similarly, Tang et al. (2020) investigated the interaction between commodity prices and momentum strategies and concluded that commodity price volatility affected the profitability of momentum strategies. This influence of commodity price fluctuations on momentum investment strategies can be attributed to the sector-specific effects of commodity prices. According to Hassan et al. (2017), rising commodity prices may lead to positive price momentum in sectors such as energy and materials, aligning with the momentum investment strategy. Conversely, falling commodity prices can result in negative price momentum in these sectors. These findings underscore the importance of considering commodity price movements when implementing momentum investment strategies.

2.5 Index Investing

2.5.1 Definition

Tang and Xiong (2012) describe investing, also known as passive investing or indexing, as an investment strategy that aims to replicate the performance of a specific market index rather than attempt to outperform the market. This approach involves constructing a portfolio that closely mimics the composition and weights of the index, thereby providing investors with exposure to the overall market or a specific segment of it (Tang and Xiong, 2012). The strategy is characterized by simplicity, transparency, and potential for long-term growth (Elton et al., 2019). By tracking the performance of an index, investors can gain exposure to a wide range of securities within the index, which helps to mitigate specific company or industry risks.

2.5.2 Theory and Evidence on Index Investing

The impact of commodity price fluctuations on index investing is notable. Commodity price movements can influence the composition and performance of commodity-based indices, designed to reflect the overall performance of specific commodity sectors or the broader commodity market (Tang and Xiong, 2012). Changes in commodity prices can directly impact the weights and returns of individual commodities within these indices, subsequently affecting the performance of index funds or exchange-traded funds (ETFs) that track them (Baltussen, 2011). For instance, when commodity prices experience a sustained uptrend, commodity-based indices may exhibit increased weights for commodities that have risen in price, potentially driving the performance of index funds or ETFs higher. Conversely, during declining commodity prices, the weights of underperforming commodities within the index may decrease, resulting in a reduced allocation to these commodities in index funds or ETFs (Baltussen, 2011).

2.6 Quality Investing

2.6.1 Definition

In their work, Bender et al. (2013) define quality investing as a strategy that focuses on the selection of stocks based on specific quality measures. These measures include earnings growth, return on equity (ROE), accruals, cash flows, and other relevant indicators. The primary objective of investors utilizing this strategy is to attain superior returns by ensuring that the quality metrics of the chosen stocks surpass those of the broader market. By emphasizing the importance of quality attributes, investors seek to identify companies with robust financial fundamentals and long-term growth potential, t potentially leading to superior performance relative to the broader market.

2.6.2 Theory and Evidence on Quality Investing

Sloan (1996) proposes the use of accruals as a reliable measure for evaluating a company's quality. As defined by Sloan, accruals refer to the difference between changes in non-cash current assets and current liabilities (excluding short-term debt and tax payable) after deducting depreciation expense. Expanding on Sloan's perspective, Kozlov and Petajisto (2013) further support the use of accruals as a metric to assess earnings quality. They argue that investing in companies with high earnings presents an attractive opportunity to achieve a return premium in stock investments. This assertion underscores the importance of considering earnings quality as a critical factor when making informed investment decisions.

In order to establish comparability when evaluating companies for investment, it is crucial to establish a common foundation. Bodie et al. (2014) define earnings quality as a means to assess the reliability and prudence of various earnings metrics, aiming to gauge the potential durability of actual earnings. Asness et al. (2013) define quality stocks as those expected to command higher prices. Their research reveals that, on average, high-quality stocks trade at higher prices. However, the magnitude of this price premium is relatively small, suggesting that quality characteristics have a limited impact on stock prices. Despite this anomaly, the study demonstrates that quality securities generate a substantial risk-adjusted return premium, in the United States and globally.

2.7 Low volatility Investing

2.7.1 Definition

The low-volatility investment style has gained significant attention in finance due to its potential to generate superior risk-adjusted returns. Blitz and Vliet (2007) define the low volatility anomaly, the minimum volatility effect, as the additional return achieved by a minimum-risk portfolio. Their study demonstrates that low-volatility stocks exhibit higher risk-adjusted returns than their higher-risk counterparts. Baker et al. (2014) are among the scholars who have explored the low beta anomaly. Their study discovered that stocks exhibiting lower beta, indicating lower volatility, exhibited superior performance compared to stocks with higher beta. This finding challenges the traditional finance theory's assumption that higher risk should naturally correspond to higher returns. These studies contribute to the growing body of evidence highlighting the potential advantages of low-volatility investment strategies.

2.7.2 Theory and Evidence on Low Volatility Investing

According to Blitz et al. (2012), the low volatility anomaly suggests that investors who allocate their portfolios to low-risk assets or adopt low-volatility investment strategies can potentially achieve superior risk-adjusted returns. This implies that by focusing on stocks or assets with lower volatility, investors can capture a premium that compensates for the lower risk associated with these investments (Ang et al., 2006; Blitz et al., 2012). However, this phenomenon contradicts the traditional risk-return tradeoff by suggesting that low-risk assets or portfolios can generate higher risk-adjusted returns than expected based on their level of risk (Baker et al., 2011; Blitz and van Vliet, 2018). According to the Efficient Market Hypothesis from Fama’s 1970 work, investors holding risk-free assets are not expected to achieve excess returns.

The deviation from the conventional risk-adjusted theory has captured the attention of researchers, prompting them to delve deeper into this anomaly. Of interest is the study by (Ang et al., 2016), which examined the impact of macroeconomic risks on low volatility investing. Their findings underscored the presence of variations in the performance of low-volatility portfolios across different macroeconomic conditions. Specifically, they noted a decline in the risk-reducing advantages of low-volatility stocks during periods characterized by economic downturns, potentially attributable to heightened correlations and systemic risks. However, the existing literature presents conflicting perspectives when considering the influence of fluctuations in commodity prices.

Janssen and De Roon (2015) discovered that the performance of low-volatility portfolios was adversely affected by the presence of volatility in commodity prices. Their study revealed that low-volatility stocks in industries heavily reliant on commodities experienced diminished risk-reducing advantages when commodity prices exhibited increased fluctuations. This implies that the effectiveness of the low volatility effect may be compromised or less pronounced in the presence of significant volatility in commodity prices. Similarly, Baker et al. (2011) posited that investors seeking low-volatility stocks may prefer stable, non-cyclical sectors such as utilities or consumer staples, which are less susceptible to the volatility of commodity prices.

2.8 Size Small-cap and large-cap Investing.

2.8.1 Definition

The size effect, also known as the small-cap premium, has been extensively studied. Researchers have explored the phenomenon of small-cap stocks outperforming large-cap stocks, challenging the notion that higher risk should be compensated with higher returns. According to Banz (1981), the phenomenon of small-cap companies earning higher risk-adjusted returns than large-cap companies is called the size effect. In his study, Banz examines data from 1936 to 1975 and finds that, on average, the common stock of small firms exhibited greater risk-adjusted returns than the common stock of large firms. This implies that investors who focused on small-cap stocks during this period had the potential to achieve superior investment performance.

2.8.2 Theory and Evidence on Size Small-cap and large-cap Investing.

The observed phenomenon of small-cap companies consistently exhibiting long-term outperformance compared to large-cap companies poses a challenge to the widely accepted Capital Asset Pricing Model (CAPM). In an effort to investigate this anomaly, Fama and French (1993) conducted an empirical study in the United States, utilizing a dataset covering the period from 1963 to 1999. The researchers constructed portfolios of ten distinct groups of stocks based on company size, with decile one representing the smallest 10% of stocks and decile ten representing the largest stocks. This seminal study provided initial insights into the size effect and its implications for asset pricing. Building upon the foundation laid by Fama and French, subsequent research endeavors have sought further to explore the size effect and its persistence over time. Chen et al. (2019) conducted an extensive analysis utilizing a comprehensive dataset from 1963 to 2018. Their investigation focused on examining the long-term behavior of the size effect and its variations across different sub-periods. The findings of their study revealed the enduring presence of the size effect anomaly, indicating that small-cap stocks consistently exhibited higher risk-adjusted returns compared to their large-cap counterparts.

The empirical evidence presented by Fama and French (1993) and Chen et al. (2019) contributes significantly to our understanding of the size effect and its implications for asset pricing models. The consistent outperformance of small-cap stocks challenges the underlying assumptions of the CAPM, which posits that higher returns should be associated with higher levels of systematic risk. The persistence of the size effect anomaly suggests the presence of additional factors beyond systematic risk that contribute to the determination of stock returns. Thus, further investigation is warranted to understand the complexities involved in asset pricing and the role of the size effect in the overall framework.

2.9 High Dividends Yield Investing

2.9.1 Definition

The Dogs of the Dow (DoD) theory, introduced by Slatter (1988), presents an investment strategy that prioritizes dividend sustainability by constructing a portfolio comprising stocks with the highest dividend yields among the constituents of the Dow Jones Industrial Average (DJIA). Extensive research has examined the performance and characteristics of dividend investment strategies. Fama and French (2008) assess the effectiveness of high dividend yield strategies within the context of value investing and discover that portfolios constructed based on high dividend yields tend to generate excess returns, suggesting the presence of a dividend premium.

2.9.2 Theory and Evidence on High Dividends Yield Investing

Subsequent studies have extended the examination of high dividend strategies, shedding further light on their characteristics and performance. Empirical research conducted by Yan et al. (2015), Tissayakorn et al. (2013), and Chong and Luk (2010) consistently substantiate the superior performance of high dividend strategies relative to market benchmarks across diverse geographical contexts. These investigations consistently document the attainment of higher returns through the implementation of the high dividends style in regions such as Taiwan, Thailand, and Hong Kong. The success of the high dividend style can be attributed to its emphasis on dividend sustainability and its ability to identify undervalued stocks. Focusing on companies that offer sustainable dividend payouts, the strategy selects firms with strong financial health and consistent cash flows, contributing to their long-term performance (Chong and Luk, 2010).

Supporting these findings, Baker et al. (2011) analyzed the performance of dividend-focused strategies across multiple markets and consistently observed positive results. A study by (Yan et al. (2015), Tissayakorn et al. (2013), and Chong and Luk (2010) have demonstrated the superior performance of this investment style in comparison to market benchmarks in diverse geographical contexts. Specifically, their investigations reveal that the high dividends strategy has produced higher returns in Taiwan, Thailand, and Hong Kong. The robustness of the strategy's performance can be attributed to its emphasis on dividend sustainability and its ability to identify undervalued stocks. Furthermore, Baker et al. (2011) analyzed the performance of dividend-focused strategies across multiple markets and consistently observed positive results.

The literature has also extensively examined the relationship between dividend investment strategies and commodity price fluctuations has also been extensively examined in the literature. Fluctuations in commodity prices can impact companies' profitability and cost structure, particularly those operating in commodity-intensive industries. According to Bodie et al. (1995). When commodity prices rise, companies that rely heavily on commodities as inputs may experience increased costs, potentially affecting their ability to generate and sustain high dividend payments. Conversely, falling commodity prices can lower input costs for these companies, potentially supporting their profitability and dividend sustainability (Chen et al., 2011).

2.10 Return Predictability

Stock return predictability is a significant topic in financial economics, as it has implications for macroeconomic analysis and individual investors' decision-making. From a macroeconomic standpoint, the positive relationship between stock market performance and economic growth is well-established, highlighting the value of accurately predicting future stock market developments (Beck et al., 2004; Nieuwerburgh et al., 2006). On an individual investor level, accurately forecasting stock returns is essential for effective risk management, portfolio selection, and investment strategy formulation. However, the stock return predictability issue has been controversial in finance (Abu-Mostafa et al., 1996; Cooper and Priestley, 2009).

2.10.1 Limitations of Stock return predictability methods

Several factors contribute to the complexity and challenges associated with analyzing stock return predictability. Firstly, stock return time-series data are characterized by noise, non-linearity, and chaos, making it difficult to extract meaningful patterns and predictability (Abu-Mostafa et al., 1996). Secondly, the reasons behind stock return predictability are not universally agreed upon. Some argue that predictability is explained by the correlation between stock returns and the business cycle, as financial variables are thought to co-move with economic conditions (Fama and French, 1989). However, the use of financial variables may result in predictability driven by temporary price fluctuations rather than fundamental factors. Additionally, various investor sentiment variables have shown predictive power for stock returns, further adding to the complexity of the predictability puzzle (Baker and Wurgler, 2006). Lastly, traditional business cycle variables, such as GDP growth, have proven inadequate in predicting stock returns (Pena et al., 2002), adding to the challenges of identifying reliable predictors.

Nonetheless, extensive literature has been dedicated to forecasting stock market returns using various predictive variables, including price multiples, macroeconomic variables, corporate actions, and risk measures. Welch and Goyal (2008) conducted a comprehensive study on the performance of macroeconomic variables as predictors of stock returns, examining both in-sample and out-of-sample forecasts. Their findings indicated that many variables were unstable and no longer significant for in-sample forecasting. However, Cooper and Priestley (2009) show that macroeconomic variables, such as the output gap, exhibit strong predictive power for stock returns. Moreover, their study, shows that the output gap remains robust even when subjected to various rigorous tests.

2.11 Selected Stock Return Predictability Methods

While the majority of research has focused on macroeconomic variables as predictors, relatively little attention has been given to technical indicators despite their use among practitioners, Neely et al. (2014) compared the forecasting ability of technical indicators with well-known macroeconomic variables discussed by (Welch and Goyal, 2008). Their study revealed that technical indicators exhibited statistical significance in both in-sample and out-of-sample forecasting, matching or surpassing that of macroeconomic variables. Furthermore, evidence suggests that these of indicators offer complementary information over the business cycle, emphasizing the importance of combining technical and macroeconomic information to enhance the predictability of stock market returns. However, recent studies by reputable finance researchers have highlighted that stock return predictability tends to be concentrated during economic recessions.

2.11.1 Dividend Based

The utilization of dividends in predicting stock returns has gained widespread acceptance in the academic community. Cochrane (2007) investigated the predictability of stock returns using the dividend-price ratio as a measure. Empirical evidence suggests that the predictability of stock returns through the dividend-price ratio is particularly prominent when considering longer-term horizons spanning multiple years. This finding has led researchers to interpret the variation in dividend yields primarily as a consequence of changing expectations regarding future long-term returns, with expectations of future long-term dividend growth playing a minimal role in this predictability phenomenon (Chen, 2009).

In contrast, Dladla and Malikane (2019) employed a linear asset pricing model in their study that integrates three macroeconomic variables based on the Taylor rule. The results of their analysis demonstrate that these macroeconomic variables exhibit strong predictive power for asset returns, surpassing the performance of autoregressive benchmarks commonly employed in forecasting. The findings of Dladla and Malikane (2019) highlight the efficacy of incorporating macroeconomic variables within the framework of the linear asset pricing model, shedding light on their superior predictive performance compared to traditional forecasting approaches. Gonzalo and Pitarakis (2012) argue that stock return predictability may vary across different phases of the business cycle. Rapach et al. (2010), and Dangl and Halling (2012) found evidence of return predictability primarily during recession periods, to support this notion.

2.11.2 The Use of Commodities in Stock Return Predictability

Researchers have examined the relationship between commodity prices and stock returns, seeking to identify whether commodity price movements can provide insights into future stock market performance. Jacobsen et al. (2019) conducted a study to examine the predictability of monthly industrial metal returns on both the U.S. market and the equity markets of other industrialized countries. To capture business cycle-specific patterns, they employed a state-switching model that distinguished between recession and expansion. The findings of the study indicate a robust ability of industrial metals to forecast stock market movements. Similarly, Iyke and Ho (2021) show that commodity returns have predictive power for stock returns, and this relationship holds consistently across agriculture, energy, livestock, and meat markets.

Importantly, the predictive ability of commodity returns remains robust during both recessions and expansions. They propose that commodity and stock returns exhibit a negative correlation attributed to their behavior throughout the business cycle. Specifically, during the early stages of a recession, commodity returns tend to be positive while stock returns are negative, and this pattern reverses during the latter stages. Supporting the above notion, Salisu et al. (2019) conducted a study focusing on the G7 countries to examine the predictive power of commodity prices in stock returns. By employing a linear regressive model, the researchers demonstrated that commodity prices serve as effective predictors of stock returns for both in-sample and out-of-sample forecasts.

Furthermore, their findings indicated that commodity models outperformed both time series and historic average models in terms of predictive accuracy.

In the study conducted by Black et al. (2014), the authors explore the long-term association between the S&P 500 Composite Index and the S&P GSCI Total Return Index. Their analysis highlights the dynamic nature of this relationship, which changes over time and is characterized by several structural breaks. The research paper places significant emphasis on the time-varying nature of the connection between stock and commodity returns. In light of these findings, the authors recommend employing a forecast model that incorporates the capability to capture changes in the parameter values within the framework of the forecast regression.

2.12 Conclusion

In conclusion, the selection of preferred investment styles holds significant sway over investment returns. This has led to considerable attention being directed toward investment styles within both investment and scholarly circles, prompting researchers to delve into the factors underpinning these styles and their resultant influence. Notably, alterations in commodity prices impact the performance of investment styles and their associated returns. As elucidated by Bekaert et al. (2013), positive price movements in commodities possess the potential to furnish investors with favorable returns and asset appreciation, particularly for those who maintain prolonged positions or possess exposure to commodities. Conversely, during periods marked by declines in commodity prices, investors may be confronted with deficits or diminished returns, especially in the absence of judicious risk management practices (Tang and Xiong, 2012). Consequently, the interrelation between commodity prices and investment styles assumes a pivotal significance.

Despite the potential for higher risk premiums resulting from volatility, the low correlation can help predict stock returns and reduce unsystematic risk in a portfolio, aligning with Modern Portfolio Theory (Gorton and Rouwenhorst, 2006; Iyke and Ho, 2021). However, investors must carefully assess the unique characteristics and risks associated with commodities before allocating a portion of their portfolio to this asset class. Investment styles in commodities provide investors with strategies for allocating funds across different asset classes, simplifying decision-making processes and allowing for effective information handling (Barberis and Shleifer, 2003). The performance of investment styles can be influenced by changes in commodity prices, impacting valuation and market sentiment towards commodity-intensive industries and related assets. Therefore, the presence of common factors introduced by fluctuations in commodity prices can influence the behavior of investment styles in the market and returns thereof.

Table 1: A summary of Previous main studies

Author /Year	**Countries**	**Period**	**Methodology**	**Variables**	**Conclusion**
Cooper & Prestley (2009)	G7	1948-2008	Regression analysis, Monet Carlo Simulation	Stock returns, output gap	The output gap does not contain the level of stock market prices, its predictive ability is unlikely to stem from stock mispricing. Stock and bond return predictability is the rational response to changing business conditions rather than market inefficiency.
Black et al. (2014)	US	1973-2012	Regression analysis	Stock returns, Dividend yield, Short term interest rates, commodity prices	There is a long-run relationship between stock prices and a general commodity price index. The predictive relationship for commodity prices is more consistent over the full sample, where commodity returns exhibit a significant relationship with the log price ratio of the correct sign for equilibrium reversion.
Jordan et al. (2016)	Canada	1985-2011	Regression analysis	Stock returns, commodity index	commodity returns can forecast eight Canadian sector equity returns out-of-sample.
Ali et al., (2020)	49 Developed, advanced and secondary emerging markets	2001-2018	Regression analysis. Garch (1,1)	Commodity and equity index	Commodities offer the highest conditional diversification benefits in an equally weighted portfolio for the stock markets of New Zealand and Norway, secondary emerging and frontier market classes.
Salisu et al. (2019)	G7	1960-2017	Regression analysis	Stock returns, commodity price index, interest rates, output	Commodity prices are good predictors of stock returns both for in-sample and out-of-sample forecasts.
Adekoya et al. (2021)	Egypt,Kenya, South Africa, Nigeria, Morocco	1995-2010	Regression analysis, multifactor	Stock returns, oil prices, CBOE volatility index	Both the global financial cycle and oil price are significant predictors of stock returns of the considered countries, especially in the multi-factor case
Iyke & Ho (2021)	Netherlands, UK and US	1629-2004	Regression analysis	Commodity price index, Stock returns	Commodity returns contain useful information to forecast stock returns, approximately 64% and 56% of the commodity returns can predict stock returns in-sample and out of-sample,

					respectively. Aggregating commodity returns by markets, returns from agriculture, appear to predict stock returns.
Lv & Qi (2022)		1980-2020	Regression Analysis and Dimensionality Reduction	Stock market excess returns, Goyal& Welchs Macroeconmic variables	The predictors are strong and robust when using a mean combination of forecast models during different forecasting windows, different market conditions, and multi-step-ahead forecasts.
Matsumuto et al. (2023)	Global study	1980-2018	Regression Analysis	Commodity prices, MCSI, production index, US Tbill	Commodity prices offer valuable insights into both present and prospective global economic dynamics, with signals derived from changes in commodity prices serving as informative indicators for the real-time assessment and predictive modeling of global GDP and industrial production.

3. Research methodology and data

3.1 Methodology

3.1.1 The Theoretical Framework of the Relationship between Commodity Prices and Stock Returns

In this section, we explore the predictive power of commodity prices for stock returns, enhancing our understanding of their influence on investment styles. We build on the theoretical proposition Jacobsen et al. (2019) put forward, which suggests that commodity prices contain valuable information that can be used to forecast stock returns. The underlying theory posits that a simultaneous rise in inflation and interest rates often accompanies increased commodity returns. This, in turn, is believed to have a negative effect on stock markets, as discussed by Black et al. (2014). By exploring this relationship between commodity returns and stock returns, we aim to uncover the potential predictive power of commodity prices and how they can impact different investment styles.

The relationship between commodity prices and stock returns has been extensively studied in the existing literature, as evidenced by research conducted by Cochrane (2011) and Ang and Bekart (2007). In line with these investigations, our primary focus centers on understanding the information embedded within commodity prices and how they exert influence on stock returns. The underlying theoretical framework that governs the relationship between stock and commodity markets is based on Modern Portfolio Theory (MPT) principles. The predictability of stock returns has garnered considerable attention in academic research. However, the issue remains contentious, with differing viewpoints regarding the extent to which stock returns can be accurately predicted. While some scholars assert that stock returns are inherently unpredictable (Fama and French, 1989), others have demonstrated that predictive models incorporating financial and macroeconomic variables can indeed forecast stock returns (Cooper and Priestly, 2008; Vivian and Wohar, 2013; Dladla and Malikane, 2019). However, it is worth noting that Dladla and Malikane (2019) contend that a significant proportion of these models exhibit instability and produce spurious results.

In prior scholarly investigations, financial variables have been widely employed to forecast stock returns. Nevertheless, according to Cooper and Priestly (2008), the utilization of financial metrics has encountered criticism, with scholars drawing attention to the possibility that their application may be driven by transitory market fads that eventually dissipate. Cooper and Priestly (2008) assert that the fluctuations observed in the stock market, influenced by temporary market sentiment or investor behavior, can create short-term predictability reliant on financial variables. However, once these trend-driven phenomena fade, the predictive power of financial metrics is likely to diminish. This critique thereby creates apprehension regarding the resilience and enduring effectiveness of financial metrics in stock return prediction.

In light of this criticism, scholars such as Cooper and Priestly (2008), Vivian and Wohar (2013), and Malikane and Dladla (2019) have advocated for the incorporation of non-financial variables to enhance the accuracy of stock return prediction models. In their study investigating the predictive power of commodities on stock returns, Black et al. (2014) incorporate non-financial variables that have been found to exhibit predictive power for stock returns. In particular, they use the dividend yield and short-term interest rates. This notion finds further validation in the work of Wen et al. (2022), whose research involves the utilization of a selection of macroeconomic variables. These variables are indicative of prevailing macroeconomic conditions and offer insights into the fundamental traits of economic activities within financial markets. Adding depth to the discussion, Lv and Qi (2022) emphasize the connection between stock market responses and macroeconomic indicators, where fluctuations in the latter wield substantial sway over both equity and commodity markets, consequently inciting fluctuations in market prices.

3.1.2 The Model

Matsumoto et al. (2023) and Niu et al. (2019) contend that two fundamental justifications underscore the significance of commodity prices as indicators of global economic activities. Firstly, countries in the extractive development phase heavily depend on fluctuations in commodity prices to propel their economic progress. When commodity prices are high, these nations witness increased performance in their stock markets; conversely, stock market activities tend to decrease during low commodity prices. Secondly, specific commodities possess the attribute of storability, akin to financial assets. Therefore, their prices encapsulate current and anticipated future dynamics of demand and supply conditions (Alquist et al., 2020).

Drawing upon the research conducted by Dladla and Malikane (2019), our study builds upon the foundational framework of the linear asset pricing model. Dladla and Malikane (2019) derived a model for stock return predictability that includes important macroeconomic variables such as the interest rate, the output gap, and the exchange rate. The model by Dladla and Malikane (2019) is in line with the asset price equations often used in the general equilibrium models such as those by Nistico (2012), Challe and Giannitsarou (2014), Milani (2017), and Alovokpinhou et al. (2024). In the later studies, macroeconomic variables enter the asset price equation through profits or dividends. These studies often assume that firms pay all profits in dividends, where profits are a function of the macroeconomic variables. We extend the stock returns model in the study by Dladla and Malikane (2019) with commodity prices. The assumption is that the firm's profit is a function of commodity prices. In other words, we assume that some domestic firms export commodities while others import commodities.

Incorporating commodity prices into the stock returns model provides a framework for understanding how shifts in commodity markets impact a firm's financial performance. For firms engaged in commodity exports, revenue is closely tied to commodity price movements. When global commodity prices rise, these firms generally experience higher revenues due to the increased value of the commodities they export, whether in raw or processed form. This growth in revenue positively affects profitability, contributing to higher stock returns. Conversely, a decrease in commodity prices leads to lower export revenues, which can exert downward pressure on stock returns.

On the other hand, firms that depend on commodity imports for their production processes face an inverse relationship. For these firms, commodity prices serve as a key determinant of production costs. Rising commodity prices lead to higher input costs, which can compress profit margins, particularly if firms are unable to pass these costs on to consumers. This increase in production costs can negatively impact profitability and result in lower stock returns. However, when commodity prices decline, input costs are reduced, potentially leading to higher profitability and improved stock performance. With that said, the primary stock returns equation is specified as follows:

$$\hat{R}_t = -\alpha_r \hat{r}_t + \alpha_y \widehat{\Pi}_t + \hat{\varepsilon}_t \tag{1}$$

In equation (1), $\hat{R}_t$ is the returns variable, $\hat{r}_t$ is the real interest rate, and $\widehat{\Pi}_t$ is the profit gap or the firm's profit expressed in its deviation from the steady state. In Dladla and Malikane (2019), the sign of α_r can either be positive or negative. However, if we assume that commodity prices appear in the firm's cost and revenue functions, the firm's profit function depends on commodity prices. In line with Blanchard (1981), Gavin (1989), and Dladla and Malikane (2019), we specify the profit function that incorporates the domestic price of the commodity as follows:

$$\widehat{\Pi}_t = \lambda_y \hat{y}_t + \lambda_d \hat{p}_t^d \tag{2}$$

In equation (2), $\hat{y}_t$ is the output gap, $\hat{p}_t^d$ is the real domestic price gap of the commodity. In line with Blanchard (1981) and Dladla and Malikane (2019), the coefficient of the output gap variable is positive, that is $\lambda_y > 0$. However, given that the commodity price appears in both the firm's cost and revenue function of the firm, the sign of the parameter $\lambda_1$is expected to be ambiguous. That is, λ_1 can be positive or negative. We substitute equation (2) into (1) to obtain the following returns equation:

$$\hat{R}_t = -\alpha_r \hat{r}_t + \delta_y \hat{y}_t + \delta_d \hat{p}_t^d + \hat{\varepsilon}_t \tag{3}$$

In equation (1), $\delta_y = \alpha_y \lambda_y$ and $\delta_y = \alpha_s \lambda_s$. The domestic currency commodity price can be written as follows:

$$P_t^d = \frac{e_t \, P_t^f}{P_t} \tag{4}$$

In equation (4), e_t is the nominal exchange rate and P_t^f is the foreign currency price or the dollar price of the commodity. Equation (4) can further be decomposed as follows:

$$P_t^d = \frac{e_t \,. P_t^*}{P_t} \cdot \frac{P_t^f}{P_t^*} \tag{5}$$

In equation (5), P_t^* denotes the foreign price index. What equation (5) states is that, the domestic currency price of the commodity is driven by the real exchange rate $S_t = \frac{e_t\, P_t^*}{P_t}$ and the real international price $P_t^{int} = \frac{P_t^f}{P_t^*}$ of the commodity. The assumption is that both the real exchange rate and the real international price of the commodity enter the firm's profit function. With this said, the profit function can be rewritten as follows:

$$\hat{\Pi}_t = \lambda_y \hat{y}_t + \lambda_f \hat{p}_t^f + \lambda_s \hat{s}_t \tag{6}$$

In equation (6), $\hat{p}_t^f$ is the real international price gap of the commodity and $\hat{s}_t$ is the real dollar exchange rate gap. We substitute equation (6) into (1) to obtain a model that considers the role of the real exchange rate and the role of the real international commodity price.

$$\hat{R}_t = -\alpha_r \hat{r}_t + \delta_y \hat{y}_t + \delta_f \hat{p}_t^f + \delta_s \hat{s}_t + \hat{\varepsilon}_t \tag{7}$$

The objective is to estimate equation (3) and equation (7). Equation (3) expresses the returns on the investment style as a function of the real domestic currency price of the commodity. Equation (7) decomposes the effect of the domestic currency price of the commodity in terms of the effect of the exchange rate and the effect of the real international currency price of the commodity.

3.2 Data

3.2.1 Data Collection and Description

This section presents an overview of the data used for the empirical analysis of our model. The dataset includes key variables crucial for examining our model's characteristics. The use of multiple variables in the model was important as it highlights the potential impact of diverse elements on stock returns. Furthermore, the incorporation of diverse elements provides a more credible explanation of the intricate interplay among the diverse variables influencing returns

(Perlin et al., 2014). The dependent variable of primary interest is investment returns, which are linked to three investment styles. We gather monthly information from reputable financial data providers, including the International Monetary Fund (IMF) and World Bank database to obtain the required data.

We collect monthly returns on investment styles from MorningStar for each respective country, denominated in the local currency. Investment styles are assessed through the classification of stocks according to their attributes and market behavior. MorningStar employs a style box methodology to evaluate investment styles, considering the stocks' characteristics and market capitalization. This approach categorizes equities based on their observed behavior and specific attributes. These investment styles are indicative of major stock markets and commodity-producing countries, including the US, UK, Canada, South Africa, Brazil, and Australia.

The time period covered in the data spans from December 1999 to June 2022, allowing for the assessment of investment styles across multiple business cycles. However, we are limited in our analysis, as the different styles have different time spans of available data. To ensure the validity of our analysis, it is important that the time horizons for each style are consistent, as highlighted by Pedersen (2015). Disparities in the time span of data could affect the reliability of the analysis and must be addressed for accurate comparative evaluation.

In relation to the explanatory variables, we collect prices of individual commodities indices, covering food, energy, and precious metals from the World Bank database. This approach aligns with similar studies conducted by Bessler and Wolff (2015) and Daigler et al. (2017). The selection of specific commodities is based on their ability to accurately reflect their respective commodity sectors' unique characteristics and dynamics. By incorporating a wide array of individual commodities, we aim to capture the broader trends and influences within the commodity market. As the collected commodity prices are denominated in US dollars, we convert them to the domestic price currency. This conversion entails multiplying the dollar price of the commodity by the dollar exchange rate of the domestic currency, whilst the real domestic price of the commodity is obtained by deflating the commodity price with the domestic consumer price index. In the context of other variables, we collect interest rates, output, and real exchange rate data from the IMF database.

Table 2: Summary of Variables for Analysing Stock Returns

Variable	**Description**
$\hat{R}_t$	Returns on growth, value, and momentum investment styles
r_t	real interest rate
$\hat{y}_t$	Output gap
$\hat{S}_t$	real exchange rate gap
$\hat{p}_t^d$	Real domestic price gap of commodity
$\hat{p}_t^f$	Real international price gap of commodity

4. Results and Analysis

This chapter reports the findings from the conducted data analysis to investigate the impact of commodity prices on investment style return. Three distinct commodity classes, namely those pertaining to food, energy, and precious metals, are examined, each in relation to value, growth, and momentum investment style returns.

4.1. Descriptive Statistics

This section provides a condensed overview of the descriptive statistics associated with the study variables. As previously indicated, changes in commodity prices may contain useful information about anticipated future economic conditions. Specifically, an upward trajectory in commodity prices indicates an increase in global economic demand. This, in turn, is expected to impact stock prices, thus higher returns (Jacobsen et al., 2019).

Table 3 presents the correlations between the right-hand side variables and returns on investment styles. Our analysis begins with examining the returns on value investment styles. Across the six countries studied, we observe that returns on investment styles exhibit a positive and weak correlation with interest rates in four countries. Notably, the relationship demonstrates statistical significance at the 10% level of significance in both the United States and Australia. On average, the coefficient of correlation is estimated to be 0.03.

The results further reveal that the output gap has a weak and negative correlation with return on value investment styles. The average estimated coefficient of correlation is 0.10 and statistically significant in five of the six countries at a 10% level of significance. In line with this perspective, Koijen et al. (2017) suggest that growth investments perform relatively better during periods of economic expansion characterized by higher output levels than value investments. The rationale behind this preference lies in the anticipation of stronger future growth and the potential for capital appreciation in growth stocks. In contrast, value stocks are perceived to offer more stable earnings but with lower growth prospects. Hence, the observed negative correlation between the output gap and returns on value investment styles may be attributed to investors' preference for growth-oriented strategies during periods of economic expansion, leading to relatively subdued performance of value stocks in this context.

Regarding commodity prices, food and energy commodity prices exhibit a negative and weak relationship with returns on value investment styles. Conversely, precious metals exhibit mostly a positive and weak relationship, with the average correlation coefficient estimated at 0.02. Notably, this relationship attains statistical significance in Canada at a 10% level of significance. This could be attributed to Canada's substantial role as a producer of precious metals, particularly gold, with a significant portion of its economic activity tied to the mining sector. Consequently, fluctuations in precious metal prices can exert a discernible impact on the Canadian stock markets and investment returns across various investment styles.

Panel B displays the correlation between returns on growth investment styles and the right-hand side variables. Similar to returns on value investment styles, interest rates exhibit a positive and weak correlation with returns on growth investment styles, except in the case of Canada, where a negative and weak relationship is observed. We note that the relationship is statistically significant at the 1% level of significance in both the United States and Australia, with correlation coefficients estimated at 0.16 and 0.17, respectively.

Examining commodities, it becomes apparent that energy prices demonstrate a negative and weak correlation with returns on growth investment styles across the six countries, with an average coefficient of -0.12. We note that the relationship is statistically significant in four countries: the United States and the United Kingdom at a 5% significance level, and South Africa and Brazil at a 1 % level of significance. This observation suggests an inverse relationship between energy commodity prices and returns on growth investment styles.

Lastly, we examine the relationship between returns on momentum investment styles and the above-mentioned right-hand side variables. Like returns on value, interest rates have a positive relationship with returns on momentum investment styles. We further note the negative and weak relationship between the output gap and returns on momentum investment styles; like previously noted with value and growth investment styles, the estimated average correlation coefficient is -0.11 and statistically significant in five of the six countries.

With commodity prices, we tend to observe a similar relationship with returns growth investment styles, with an exception on the relationship between food prices and returns on momentum investment style in the United States. The estimated correlation coefficient is -0.05, negative, and very weak; however, it is statistically significant at 1% level of significance. Like energy prices, higher food prices can signal broader inflationary pressures within the economy. Inflation erodes purchasing power and can lead to higher interest rates as central banks seek to curb inflationary pressures. Rising interest rates can negatively impact momentum investments, as higher borrowing costs and reduced consumer spending may weigh on corporate earnings growth prospects. Additionally, higher interest rates can make fixed-income investments relatively more attractive compared to equities, leading to capital outflows from the stock market and downward pressure on momentum stocks.

Table 3: Descriptive statistics-correlations.

Panel A	Value Investment Style					
Country	ρ_{qr}	ρ_{qy}	ρ_{qs}	ρ_{qp1}	ρ_{qp2}	ρ_{qp3}
USA	0.09*	-0.10*	N/A	0.02	-0.03	-0.00
	(1.71)	(-1.82)		(0.43)	(0.58)	(-0.07)
UK	-0.01	0.01	-0.01	0.02	-0.03	-0.01
	(-0.21)	(0.17)	(-0.24)	(0.38)	(-0.55)	(-0.09)
AUS	0.12*	-0.13**	-0.05	-0.06	-0.05	0.01
	(1.75)	(1.97)	(-0.78)	(-0.95)	(-0.77)	(0.21)
CAN	-0.06	-0.13***	-0.11**	0.04	0.02	0.10*
	(-0.12)	(-2.39)	(-2.02)	(0.64)	(0.44)	(1.74)
SA	0.04	-0.14**	-0.03	-0.05	-0.09	-0.01
	(0.66)	(-2.30)	(-0.42)	(-0.81)	(-1.54)	(-0.15)
BRZ	0.02	-0.10*	0.00	0.00	-0.09	0.05
	(0.39)	(-1.68)	(0.06)	(0.02)	(-1.57)	(0.77)
AVERAGE	**0.03**	**-0.10**	**-0.05**	**-0.05**	**-0.05**	**0.02**
Panel B	Growth Investment Style					
USA	0.16***	-0.13***	N/A	-0.03	-0.12**	-0.00
	(3.06)	(-2.43)		(-0.67)	(0.02)	(-0.03)
UK	0.06	-0.07	-0.01	-0.03	-0.12**	-0.00
	(1.16)	(-1.26)	(-0.20)	(0.51)	(-2.17)	(-0.07)
AUS	0.17***	-0.14**	-0.01	-0.07	-0.07	-0.03
	(2.55)	(2.12)	(-0.11)	(-1.09)	(-1.01)	(-0.46)
CAN	-0.01	-0.05	-0.06	0.05	-0.07	0.06
	(-0.09)	(-0.87)	(-1.22)	(0.89)	(-1.30)	(1.20)
SA	0.12*	-0.16***	0.08	-0.11*	-0.18***	-0.01
	(1.90)	(-2.61)	(1.38)	(-1.74)	(-2.93)	(-0.21)
BRZ	0.04	-0.12**	0.02	-0.11*	-0.15***	0.01
	(0.72)	(-1.98)	(0.29)	(-1.82)	(-2.42)	(0.18)
AVERAGE	**0.09**	**-0.11**	**0.00**	**-0.05**	**-0.12**	**0.00**
Panel C	Momentum Investment Style					
USA	0.18***	-0.11**	N/A	-0.05**	-0.12**	0.01
	(0.00)	(0.05)		(0.40)	(0.03)	(0.89)
UK	0.08	-0.01	-0.03	-0.05	-0.12**	0.05
	(1.29)	(-0.18)	(0.48)	(-0.89)	(-2.16)	(0.09)
AUS	0.16***	-0.15**	-0.03	-0.08	-0.08	0.00
	(2.48)	(-2.36)	(-0.42)	(-1.15)	(-1.19)	(0.03)
CAN	-0.01	-0.10*	-0.11**	-0.02	-0.02	0.09
	(-0.19)	(-1.75)	(-2.03)	(-0.27)	(-0.05)	(0.56)
SA	0.14**	-0.16***	0.03	-0.09	-0.15	0.01
	(2.29)	(-2.65)	(0.43)	(-1.46)	(-2.40)	(0.11)
BRZ	0.03	-0.12*	0.01	-0.05	-0.13**	0.03
	(0.52)	(-1.94)	(0.14)	(-0.84)	(-2.13)	(0.50)
AVERAGE	**0.10**	**-0.11**	**-0.03**	**-0.06**	**-0.10**	**0.03**

Note: T-statics in parenthesis, *is significant at 10%, ** is significant at 5% and *** is significant at 1%. ρ_{qp1} is the correlation between returns on value styles and food prices, ρ_{qp2} is energy prices, ρ_{qp3} is precious metals prices, ρ_{qpr} is interest rates, $\rho_{qpy}$is output gap, and ρ_{qps} is exchange rate.

Table 4 displays the standard deviations of all the variables; we note that the estimates range from 2-18%, and the very low standard deviation indicates low variability across the investment returns as the main dependent variables and within the independent variables. Moreover, the data suggests that the choice of investment style offers similar risk (5%). This implies that investors are more likely to get similar returns for each investment style. Furthermore, of the commodity indices, the data suggests that energy yields the highest risk by a standard deviation of 16%, followed by food at 10% and gold at 8%. This means that investments linked with the energy price index would yield a slightly higher investment return.

Table 4: Descriptive Statistics, standard deviations

Panel A	Results based on HP- Filter								
Countries	σ_{qv}	σ_{qg}	σ_{qm}	σ_{r}	σ_{y}	σ_{s}	σ_{p}	σ_{p1}	σ_{p2}
USA	4%	4%	4%	1%	2%	-	10%	18%	6%
UK	4%	4%	4%	2%	3%	5%	11%	18%	8%
AUS	4%	4%	4%	4%	3%	7%	8%	7%	6%
CAN	4%	6%	5%	1%	3%	3%	11%	17%	9%
SA	5%	5%	6%	1%	4%	7%	11%	17%	9%
BRZ	8%	7%	7%	3%	4%	8%	11%	16%	9%
AVERAGE	**5%**	**5%**	**5%**	**2%**	**3%**	**6%**	**10%**	**16%**	**8%**

4.2. Model Estimation

This section presents formulated models, represented by equations (3) and (7). Consistent with previous research (Jacobsen et al., 2019; Goyal and Welch, 2008), we employ the Ordinary Least Squares Method (OLS) with HAC standard errors to estimate our models. The findings of the foundational model are detailed in Tables (5) to (10).

For this section of the study, we discuss the results from the regression analysis and apply economic theory and empirical observations to explain the findings of our final regression models. Firstly, we present the regression outcomes represented by equation (3), which looks at the influence of the real domestic price gap of the commodity. Subsequently, we analyze the results represented by equation (7), which decomposes the effect of the domestic currency price of the commodity in terms of the effect of the exchange rate and the effect of the real international currency price of the commodity.

4.2.1 Real domestic price and international price of food and returns on style investments.

Table 5 illustrates the findings derived from equation (3), demonstrating that interest rates notably positively impact returns on value investment styles. The results indicate statistical significance at a 1% level across five of the six countries, except Brazil; according to equation (3), the interest rate is supposed to be either positive or negative. Thus, interest rates carry the correct sign. This is in line with Dladla and Malikane (2019), who posits that interest rates can either be positive or negative, depending on the magnitude of the quasi-duration. In the case of Brazil, where we observe a non-significant impact, this can be attributable to a high degree of interest rate smoothing. This strategy entails deliberate adjustment of interest rates in a gradual manner, resulting in small fluctuations in interest rates than fluctuations in asset prices. (Dladla and Malikane, 2019).

Furthermore, we note an interesting observation of the impact of interest rates on returns on growth and momentum investment styles, which is positive, similar to that observed with value investment styles. The relationship is statistically significant at a 1% level of significance in five of the six countries. Investors typically anticipate that distinct investment styles will generate varying returns across different economic cycles. In their study, Smirlock and Yawitz (1985) explain similar returns, arguing that prolonged periods of exceptionally low interest rates stemming from expansive monetary policies can cause the relationship between interest rates and returns on growth stocks to be positive. In such scenarios, characterized by minimal interest rates, incremental increases exert a smaller impact on the discount rates employed in discounted cash flow models. Consequently, this mitigates the adverse effects on the valuation of growth stocks. This implies that, during such circumstances, the returns on growth stocks become positively associated with interest rates, thus yielding similar returns as value investment styles.

Concerning the output gap, we note that it negatively impacts returns on investment styles. This effect achieves statistical significance at a 1% significance level in three of the six countries, namely the United States, Australia, and Canada, across the three investment styles. In countries where the effect lacks significance, it may result from the response of central banks, which may not be particularly responsive to changes in the output gap (Dladla and Malikane, 2019).

Evidence of this negative effect is further highlighted by Atanasov (2018), who, in their study, present findings indicating a negative relationship between the expected future returns and the output gap. The initial point of notice is that the estimates reveal a consistently negative trend, suggesting that a decline in the global output gap is associated with higher expected returns in the future, aligning with a countercyclical risk premium. A countercyclical risk premium suggests that investors demand higher returns for investing in riskier assets during economic downturns. When the global output gap narrows or becomes negative, it signifies that actual economic output is below its potential level, indicating an economic downturn or recession. During such periods, there is typically increased uncertainty and higher perceived risk in financial markets, leading investors to seek higher returns to compensate for the elevated risk. This discovery aligns with the observations made by Cooper and Priestley (2009), who similarly identify evidence supporting the negative effect between returns and the output gap in the United States.

Table 5: Estimation results of Equation (3) with the domestic price of food.

Panel A	Value Investment Style			
Model	$\hat{R}_t = -\alpha_r \hat{r}_t + \delta_y \hat{y}_t + \delta_d \hat{p}_t^d + \hat{\varepsilon}_t$			
Countries	α_r	δ_y	δ_d	R^2
USA	0.68***	-0.17***	-0.02***	0.78
	(0.05)	(0.03)	(0.01)	
UK	0.57***	0.00	-0.02***	0.56
	(0.00)	(0.01)	(0.01)	
AUS	1.03***	-0.08***	-0.02***	0.99
	(0.02)	(0.02)	(0.00)	
CAN	0.57***	-0.09***	0.00	0.54
	(0.09)	(0.02)	(0.01)	
SA	1.26***	-0.01	-0.02**	0.76
	(0.09)	(0.01)	(0.01)	
BRZ	0.17	0.09	-0.01	0.06
	(0.11)	(0.06)	(0.02)	
	Growth Investment Style			
USA	0.69***	-0.17***	-0.02***	0.77
	(0.05)	(0.03)	(0.01)	
UK	0.60***	0.00	-0.01***	0.58
	(0.07)	(0.01)	(0.01)	
AUS	1.03***	-0.07***	-0.02***	0.99
	(0.02)	(0.02)	(0.01)	
CAN	0.62***	-0.07***	0.00	0.56
	(0.09)	(0.02)	(0.01)	
SA	1.23***	-0.02	-0.02**	0.76
	(0.09)	(0.01)	(0.01)	
BRZ	0.16	0.09	-0.01	0.06
	(0.11)	(0.06)	(0.02)	
	Momentum Investment Style			
USA	0.68***	-0.17***	-0.02***	0.78
	(0.05)	(0.03)	(0.01)	
UK	0.62***	-0.03	-0.02***	0.57
	(0.07)	(0.81)	(0.01)	
AUS	1.03***	-0.08***	-0.02***	0.99
	(0.02)	(0.02)	(0.01)	
CAN	0.60***	-0.08***	0.00	0.59
	(0.08)	(0.02)	(0.01)	
SA	1.25***	-0.01	-0.02	0.76
	(0.09)	(0.01)	(0.01)	
BRZ	0.16	0.09	-0.01	0.06
	(0.11)	(0.07)	(0.02)	

Note: HAC Standard errors in parenthesis, * is significant at 10%, ** is significant at 5% and *** is significant at 1%. R^2 is the adjusted R-square

We look at commodity prices; food prices negatively impact returns on investment styles in all countries. The relationship holds statistical significance in the United States, United Kingdom, and Australia at a 1% level of significance and in South Africa at a 5% level. This aligns with Gorton and Rouwenhorst (2006), who posits that the negative effect is mostly driven by commodities' different behaviour over the business cycle. They assert that commodities tend to be positively correlated with inflation and exhibit sensitivity to both fundamental demand factors and supply-side influences. For instance, certain commodities, such as natural gas and cereals, respond to weather conditions, while others, like crude oil, are susceptible to geopolitical instability and macro-financial variables. Additionally, industrial metals are influenced by factors such as mining strikes. This divergence in commodity behaviors implies that their relationships with equity markets are inherently varied.

Lastly, Table (6) displays the results of the international price of food on returns on investment styles. Our first observation is that the variables on the right-hand side of the regression, interest rate, output gap, and the international price of food, exhibit a similar relationship as the domestic price of food. However, when using the international price of food, we introduce the real exchange rate, which is not statistically significant in any of the countries. According to Kilic (2016), the lack of significance between the real exchange rate and returns on investment styles can be due to incomplete transmission of changes in the real exchange rate to export prices. When the real exchange rate changes, firms may not fully reflect these changes in the prices of their goods.

Table 6: Estimation results of equation (7) with the international price of food.

	Value Investment Style				
Model	$\hat{R}_t = -\alpha_r \hat{r}_t + \delta_y \hat{y}_t + \delta_f \hat{p}_t^f + \delta_s \hat{s}_t + \hat{\varepsilon}_t$				
Countries	α_r	δ_y	δ_f	δ_s	R^2
UK	0.63***	0.01	-0.02***	0.01	0.58
	(0.07)	(0.01)	(0.01)	(0.01)	
AUS	1.02***	-0.07***	-0.02***	-0.01	0.99
	(0.02)	(0.02)	(0.01)	(0.01)	
CAN	0.57***	-0.08***	0.00	0.00	0.54
	(0.09)	(0.03)	(0.01)	(0.02)	
SA	1.26***	-0.01	-0.02***	-0.02	0.76
	(0.11)	(0.01)	(0.01)	(0.02)	
BRZ	0.17	0.09	-0.01	-0.01	0.06
	(0.11)	(0.06)	(0.02)	(0.03)	
	Growth Investment Style				
UK	0.66***	0.01	-0.02***	0.01	0.60
	(0.08)	(0.01)	(0.01)	(0.01)	
AUS	1.02***	-0.06***	-0.02***	-0.00	0.99
	(0.02)	(0.02)	(0.01)	(0.01)	
CAN	0.62***	-0.07***	0.00	0.00	0.57
	(0.09)	(0.02)	(0.01)	(0.01)	
SA	1.24***	-0.01	-0.02***	-0.01	0.76
	(0.10)	(0.01)	(0.01)	(0.02)	
BRZ	0.16	0.09	-0.01	-0.01	0.06
	(0.11)	(0.06)	(0.02)	(0.03)	
	Momentum Investment Style				
UK	0.68***	0.00	-0.01***	0.01	0.59
	(0.08)	(0.01)	(0.01)	(0.01)	
AUS	1.02***	-0.07***	-0.02***	-0.01	0.99
	(0.02)	(0.02)	(0.01)	(0.01)	
CAN	0.60***	-0.08***	0.00	0.01	0.59
	(0.09)	(0.02)	(0.01)	(0.02)	
SA	1.26***	-0.01	-0.02***	-0.01	0.76
	(0.10)	(0.01)	(0.01)	(0.02)	
BRZ	0.16	0.09	-0.01	-0.01	0.06
	(0.11)	(0.06)	(0.02)	(0.03)	

Note: HAC Standard errors in parenthesis, * is significant at 10%, ** is significant at 5% and *** is significant at 1%. R^2 is the adjusted R-square

4.2.2 Real domestic price and international price of energy and returns on style investments.

In Table 7, we note that interest rates positively impact returns on investment styles, as previously described. The effect is positive across all six countries, and significant at a 1% significance level, except for Brazil, which is statistically significant at a 10% significance level. The output gap negatively affects returns on investment styles in the United States, Australia, and Canada. However, the output positively affects returns on Brazil's investment styles across the three investment styles.

Table 7:Estimation results of equation (3) with the domestic price of energy.

Countries	α_r	δ_y	δ_d	R^2
Value Investment Style				
USA	0.54***	-0.10***	-0.01***	0.79
	(0.07)	(0.03)	(0.00)	
UK	0.55***	0.01	-0.01***	0.58
	(0.06)	(0.01)	(0.00)	
AUS	1.03***	-0.08***	-0.02***	0.99
	(0.02)	(0.02)	(0.01)	
CAN	0.49***	-0.06***	-0.01***	0.58
	(0.10)	(0.02)	(0.00)	
SA	1.27***	-0.01	-0.00	0.75
	(0.10)	(0.02)	(0.01)	
BRZ	0.18	0.13***	-0.02*	0.08
	(0.10)	(0.05)	(0.01)	
Growth Investment Style				
USA	0.53***	-0.10***	-0.01***	0.78
	(0.07)	(0.03)	(0.00)	
UK	0.58***	0.01	-0.01***	0.61
	(0.07)	(0.01)	(0.00)	
AUS	1.03***	-0.08	-0.02***	0.99
	(0.02)	(0.01)	(0.01)	
CAN	0.55***	-0.05**	-0.01***	0.60
	(0.09)	(0.02)	(0.00)	
SA	1.25***	-0.01	-0.01	0.75
	(0.09)	(0.01)	(0.01)	
BRZ	0.17*	0.13***	-0.02*	0.08
	(0.10)	(0.05)	(0.01)	
Momentum Investment Style				
USA	0.53***	-0.10***	-0.01***	0.78
	(0.06)	(0.03)	(0.00)	
UK	0.60***	0.01	-0.01***	0.61
	(0.07)	(0.01)	(0.00)	
AUS	1.03***	-0.08***	-0.02***	0.99
	(0.02)	(0.02)	(0.01)	
CAN	0.53***	-0.06***	-0.01***	0.62
	(0.09)	(0.02)	(0.00)	
SA	1.26***	-0.01	-0.00	0.75
	(0.10)	(0.01)	(0.01)	
BRZ	0.18*	0.13***	-0.02*	0.08
	(0.10)	(0.05)	(0.01)	

Note: HAC Standard errors in parenthesis, * is significant at 10%, ** is significant at 5% and *** is significant at 1%. R^2 is the adjusted R-square

In the context of commodity prices, like food prices, energy prices negatively impact returns on investment styles. The relationship is statistically significant at a 1 % significance level in the United States, United Kingdom, Australia, and Canada, and 10% in Brazil. Notably, the impact of energy prices on returns appears consistent across the three investment styles. As previously explained, this phenomenon can be attributed to the impact of interest rate dynamics and investor behaviour.

This relationship can be ascribed to the influence of interest rate dynamics and investor behavior, as previously elucidated. Lakonishok et al. (1994) and Chan and Lakonishok (2004) assert that cognitive biases and irrational expectations among investors contribute to the value and growth premium anomaly. Their research demonstrates that investors tend to exhibit excessive optimism towards growth stocks and excessive pessimism towards undervalued stocks, resulting in favorable sentiment towards growth equities and unfavorable sentiment towards value equities. Similarly, Basu (1977) reveals that investors tend to overly discount the future performance of equities following reports of poor earnings, leading to an overestimation of the potential of growth equities relative to value equities. Consequently, market pricing errors occur, leading to disparate returns relative to market expectations.

Table 8 presents findings on the influence of the international price of energy on returns on investment styles. Consistent with previous observations, interest rates positively impact returns on investment styles across four countries, except for Brazil. Similarly, output negatively impacts returns on investment styles across the three investment styles, as previously noted, achieving statistical significance in Australia, Canada, and Brazil. Moreover, we note a negative effect of energy prices on returns on investment styles in the three countries. In order to explain this negative effect, we refer to the work of Huang et al. (1996) and Mussa (2000), who investigated the impact of oil prices on returns on investments. As an energy commodity, oil holds significant weight within the energy price index due to its pivotal role in global energy markets and economic activities. It is important to note that the three countries are oil producers.

Their research highlights the interconnection between oil prices and stock performance, rooted in underlying economic mechanisms concerning cash flows and discount rates. They assert that oil, a vital resource in producing numerous goods, exerts a significant influence on expected cash flows. Fluctuations in oil prices impact expected costs, with higher oil prices generally depressing stock performance. This effect is contingent upon whether a firm is a producer or consumer of oil. However, at the macroeconomic level, higher oil prices are generally associated with reduced stock returns, given the essential role of oil as an input in the global economy.

Furthermore, Kilian (2007), Lardic and Mignon (2008), and Lescaroux and Mignon (2008) emphasize the broader impact of oil price movements on consumer expenditures. Increased oil prices typically result in higher consumer expenditures, leading to diminished disposable income and reduced demand for company output. Moreover, escalating oil prices can introduce uncertainty into financial markets, consequently exerting downward pressure on stock prices (Filis, 2010).

Table 8:Estimation results of equation (7) with the international price of energy.

Panel	Value Investment Style				
Model	$\hat{R}_t = -\alpha_r \hat{r}_t + \delta_y \hat{y}_t + \delta_f \hat{p}_t^f + \delta_s \hat{s}_t + \hat{\varepsilon}_t$				
Countries	α_r	δ_y	δ_f	δ_s	R^2
UK	0.61***	0.01	-0.01***	0.01	0.60
	(0.07)	(0.01)	(0.00)	(0.01)	
AUS	1.01***	-0.08***	-0.01	-0.01	0.99
	(0.02)	(0.02)	(0.00)	(0.01)	
CAN	0.47***	-0.07***	-0.01***	-0.04	0.59
	(0.09)	(0.02)	(0.00)	(0.02)	
SA	1.26***	-0.02	-0.00	-0.01	0.75
	(0.12)	(0.02)	(0.01)	(0.02)	
BRZ	0.17	0.12**	-0.02*	-0.03	0.08
	(0.10)	(0.05)	(0.01)	(0.03)	
	Growth Investment Style				
UK	0.63***	0.01	-0.01***	0.01	0.64
	(0.07)	(0.01)	(0.00)	(0.01)	
AUS	1.02***	-0.08***	0.00	0.01	0.99
	(0.02)	(0.02)	(0.00)	(0.01)	
CAN	0.54***	-0.06***	-0.01***	-0.03	0.60
	(0.08)	(0.02)	(0.00)	(0.02)	
SA	1.23***	-0.01	-0.01	-0.01	0.75
	(0.11)	(0.02)	(0.01)	(0.02)	
BRZ	0.16	0.13***	-0.02**	-0.02	0.08
	(0.11)	(0.05)	(0.01)	(0.03)	
	Momentum Investment Style				
UK	0.66***	0.01	-0.01***	0.01	0.63
	(0.07)	(0.01)	(0.00)	(0.01)	
AUS	1.02***	-0.08***	-0.02	0.01	0.99
	(0.02)	(0.02)	(0.00)	(0.01)	
CAN	0.51***	-0.07***	-0.01***	-0.03	0.63
	(0.08)	(0.02)	(0.00)	(0.02)	
SA	1.25***	-0.01	-0.00	-0.01	0.75
	(0.12)	(0.01)	(0.01)	(0.02)	
BRZ	0.17	0.13**	-0.02*	-0.03	0.08
	(0.10)	(0.05)	(0.01)	(0.03)	

Note: HAC Standard errors in parenthesis, * is significant at 10%, ** is significant at 5% and *** is significant at 1%. R^2 is the adjusted R-square

4.2.3 Real domestic price and international price of precious metals and returns on style investments.

Table 9 provides insights into the impact of the real domestic price of precious metals on investment returns. Consistent with the observations regarding food and energy prices, interest rates exhibit a comparable impact on returns on investment styles, with statistical significance observed in all six countries. Similarly, the output gap demonstrates a uniform negative effect with returns on investment styles. However, on the findings regarding the impact of precious metals, we note a variation in the impact of precious metals on returns on investment styles across different countries. Nevertheless, none of these relationships achieve statistical significance. This suggests that while interest rates and the output gap consistently influence investment returns, the impact of precious metals is less conclusive and lacks statistical significance.

Table 9: Estimation results of equation (3) with the domestic price of precious metals.

Countries	α_r	δ_y	δ_d	R^2
Value Investment Style				
USA	0.60***	-0.15***	-0.01	0.76
	(0.06)	(0.02)	(0.01)	
UK	0.59***	-0.00	0.00	0.49
	(0.08)	(0.01)	(0.00)	
AUS	1.02***	-0.09***	-0.00	0.99
	(0.02)	(0.02)	(0.01)	
CAN	0.57***	-0.08***	-0.00	0.54
	(0.09)	(0.02)	(0.01)	
SA	1.28***	-0.02	-0.00	0.74
	(0.10)	(0.02)	(0.01)	
BRZ	0.21*	0.10*	0.01	0.06
	(0.12)	(0.05)	(0.02)	
Growth Investment Style				
USA	0.61***	-0.15***	-0.01	0.75
	(0.06)	(0.02)	(0.00)	
UK	0.52***	-0.00	0.00	0.41
	(0.08)	(0.01)	(0.01)	
AUS	1.03***	-0.09***	-0.00	0.99
	(0.02)	(0.02)	(0.01)	
CAN	0.61***	-0.07***	0.01	0.56
	(0.08)	(0.02)	(0.01)	
SA	1.27***	-0.02	0.00	0.75
	(0.09)	(0.02)	(0.01)	
BRZ	0.20*	0.10*	0.01	0.06
	(0.12)	(0.05)	(0.02)	
Momentum Investment Style				
USA	0.58***	-0.15***	-0.01	0.72
	(0.10)	(0.02)	(0.01)	
UK	0.64***	-0.01	0.01	0.53
	(0.09)	(0.01)	(0.01)	
AUS	1.03***	-0.09***	-0.00	0.99
	(0.02)	(0.02)	(0.01)	
CAN	0.60***	-0.08***	0.01	0.59
	(0.08)	(0.02)	(0.01)	
SA	1.28***	-0.02	0.00	0.75
	(0.09)	(0.02)	(0.01)	
BRZ	0.20*	0.10*	0.01	0.06
	(0.12)	(0.05)	(0.02)	

Note: HAC Standard errors in parenthesis, * is significant at 10%, ** is significant at 5% and *** is significant at 1%. R^2 is the adjusted R-square

Moving to Table 10, which evaluates the impact of the international price of precious metals on investment returns, we observe a similar relationship between the right-hand side variables and returns on investment styles as seen with the international price of food and energy. However, an interesting observation emerges regarding the international price of precious metals, where we note a positive impact on returns on momentum investment styles, particularly significant in Canada. Given Canada's status as a major gold-producing country, its gold production contributes to the supply dynamics of precious metals, thereby influencing their prices and market behaviour.

Table 10: Estimation results of Equation (7) with the international price of precious metals.

Panel C	Value Investment Style				
Model	$\hat{R}_t = -\alpha_r \hat{r}_t + \delta_y \hat{y}_t + \delta_f \hat{p}_t^f + \delta_s \hat{s}_t + \hat{\varepsilon}_t$				
Countries	α_r	δ_y	δ_f	δ_s	R^2
UK	0.67***	0.00	-0.01	0.03**	0.53
	(0.09)	(0.01)	(0.01)	(0.01)	
AUS	1.01***	-0.08***	-0.01	0.01	0.99
	(0.02)	(0.02)	(0.01)	(0.01)	
CAN	0.57***	-0.08***	-0.00	0.00	0.54
	(0.09)	(0.03)	(0.01)	(0.02)	
SA	1.27***	-0.02	0.00	-0.01	0.75
	(0.11)	(0.02)	(0.02)	(0.02)	
BRZ	0.21*	0.08	0.03	-0.00	0.07
	(0.12)	(0.06)	(0.03)	(0.03)	
	Growth Investment Style				
UK	0.70***	0.00	-0.00	0.03***	0.55
	(0.09)	(0.01)	(0.01)	(0.01)	
AUS	1.02***	-0.08***	-0.01	0.01	0.99
	(0.02)	(0.02)	(0.01)	(0.01)	
CAN	0.61***	-0.07***	0.01	0.01	0.57
	(0.08)	(0.02)	(0.01)	(0.02)	
SA	1.26***	-0.02	0.01	-0.00	0.75
	(0.10)	(0.02)	(0.02)	(0.02)	
BRZ	0.20*	0.08	0.03	0.02	0.07
	(0.12)	(0.06)	(0.03)	(0.03)	
	Momentum Investment Style				
UK	0.71***	-0.00	0.00	0.03***	0.55
	(0.09)	(0.01)	(0.01)	(0.01)	
AUS	1.02***	-0.08***	-0.01	0.01	0.99
	(0.02)	(0.02)	(0.00)	(0.01)	
CAN	0.60***	-0.08***	0.01***	0.01	0.63
	(0.08)	(0.02)	(0.01)	(0.02)	
SA	1.27***	-0.02	0.01	-0.00	0.75
	(0.10)	(0.02)	(0.02)	(0.02)	
BRZ	0.20*	0.08	0.03	-0.00	0.07
	(0.12)	(0.06)	(0.03)	(0.03)	

Note: HAC Standard errors in parenthesis, * is significant at 10%, ** is significant at 5% and *** is significant at 1%. R^2 is the adjusted R-square.

Precious metals, notably gold and silver, are widely acknowledged as safe haven assets due to their intrinsic characteristics that render them attractive during economic uncertainty (Gorton and Rouwenhorst, 2013). Moreover, Qian et al. (2023) emphasize the robust relationship between precious metals and investor sentiment, underscoring how fluctuations in market sentiment can significantly impact the prices of these commodities. In times of low investor confidence and heightened uncertainty, demand for precious metals tends to increase, thereby driving their prices higher. Conversely, during periods of economic stability and optimism, demand for precious metals may decline, leading to price declines.

A positive relationship with the price of precious metals is observed in momentum investment styles, which typically outperform during economic upswings and underperform during downturns. During bullish market conditions, momentum strategies capitalize on strong recent performance by investing in assets with upward price momentum, leading to further price appreciation. Consequently, the appeal of precious metals as safe-haven assets diminishes, resulting in lower demand and prices. Conversely, during bearish market phases, when investor sentiment turns negative and risk aversion increases, the attractiveness of precious metals as safe havens intensifies. Investors seeking refuge from market volatility may allocate funds to precious metals, thereby driving their prices and establishing a positive relationship with momentum investment styles.

Lastly, we note the impact of depreciation and appreciation of the real exchange rate on returns on investment styles. We note that the impact is statistically significant in the United Kingdom at a 1% level of significance. According to Wong (2021), a symmetric relationship is evident within the United Kingdom, where the depreciation of the real exchange rates implies a reduction in export prices. Consequently, firms may capitalise on this by increasing export volumes, thereby increasing profits and increasing stock prices, yielding higher returns. On the other hand, appreciation of the real exchange rate, in this case, is associated with higher input costs of imported goods, exerting downward pressure on profitability and returns.

The pricing of the majority of commodities in the global market being denominated in US dollars leads to significant implications of fluctuations in the US dollar exchange rate on these commodity prices. A decline in the value of the dollar, for example, must be offset by an increase in the dollar price of tradable commodities or a decline in their foreign currency prices to ensure the law of one price holds for such commodities. Furthermore, a depreciation in the value of the US dollar may stimulate demand for commodities among foreign consumers, potentially impacting the returns of countries engaged in commodity production and influencing their production levels. Hamilton (2008) highlights this phenomenon. Moreover, concerning the association between gold and the US dollar exchange rate, Capie et al. (2005) reveal that gold functions as a hedge against declines in the dollar's foreign exchange value.

4.3 Summary of results in relation to the research questions

A large body of literature argues that commodities contain useful information for predicting stock returns (Black et al., 2014; Jacobsen et al., 2019; Iyke and Ho, 2021). We estimate our model using the commodity's real domestic price and the commodity's decomposed price on the returns on investment styles. As commodity prices are denominated in US dollars, the decomposed price of the commodity is expressed in terms of the real exchange rate and the international price of the commodity. Decomposing the US dollar denominated commodity price into its real exchange rate and international price components enables us to analyse the factors driving commodity price movements within a particular country. Secondly, analysing the international price component allows for a deeper understanding of global supply and demand dynamics and external factors, such as macroeconomic trends that may impact commodity prices.

In our study, we analyse the influence of three commodity classes, food, energy, and precious metals, on the returns of various investment styles. Our objective is to assess how fluctuations in commodity prices affect returns on investment styles and to identify which commodity class offers valuable insights for predicting returns on investment styles. Additionally, we incorporate three macroeconomic variables, namel,y real interest rates, output gap, and real exchange rate, which are known to impact returns on investment styles.

Our empirical results reveal that commodity prices play a significant role in explaining returns on investment styles. We find that food and energy prices negatively impact the returns on investment styles, whilst precious metals exert a positive impact. Food prices negatively impact returns on investment styles across all the countries. This effect holds statistical significance in the United States, United Kingdom, Australia, and South Africa. We further note that energy prices exert a similar impact as food prices. The effect of energy prices is statistically significant in the United States, United Kingdom, Australia, Canada, and Brazil. Fluctuations in energy prices impact expected costs, with higher oil prices generally depressing stock performance. However, at the macroeconomic level, higher oil prices are generally associated with reduced stock returns, given the essential role of oil as an input in the global economy. We note that the impact of energy prices on returns appears consistent across the three investment styles.

This effect is in line with Gorton and Rouwenhorst (2006), who argue that increasing commodity prices are associated with upward movement inflation and interest rates and, consequently, declining stock markets. In addition, commodities are influenced by a combination of demand-side fundamentals and supply-side dynamics. Thus, the divergence in the behavior of commodities implies that their relationships with equity markets vary. On the other hand, our results reveal that the effect of the domestic price of precious metals is not significant in any of the countries, whilst the international price of precious metals is only statistically significant in Canada on returns on momentum investment styles. This effect is positive. Precious metals, notably gold and silver, are widely acknowledged as safe haven assets due to their intrinsic characteristics that render them attractive during times of economic uncertainty (Gorton and Rouwenhorst, 2013). In times of low investor confidence and heightened uncertainty, demand for precious metals tends to increase, thereby driving their prices higher. Conversely, during periods of economic stability and optimism, demand for precious metals may decline, leading to price declines.

In addition to commodity prices, interest rates and the output gap are significant players in explaining returns on investment styles. Interest rates positively impact on interest rates across all of the six countries. We note that the output gap negatively impacts returns on investment styles, an oppositive impact of interest rates. This is largely due to the response of central banks.

5. Conclusions

This research investigates the impact of fluctuations in commodity prices on investment styles through a linear regression analysis conducted across six countries: the United States, the United Kingdom, Canada, Australia, South Africa, and Brazil. The primary objectives are to determine how changes in commodity prices affect returns on investment styles and identify which commodity classes offer significant insights into explaining such returns. The study focuses on three commodity classes, namely food, energy, and precious metals, applied to the value, growth, and momentum investment styles, which exhibit dominance and consistency across the above-mentioned countries. We use the real domestic price of commodities and the decomposed price of commodities, reflecting the real exchange rate and the USD denominated international price.

A significant body of literature posits that commodities contain useful information for predicting stock returns. In addition to commodities, our model integrates the macroeconomic variables, namely real interest rates, the output gap, and the real exchange rate, which influence commodity prices and returns on investment styles. Empirical results reveal two interesting observations. Firstly, the real domestic price of commodities demonstrates a comparable influence on returns on investment styles as the decomposed price of a commodity. Secondly, we observe a similar response in returns on investment styles to changes in the right-hand side variables of our regression.

The findings of this investigation indicate that fluctuations in commodity prices, interest rates, and the output gap play an important role in explaining the returns on investment styles. Regarding commodity prices, food and energy prices negatively impact returns on investment styles, whereas precious metals positively impact these styles. These findings are consistent with Gorton & Rouwenhorst (2006) and reveal that the negative association between commodities and the stock market is mostly driven by commodities' different behaviour over the business cycle. Moreover, commodities tend to be positively correlated with inflation and exhibit sensitivity to both fundamental demand factors and supply-side influences. For instance, certain commodities, such as natural gas and cereals, respond to weather conditions, while others, like crude oil, are susceptible to geopolitical instability and macro-financial variables.

Interest rates positively impact interest rates across all of the six countries. Our findings are in line with Dladla and Malikane (2019), who argue that the effect of interest rates on returns on stock returns is either positive or negative, depending on the quasi-duration. We note that the output gap negatively impacts returns on investment styles, an oppositive impact of interest rates. This is largely due to the response of central banks. In light of our study, we conclude that returns on the different investment styles respond to changes in interest rates, the output gap, and commodity prices in a similar manner.

The findings of this study have notable implications for both investors and policymakers, particularly in the areas of financial regulation and investment strategy development. By demonstrating the predictive power of commodity prices for various investment styles, the research highlights the need for policies that mitigate the risks associated with commodity market volatility, which can have widespread effects on economic stability. In addition, the insights gained regarding the impacts of commodity price fluctuations on value, growth, and momentum investment styles can inform sector-specific policies, specifically in commodity-dependent economies, to bolster market resilience. Lastly, these findings also provide a basis for informing tax policies, and trade agreements that take into account the cyclical nature of commodity markets, thus contributing to more sustainable economic growth and stability.

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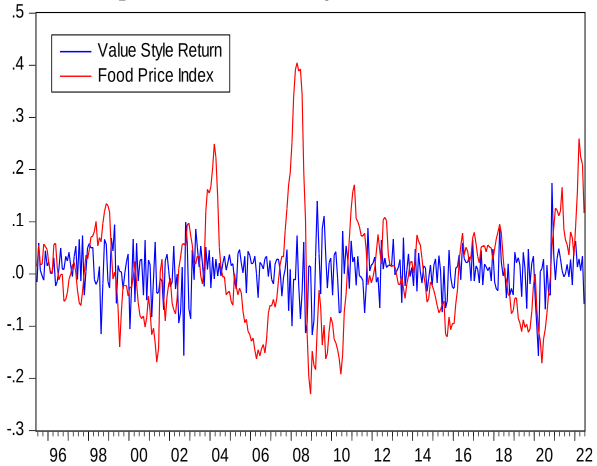
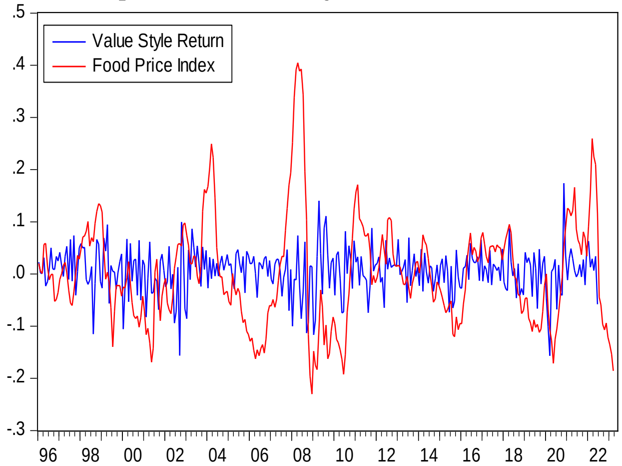
7. APPENDICES

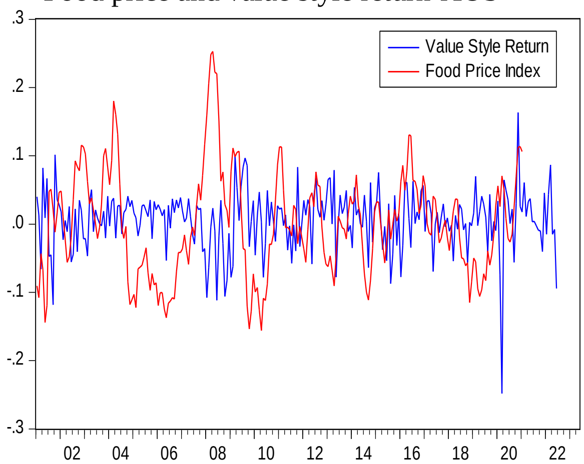
Food price and value style return-USA



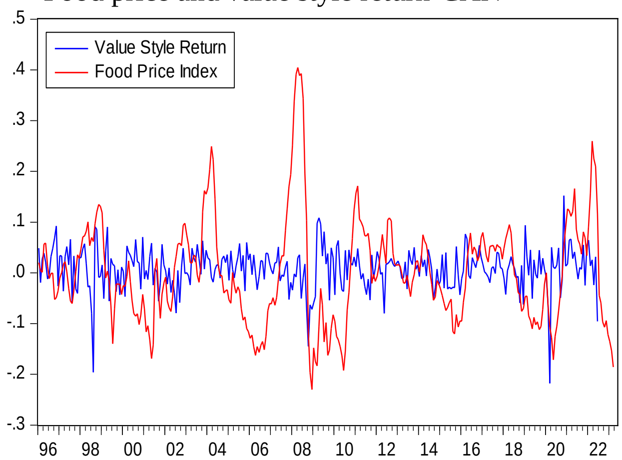
Food price and value style return-UK



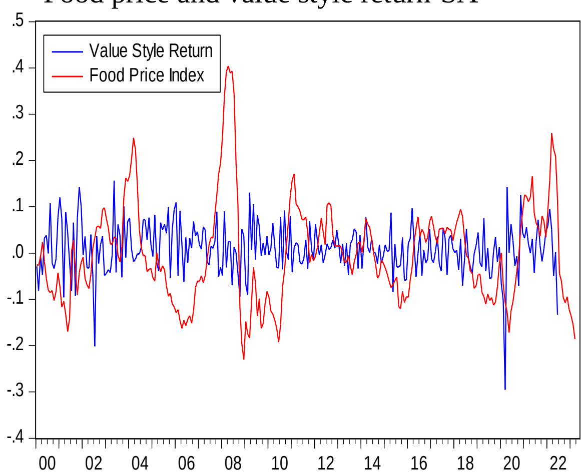
Food price and value style return-AUS



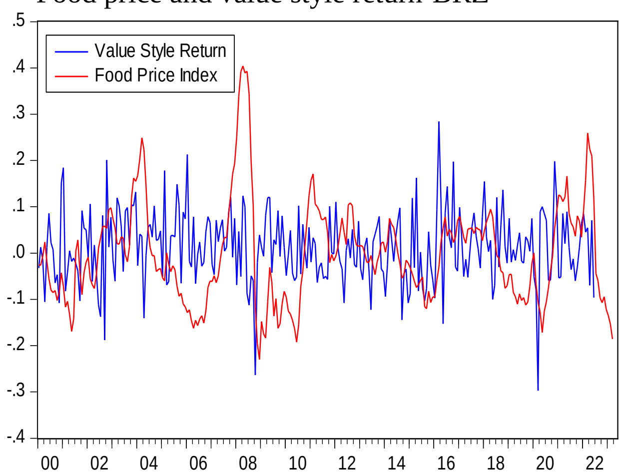
Food price and value style return-CAN



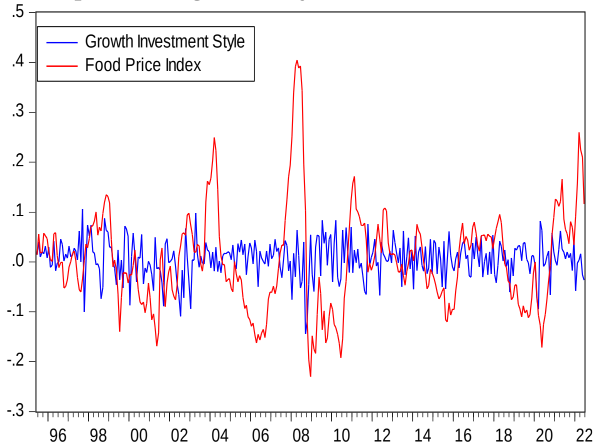
Food price and value style return-SA



Food price and value style return-BRZ



Food price and growth style return-USA



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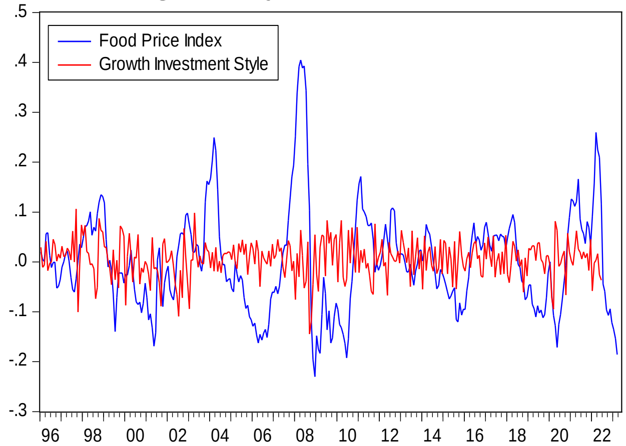

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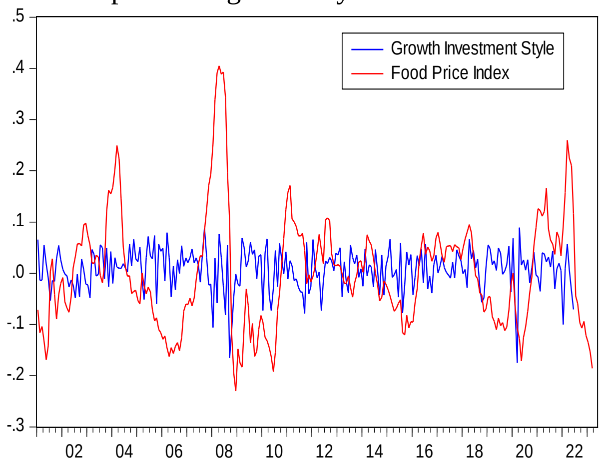
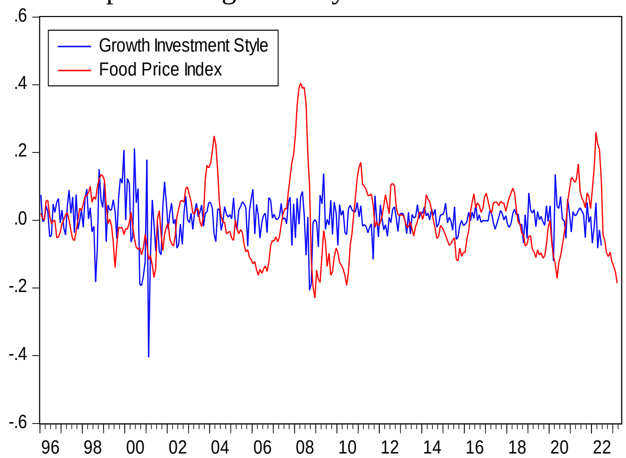
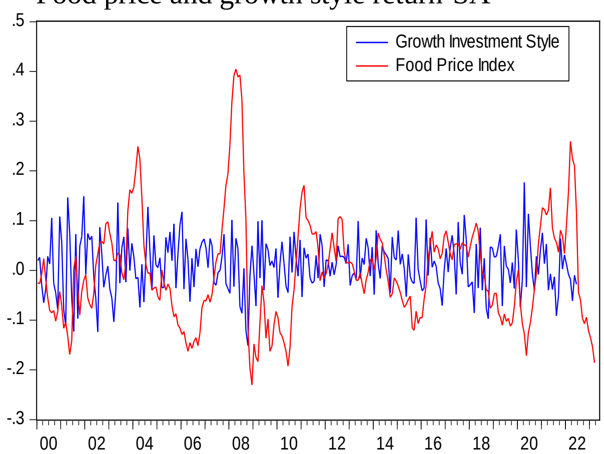


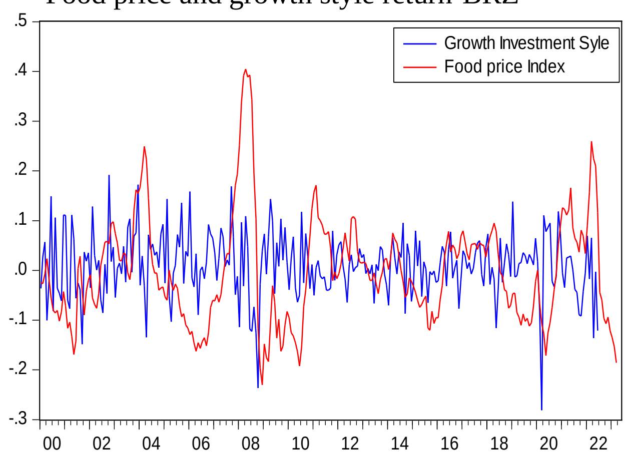
Food price and growth style return-CAN



Food price and growth style return-SA

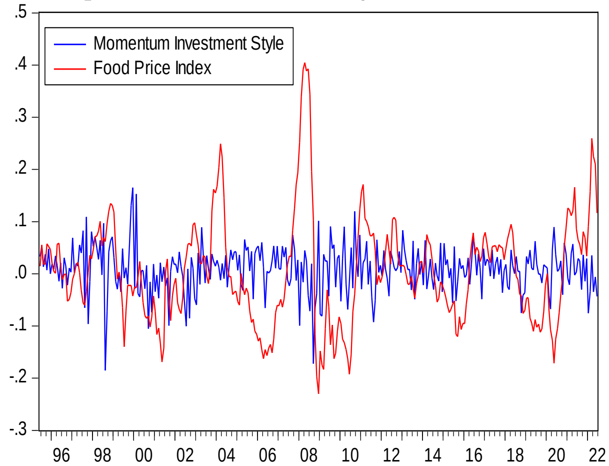


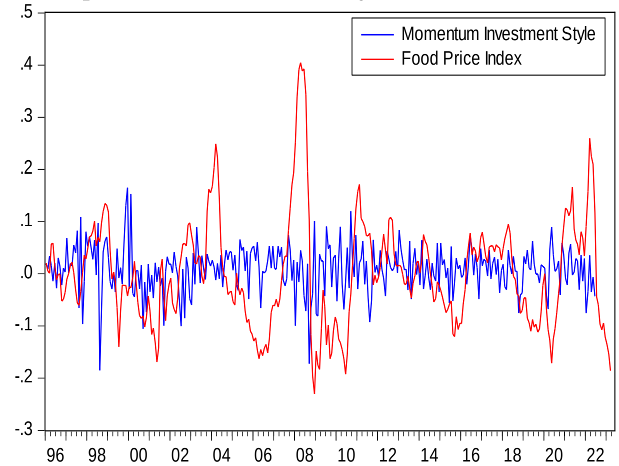
Food price and growth style return-BRZ



Food price and momentum style return-USA

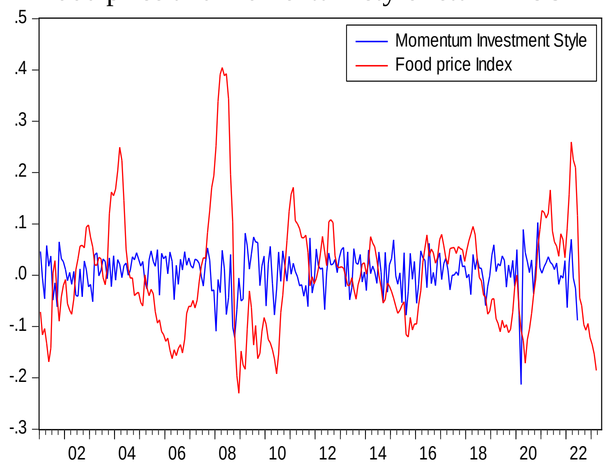
Food price and momentum style return-UK

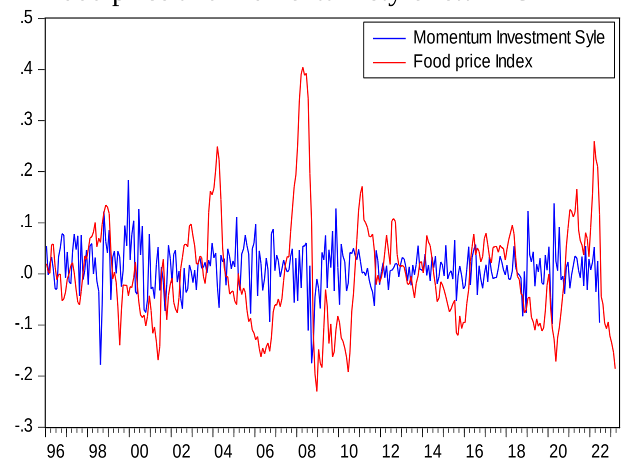




Food price and momentum style return-AUS

Food price and momentum style return-CAN





Food price and momentum style return-SA

Food price and momentum style return-BRZ

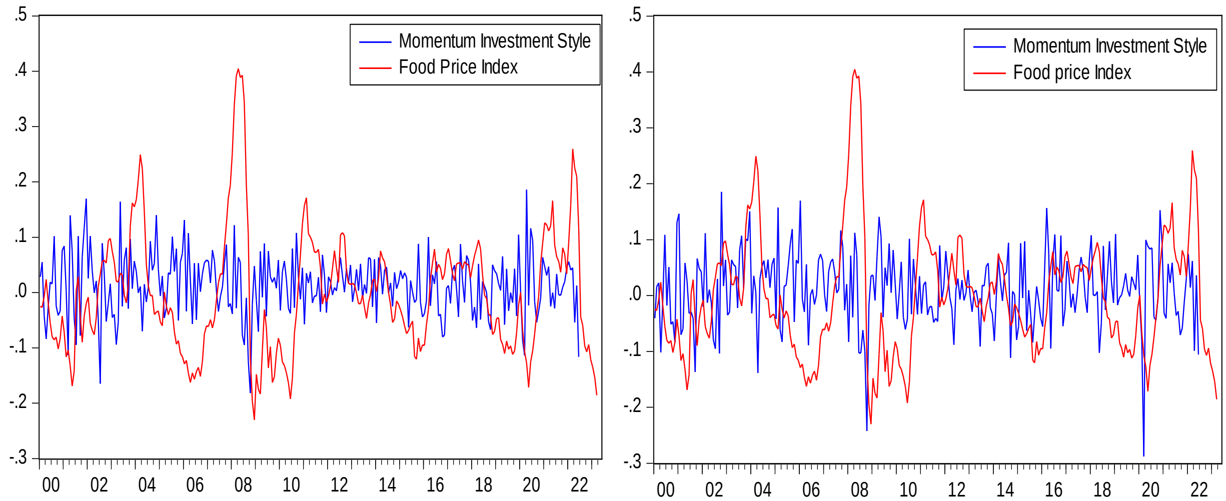
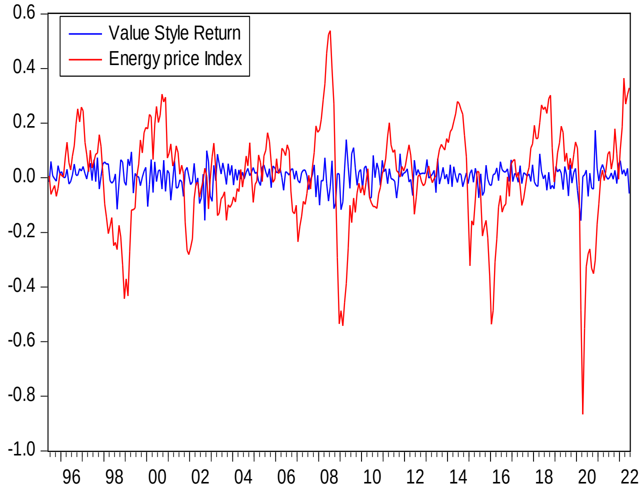
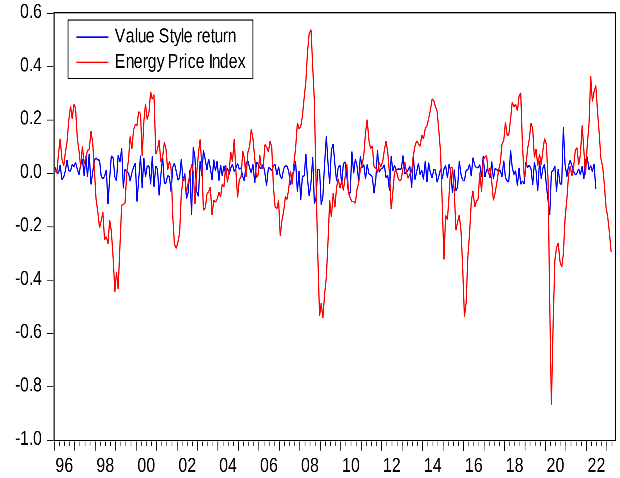


Figure 1: Style returns response to changes in food prices.

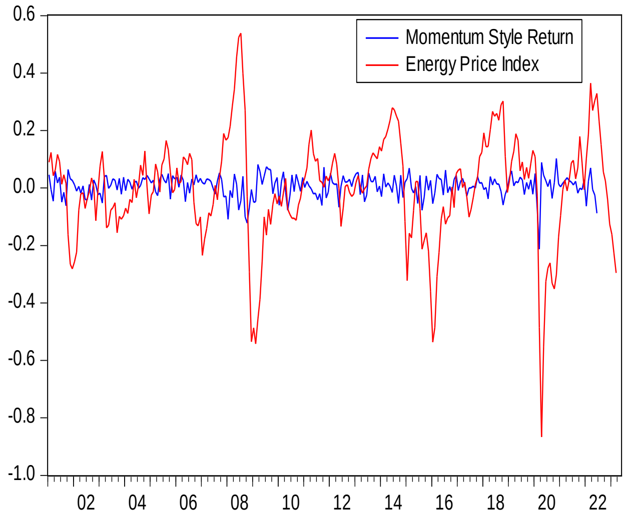
Energy price and value style return-USA



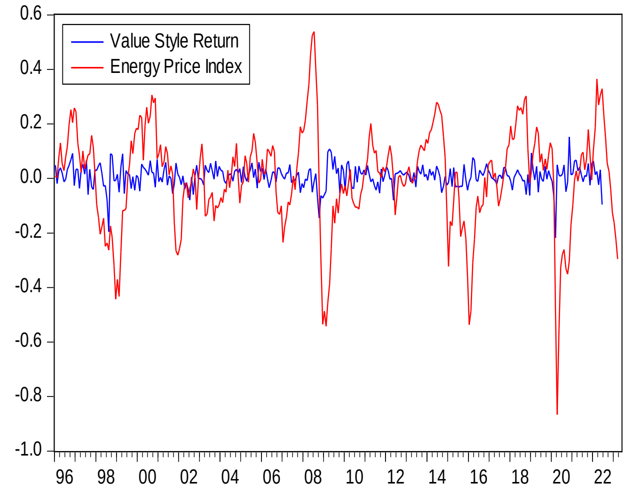
Energy price and value style return-UK



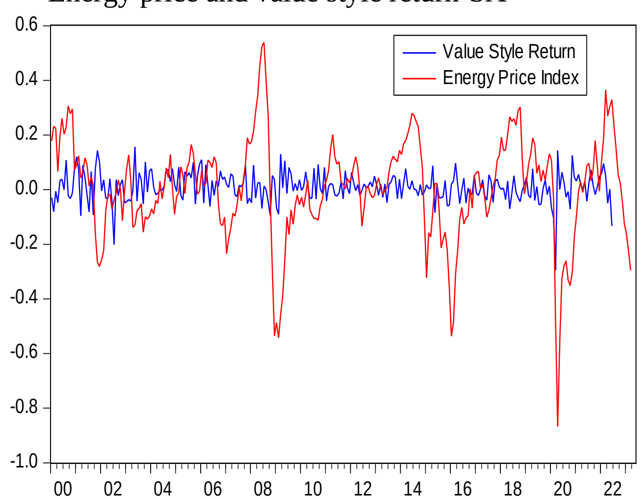
Energy price and value style return-AUS



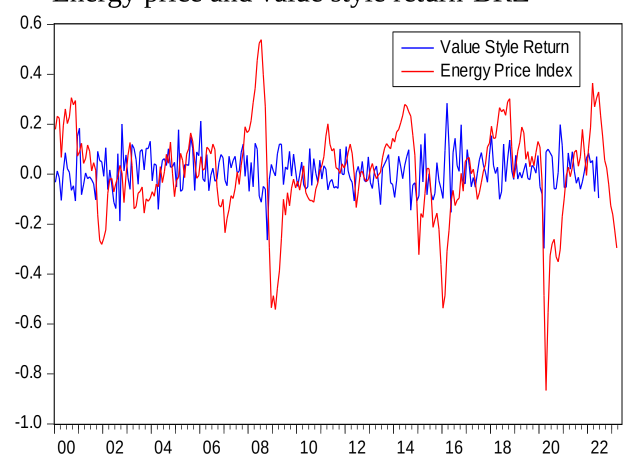
Energy price and value style return-CAN



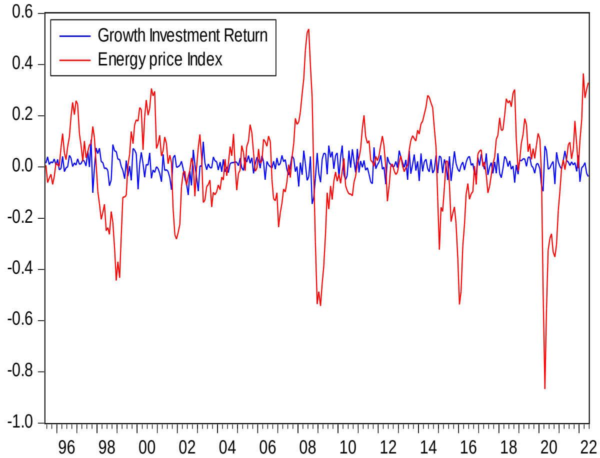
Energy price and value style return-SA



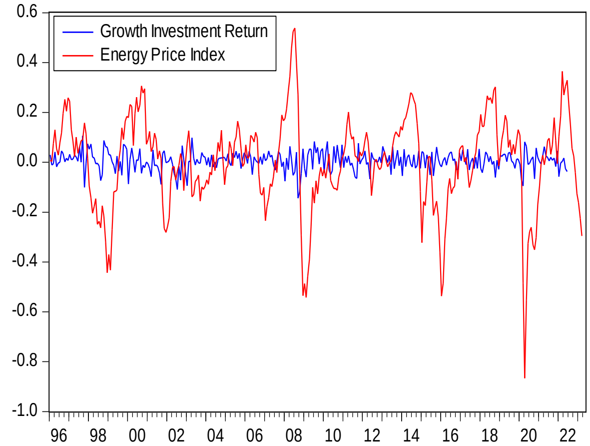
Energy price and value style return-BRZ



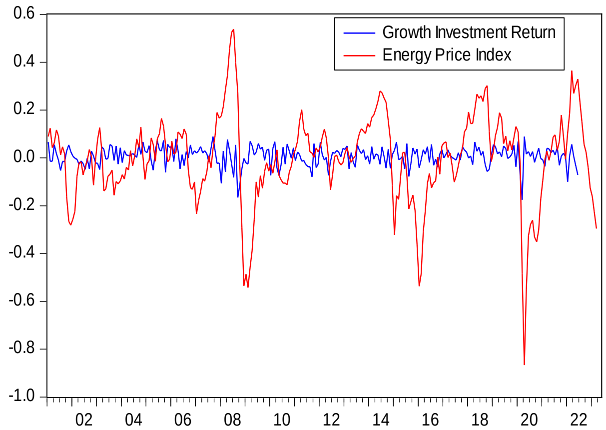
Energy price and growth style return-USA



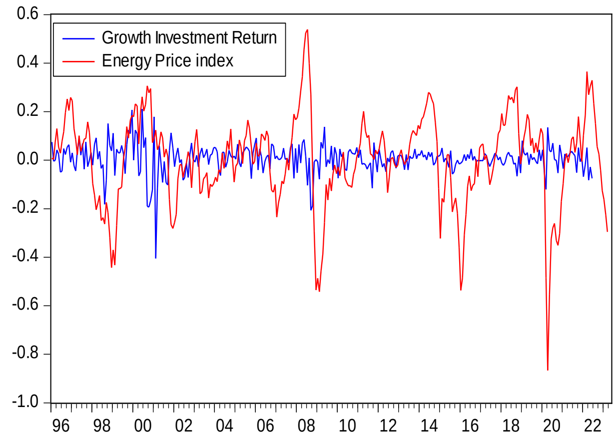
Energy price and growth style return-UK



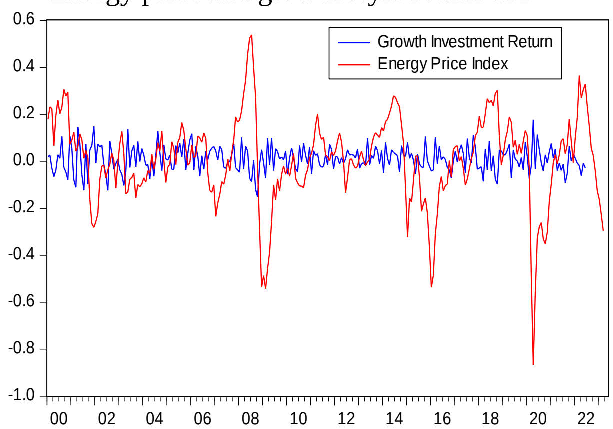
Energy price and growth style return-AUS



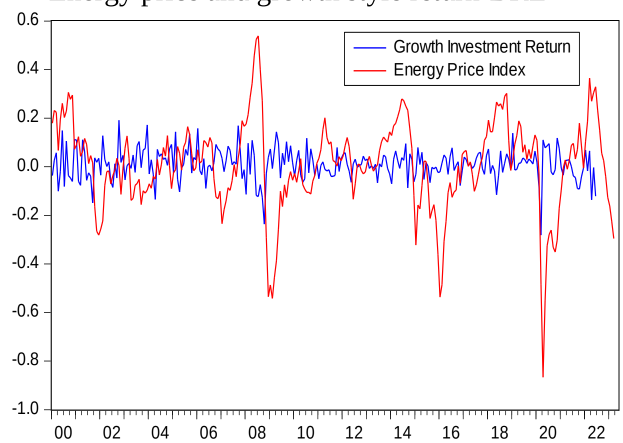
Energy price and growth style return-CAN



Energy price and growth style return-SA

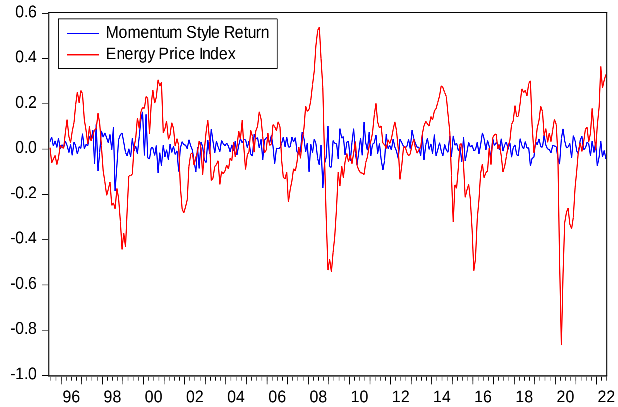


Energy price and growth style return-BRZ

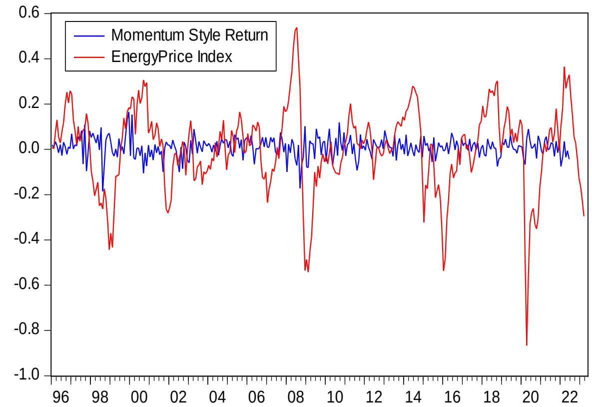


Energy price and momentum style return-USA

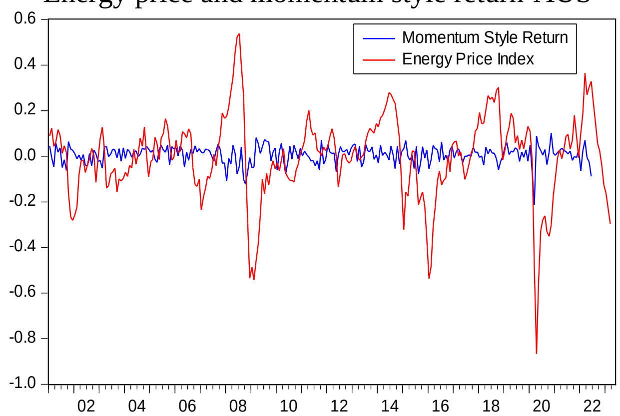
Energy price and momentum style return-UK



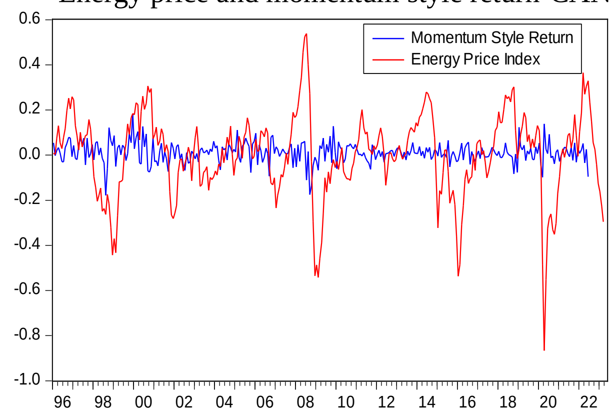
Energy price and momentum style return-AUS



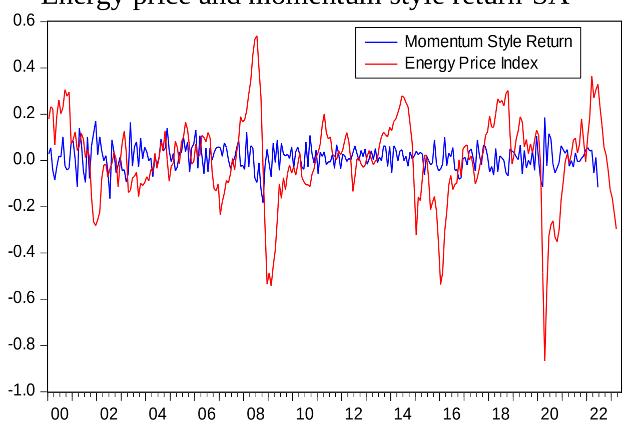
Energy price and momentum style return-CAN

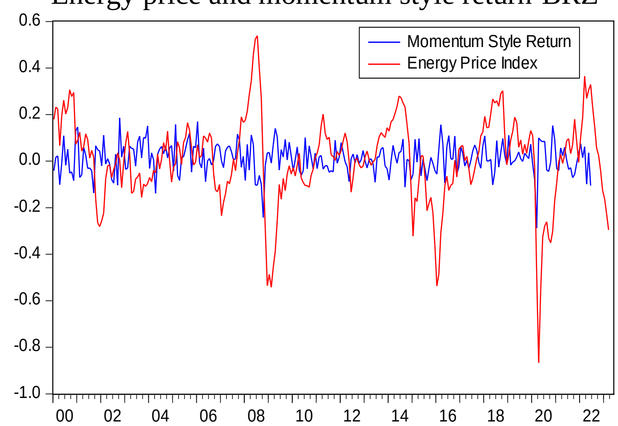


Energy price and momentum style return-SA



Energy price and momentum style return-BRZ





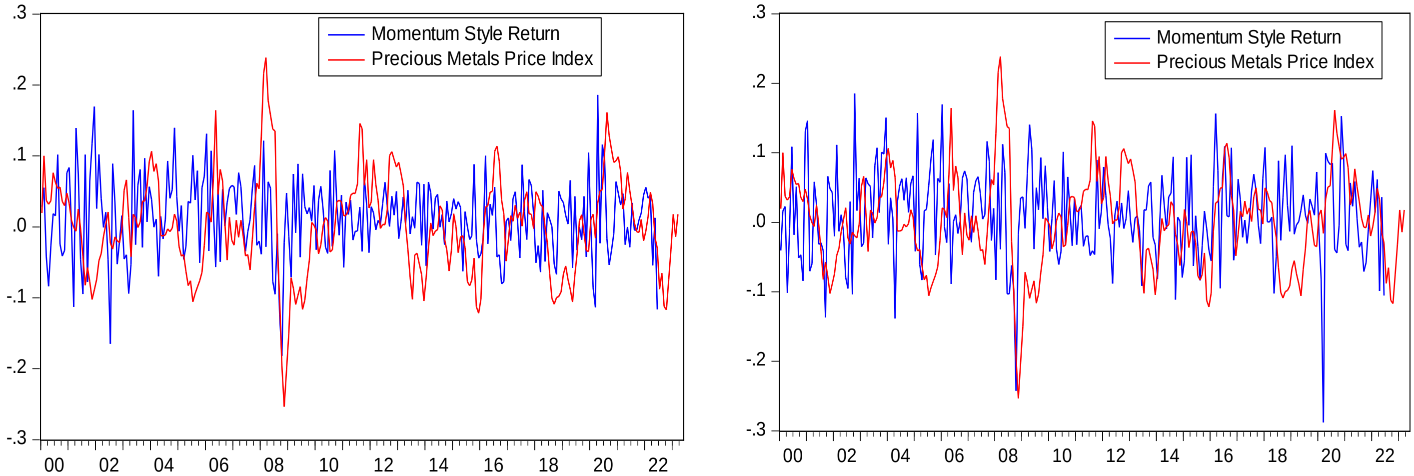
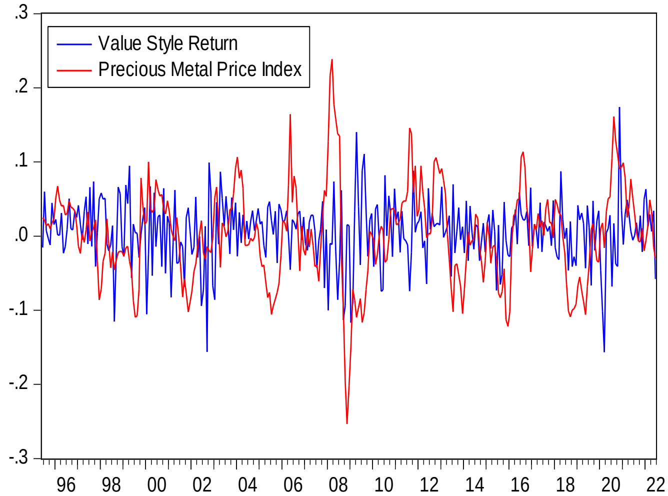
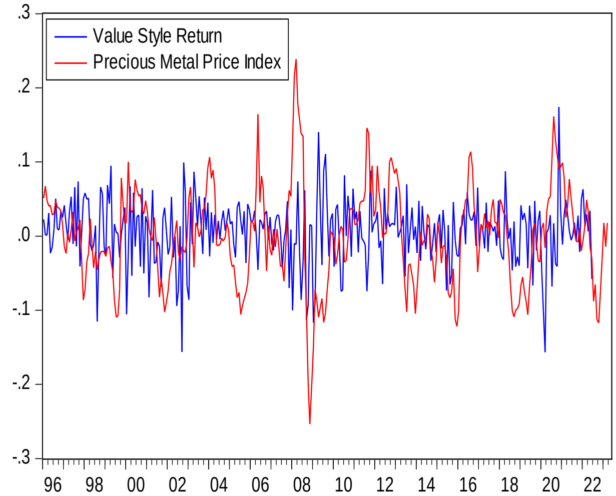


Figure 2: Style returns response to changes in energy prices.

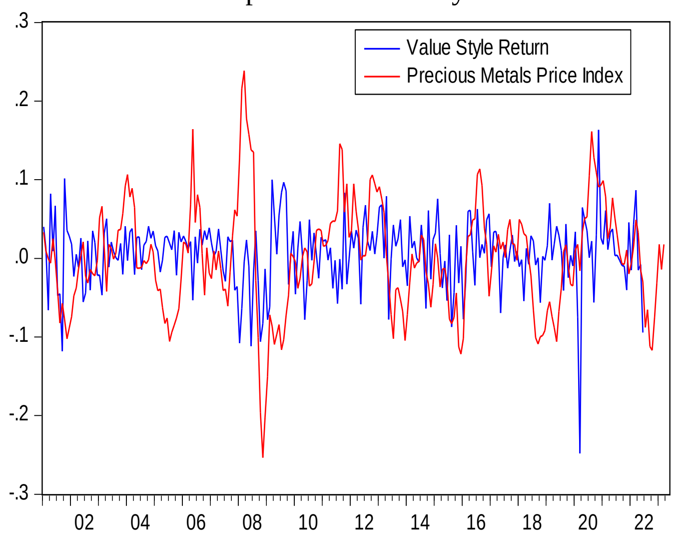
Precious Metals price and value style return-USA



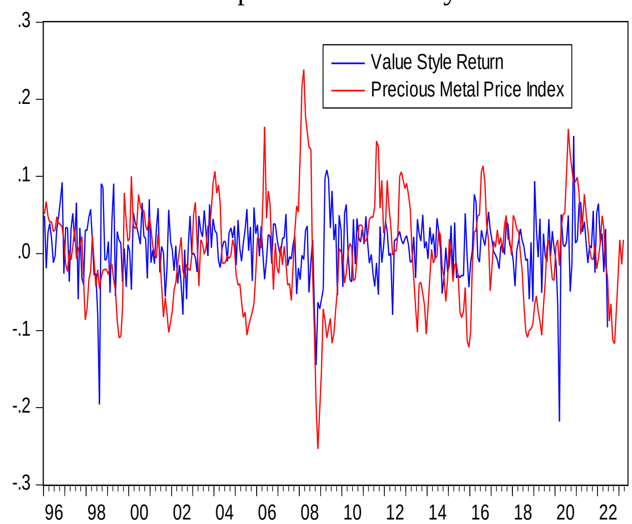
Precious Metals price and value style return-UK



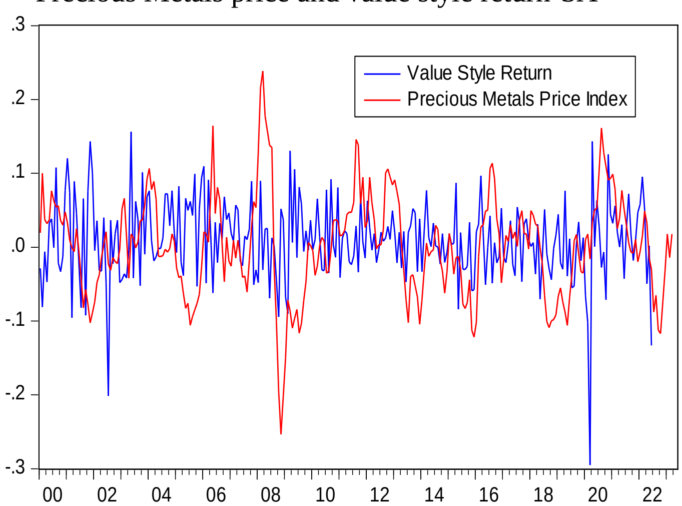
Precious Metals price and value style return-AUS



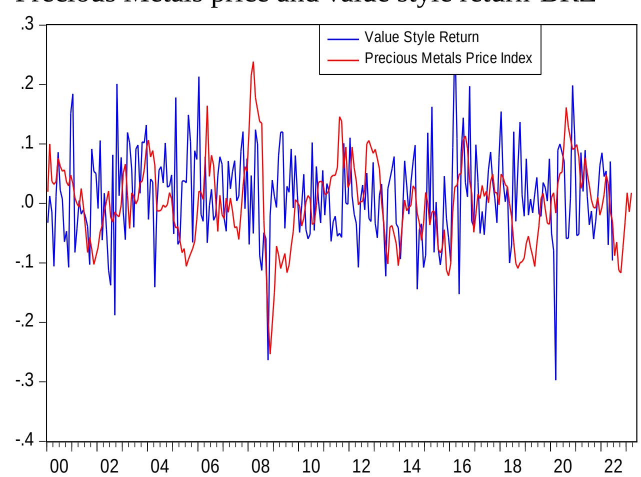
Precious Metals price and value style return-CAN



Precious Metals price and value style return-SA

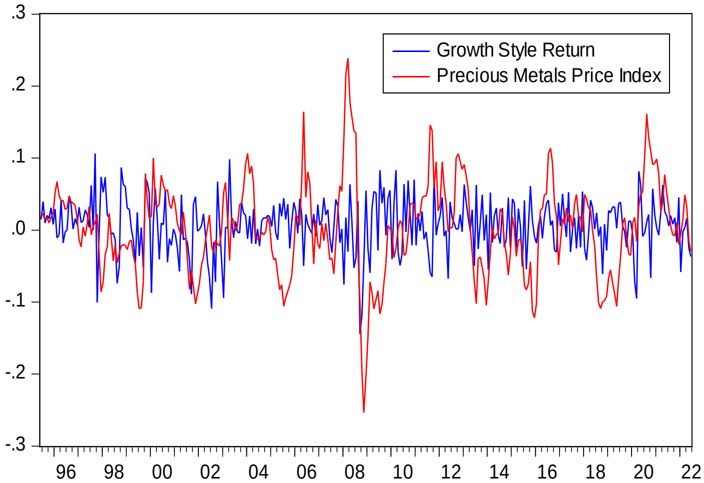


Precious Metals price and value style return-BRZ

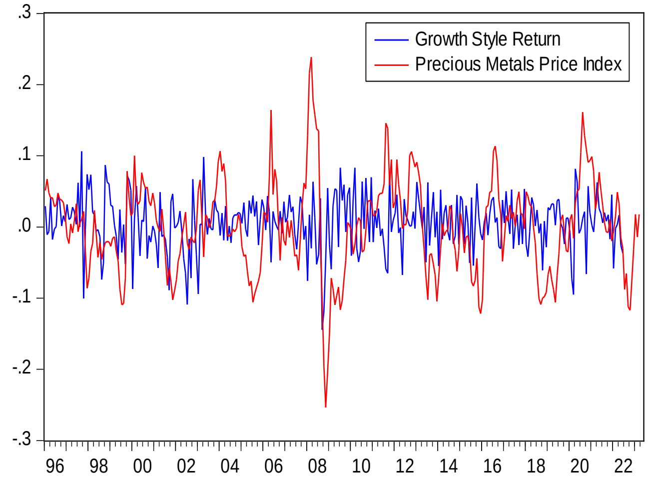


Precious Metals price and growth style return-USA

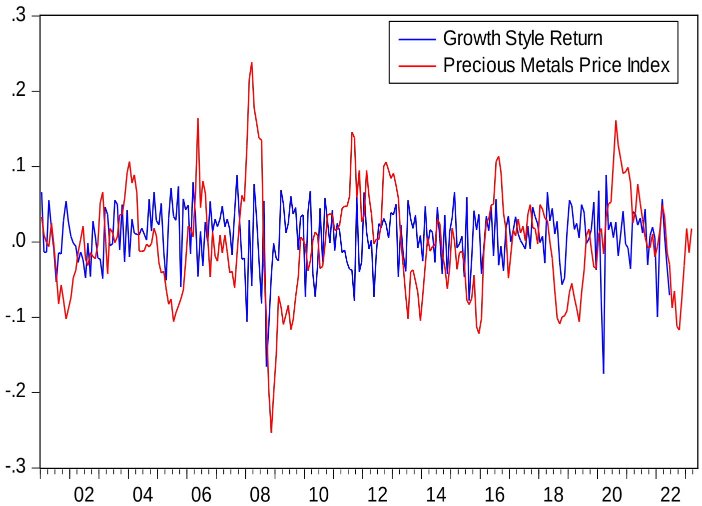
Precious Metals price and growth style return-UK



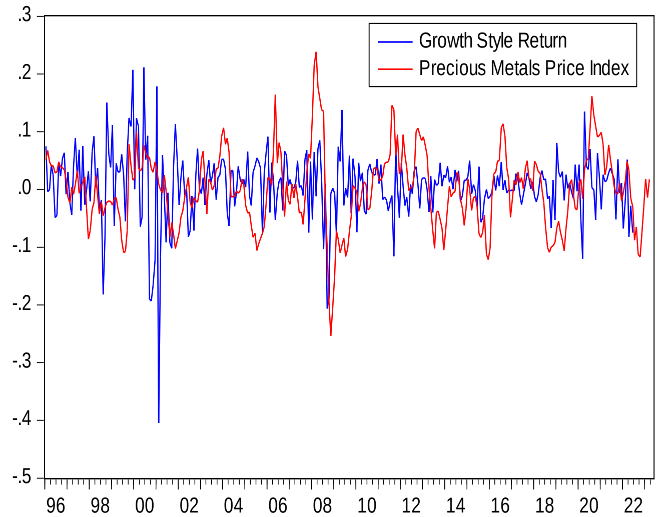
Precious Metals price and growth style return-AUS



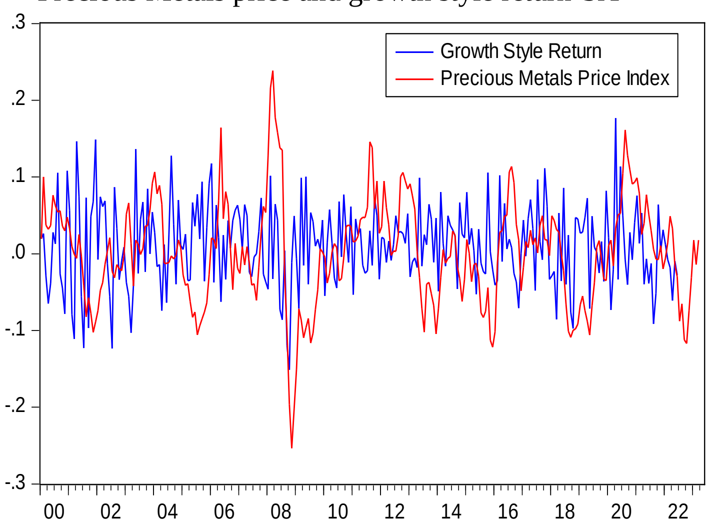
Precious Metals price and growth style return-CAN

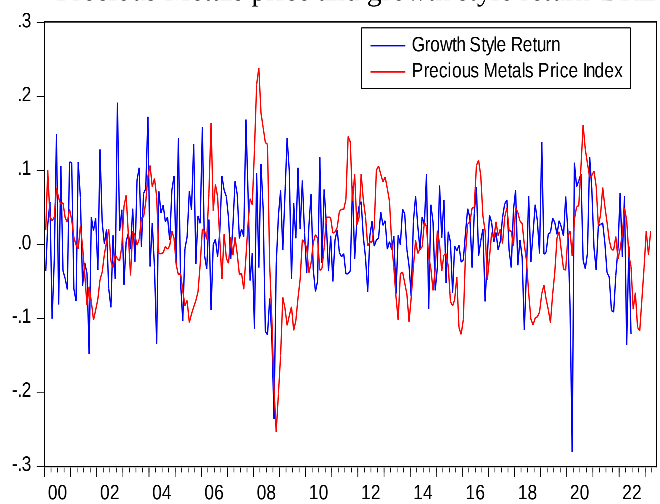


Precious Metals price and growth style return-SA



Precious Metals price and growth style return-BRZ





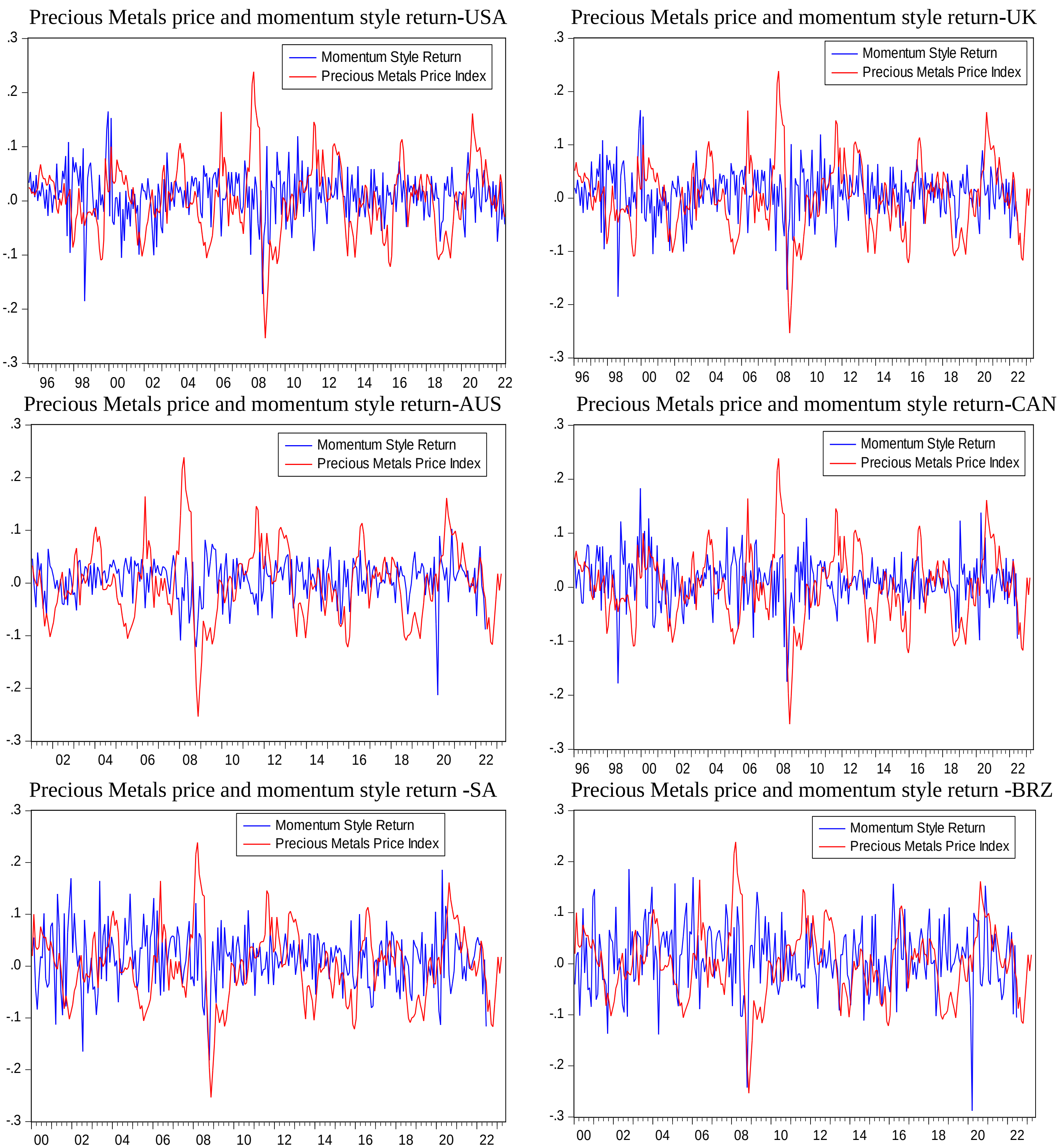


Figure 3: Style returns response to changes in precious metal prices.