The Manchester School

WILEY

ORIGINAL ARTICLE OPEN ACCESS

The Effects of U.S. Monetary Policy Shocks on Portfolio Diversification

Rong Huang[1] | Dimos Kambouroudis[2] | David G. McMillan[2]

[1]School of Digital Economy, NanNing University, Nanning, China | [2]Division of Accounting and Finance, University of Stirling, Stirling, UK

Correspondence: David G. McMillan (david.mcmillan@stir.ac.uk)

Received: 17 November 2025 | **Revised:** 2 June 2026 | **Accepted:** 29 June 2026

Keywords: monetary policy | portfolios | stocks | surprises

ABSTRACT

We investigate the impact of changes in U.S. monetary policy on portfolio diversification. We build four different types of portfolios, including a U.S.-only, a stock-bond (60/40) portfolio, an international diversified stock portfolio, and an asset diversified portfolio. Our assets include the S&P 500 index, a developed market index (MSCI EAFE), an emerging market index (MSCI EM), gold, oil, and U.S. 10-year Treasury notes (10-year T-Note). We provide the following evidence. First, U.S. monetary policy is a risk factor in these global asset markets. Second, the results demonstrate that these markets, except for the 10-year Treasury notes, are unlikely to react to anticipated monetary policy changes. Third, we suggest that risk-averse investors can use U.S. 10-year Treasury notes and choose the stock-bond portfolio to hedge risks when monetary policy is volatile, as we find that all stock indexes, gold and oil respond more to U.S. monetary policy surprises than 10-year Treasury notes. Fourth, all portfolios are negatively related to the monetary policy surprise, and we contend that U.S. monetary policy may be a systemic risk that cannot be fully diversified.

JEL Classification: C22, G12

1 | Introduction

One of the most important factors affecting economic and market conditions is monetary policy. The ultimate purpose of monetary policy is to achieve macroeconomic goals such as output, employment, and inflation stability (Karagiannis et al. 2010). However, the impact of monetary policy tools on these variables is, at best, indirect. The most direct and immediate effect of monetary policy actions, such as changes in the Federal funds rate, are on financial markets. Indeed, the impact of U.S. monetary policy shocks on global asset prices, especially international stock prices, is a topic of great interest to policymakers and market participants. By affecting asset prices and returns, policymakers try to modify economic behaviour in ways that will help to achieve their policy objectives (Karagiannis et al. 2010).

Extensive studies document the influence of U.S. monetary policy on U.S. asset prices (e.g., Cook and Hahn 1989; Campbell and Ammer 1993; Jensen and Johnson 1995; Patelis 1997; Kuttner 2001; Detzel 2017; Wang 2026), with some suggesting that U.S. monetary policy is a risk factor in said markets (e.g., Jensen et al. 1996; Thorbecke 1997; Bernanke and Kuttner 2005). Further, other studies examine the relation between U.S. monetary policy and foreign asset markets (e.g., Tandon and Urich 1987; Husted and Kitchen 1985; Bailey 1989, 1990; Johnson and Jensen 1993; S. Kim 2001; Ehrmann and Fratzscher 2004; Anaya et al. 2017; Miranda-Agrippino and Rey 2020; Laeven and Tong 2012), again arguing that U.S. monetary policy is a risk factor across global markets (e.g., Rigobon and Sack 2003, 2004; Kalemli-Özcan 2019).

Given the leading role played by the U.S. within the global economy, any new information on the Fed's interest rate policy will have direct and indirect effects on international asset prices and, thus, on portfolio dynamics. We can view assets within in a portfolio as a bundle of factors that reflect the risks and rewards of that portfolio. Bernanke and Kuttner (2005) find that U.S. monetary policy shocks impact U.S. stock markets mainly through their effects on risk premiums. The importance of U.S. monetary policy for financial markets is also indicated by the amount of private sector resources devoted to predicting future Federal Open Market Committee (FOMC) decisions. The transmission mechanism of U.S. monetary policy shows that it significantly affects asset risks and returns, thereby affecting portfolio performance. An increase in interest rates by the Federal Reserve can result in higher borrowing costs, lower bond prices, and a decrease in the attractiveness of stocks. This, in turn, can impact asset correlations and the effectiveness of diversification (Bernanke and Kuttner 2005). Expansionary, for example, monetary policy (such as lower interest rates or quantitative easing) increases liquidity, which can drive up asset prices and change the dynamics of risk and return across asset classes (Croushore and Stark 2002; Bernanke and Kuttner 2005; Gagnon et al. 2011; Krishnamurthy and Vissing-Jorgensen 2011; Borio and Zhu 2012). Thus, understanding how the U.S. monetary policy shocks affect portfolio diversification is crucially important for investors in managing their investment risks.

Various methods for estimating monetary policy shocks are suggested in the literature, with two main approaches preferred. The first utilises changes in short-term interest rates (especially the 2-year nominal Treasury yield) within a constrained time window around FOMC policy announcements (Gürkaynak et al. 2005; Gilchrist et al. 2015; Hanson and Stein 2015). The second is based on the Federal Funds futures rate and has drawn particular recent attention. Using the Federal Funds futures rate, Bernanke and Kuttner (2005) show that S&P 500 index returns increase by around 1% following an unforeseen Fed rate drop of 25 basis points. They contend that favourable effects on future dividend streams, discount rates, and stock market premiums arise from such a policy measure. Given heightened interconnectedness of global markets, this research line expands to include foreign stock markets. Ehrmann and Fratzscher (2009) find that foreign stock returns also react favourably to an unexpected Fed interest rate drop. They note diversity in reactions between countries and argue this is due to the degree of financial market integration and the country's degree of exchange rate flexibility.

Most current studies on the response of stock returns to monetary policy shocks consider a fixed-coefficient approach. This implies that the reaction of stocks to monetary policy shocks remains constant across time. In contrast, however, Andersen et al. (2007) note that the stage of the business cycle affects how the stock market reacts to macroeconomic news. Similarly, according to Bernanke and Kuttner (2005), time-varying stock risk premia explains how returns react to monetary policy shocks, with Campbell et al. (1998) arguing similarly. As such, a fixed coefficient methodology to model the stock market response to monetary policy surprises may generate misleading results as responses can change over time due to time-variation in the degree of financial integration, the state of the business cycles and risk premia (Kishor and Marfatia 2013).

Given the above, in this study, we consider the impact of U.S. monetary policy on a range of asset returns and their correlations, which informs portfolio design and the ability to manage risks arising from surprise policy changes. We use the Federal Funds futures rate to measure the monetary surprise by examining FOMC announcements from January 2000 to December 2024. To consider the implications for portfolio dynamics and to capture the time-varying response to monetary policy surprises, we utilise both fixed-coefficient and time-varying analyses, where the latter includes both a time-varying (DCC-GARCH) correlation model and a Kalman filter approach.[1]

After obtaining U.S. monetary policy surprises using the approach of Bernanke and Kuttner (2005), we use these fixed and time-varying coefficient techniques to examine the response of different assets and portfolios to both expected and unexpected Fed Funds target rate changes. Our assets are three stock indices, representing the U.S. (S&P 500), other developed markets (MSCI EAFE), and emerging markets (MSCI EM), and three further assets, gold, oil, and 10-year Treasury notes. We examine the monetary policy impact not only on asset returns, but also a set of portfolios. This includes the S&P 500 as a domestically diversified portfolio, stock-bond, international stock, and cross-asset portfolios.

Our results show significant time-varying movement in the response of global stock markets to U.S. monetary policy surprises. Furthermore, we see that correlations between each index and U.S. monetary policy surprises and the correlations between each portfolio and U.S. monetary policy surprises are mostly negative over the sample. Based on these results, we suggest the following implications. First, we provide evidence that all assets and portfolios are negatively affected by monetary surprises such that U.S. monetary policy can be regarded as a systemic risk that cannot be fully diversified. Second, all markets, with the exception of the 10-year Treasury note, are unlikely to react to anticipated monetary policy moves. Third, we suggest that risk-averse investors can use U.S. 10-year Treasury notes and a stock/bond (60%/40%) portfolio to hedge risks when monetary policy is volatile, as all other assets exhibit a greater response to U.S. monetary policy surprises.

This study extends the existing literature by examining how different portfolios respond to surprises from FOMC announcements. Where investors diversify their risk by holding a range of asset classes, our results provide information on which diversification approach is less impacted by the surprises. This further adds to our understanding on how monetary policy surprises affect comovement and portfolio behaviour and will provide an insight into how shocks propagate across markets (e.g., Kyle and Xiong 2001). For example, when U.S. investors experience a negative wealth shock from an unexpected change in the Federal funds rate, they may alter their positions in other countries or adjust portfolio weights in different assets. This can create a contagion effect, impacting portfolio diversification and asset correlations (Kodres and Pritsker 2002). Thus, this work contributes to our knowledge regarding how different assets and portfolios respond to monetary surprise. Several studies examine how U.S. monetary policy affects global stock markets and asset prices (e.g., Ehrmann and Fratzscher 2004; Wongswan 2006; Andersen et al. 2007; Bernanke and Kuttner 2005; Ehrmann and Fratzscher 2009; Wongswan 2009; Hausman and Wongswan 2011). However, these studies focus on a limited number of nations and a specific asset classification. This paper examines how U.S. monetary policy affects a range of global assets and portfolio diversification. This should provide more exhaustive and reliable results and be of interest to investors and policymakers.

2 | Literature Review

The influence of U.S. monetary policy on financial markets is a crucial area of research, given its significant role in shaping both domestic and international economic conditions. This literature review explores the effects of U.S. monetary policy on asset prices and volatility, as well as its implications for portfolio management.

2.1 | Influence of U.S. Monetary Policy on Financial Markets

The role of U.S. monetary policy in influencing asset prices and economic conditions is a key area of research, given its importance in shaping domestic and international financial markets. This effect has been extensively documented, dating back to seminal work by Waud (1970) and Cook and Hahn (1989), which provide the fundamental understanding that changes in the discount rate can have major effects on U.S. financial markets. Bernanke and Blinder (1992) provide evidence that the Federal funds rate effectively predicts various real variables such as unemployment and industrial output throughout the period. Campbell and Ammer (1993) show that information pertaining to prospective excess stock returns and inflation has a considerable impact on stock and bond returns. Thorbecke (1997) note the impact on stock returns of U.S. monetary policy. Further evidence is seen in Patelis (1997), Rigobon and Sack (2003), Ehrmann and Fratzscher (2004), Gurkaynak et al. (2005) and Bjørnland and Leitemo (2009).

Additionally, Kuttner (2001) provides a further refinement by distinguishing between expected and unexpected components of monetary policy and finds that they have different effects on bond yields. Bernanke and Kuttner (2005) find that the main impact of U.S. monetary policy surprises on stock markets is through changes in risk premia. This result is confirmed by Krishnamurthy and Vissing-Jorgensen (2011) who examine the various effects of quantitative easing. Research, such as the work of Gospodinov and Jamali (2012), has paid particular attention to the volatility responses, showing that unexpected policy rate changes are associated with a significant rise in market volatility.

2.2 | Global Spillover Effects of U.S. Policy

The effects of U.S. monetary policy do not stop at its borders but are global. The work of Tandon and Urich (1987) and Bailey (1989) document important effects on international markets, with different responses depending on factors such as financial integration and exchange rate regimes (see Ehrmann and Fratzscher 2009). Johnson and Jensen (1993) report on the impact of U.S. discount rate changes on 15 foreign stock markets, while S. Kim (2001) finds similar results for non-U.S. G7 countries. Additional studies by Ehrmann and Fratzscher (2009), Wongswan (2009), S. J. Kim and Nguyen (2009), Hausman and Wongswan (2011), Kishor and Marfatia (2013), Barakchian and Crowe (2013), Yang and Hamori (2014), Anaya et al. (2017), Ansari and Sensarma (2019), Albagli et al. (2019), Kalemli-Özcan (2019), Miranda-Agrippino and Rey (2020), and Bhar and Malliaris (2021) confirm these findings across various global markets, including European, Asia-Pacific, BRICS, and others.

Recent research emphasises the interconnectivity of global financial systems, highlighting how U.S. policy is transmitted internationally. Empirical studies and policy debates in a large literature highlight the importance of U.S. monetary policy spillovers for global business cycles and financial conditions (Banerjee et al. 2016; Dedola et al. 2013; Iacoviello and Navarro 2019; Degasperi et al. 2026). The results show how important are U.S. choices for the global system and how they are a main factor in world financial dynamics. Recent studies provide more depth on these dynamics. Laeven and Tong (2012) study the impact of monetary shocks in the U.S. on stock prices globally and shed light on financial linkages across borders. Rosa (2025) extends the discussion of market reactions by investigating whether the effect of monetary policy on stock prices is accelerating or decelerating. Additionally, Acosta et al. (2025) analyse the effects of FOMC communication on financial markets, using a new event-study database to offer fresh perspectives on policy transparency and its market implications.

2.3 | Implications for Portfolio Management

In the realm of portfolio diversification and risk management, studies by Ang and Bekaert (2002) and Bekaert et al. (2013) examine how interest rate changes influence asset allocation, affecting both domestic and international diversification strategies. These works underscore the necessity of understanding shifts in asset correlations in response to monetary policy shocks, particularly during periods of economic uncertainty, as noted by Baker et al. (2016). To capture the dynamic nature of these effects, advanced modelling approaches such as the Kalman filter are considered (Kishor and Marfatia 2013). This methodology offers insights into the time-varying nature of policy impacts on portfolio risk and return dynamics, enabling a nuanced understanding of how investors might adjust their portfolios in response to policy changes.

By comparing the heterogeneous impacts of unexpected U.S. monetary policy shocks across these four categories, this study aims to answer two pivotal questions: First, does U.S. monetary policy risk exhibit non-diversifiable, systematic characteristics? Second, if such characteristics exist, can different portfolio structures offer differentiated capabilities for hedging against this risk? This research design not only fills a void in existing literature regarding portfolio-level analysis but also provides direct empirical guidance for global investors formulating asset allocation strategies amid environments characterised by monetary policy volatility.

3 | Data and Methodology

FOMC meetings typically take place eight times per year, approximately every 6 weeks. Our sample covers the period from January 2000 to December 2024, incorporating three major crises (two economic crises and one health crisis). We examine all Federal Open Market Committee (FOMC) meetings for this period. Our sample contains 204 scheduled meetings and 3 unscheduled meetings. We check the meetings one by one from the official website of the Board of Governors of the Federal Reserve System. This website contains real-time updates on both the meeting dynamics and the latest Federal funds rate level.

The data used in this study is daily and includes the price of the Fed funds futures rate and six assets that comprise four different portfolios. To generate the monetary surprise, we use the 30-day Fed funds futures market contract that most closely tracks the effective overnight Fed funds rate for a given month. The Chicago Board of Trade (CBOT) has offered Fed funds futures contracts since October 1988, where these contracts allow market participants to hedge interest rate risk and have a key role in revealing market expectations about future monetary policy actions. We use the most liquid spot-month contract to extract monetary policy surprises at each FOMC meeting, which is currently the most popular method for extracting monetary policy surprises in the literature (Kuttner 2001). Among alternative market-based indicators of monetary policy expectations, the Fed funds futures rate dominates in predicting the future path of monetary policy (Gürkaynak et al. 2007). The data for the 30-day Fed Funds futures rate comes from Bloomberg.

The assets, which define four types of diversification opportunities, consist of three stock indexes (S&P 500 index, MSCI EAFE index, and MSCI EM index) and three non-stock assets (gold, oil, and bonds).[2] The diversification opportunities available to U.S. investors are defined in Table 1. The first portfolio is limited to the United States and uses the S&P 500 index as its indicator (hence, domestically diversified). The second portfolio (Portfolio 1) is a stock-bond portfolio comprised of the S&P 500 index and U.S. 10-year Treasury notes. We adopt the well-known pension fund distribution principle, allocating a 60% weight to stocks and a 40% weight to bonds. The third portfolio (Portfolio 2) is an international-diversified portfolio that consists of the stock indices. The fourth portfolio (Portfolio 3) is a cross-asset portfolio that consists of the S&P500 index, gold, oil, and U.S. 10-year Treasury note. For Portfolios 2 and Portfolios 3, we take an equally weighted approach. All series are denominated in U.S. dollars. The data for the S&P500 index is from Capital I.Q., while the MSCI EAFE and MSCI EM indexes are sourced from the Morgan Stanley Capital International stock market (MSCI) database.

3.1 | Measuring Monetary Policy Surprise

To measure the monetary policy shock, we need to capture market expectation. While several methods are utilised in the literature, the most popular approach to estimate monetary policy shocks uses information from the Federal funds futures market as proposed by Kuttner (2001) and used by Krueger and Kuttner (1996) among others. Of note, the Fed funds futures rates are found to generate accurate forecasts of the one- and 2-month horizon Fed funds rate. For example, Gürkaynak et al. (2007) shows the superiority of the Fed funds futures price among different market-based measures of monetary policy expectations.

We follow the strategy proposed by Kuttner (2001) to obtain the expected and unexpected (surprise) components of monetary policy. The 1-day surprise is determined as:

$$r_\tau^u = \frac{m_s}{m_s - \tau}\left(f_{s,\tau}^0 - f_{s,\tau-1}^0\right) \tag{1}$$

Where r_τ^u is the monetary shock, m_s represents the number of days in the months, τ is the FOMC announcement time, $f_{s,\tau}^0$ denotes the spot-month futures rate on day τ of month s and $f_{s,\tau-1}^0$ denotes the spot-month futures rate on day $\tau - 1$.

When the change occurs on the first day of the month, $f_{s-1,\tau-1}^0$ is chosen over $f_{s,\tau-1}^0$, because its expectations are already included into the spot rate of the preceding month. Similarly, when the change occurs on the last three trading days of the month, the change in the 1-month futures rate is used instead (Bernanke and Kuttner 2005). The actual target rate change minus the unexpected target change is then used to compute the expected change in the target rate, $r_\tau^{\sim e} = r_\tau^{\sim} - r_\tau^u$. Figure 1 presents the plot of U.S. monetary surprise from 2000 to 2024, while the Appendix Table A1 lists the 71 target rate changes contained in our sample, three of which are not associated with FOMC meetings, a futures-based decomposition of expected and unexpected components is also reported here.

In Figure 1, we note that there are some sharp spikes from the beginning of 2000 to the end of 2002, and some from the late of 2007 to the end of 2009. Similarly, there are some sharp spikes from the end of 2019 to the middle of 2020. Relating these to recent crisis periods, we find that almost all happened during the dot-com burst (2000–2002), the great recession (2007–2009),

TABLE 1 | Types of diversification opportunities.

	Components			
U.S.-only	S&P 500			
Portfolio 1	S&P 500	10-year T-note		
Portfolio 2	S&P 500	MSCI EAFE	MSCI EM	
Portfolio 3	S&P 500	Gold	Oil	10-year T-note

and the Covid-19 health crisis period (2000–2021), respectively.[3] Thus, it is evident that during crisis periods, the U.S. monetary policy exhibits a larger number of surprises.

3.2 | Event Study Approach for Normal and Abnormal Returns

To identify abnormal returns arising from each of the FOMC meetings, we use a one-day event window size and following Bernanke and Kuttner (2005) and Hausman and Wongswan (2011).

To analyse the impact of the event, we define abnormal returns as the actual ex-post return (event returns) of the asset over the event window that exceeds the normal return, or the returns that would have been expected if the event had not occurred (Kishor and Marfatia 2013). Using a variant of the constant-mean-return model, the normal returns are derived using the average daily return over the previous 21 trading days, that is, 1-month prior to the event (FOMC meeting). If the meeting dates are within 21 trading days of each other, the average returns are adjusted appropriately. Figures 2 and 3 plot the abnormal return for the six assets.[4]

3.3 | Response to U.S. Monetary Surprise

Following Kuttner (2001) and Bernanke and Kuttner (2005), we use the below regression to consider how the different assets and portfolios respond to U.S. monetary policy surprises:

$$\mathrm{R}_{\tau}^{i} = \alpha^{i} + \omega^{i}\mathrm{r}_{\tau}^{\mathrm{u}} + \varepsilon_{\tau}^{i} \tag{2}$$

where R_{τ}^{i} represents the abnormal return of asset (portfolio) i at event date τ, and $\mathrm{r}_{\tau}^{\mathrm{u}}$ is monetary policy surprise. The coefficient ω^{i} shows how much the abnormal return responds to a 100-basis point unanticipated interest rate change.

While Equation (2) considers only the monetary policy surprise, a natural extension is to ask is whether the responses of the six assets and three portfolios differ across the inclusion of expected and unexpected policy. Thus, we estimate:

$$\mathrm{R}_{\tau}^{i} = \alpha^{i} + \omega_{1}^{i}\mathrm{r}_{\tau}^{\mathrm{u}} + \omega_{2}^{i}\mathrm{r}_{\tau}^{\mathrm{e}} + \varepsilon_{\tau}^{i} \tag{3}$$

where R_{τ}^{i} represents the abnormal return of asset i at the event date τ as defined earlier, $\mathrm{r}_{\tau}^{\mathrm{u}}$ is monetary policy surprise, and $\mathrm{r}_{\tau}^{\mathrm{e}}$ is the expected change in the Fed funds target rate. The coefficient ω_{1}^{i} shows how much the abnormal return responds to a 100-

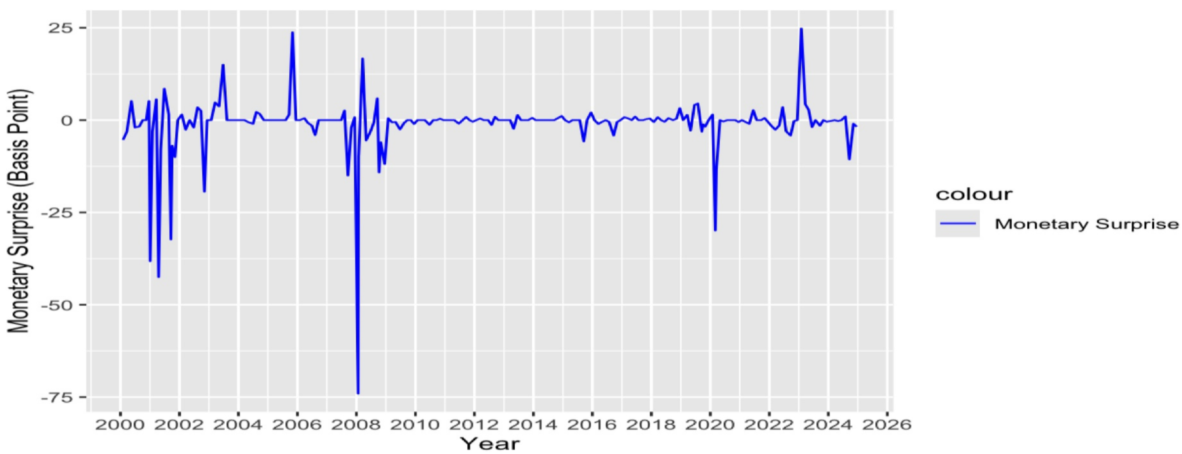

FIGURE 1 | The plot of U.S. monetary surprise.

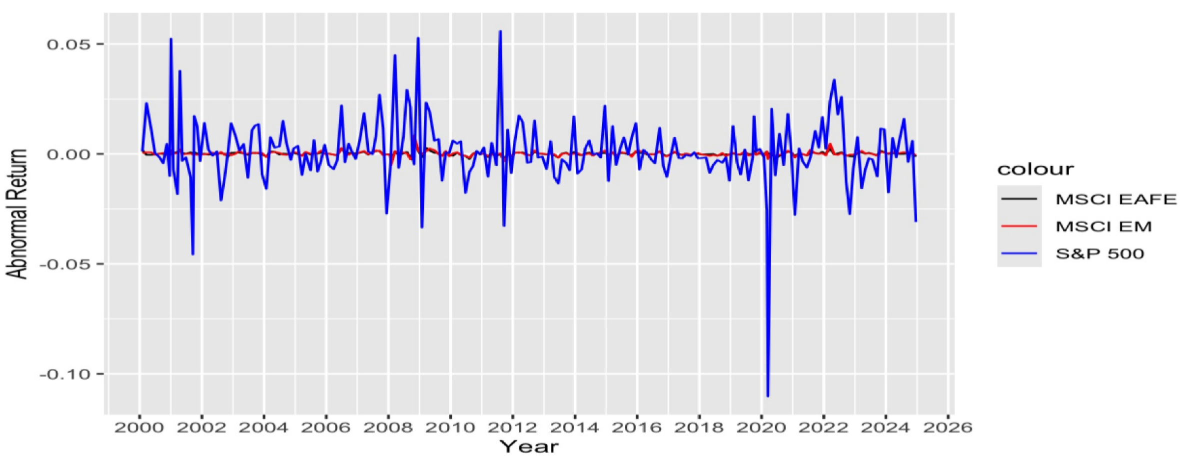

FIGURE 2 | The plot of abnormal returns of three indexes within Portfolio 2.

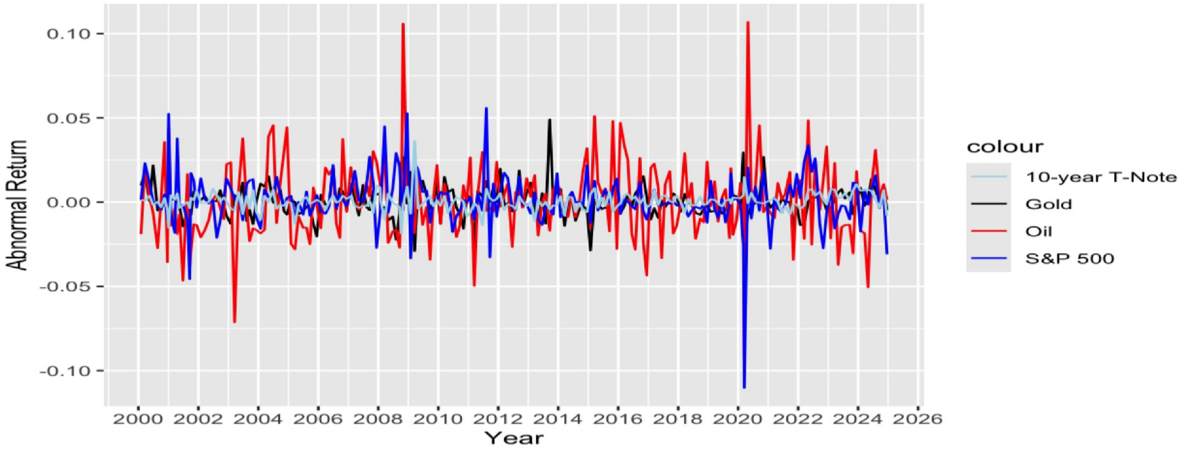

FIGURE 3 | The plot of abnormal returns of three indexes within Portfolio 3.

basis point surprise change, and the coefficient ω_2^i shows how much the abnormal return adjusts to a 100-basis point anticipated Fed funds rate change.

4 | Empirical Results

4.1 | Impact of Unexpected Fed Funds Target Rate Changes

The results of Equation (2) are presented in Table 2. These results over the full sample show that an unexpected Fed Funds target rate cut by the Fed boosts the return across each asset and portfolio, indicating that monetary policy surprises positively influence market performance. A surprise rate cut (negative surprise) of 25 basis points by the Fed triggers an increase in developed market returns (EAFE) by 0.09%, emerging market returns (EM) index by 0.13%, and S&P 500 returns by 0.85%. This suggests varying sensitivities, with the S&P 500 being particularly responsive. There is also evidence that the gold market is significantly affected, with a 0.62% increase, and the oil market with a 1.28% increase, highlighting their sensitivity to monetary policy changes. However, the results show no statistically significant effect for the U.S. 10-year Treasury bill, implying that bonds may be less responsive to rate cuts, consistent with Roley and Sellon (1995).

We consider the same effect (i.e., a negative surprise of 25 basis points) for the portfolios and also find a negative and significant effect. For Portfolio 1, a surprise cut triggers a jump by 0.10%, for Portfolio 2 by 0.69%, and for Portfolio 3 by 0.51%. These results suggest that monetary policy shocks are a systemic risk factor, in line with Thorbecke (1997), and cannot be diversified. Among these portfolios, the stock-bond (Portfolio 1) is relatively less affected by monetary policy shocks compared to the U.S. only (S&P 500), the international-diversified (Portfolio 2), and asset-diversified (Portfolio 3) approaches, indicating that broader diversification strategies may be more sensitive to monetary surprises.

4.2 | Effects of Expected Versus Unexpected Fed Funds Target Rate Changes

While Table 2 focuses solely on monetary policy surprises, it is important to consider whether the inclusion of both expected and unexpected policy components alters the responses of the six assets and three portfolios. To investigate this, we estimate Equation (3) and present the results in Table 3. As anticipated, the coefficients for expected and surprise components differ. The unanticipated component leads to negative and significant responses in the three stock indices, gold, oil, and the three portfolios, emphasising the market's sensitivity to unexpected changes and aligns with the findings in Table 2. In contrast, the anticipated component elicits statistically insignificant responses from these assets, indicating that markets already price in expected rate adjustments, leading to minimal volatility. Interestingly, the 10-year Treasury note shows no significant response to either expected or unexpected changes, suggesting stability and a lack of sensitivity to monetary policy fluctuations. Gospodinov and Jamali (2012) support the conclusion that anticipated rate adjustments do not significantly influence market volatility. These insights highlight the importance of unexpected policy changes in driving market reactions, while anticipated changes have limited impact.

TABLE 2 | Fixed response of different indexes and portfolios to the fed surprise.

	Full sample			
Index	**Estimate**	**R-Sq**	***p*-value**	**Obs**
MSCI EAFE	−0.004	0.077	< 0.001***	204
MSCI EM	−0.005	0.101	< 0.001***	204
Gold	−0.025	0.032	0.011**	204
Oil	−0.051	0.022	0.036*	204
S&P 500	−0.034	0.029	0.015**	204
10-year T-note	−0.001	0.000	0.960	204
Portfolio 1	−0.004	0.099	< 0.001***	204
Portfolio 2	−0.028	0.057	0.001***	204
Portfolio 3	−0.021	0.027	0.019**	204

Note: The table shows the estimates from the regression equation for the full sample period (2000–2024). The estimated regression equation is: $r_\tau^i = \alpha^i + \omega^i r_\tau^u + \varepsilon_\tau^i$, where Δr_τ^i represents the abnormal return of indexes i at the event date t and r_τ^u captures the monetary policy surprise calculated from the Fed funds futures data. The *p*-value is under the estimates. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

5 | Time-Variation Analysis

As noted, the results above assume that the response of global returns to U.S. monetary policy shocks remain constant over time. We consider different aspects of time-variation within the relations and response, beginning with how monetary policy affects comovement.

5.1 | Time-Variation I: Modelling the Time-Varying Correlation

To model heteroscedasticity and extract the time-varying correlation between the abnormal returns of assets, we estimate the DCC-GARCH (1,1) process proposed by Engle (2002). This model is considered for all six assets, and the resultant time-varying correlations are presented in Figures 4 and 5.

First, Figure 4 plots the time-varying correlation between each pair of stock indexes in the international diversified portfolio (Portfolio 2). The pattern in Figure 4 suggests that each pair of indexes in the international diversified portfolio is highly correlated. Moreover, we can find that the correlation between the developed (EAFE) and emerging (EM) markets is the highest for most of the sample period among these three pairs. It is worth noting that during our sample period, the correlation

TABLE 3 | Response of different asset indexes and portfolios to expected and unexpected Fed funds target rate changes.

	Full sample				
Indexes	**Intercept**	**Estimate for the unexpected**	**Estimate for the expected**	**R-Sq**	**Obs**
MSCI EAFE	0.0001	−0.004	0.000	0.079	204
		0.000***	0.451		
MSCI EM	0.0001	−0.005	0.000	0.103	204
		0.000***	0.514		
Gold	0.0001	−0.025	0.002	0.033	204
		0.010**	0.641		
Oil	0.0006	−0.053	0.006	0.025	204
		0.031**	0.444		
S&P 500	0.0018	−0.032	−0.006	0.038	204
		0.021**	0.186		
10-year T-note	0.0003	−0.001	0.002	0.004	204
		0.893	0.383		
Portfolio 1	0.0001	−0.004	0.000	0.100	204
		0.000***	0.632		
Portfolio 2	0.0007	−0.028	0.001	0.057	204
		0.000***	0.767		
Portfolio 3	0.0012	−0.020	−0.003	0.032	20
		0.026*	0.295		

Note: The table shows the estimates from the regression equation for the full sample period (2000–2024). The estimated regression equation is: $r^i_\tau = \alpha^i + \omega^i_1 r^u_\tau + \omega^i_2 r^e_\tau + \varepsilon^i_\tau$, where Δr^i_τ represents the abnormal return of asset index *i* or portfolio *i* at the event date τ as defined earlier, and r^u_τ is monetary policy surprise. r^e_τ is the expected change in the Fed funds target rate. The coefficient ω^i_1 shows how much the abnormal return of asset index *i* or portfolio *i* responds to a 100 basis point unanticipated Fed funds target rate increase in the U.S, and the coefficient ω^i_2 shows how much the abnormal return of asset index *i* or portfolio *i* responds to a 100 basis point anticipated Fed funds target rate increase in the U.S. The *p*-value is reported under the estimates. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

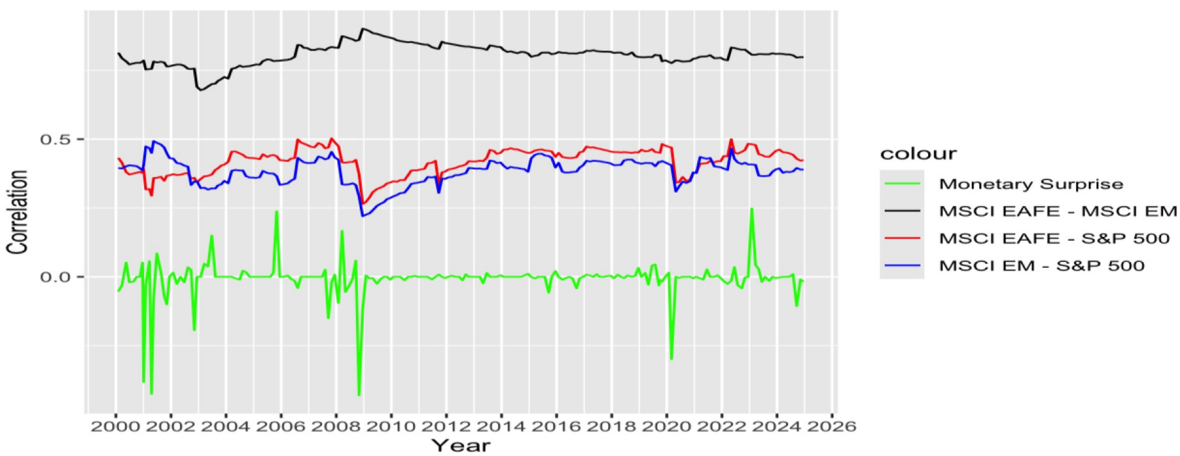

FIGURE 4 | The plot of correlation between three stock indexes.

trend of the S&P 500 and EAFE is very similar to that of the S&P 500 and EM.

Second, Figure 5 displays the pattern of the time-varying correlation between each pair of assets in the cross asset diversified portfolio (Portfolio 3). As can be seen, the abnormal returns of gold and oil are positively correlated, with most of their correlation ranging between 0.05 and 0.25. We observe that the correlation between the abnormal returns of gold and the S&P 500 wanders between positive and negative from 0.12 to −0.12, but with some extreme values during a crisis period. For the abnormal returns of gold and the 10-year Treasury note, the correlation again fluctuates around zero but with an extreme negative value of −0.50 during the financial crisis. We observe a distinct negative correlation between the abnormal returns of oil and the 10-year Treasury notes. Generally, we find that oil has a positive correlation with the S&P 500 for most of the period.

Figure 6–8 illustrate the time-varying correlation between each asset, portfolio, and U.S. monetary surprises. These figures reveal that the correlation between each variable and unexpected changes in the Fed's policy actions varies significantly over time. Notably, the abnormal returns of the assets and portfolios are generally negatively correlated with U.S. monetary policy surprises throughout most of the sample period. An intriguing pattern emerges during major economic events: the dot-com bust (2000–2002), the Great Recession (2007–2009), and the COVID-19 pandemic (2020–2021). During these periods, the correlation between monetary shocks and the EAFE, as well as the S&P 500, showed substantial fluctuations and became stronger and more negative. Interestingly, during COVID-19, while the correlation with the S&P 500 fluctuated significantly, it becomes less negative. For a comparative perspective, Appendix Tables A2-A4 present equivalent fixed correlation values.

Having obtained the time-varying correlations, we use the following regression to assess the impact of U.S. monetary policy surprises on the correlations between the assets:

$$c_t^{\text{index } i \text{ and } j} = \alpha^{\text{index } i \text{ and } j} + \theta^{\text{index } i \text{ and } j} r_\tau^{u} + \epsilon_\tau^{\text{index } i \text{ and } j} \qquad (4)$$

where $c_t^{\text{indexes } i \text{ and } j}$ represents the correlation between the abnormal return of asset i and j and r_τ^u is unanticipated Fed funds target rate change (monetary policy surprise). The coefficient $\theta^{\text{index } i \text{ and } j}$ shows how much the correlation between the assets changes following a 100-basis point Fed funds target rate surprise.

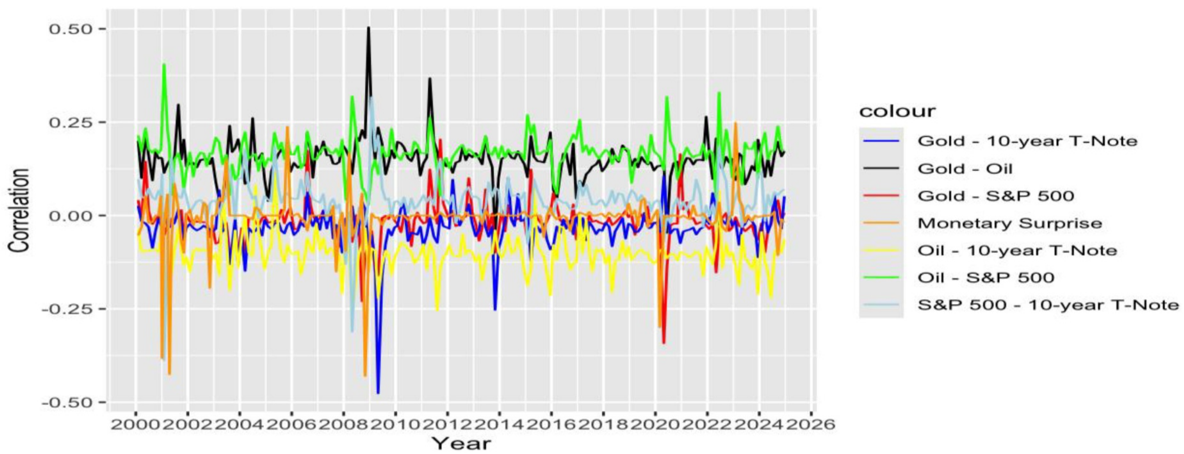

FIGURE 5 | The plot of correlation between three asset indexes and the S&P 500 index.

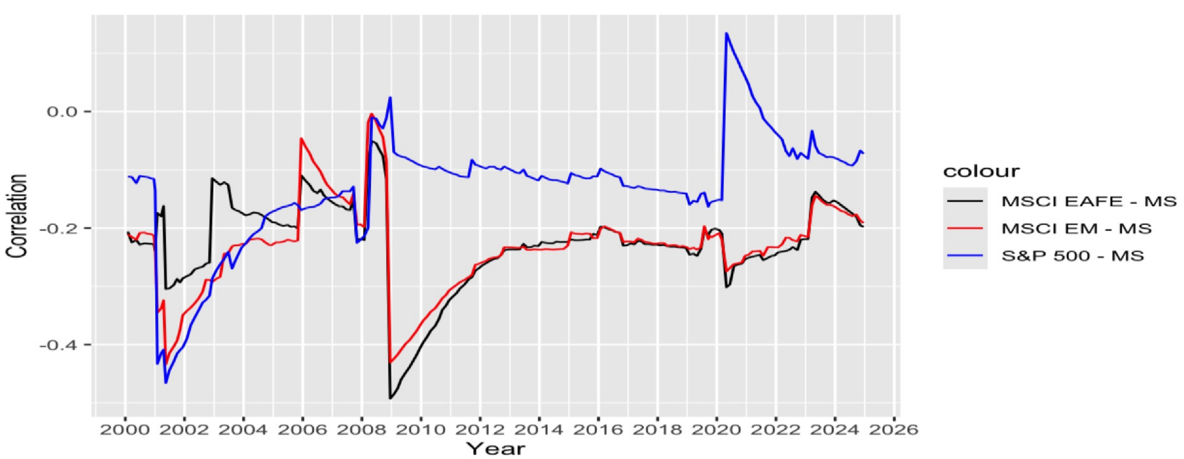

FIGURE 6 | Plot of time-varying correlation between stock indexes and monetary surprise.

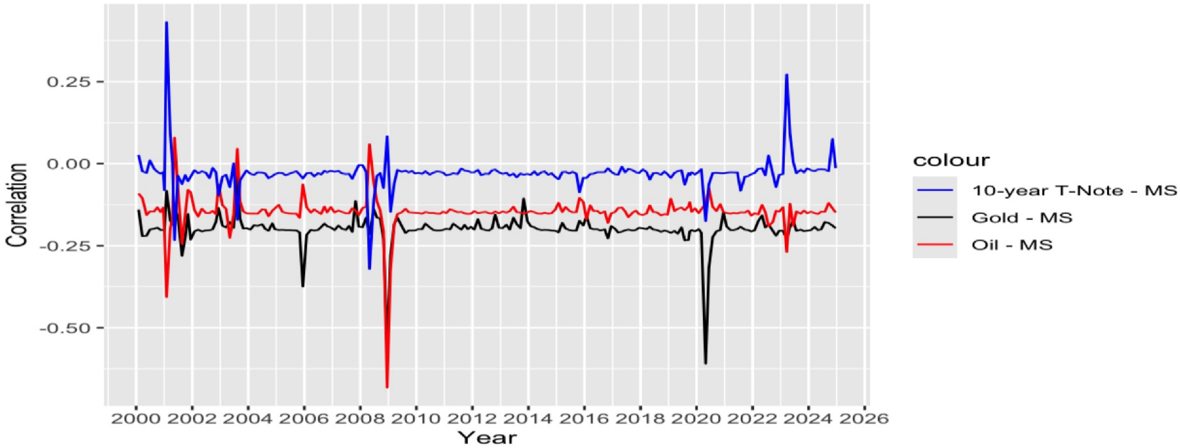

FIGURE 7 | Plot of the time-varying correlation between asset and monetary surprise.

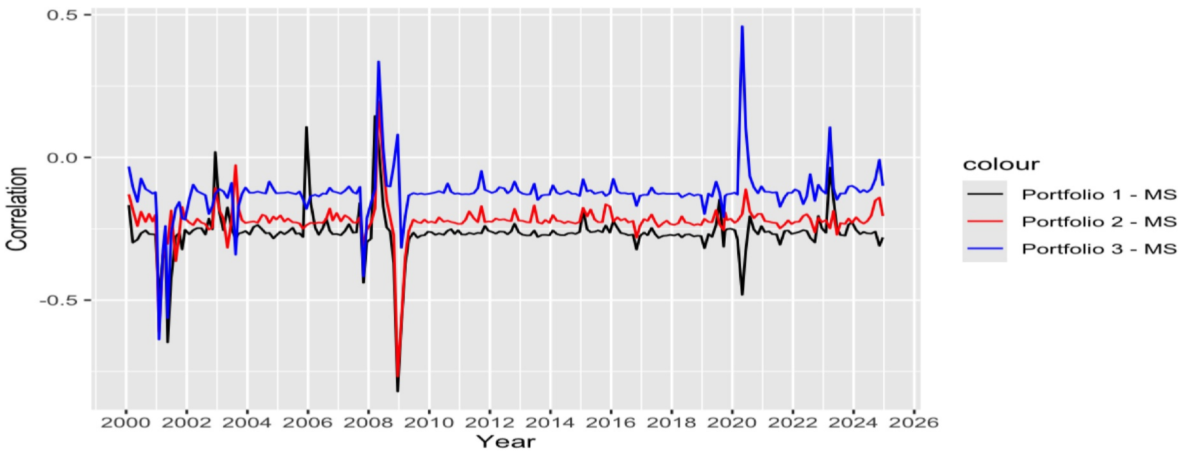

FIGURE 8 | Plot of the time-varying correlation between portfolios and monetary surprise.

Tables 4 and 5 present the results for Equation (4). Table 4 focuses on how monetary surprises impact stock index correlations (Portfolio 2 assets), while Table 5 examines cross-asset correlations (Portfolio 3 assets). Table 4 shows that the Fed's monetary surprises have a positive and statistically significant effect on the correlation between U.S. and developed market indexes (S&P 500 and EAFE), suggesting synchronised movements in reaction to unexpected policy changes. This aligns with the view that a surprise rate increase can lead to stock price declines in both markets, strengthening their correlation. While the coefficients involving the emerging market index (EM) are positive, they are not statistically significant, indicating a different or less uniform reaction to U.S. monetary surprises. In Table 5, correlations involving 10-year Treasury notes are not significantly affected, which might be due to their small correlation values with other assets. However, the correlation between gold and oil is negatively and significantly influenced at the 10% level, suggesting a potential inverse relation. Additionally, the correlation between oil and the S&P 500 is positively impacted at the 10% level, indicating a possible connection in their movements following monetary surprises. Notably, correlations involving the S&P 500 are positively affected by changes in Fed monetary surprises, though not statistically significant, hinting at a general sensitivity to such changes.

TABLE 4 | Effect of the fed surprise on the correlations between abnormal returns of indexes in Portfolio 2.

	Full sample			
Correlation	**Estimate**	**R-Sq**	**Obs**	***p*-value**
MSCI EAFE—MSCI EM	0.021	0.003	204	0.597
MSCI EAFE—S&P 500	0.104	0.072	204	0.036**
MSCI EM—S&P 500	0.017	0.005	204	0.741

5.2 | Time-Variation II: Modelling the Time-Varying Response

Given that fixed-coefficient estimates may not adequately reflect how markets react to U.S. monetary policy shocks, we utilise a time-varying parameter (TVP) framework to better capture any evolving response of returns to such monetary policy shocks. There are alternative methods for modelling time variation, which have different advantages and disadvantages. For example, Boivin (2005) argues that structural break models represent a limited subset of time variation and do not account for gradual changes in how markets respond to. As such, we follow Kishor and Marfatia (2013) in using a state-space model based around the Kalman filter, as:

$$R_\tau^i = \alpha^i + \omega_\tau^i r_\tau^u + \varepsilon_\tau^i \text{ where } \varepsilon_\tau^i \sim N(0, M) \tag{5}$$

The coefficient ω_τ^i measures how the abnormal return of asset i changes over time, τ, in response to U.S. monetary policy surprise. Based on our fixed-coefficient model presented above, and previous findings in the literature, this coefficient is expected to be negative implying that an unexpected increase in the interest rate by the Fed would be associated with a drop in asset value. To introduce time-variation, we assume ω_τ^i follows a random walk.

$$\omega_\tau^i = \omega_{\tau-1}^i + v_\tau^i \text{ where } v_\tau^i \sim N(0, Q) \tag{6}$$

The state equation (6) describes how the coefficient ω_τ^i evolves over time.

The time-varying filtered responses of the different asset returns to U.S. monetary policy surprises are shown in Figures 9–14. Our results support the presence of time-variation in the response of asset returns to U.S. monetary policy surprises, although with some nuance across markets. Considering the impact of the Fed's policy surprise on developed and emerging countries, this is highest during the period of 2007–2009 (Great Recession) and lowest during the 2014–2019 period. Further, the response pattern during 2006–2012 is the most stable over the sample period, even though small variations remain. The monetary surprise triggers greater movement in the S&P 500 index, oil, and gold, with the S&P 500 index and oil moving the most across all assets. This is consistent with the fixed coefficients results where the Fed Funds rate provokes the biggest changes in these two assets. Of note, the 10-year Treasury note's response pattern is the least affected, except for the period from late 2008 to early 2009, indicating its potential for hedging properties.

TABLE 5 | Effect of the fed surprise on the correlations between abnormal returns of indexes in portfolio 3.

	Full sample			
Correlation	**Estimate**	**R-Sq**	**Obs**	***p*-value**
Gold—oil	−0.077	0.010	204	0.160*
Gold—S&P 500	0.054	0.005	204	0.332
Gold—10-year- T-note	−0.012	0.001	204	0.814
Oil—S&P 500	0.025	0.061	204	0.092*
Oil—10-year T-note	−0.035	0.002	204	0.524
S&P 500–10-year T-note	0.056	0.004	204	0.387

Note: Tables 4 and 5 show the estimates from the regression equation for the full sample (2000–2024) sample period. The estimated regression equation is: $c_t^{\text{index } i \text{ and } j} = \alpha^{\text{index } i \text{ and } j} + \theta^{\text{index } i \text{ and } j} r_\tau^u + \epsilon_\tau^{\text{index } i \text{ and } j}$, where $c_t^{\text{index } i \text{ and } j}$ represents the correlation between the abnormal return of asset i and j (e.g., MSCI EAFE index and MSCI EM index), and r_τ^u is monetary policy surprise. The coefficient $\beta^{\text{index } i \text{ and } j}$ shows how much the correlation between the abnormal returns of assets i and j responds to a 100-basis point unanticipated Fed funds target rate change. The p-value is reported under the estimates. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

The filtered time-varying responses for the different portfolios are presented in Figures 15–17. Evident are differences in the strength of the response to monetary policy surprises across the portfolios. Portfolio 1 (60% stock and 40% bond) experiences the least impact from the monetary shocks, which aligns with the fixed response results, and is further support for the 10-year Treasury note acting as a more stable asset. Nonetheless, we see notable spikes during the Great Recession period (2008–2009) and the Covid-19 period (2020–2021). The shape of the response pattern for Portfolio 2 is similar to that of Portfolio 3. They both actively respond to the monetary shocks, with the dot-com burst period (2000–2002), the Great Recession period (2008–2009), and the Covid-19 period (2020–2021) resulting in some large spikes. That said, the international stock portfolio (Portfolio 2), does exhibit a greater magnitude of responses across the full period.

6 | Robustness Check

To ensure that our main results are not driven by the specific measurement of monetary policy shocks using Fed funds futures, we employ an alternative measure based on Treasury bill rates. Following Demiralp (2008), we define the monetary policy surprise as the change in the 3-month Treasury bill rate around FOMC announcements:

$$\text{Shock}_\tau^{TB3} = \text{TB3}_\tau^{after} - \text{TB3}_\tau^{before} \tag{7}$$

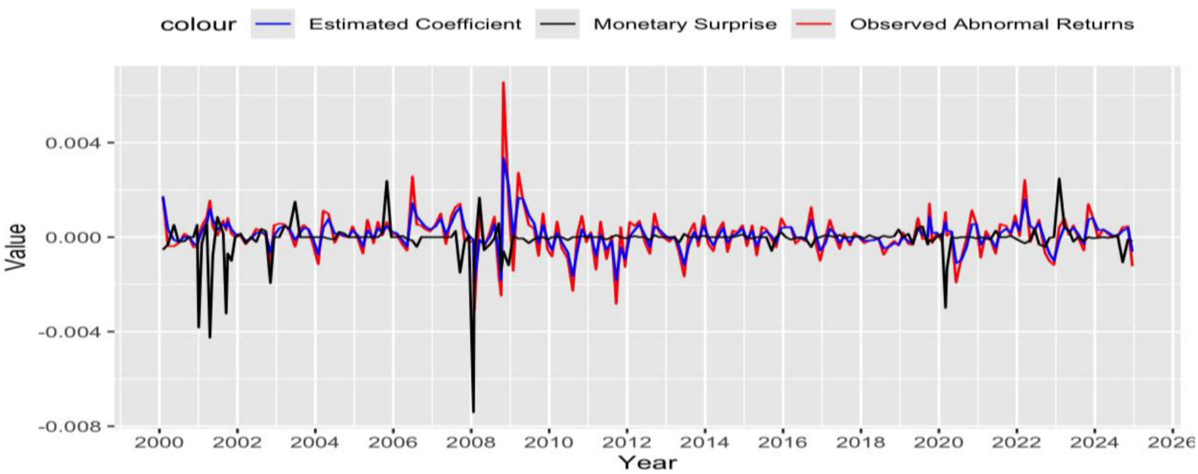

FIGURE 9 | The filtered time varying response of MSCI EAFE to FOMC announcements.

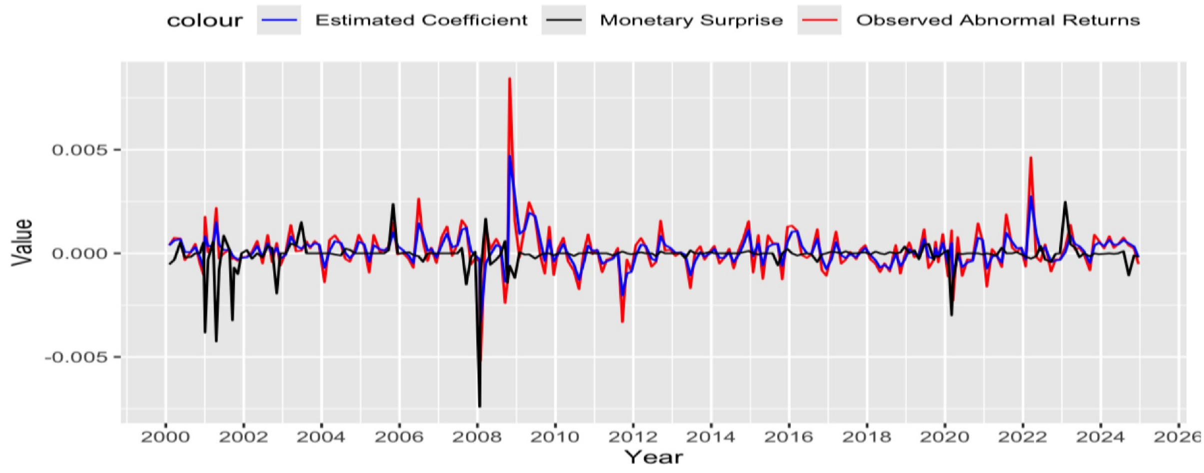

FIGURE 10 | The filtered time varying response of MSCI EM to FOMC announcements.

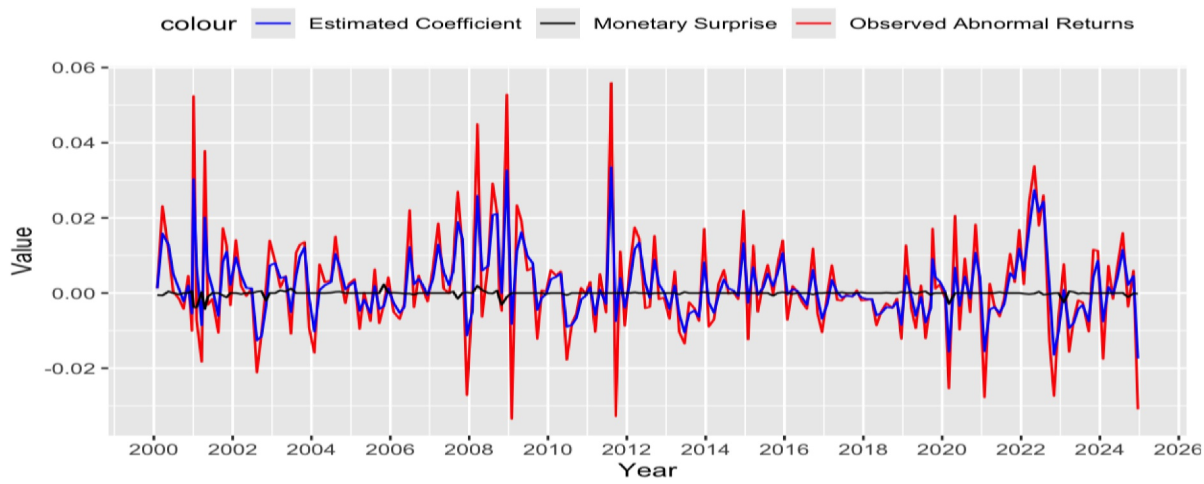

FIGURE 11 | The filtered time-varying response of S&P 500 to FOMC announcements.

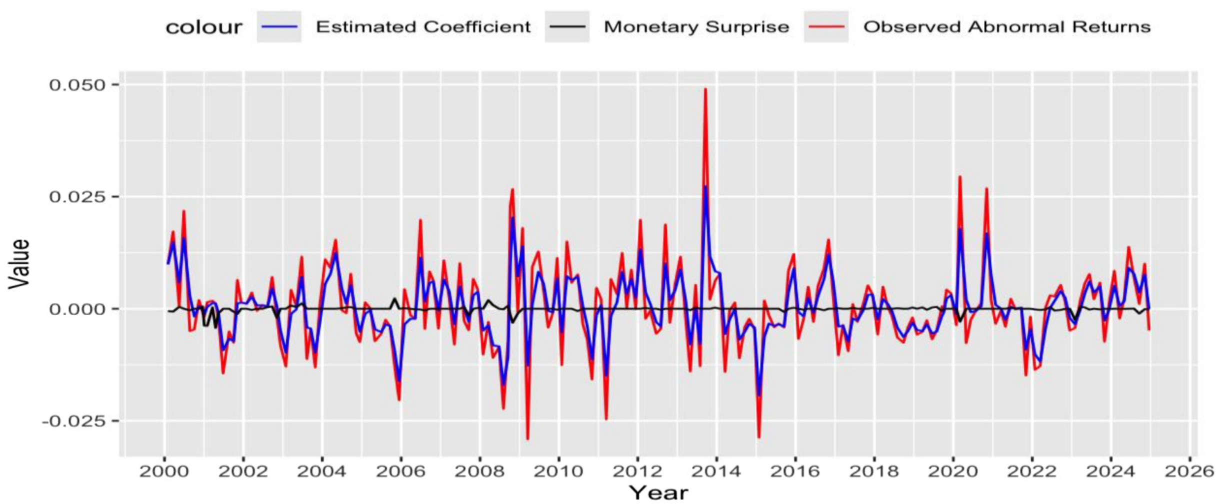

FIGURE 12 | The filtered time-varying response of gold to FOMC announcements.

where TB3 is the secondary market rate on 3-month Treasury bills. Demiralp (2008) shows that changes in TB3 closely track revisions in market expectations of future overnight rates, validating this approach for identifying monetary policy surprises. The actual target rate change minus the unexpected target change is then used to compute the expected change in the target rate, $r_{\tau}^{\sim e} = r_{\tau}^{\sim}$ - Shock$_{\tau}^{TB3}$. Tables 6 and 7 replicate the results from Tables 2 and 3 but the with alternative measure of

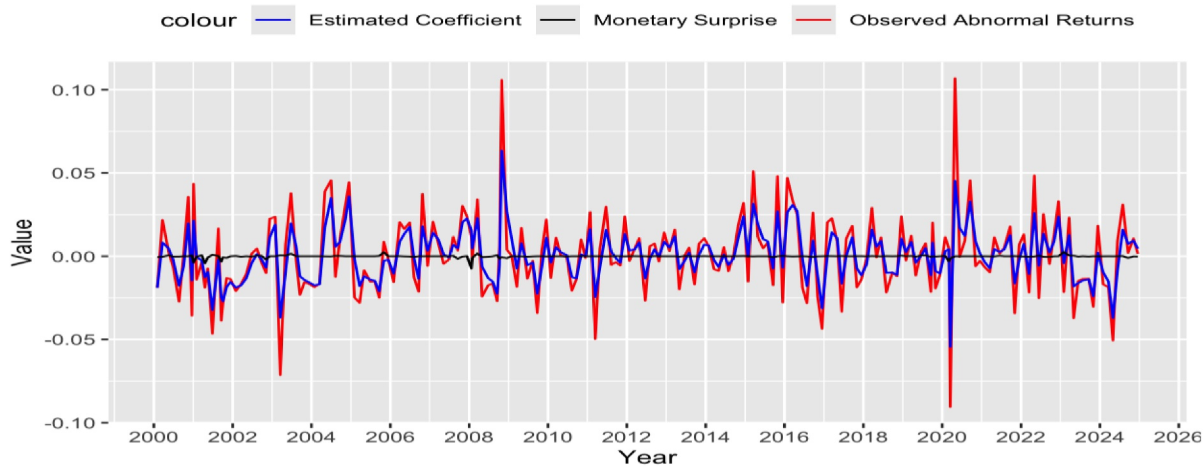

FIGURE 13 | The filtered time-varying response of oil to FOMC announcements.

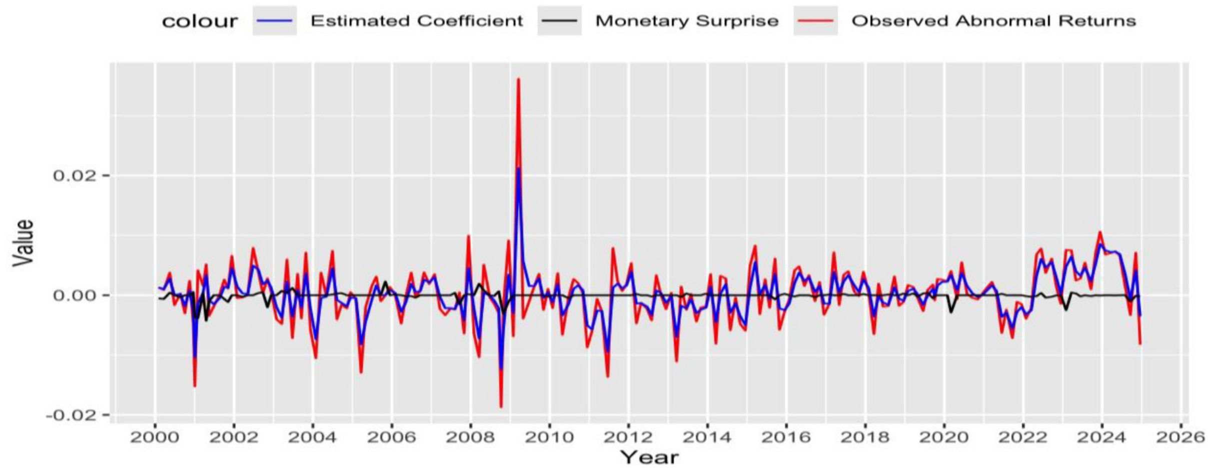

FIGURE 14 | The filtered time-varying response of the 10-year Treasury-note to FOMC announcements.

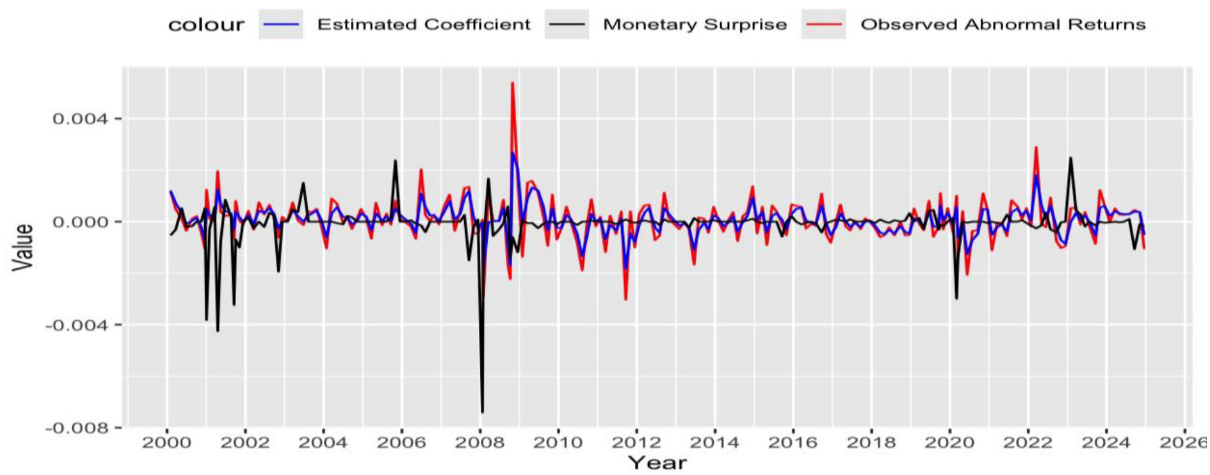

FIGURE 15 | The filtered time varying response of Portfolio 1 to monetary surprises.

monetary surprise. Across the two sets of tables, the results are consistent with the coefficients remaining negative and statistically significant and with comparable magnitudes. This confirms that our main findings are robust to alternative measures of monetary policy shocks.

7 | Summary and Conclusion

In this paper, we estimate the responses of six assets and four portfolios to U.S. monetary policy surprises derived from the Federal funds futures market. The assets include the S&P 500

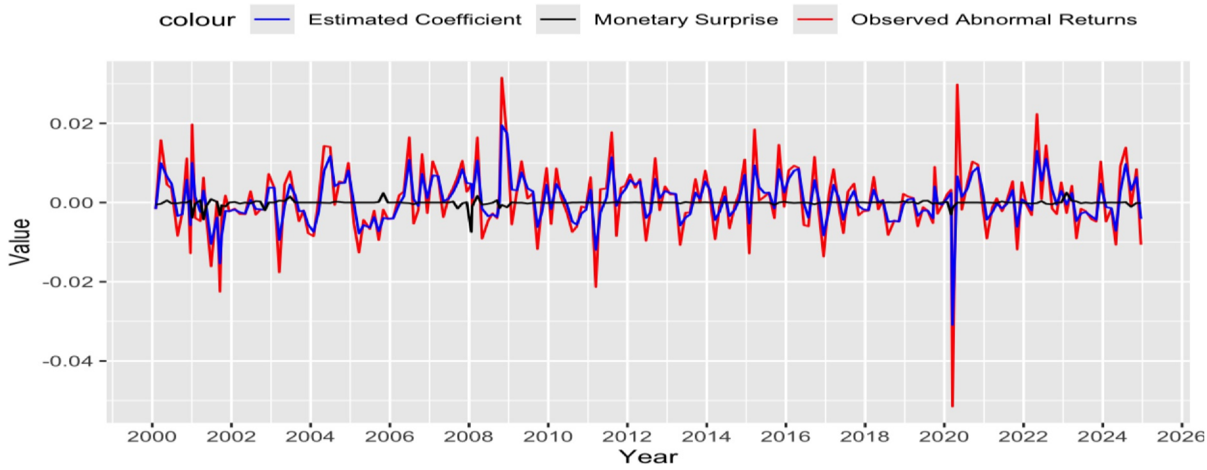

FIGURE 16 | The filtered time varying response of Portfolio 2 to monetary surprises.

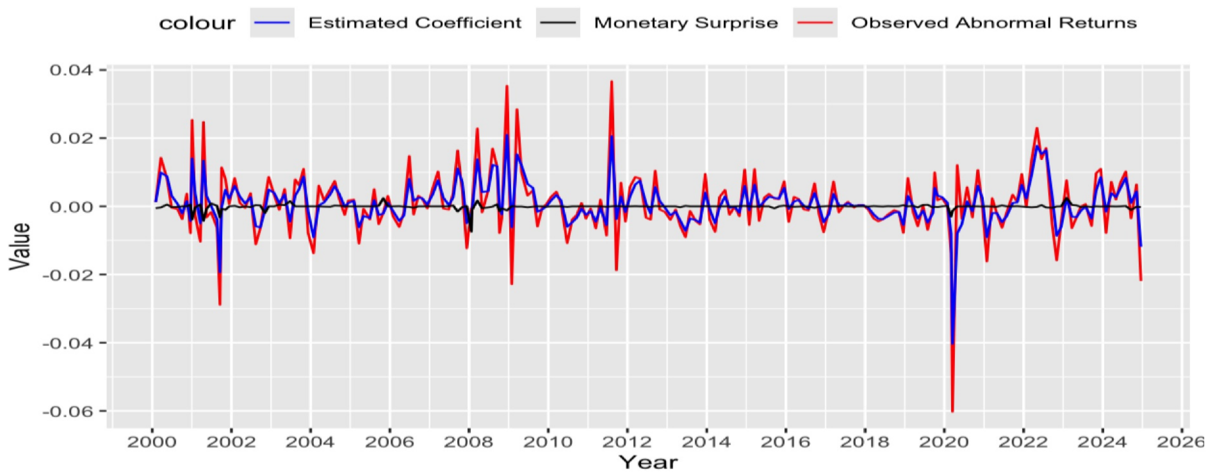

FIGURE 17 | The filtered time varying response of Portfolio 3 to monetary surprises.

TABLE 6 | Response of different asset indexes and portfolios to monetary shocks based on the 3-month treasury-bill.

	Full sample			
Index	**Estimate**	**R-Sq**	***p*-value**	**Obs**
MSCI EAFE	−0.005	0.048	0.001***	203
MSCI EM	−0.005	0.035	0.008***	203
Gold	−0.012	0.003	0.429	203
Oil	−0.058	0.011	0.133	203
S&P 500	−0.086	0.074	< 0.001***	203
10-year T-note	−0.012	0.010	0.162	203
Portfolio 1	−0.004	0.049	0.001***	203
Portfolio 2	−0.042	0.053	0.001***	203
Portfolio 3	−0.056	0.080	< 0.001***	203

Note: The table shows the estimates from the regression equation of the robustness check for the full sample period (2000–2024). The estimated regression equation is: $\mathrm{r}_{\tau}^{i} = \alpha^{i} + \omega^{i}\mathrm{Shock}_{\tau}^{TB3} + \varepsilon_{\tau}^{i}$, where $\Delta\mathrm{r}_{\tau}^{i}$ represents the abnormal return of indexes i at the event date t and $\mathrm{Shock}_{\tau}^{TB3}$ captures the monetary policy surprise calculated from the 3-month Treasury bill rate. The *p*-value is under the estimates. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

index (as a domestically diversified portfolio), developed and emerging market indices, gold, oil, and 10-year Treasury notes, which help create a stock-bond and a cross-asset portfolio. We find that a surprise rate cut of 25 basis points by the Fed results in increases for the developed markets index (0.09%), emerging market index (0.13%), gold (0.62%), and the S&P 500 index (0.85%). The oil market also sees a 1.28% increase, while the U.S. 10-year Treasury note shows no statistically significant effect. Additionally, a negative surprise triggers increases in the stock-bond portfolio (0.10%), the international stock portfolio (0.69%), and the cross-asset portfolio (0.51%). These findings suggest that monetary policy shocks are a systemic risk factor. Among the portfolios, the stock-bond (60%–40%) portfolio is less affected by these shocks compared to the cross-stock and cross-asset portfolios.

Given that a fixed-coefficient approach to estimating the response to U.S. monetary policy surprises is unable to capture any gradual evolution of the different assets, we allow for two time-varying techniques. Using a DCC-GARCH model to capture time-variation in the correlations between our assets,

TABLE 7 | Response of different asset indexes and portfolios to expected and unexpected Fed funds target rate changes based on the 3-month treasury-bill.

	Full sample				
Indexes	**Intercept**	**Estimate for the unexpected**	**Estimate for the expected**	**R-Sq**	**Obs**
MSCI EAFE	0.0001	−0.004	0.000	0.053	204
		0.005***	0.271		
MSCI EM	0.0001	−0.005	0.000	0.035	204
		0.010**	0.865		
Gold	0.0002	−0.011	−0.001	0.004	204
		0.478	0.778		
Oil	0.0001	−0.063	0.004	0.013	204
		0.115	0.608		
S&P 500	0.0007	−0.082	−0.003	0.076	204
		< 0.001***	0.479		
10-year T-note	0.0001	−0.014	0.003	0.020	204
		0.0916*	0.143		
Portfolio 1	0.0001	−0.004	0.000	0.054	204
		0.004***	0.301		
Portfolio 2	0.0003	−0.043	0.001	0.053	204
		0.001***	0.805		
Portfolio 3	0.0005	−0.055	−0.001	0.080	204
		< 0.001***	0.754		

Note: The table shows the estimates from the regression equation of the robustness check for the full sample period (2000–2024). The estimated regression equation is: $r_\tau^i = \alpha^i + \omega_1^i \text{Shock}_\tau^{TB3} + \omega_2^i r_\tau^e + \varepsilon_\tau^i$, where Δr_τ^i represents the abnormal return of asset index i or portfolio i at the event date τ as defined earlier, and Shock_τ^{TB3} captures the monetary policy surprise calculated from the 3-month Treasury bill rate. r_τ^e is the expected change in the Fed funds target rate, calculated as $r_\tau^{\sim e} = r_\tau^{\sim} - \text{Shock}_\tau^{TB3}$. The coefficient ω_1^i shows how much the abnormal return of asset index i or portfolio i responds to a 100 basis point unanticipated Fed funds target rate increase in the U.S, and the coefficient ω_2^i shows how much the abnormal return of asset index i or portfolio i responds to a 100 basis point anticipated Fed funds target rate increase in the U.S. The p-value is reported under the estimates. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

results show significant co-movement in the response of global stock markets to U.S. monetary policy surprises. Notably, we see that correlation between each stock index strengthen with U.S. monetary policy surprises. The same is also true with the S&P 500 and 10-year Treasuries, while oil has a mixed, but statistically, muted effect. We apply the time-varying parameter with the Kalman filter to capture the time-varying response of each index and portfolio. The results indicate that responses from different indexes and portfolios to U.S. monetary policy surprises are time-varying and notably punctuated by large impacts around crisis periods.

Overall, based on the analysis and results presented above, we draw the following conclusions. First, we provide evidence that proves U.S. monetary policy is a risk factor in global asset markets. Notably, the effect of monetary policy surprises on the six assets and four portfolios are negative. Second, we demonstrate that markets, except for the 10-year Treasury note, are unlikely to respond to anticipated monetary policy moves. Third, our results indicate that risk-averse investors can use U.S. 10-year Treasury notes and the stock-bond (60/40) portfolio to hedge risks, especially when the monetary policy is more volatile. In contrast, the other chosen portfolios considered all respond more to U.S. monetary policy surprises. Fourth, each of the considered portfolios (U.S.-only, a stock-bond, an international-diversified, and cross-asset portfolios) are negatively impacted by monetary policy surprises, such that we contend that U.S. monetary policy is a systemic risk that cannot be fully diversified.

Data Availability Statement

The data that support the findings of this study are available from Multiple Database Providers. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the author(s) with the permission of Multiple Database Providers.

Endnotes

[1] We argue that a fixed-coefficient approach to estimating the asset return response to U.S. monetary policy surprises is unable to capture the gradual evolution of the different assets and portfolios following U.S. monetary policy changes.

[2] MSCI is Morgan Stanley Capital International. EAFE refers to Europe, Australasia and the Far East, and EM to emerging markets.

[3] These are reflected by some large negative values in the Appendix table.

[4] For the non-U.S. stock index series, we need to be cognisant of need to consider the impact of time zones. Hence, the computation of event impact for the international portfolio (Portfolio 2) involves determining the mean returns during the FOMC meeting date and the

subsequent date. This practice guarantees uniformity in the comparison process, as well as accounts for the slower assimilation of new information in certain markets.

References

Acosta, M., A. Ajello, M. D. Bauer, F. Loria, and S. Miranda-Agrippino. 2025. "Financial Market Effects of FOMC Communication: Evidence From a New Event-Study Database (No. 227)." *IMFS Working Paper Series*.

Albagli, E., L. Ceballos, S. Claro, and D. Romero. 2019. "Channels of US Monetary Policy Spillovers to International Bond Markets." *Journal of Financial Economics* 134, no. 2: 447–473. https://doi.org/10.1016/j.jfineco.2019.04.007.

Anaya, P., M. Hachula, and C. J. Offermanns. 2017. "Spillovers of US Unconventional Monetary Policy to Emerging Markets: The Role of Capital Flows." *Journal of International Money and Finance* 73: 275–295. https://doi.org/10.1016/j.jimonfin.2017.02.008.

Andersen, T. G., T. Bollerslev, F. X. Diebold, and C. Vega. 2007. "Real-Time Price Discovery in Global Stock, Bond and Foreign Exchange Markets." *Journal of International Economics* 73, no. 2: 251–277. https://doi.org/10.1016/j.jinteco.2007.02.004.

Ang, A., and G. Bekaert. 2002. "International Asset Allocation With Regime Shifts." *Review of Financial Studies* 15, no. 4: 1137–1187. https://doi.org/10.1093/rfs/15.4.1137.

Ansari, M. G., and R. Sensarma. 2019. "US Monetary Policy, Oil and Gold Prices: Which Has a Greater Impact on BRICS Stock Markets?" *Economic Analysis and Policy* 64: 130–151. https://doi.org/10.1016/j.eap.2019.08.003.

Bailey, W. 1989. "The Effect of US Money Supply Announcements on Canadian Stock, Bond, and Currency Prices." *Canadian Journal of Economics* 22, no. 3: 607–618. https://doi.org/10.2307/135543.

Bailey, W. 1990. "US Money Supply Announcements and Pacific Rim Stock Markets: Evidence and Implications." *Journal of International Money and Finance* 9, no. 3: 344–356. https://doi.org/10.1016/0261-5606(90)90015-r.

Baker, S. R., N. Bloom, and S. J. Davis. 2016. "Measuring Economic Policy Uncertainty." *Quarterly Journal of Economics* 131, no. 4: 1593–1636. https://doi.org/10.1093/qje/qjw024.

Banerjee, R., M. B. Devereux, and G. Lombardo. 2016. "Self-Oriented Monetary Policy, Global Financial Markets and Excess Volatility of International Capital Flows." *Journal of International Money and Finance* 68: 275–297. https://doi.org/10.1016/j.jimonfin.2016.02.007.

Barakchian, S. M., and C. Crowe. 2013. "Monetary Policy Matters: Evidence From New Shocks Data." *Journal of Monetary Economics* 60, no. 8: 950–966. https://doi.org/10.1016/j.jmoneco.2013.09.006.

Bekaert, G., M. Hoerova, and M. L. Duca. 2013. "Risk, Uncertainty and Monetary Policy." *Journal of Monetary Economics* 60, no. 7: 771–788. https://doi.org/10.1016/j.jmoneco.2013.06.003.

Bernanke, B. S., and A. S. Blinder. 1992. "The Federal Funds Rate and the Channels of Monetary Transmission." *American Economic Review* 82, no. 4: 901–921. https://www.jstor.org/stable/2117350.

Bernanke, B. S., and K. N. Kuttner. 2005. "What Explains the Stock Market's Reaction to Federal Reserve Policy?" *Journal of Finance* 60, no. 3: 1221–1257. https://doi.org/10.1111/j.1540-6261.2005.00760.x.

Bhar, R., and A. G. Malliaris. 2021. "Modeling US Monetary Policy During the Global Financial Crisis and Lessons for Covid-19." *Journal of Policy Modeling* 43, no. 1: 15–33. https://doi.org/10.1016/j.jpolmod.2020.07.001.

Bjørnland, H. C., and K. Leitemo. 2009. "Identifying the Interdependence Between US Monetary Policy and the Stock Market." *Journal of Monetary Economics* 56, no. 2: 275–282. https://doi.org/10.1016/j.jmoneco.2008.12.001.

Boivin, J. 2005. Has US Monetary Policy Changed? Evidence from Drifting Coefficients and real-time Data.

Borio, C., and H. Zhu. 2012. "Capital Regulation, Risk-Taking and Monetary Policy: A Missing Link in the Transmission Mechanism?" *Journal of Financial Stability* 8, no. 4: 236–251. https://doi.org/10.1016/j.jfs.2011.12.003.

Campbell, J. Y., and J. Ammer. 1993. "What Moves the Stock and Bond Markets? A Variance Decomposition for Long-Term Asset Returns." *Journal of Finance* 48, no. 1: 3–37. https://doi.org/10.2307/2328880.

Campbell, J. Y., A. W. Lo, A. C. MacKinlay, and R. F. Whitelaw. 1998. "The Econometrics of Financial Markets." *Macroeconomic Dynamics* 2, no. 4: 559–562. https://doi.org/10.1017/s1365100598009092.

Cook, T., and T. Hahn. 1989. "The Effect of Changes in the Federal Funds Rate Target on Market Interest Rates in the 1970s." *Journal of Monetary Economics* 24, no. 3: 331–351. https://doi.org/10.1016/0304-3932(89)90025-1.

Croushore, D. and T. Stark. 2002. *Is Macroeconomic Research Robust to Alternative Data Sets?* Federal Reserve Bank of Philadelphia, Working Paper, Number 02–3.

Dedola, L., P. Karadi, and G. Lombardo. 2013. "Global Implications of National Unconventional Policies." *Journal of Monetary Economics* 60, no. 1: 66–85. https://doi.org/10.1016/j.jmoneco.2012.12.001.

Degasperi, R., S. S. Hong, and G. Ricco. 2026. "The Global Transmission of US Monetary Policy." *Journal of International Economics* 161: 104259. https://doi.org/10.1016/j.jinteco.2026.104259.

Demiralp, S. 2008. "Monetary Policy Surprises and the Expectations Hypothesis at the Short End of the Yield Curve." *Economics Letters* 101, no. 1: 1–3. https://doi.org/10.1016/j.econlet.2008.03.018.

Detzel, A. 2017. "Monetary Policy Surprises, Investment Opportunities, and Asset Prices." *Journal of Financial Research* 40, no. 3: 315–348. https://doi.org/10.1111/jfir.12126.

Ehrmann, M., and M. Fratzscher. 2004. "Taking Stock: Monetary Policy Transmission to Equity Markets." *Journal of Money, Credit, and Banking* 36, no. 4: 719–737. https://doi.org/10.1353/mcb.2004.0063.

Ehrmann, M., and M. Fratzscher. 2009. "Global Financial Transmission of Monetary Policy Shocks." *Oxford Bulletin of Economics & Statistics* 71, no. 6: 739–759. https://doi.org/10.1111/j.1468-0084.2009.00561.x.

Engle, R. 2002. "Dynamic Conditional Correlation: A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models." *Journal of Business & Economic Statistics* 20, no. 3: 339–350. https://doi.org/10.1198/073500102288618487.

Gagnon, J., M. Raskin, J. Remache, and B. Sack. 2011. "The Financial Market Effects of the Federal Reserve's Large-Scale Asset Purchases." *International Journal of Central Banking* 7, no. 1: 3–43. https://www.ijcb.org/journal/v7n1/financial-market-effects-federal-reserves-large-scale-asset-purchases.

Gilchrist, S., D. López-Salido, and E. Zakrajšek. 2015. "Monetary Policy and Real Borrowing Costs at the Zero Lower Bound." *American Economic Journal: Macroeconomics* 7, no. 1: 77–109. https://doi.org/10.1257/mac.20130324.

Gospodinov, N., and I. Jamali. 2012. "The Effects of Federal Funds Rate Surprises on S&P 500 Volatility and Volatility Risk Premium." *Journal of Empirical Finance* 19, no. 4: 497–510. https://doi.org/10.1016/j.jempfin.2012.04.009.

Gürkaynak, R. S., B. Sack, and E. Swanson. 2005. "The Sensitivity of Long-Term Interest Rates to Economic News: Evidence and Implications for

Macroeconomic Models." *American Economic Review* 95, no. 1: 425–436. https://doi.org/10.1257/0002828053828446.

Gürkaynak, R. S., B. Sack, and J. H. Wright. 2007. "The U.S. Treasury Yield Curve: 1961 to the Present." *Journal of Monetary Economics* 54, no. 8: 2291–2304. https://doi.org/10.1016/j.jmoneco.2007.06.029.

Hanson, S. G., and J. C. Stein. 2015. "Monetary Policy and Long-Term Real Rates." *Journal of Financial Economics* 115, no. 3: 429–448. https://doi.org/10.1016/j.jfineco.2014.11.001.

Hausman, J., and J. Wongswan. 2011. "Global Asset Prices and FOMC Announcements." *Journal of International Money and Finance* 30, no. 3: 547–571. https://doi.org/10.1016/j.jimonfin.2011.01.008.

Husted, S., and J. Kitchen. 1985. "Some Evidence on the International Transmission of US Money Supply Announcement Effects." *Journal of Money, Credit, and Banking* 17, no. 4: 456–466. https://doi.org/10.2307/1992441.

Iacoviello, M., and G. Navarro. 2019. "Foreign Effects of Higher US Interest Rates." *Journal of International Money and Finance* 95: 232–250. https://doi.org/10.1016/j.jimonfin.2018.06.012.

Jensen, G. R., and R. R. Johnson. 1995. "Discount Rate Changes and Security Returns in the US, 1962–1991." *Journal of Banking & Finance* 19, no. 1: 79–95. https://doi.org/10.1016/0378-4266(94)00048-8.

Jensen, G. R., J. M. Mercer, and R. R. Johnson. 1996. "Business Conditions, Monetary Policy, and Expected Security Returns." *Journal of Financial Economics* 40, no. 2: 213–237. https://doi.org/10.1016/0304-405x(96)89537-7.

Johnson, R. R., and G. R. Jensen. 1993. "The Reaction of Foreign Stock Markets to US Discount Rate Changes." *International Review of Economics & Finance* 2, no. 2: 181–193. https://doi.org/10.1016/1059-0560(93)90022-i.

Kalemli-Özcan, Ș. 2019. *US Monetary Policy and International Risk Spillovers (No. w26297)*. National Bureau of Economic Research.

Karagiannis, S., Y. Panagopoulos, and P. Vlamis. 2010. "Interest Rate Pass-Through in Europe and the US: Monetary Policy After the Financial Crisis." *Journal of Policy Modeling* 32, no. 3: 323–338. https://doi.org/10.1016/j.jpolmod.2010.02.006.

Kim, S. 2001. "International Transmission of US Monetary Policy Shocks: Evidence From Var's." *Journal of Monetary Economics* 48, no. 2: 339–372. https://doi.org/10.1016/s0304-3932(01)00080-0.

Kim, S. J., and D. Q. T. Nguyen. 2009. "The Spillover Effects of Target Interest Rate News From the US Fed and the European Central Bank on the Asia-Pacific Stock Markets." *Journal of International Financial Markets, Institutions and Money* 19, no. 3: 415–431. https://doi.org/10.1016/j.intfin.2008.12.001.

Kishor, N. K., and H. A. Marfatia. 2013. "The Time-Varying Response of Foreign Stock Markets to US Monetary Policy Surprises: Evidence From the Federal Funds Futures Market." *Journal of International Financial Markets, Institutions and Money* 24: 1–24. https://doi.org/10.1016/j.intfin.2012.11.004.

Kodres, L. E. and M. Pritsker. 2002. "A Rational Expectations Model of Financial Contagion." *Journal of Finance* 57: 769–799. https://doi.org/10.1111/1540-6261.00441.

Krishnamurthy, A., and A. Vissing-Jorgensen. 2011. *The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy (No. w17555)*. National Bureau of Economic Research.

Krueger, J. T., and K. N. Kuttner. 1996. "The Fed Funds Futures Rate as a Predictor of Federal Reserve Policy." *Journal of Futures Markets* 16, no. 8: 865–879. https://doi.org/10.1002/(sici)1096-9934(199612)16:8<865::aid-fut2>3.0.co;2-k.

Kuttner, K. N. 2001. "Monetary Policy Surprises and Interest Rates: Evidence From the Fed Funds Futures Market." *Journal of Monetary Economics* 47, no. 3: 523–544. https://doi.org/10.1016/s0304-3932(01)00055-1.

Kyle, A. S. and W. Xiong. 2001. "Contagion as a Wealth Effect." *Journal of Finance* 56: 1401–1440. https://doi.org/10.1111/0022-1082.00373.

Laeven, L., and H. Tong. 2012. "US Monetary Shocks and Global Stock Prices." *Journal of Financial Intermediation* 21, no. 3: 530–547. https://doi.org/10.1016/j.jfi.2012.02.002.

Miranda-Agrippino, S., and H. Rey. 2020. "US Monetary Policy and the Global Financial Cycle." *Review of Economic Studies* 87, no. 6: 2754–2776. https://doi.org/10.1093/restud/rdaa019.

Patelis, A. D. 1997. "Stock Return Predictability and the Role of Monetary Policy." *Journal of Finance* 52, no. 5: 1951–1972. https://doi.org/10.1111/j.1540-6261.1997.tb02747.x.

Rigobon, R., and B. Sack. 2003. "Measuring the Reaction of Monetary Policy to the Stock Market." *Quarterly Journal of Economics* 118, no. 2: 639–669. https://doi.org/10.1162/003355303321675473.

Rigobon, R., and B. Sack. 2004. "The Impact of Monetary Policy on Asset Prices." *Journal of Monetary Economics* 51, no. 8: 1553–1575. https://doi.org/10.17016/feds.2002.04.

Roley, V. V., and G. H. Sellon. 1995. "Monetary Policy Actions and Long-Term Interest Rates." *Federal Reserve Bank of Kansas City Economic Quarterly* 80, no. 4: 77–89.

Rosa, C. 2025. "The Impact of Monetary Policy on Stock Prices: Gaining Momentum or Losing Steam?" *Financial Markets and Portfolio Management*: 1–34. https://doi.org/10.1007/s11408-025-00490-9.

Tandon, K., and T. Urich. 1987. "International Market Response to Announcements of US Macroeconomic Data." *Journal of International Money and Finance* 6, no. 1: 71–83. https://doi.org/10.1016/0261-5606(87)90014-3.

Thorbecke, W. 1997. "On Stock Market Returns and Monetary Policy." *Journal of Finance* 52, no. 2: 635–654. https://doi.org/10.1111/j.1540-6261.1997.tb04816.x.

Wang, Z. 2026. "Monetary Policy Surprises and the Cross Sectional Stock Return Predictability in Volume Sorted Portfolios." *International Review of Financial Analysis* 113: 105134. https://doi.org/10.1016/j.irfa.2026.105134.

Waud, R. N. 1970. "Public Interpretation of Federal Reserve Discount Rate Changes: Evidence on The 'Announcement Effect'." *Econometrica: Journal of the Econometric Society* 38, no. 2: 231–250. https://doi.org/10.2307/1913006.

Wongswan, J. 2006. "Transmission of Information Across International Equity Markets." *Review of Financial Studies* 19, no. 4: 1157–1189. https://doi.org/10.1093/rfs/hhj033.

Wongswan, J. 2009. "The Response of Global Equity Indexes to US Monetary Policy Announcements." *Journal of International Money and Finance* 28, no. 2: 344–365. https://doi.org/10.1016/j.jimonfin.2008.03.003.

Yang, L., and S. Hamori. 2014. "Spillover Effect of US Monetary Policy to ASEAN Stock Markets: Evidence From Indonesia, Singapore, and Thailand." *Pacific-Basin Finance Journal* 26: 145–155. https://doi.org/10.1016/j.pacfin.2013.12.003.

Appendix

TABLE A1 | Expected, unexpected, and actual changes in the Federal funds target.

Date	Actual	FOMC	Expected	Unexpected
Panel A. The period from January 2010 to December 2024				
2024-12-18	−25	Yes	−23	−2
2024-11-07	−25	Yes	−24	−1
2024-09-18	−50	Yes	−39	−11
2023-07-26	25	Yes	25	0
2023-05-03	25	Yes	22	3
2023-03-22	25	Yes	21	4
2023-02-01	25	Yes	0	25
2022-12-14	50	Yes	50	0
2022-11-02	75	Yes	75	0
2022-09-21	75	Yes	79	−4
2022-07-27	75	Yes	78	−3
2022-06-15	75	Yes	72	3
2022-05-04	50	Yes	51	−1
2022-03-16	25	Yes	28	−3
2020-03-16	−100	Yes	−87	−13
2020-03-03	−50	Yes	−20	−30
2019-10-30	−25	Yes	−23	−2
2019-09-18	−25	Yes	−22	−3
2019-07-31	−25	Yes	−30	5
2018-12-19	25	Yes	22	3
2018-09-26	25	Yes	25	0
2018-06-13	25	Yes	25	0
2018-03-21	25	Yes	24	1
2017-12-13	25	Yes	25	0
2017-06-14	25	Yes	24	1
2017-03-15	25	Yes	25	0
2016-12-14	25	Yes	25	0
2015-12-16	25	Yes	23	2
Panel B. The period from January 2000 to December 2010				
2008-12-16	−100	Yes	−88	−12
2008-10-29	−50	Yes	−44	−6
2008-10-08	−50	No	−36	−14
2008-04-30	−25	Yes	−20	−5
2008-03-18	−75	Yes	−92	17
2008-01-30	−50	Yes	−40	−10
2008-01-22	−75	NO	−1	−74
2007-12-11	−25	Yes	−26	1
2007-10-31	−25	Yes	−23	−2
2007-09-18	−50	Yes	−35	−15
2006-06-29	25	Yes	27	−2
2006-05-10	25	Yes	26	−1
2006-03-28	25	Yes	25	0
2006-01-31	25	Yes	25	0

(Continues)

TABLE A1 | (Continued)

Date	Actual	FOMC	Expected	Unexpected
2005-12-13	25	Yes	25	0
2005-11-01	25	Yes	1	24
2005-09-20	25	Yes	24	1
2005-08-09	25	Yes	25	0
2005-06-30	25	Yes	25	0
2005-05-03	25	Yes	25	0
2005-03-22	25	Yes	25	0
2005-02-02	25	Yes	25	0
2004-12-14	25	Yes	25	0
2004-11-10	25	Yes	25	0
2004-09-21	25	Yes	23	2
2004-08-10	25	Yes	23	2
2004-06-30	25	Yes	26	−1
2003-06-25	−25	Yes	−40	15
2002-11-06	−50	Yes	−31	−19
2001-12-11	−25	Yes	−25	0
2001-11-06	−50	Yes	−40	−10
2001-10-02	−50	Yes	−43	−7
2001-09-17	−50	No	−18	−32
2001-08-21	−25	Yes	−27	2
2001-06-27	−25	Yes	−33	8
2001-05-15	−50	Yes	−42	−8
2001-04-18	−50	Yes	−7	−43
2001-03-20	−50	Yes	−56	6
2001-01-31	−50	Yes	−47	−3
2001-01-03	−50	Yes	−12	−38
2000-05-16	50	Yes	45	5
2000-03-21	25	Yes	28	−3
2000-02-02	25	Yes	30	−5

Note: The table displays the 71 target rate changes contained in our sample, 3 of which are not associated with FOMC meetings. The equation for calculating the unexpected monetary policy surprise is: $\Delta r^{u}_{\tau} = \frac{m_s}{m_s - \tau}(f^{0}_{s,\tau} - f^{0}_{s,\tau-1})$, where Δr^{u}_{τ} is the monetary shocks, m_s represents the number of days in the months, τ is is the FOMC announcement time. $f^{0}_{s,\tau}$ denotes the spot-month futures rate on day τ of month s and $f^{0}_{s,\tau-1}$ denotes the spot-month futures rate on day $\tau - 1$. When the change occurs on the first day of the month, $f^{0}_{s-1,\tau-1}$ has been chosen over $f^{0}_{s,\tau-1}$, because its expectations have already been included into the spot rate of the preceding month. Similarly, when the change occurs on the last day of the month, the change in the 1-month futures rate is used instead. The actual target rate change minus the unexpected target change is then used to compute the expected change in the target rate, $\Delta r^{\sim e}_{\tau} = \Delta r^{\sim}_{\tau} - \Delta r^{u}_{\tau}$.

TABLE A2 | The fixed correlations between the abnormal return of three stock indexes in Portfolio 2 and monetary policy surprise.

	MSCI EAEF	MSCI EM	S&P 500	Monetary surprise
MSCI EAEF	1			
MSCI EM	0.850	1		
S&P 500	0.424	0.358	1	
Monetary surprise	−0.277	−0.318	−0.171	1

TABLE A3 | The fixed correlation between the abnormal return of four indexes in Portfolio 3 and U.S. monetary policy surprise.

	Gold	**Oil**	**S&P 500**	**10Y-TN**	**Monetary surprise**
Gold	1				
Oil	0.153	1			
S&P 500	−0.034	0.150	1		
10-year T-note	−0.079	−0.111	0.077	1	
Monetary surprise	−0.178	−0.148	−0.171	−0.004	1

TABLE A4 | The fixed correlation between the abnormal return of three portfolios and monetary policy surprise.

	Portfolio 1	**Portfolio 2**	**Portfolio 3**
Monetary policy surprise	−0.314	−0.239	−0.164