Impact of Central Bank Decisions and Communications on Sentiment, Uncertainty, Risk Aversion and Investment Behaviour

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Abstract

Central bank's policy decisions and communication influence financial markets through managing investor expectations related to the current and future economic scenario and achieve desired macroeconomic goals. This thesis empirically evaluates the role of signals given in the central bank's actions and communication in driving investor sentiment, formulating the expected risk premium and shifting the investment behaviour in financial markets. This thesis comprises of three empirical chapters focusing on the response of market participants to the central bank quantitative and qualitative announcements.

Chapter 2 investigates the impact of the United States (US) and domestic monetary policy announcements on consumer and managers' confidence in the United Kingdom (UK) and 10 countries within the euro area during conventional and unconventional policy times. More specifically, using the confidence indicators of the European Commission, the study examines the response of consumers and managers to monetary policy surprises around the global financial crisis. The findings confirm that during the conventional policy period, the domestic expansionary shock has a significant positive impact on the consumer and manager confidence in the UK and across the ten countries in the euro area. Furthermore, the US conventional monetary policy has more impact on managers' sentiment compared to domestic policy. However, after the introduction of unconventional policy programme, the monetary announcements turn to be less effective in boosting the confidence of households and businesses.

Chapter 3 analyses the influence of the Federal Reserve's (Fed's) communications on investors' risk perception and appetite in the global equity markets. The results suggest that the Fed's optimism (pessimism) decreases (increases) the market-wide uncertainty and investors' risk aversion not only in the US but also in the UK and the euro area. In addition, investors respond to the signals inbound in the communications more significantly during recessionary and uncertain times. Moreover, after estimating unique topics and their relative tone from the Fed's commutations, this chapter finds that investors pay attention particularly to the discussion related to the financial market, credit conditions, employment, and

economic growth in forming their response. Finally, investors react heterogeneously to the discussion about prospering economic outlook and future contractionary policy.

Chapter 4 investigates the effect of the Fed's communications on the returns and traders' positions in the commodity markets. Using computational linguistic analysis, this study extracts the policymakers' indication of the future path of the policy rate. This study documents that the degree of hawkishness in the Fed's communications decreases the one month ahead returns on metal, energy and overall commodity indexes. In addition, the Fed's hawkish tone increases (decreases) the commodity traders' speculating (hedging) positions. This implies that the central bank tone contains information about the economic conditions and provides signals about the future path of the policy which drive the traders' positions and affect the commodity returns. Furthermore, a topic modelling analysis of the central bank communications reveals that a hawkish discussion about consumption, financial market, and inflation plays a particularly important role in influencing the commodity returns and traders' positions.

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Chapter 1: Introduction

1.1 Research Background

To achieve the monetary policy mandate of stable prices and maximum employment, central banks attempt to influence investor expectation and trading behaviour. As Bernanke and Kuttner (2005) argue, the shift in investor expectations relating to expected excessive return transforms the impact of monetary policy on financial asset prices. Understanding the effects of central bank actions (decisions) and words (communication) on investor expectations, risk perception and investment behaviour is essential to achieve the policy objectives. After the catastrophic effects of the global financial crisis, central banks in major economies have become more concerned about asset price fluctuations and financial market meltdowns.

In the aftermath of the global financial crisis of 2007-2008, central banks around the globe adopted unconventional policy measures to restore investor confidence and decrease uncertainty in the financial markets. The Federal Reserve (Fed) reduced the policy rate and announced Large Scale Asset Purchase (LSAP) in December 2008 to regain consumer confidence and stabilize the financial markets. The central banks in other developed economies follow similar footsteps and abandoned the conventional policy tools to curtail the effects of the financial crisis. For instance, in March 2009, the Bank of England developed the Asset Purchase Facility (APF) and formally introduced the Quantitative Easing (QE) policy.[1] Similarly, European Central Bank (ECB) in May 2009 started the Covered Bonds Purchasing Program (CBPP), which was changed to Securities Markets Programme (SMP) in May 2010. Studies have shown that the introduction of these unconventional policy tools has a significant effect on financial markets (Joyce, McLaren and Young, 2012; Bowdler and Radia, 2014; Roger, Scotti and Wright, 2014; Amatov and Dorfman, 2017; and Bekaert, Hoerova and Xu, 2020).

Due to the zero lower bound on policy rates, central bank communication has become more influential and important in recent years. The central bank communications not only carry information regarding the policy objectives but also provide a professional assessment about current and future economic outlook (Blinder et al. 2008; Eijffinger, Mahien and Raes, 2017; Neuhierl and Webner, 2019; and Hansen and McMahon, 2016). Therefore, central banks in

[1] Buraschi and Whelan (2016) provide the details of unconventional policy announcements of the Federal Reserve, Bank of England, and European Central Bank.

developed economies rely increasingly on their communications to manage investor expectations in the financial markets.[2]

This thesis first, investigates the effectiveness of conventional and unconventional monetary policy announcements in restoring the consumers (households) and managers (businesses) confidence in the United Kingdom and the euro area. In this thesis, we use the computational linguistic technique to estimate the Fed's tone in the discussions of the Federal Open Market Committee (FOMC) meetings. Next, we examine the effects of the Fed's tone on investors' perception and appetite towards risk in the global equity markets. Finally, we study the role of the Fed's tone in altering trading behaviour and the returns in the commodity markets. Investors' risk perception and risk-bearing capacity determines investment behaviour and moves asset prices in the financial market.

1.2 Contributions and Findings

The inverse relationship between the policy rate and equity prices is well documented in the literature (Rozeff, 1974; Thorbecke, 1997; Kohn and Sack, 2003; Bernanke and Kuttner, 2005; Kurov, 2012; Melosi, 2016; and Jansen and Zervou, 2017). The decrease in future expected cash flows after an increase in the policy rate is the rationale for this negative link. For instance, a contractionary policy raises the discount rate and reduces the value of future cash flows that in turn decrease the asset prices.[3] This suggests that the effect of monetary policy news is similar to other macroeconomic factors and rational investors respond to the additional information in the shape of the policy rate.

On the other hand, many studies document the important role of sentiment in setting asset prices in financial markets (Baker and Wurgler, 2006; Brown and Cliff, 2004). Specifically, the existence of market frictions limits rational agents to eliminate the overly optimistic (pessimistic) investors from the market and eventually both interact with each other to reach an equilibrium market price. While explaining the rationale for the effect of monetary policy on stock prices, Bernanke and Kuttner (2005) also point out the potential role of excessive sensitive investors in changing equity prices. Several studies show that sentiment plays an important role in the transmission of monetary policy to financial markets (Basisitha and Kurov, 2008, Kurov, 2010; Jansen and Tsai, 2010; and Gao, Hung and Kontonikas, 2020). In Chapter 2, we investigate empirically the response of investor sentiment to the surprise in conventional

[2] Blinder (2009) provides a comprehensive review of the studies on the role of central bank communication in deriving asset price variations.

[3] Patelis (1997) shows that change in future expected dividend yield transforms the impact of monetary policy on equity prices.

and unconventional monetary policy.[4] Lutz (2015) and Galariotis, Makrichoriti and Spyrou (2018) show the significant positive impact of a conventional expansionary policy on investor sentiment. However, Galariotis, Makrichoriti and Spyrou (2018) find a negative impact of easing unconventional announcements on sentiment during the crisis period. Chapter 2 adds to the growing literature on the effect of monetary policy on investor sentiment by extending the investigation beyond the global financial crisis and sovereign debt crisis. Furthermore, Mahani and Poteshman (2008) argue that individual investors respond to macroeconomic news overwhelmingly compare to more sophisticated institutional investors. We, therefore, distinguish the expectations of households from more professional views of the manager using the consumer and businesses confidence indicators respectively. Specifically, using the European Commission's confidence indicators in the United Kingdom (UK) and the euro area, we investigate the impact of the conventional and unconventional monetary policy decisions on consumer and managers' confidence. In addition, to allow for the unique position[5] of the Federal Reserve in driving the global equity market volatilities, Chapter 2 also studies the potential spillover effect of US monetary policy on consumer and manager confidence in other financially integrated economies i.e. the UK and the euro area.

The results of our Factor-augmented Vector Autoregressive (FAVAR) model indicate that both the US and domestic conventional monetary policy shock has a significant impact on consumer and manager confidence in the UK and across the ten countries in the euro area. However, the results of this study show that the response of confidence indicators to domestic and the Federal Reserve's unconventional policy remained relatively low or even muted. This suggests that, after reducing the policy rate to near zero, the impact of unconventional policy announcements on investor expectations becomes either very weak or fades away.

Building on the results of Chapter 2 and realizing the role of the central bank qualitative communication in providing professional assessment related to the future economic outlook,[6] Chapter 3 of this thesis investigates the effect of the central bank's optimistic and pessimistic views on market uncertainty and investors' risk tolerance in the global equity markets. More specifically, Chapter 3 analyses the impact of the Federal Reserve's (Fed) tone on investor's risk perception and risk-bearing capacity in the equity markets of the United States, United Kingdom and euro area. Using the variance decomposition method, Bernake and Kuttner

[4] We use surprise change as the efficient market hypothesis suggests that asset prices should move in response to additional (unexpected) information in financial markets.

[5] In explaining the impact of the Fed's policy decisions on the risk premium in the global equity markets, Brusa, Savor and Wilson (2020) demonstrate that the Fed plays a unique role as the "world's central bank". Similarly, Armelius et al. (2020) also document that the Fed's communication drive policy decisions of other central banks across the world.

[6] Studies show that the central bank communications contain vital additional information about future economic conditions (Hayo, Kutan and Neuenkirch 2014; Cieslak and Schrimpf 2019; and Ostapenko, 2020).

(2005) find that the monetary policy moves equity prices by decreasing the perceived risk associated with a security or through increasing the risk-bearing capacity of the investor. Building on these results, Bekaert, Hoerova and Duca (2013) decomposed the option implied volatility on equity index into market-wide uncertainty and investors' risk aversion components. The results of Bekaert, Hoerova and Duca (2013) show that an expansionary shock reduces uncertainty and risk aversion in the equity market. Extending the work of Bekaert, Hoerova and Duca (2013) on monetary policy decisions (actions), Chapter 3 examines the impact of the Fed's optimistic and pessimistic tones (words) on investor risk perception and appetite.

We use the computational linguistic analysis to estimate the Fed's optimism (pessimism) and use the difference between risk-adjusted and risk-free variance of equity market index to measure the market uncertainty and investors' risk aversion. The results suggest that the Fed's optimistic (pessimistic) tone decreases (increases) the market uncertainty and investors' risk aversion in global equity markets. In addition, the impact of the Fed's tone is state-dependent and appear to be more profound during recessions and uncertain times (investors may consider the Fed's optimism as an indication for the future prosper economic conditions). Moreover, a topic modelling analysis reveals that investor responds differently to an optimistic tone about the future macroeconomic outlook and future course of the policy rate. Overall, Chapter 3 extends the literature related to the impact of monetary policy on expected risk premium by examining the response of investors' risk perception and appetite to the Fed's tone. More specifically, it is found that central banks' policy decisions and communications comprise important signals related to future economic situations that subsequently shift investor expectations and risk premium.

Given the above findings, Chapter 4 of this thesis investigates the impact of the central bank's signals related to the path of the monetary policy on investment behaviour and returns in the commodity markets. In addition, the increased financialization of commodities and the effect of commodity returns on macroeconomic indicators during 2006-2008 have motivated scholars and practitioners to revisit the link between monetary policy and commodity returns. Therefore, in Chapter 4 we examine the impact of the Fed's tone on the returns and traders' positions in the commodity markets of the United States.

Frankel (2008) and Glick and Leduct (2012) find that monetary policy decisions (actions) have a significant effect on commodity returns for the conventional policy period and unconventional policy period. Apart from the direct impact of policy rate decisions, Barasky and Killian (2004) argue that the indirect effect of the future path of the policy may also move commodity returns as the investors participate in the commodity markets to earn the required yield after the anticipation of expansionary (contractionary) monetary policy. Gagnon et al.

(2010) also show that investors rebalance their portfolio after a monetary easing announcement to earn a higher yield. They find that the change in the value of the private portfolio after a monetary policy shock drives investor behaviour in the financial market.

To examine this portfolio rebalancing argument in the monetary policy transmission, we analyse the effect of central bank communication on the level of speculating and hedging activities in the commodity markets. Specifically, using the Commitment of Traders (COT) reports, Chapter 4 estimate the level of speculating and hedging activities in commodity markets. The weekly COT reports contain the long and short positions of commercial and non-commercial traders on futures contracts. Specifically, we use the open interest of commercial (hedgers) and non-commercial (speculators) traders from COT weekly reports for each commodity, and extract the Fed's hawkish (dovish) tone using the bag of the word approach. The results of Chapter 4 show that the central bank's hawkish tone decreases the one-month ahead return on metals, energy and overall commodity indexes. In addition, commodity traders' speculating (hedging) positions increase (decrease) in response to a hawkish tone of the central bank. This implies that the Fed's tone carries vital information about the future path of the policy rate that may affect the traders' positions and move the commodity returns.

1.3 Central Bank Communications

Historically the central banks were reluctant to share the qualitative discussions of the policymakers. The discussions remained confidential to avoid the negative consequences of new information on market stability. After realising the benefits of communication in achieving the policy objectives through altering expectations in the financial markets, central banks around the world and specifically in developed economies started to improve the transparency of the policymaking process.[7] For instance, the Fed only published policy actions and the record of the minutes on a periodical basis before 1990. In the year 1993, the Fed started to publish the minutes of the FOMC meeting and in the following year, policy statements were available for the public. However, initially, the policy statements provide only the rationale for the policy rate decision. The FOMC statements started to convey the indication about the future course of the policy rate after May 1999. The minutes of the FOMC meetings consist of a detailed view of each committee member about the economic outlook and future path of the policy rate. Before December 2004 there was a six-week wait to read the proceedings of FOMC meetings but after that Fed started to publish minutes after three weeks of the FOMC meeting. In 2007 the Fed started announcing macroeconomic forecasts "summary of

[7] The increased independence of the central bank in decision making also requires more transparency and accountability.

economic projections", and in April 2011 the Fed's Chairman press conference after the FOMC meeting was initiated.

One of the main objectives of having more frequent and clear communication from policymakers is to reduce market uncertainty and decrease price fluctuations. For instance, Romer and Romer (2000) point out that information about the future economic outlook in the central bank communication drives the market expectations. Woodford (2001) also argues that signals about the future path of policy rate inbound in the communications move asset prices. Moreover, Hansen, McMahon and Tong (2018) develop expectation and uncertainty channels through which the information content of the central bank communication influences the short-term and long-term interest rate expectations in the financial markets.

Central banks communications include various channels such as speeches, forecasting reports, policy statements, committee meeting minutes and press conferences. The literature does not agree upon a single efficient channel to manage the investor expectations on the future path of the policy. Compared to policy statements, minutes of the committee meeting offers a more detailed view of each members assessment of the macroeconomic outlook and future course of the policy rate. The FOMC consists of 12 members comprising five Presidents of Reserve Banks and seven members of the Board of Governors. Each member is appointed by the President and requires Senate's validations before his/her 14 years tenure. Several content analysis techniques are available in the literature to extract information from FOMC meeting minutes. These techniques differ in terms of the subjectivity of the researcher involved. On one hand, the narrative approach relies solely on the interpretation of the researcher. On the other extreme, the computational content analysis offers a total automated process with no involvement of the researcher. Recent studies also use supervised computational content analysis to allow researchers to have some control over the process. The literature suggests that the bag of the word (Dictionary-based) approach is an effective approach to extract the Fed's tone from the FOMC meeting minutes (Jegadesh and Wu, 2017).

1.4 Outline of the Thesis

Overall, this thesis comprises of the three empirical studies investigating the impact of central bank's actions and communications on investors' sentiment, risk perceptions, risk-bearing capacity and trading behaviour in the financial markets. The remainder of this thesis consists of three empirical chapters. Chapter 2 studies the impact of unexpected conventional and unconventional monetary policy on consumers and managers confidence in the US, UK and the euro area. Chapter 3 examines the impact of the Fed's optimism (pessimism) on

uncertainty and investors' risk aversiveness. Chapter 4 analyses the effects of the Fed's hawkish (dovish) tone on the commodity returns and the positions of traders.

There are five sections in each of Chapters 2-4. The first section explains our motivation for study and the research background. The second section describes the monetary policy transformation channels and reviews some of the previous studies. The third section outlines the identification of key variable and the testing methods. The fourth section presents the data description and the main findings. The fifth section concludes by summarising the key results and highlighting the future scope of research. Finally, Chapter 5 concludes this thesis by summarising the main takeaways for policy implications.

Chapter 2: The Impact of Monetary Policy on Consumer and Manager Confidence

Abstract

In response to the global financial crisis, the central banks in the major economies relied on monetary policy to regain confidence in financial markets. This chapter investigates the impact of the monetary policy on the confidence of consumers and businesses using the European Commission's confidence indicators. More specifically, this study analyses the response of consumer and manager confidence in the United Kingdom (UK) and across the euro area to the domestic and as well as the United States (US) monetary policy. The results of the Factor-augmented Vector Autoregressive (FAVAR) model document that during the conventional policy period, both the US and the domestic expansionary monetary policy shock has a significant positive impact on the consumer and manager confidence in the UK and across the ten countries in the euro area. In particular, the consumers consider domestic policy decisions more importantly whereas managers rely on US policy stances in framing their expectations. In addition, the impact of the European Central Bank's monetary policy shock is heterogeneous across the euro area countries. Surprisingly, after the introduction of the unconventional monetary policy tools the domestic and the US monetary easing announcements reduce the consumer and manager confidence. Specifically, the results of an ordinary least square (OLS) regression indicate that in response to the unexpected easing of unconventional policy decisions, the confidence indicator in many euro area countries drops. Overall, this study documents that conventional expansionary policy strengthens confidence whereas the unconventional easing policy either deteriorates the confidence of households and business or has no effect. This implies that the response of confidence indicators dramatically changed after the reduction of the policy rate to zero lower bound and the introduction of the unconventional monetary policy framework.

Keywords: Monetary Policy, Confidence Indicators, Spillover Effect.

JEL Classification: E52, G40, G51

2.1 Introduction

The global financial crisis of 2007–2008 had a profound impact on financial markets across many economies around the globe. Although the crisis started from the sub-prime market in the United States (US), it rapidly affected all sectors of economies in both developed and developing countries (Bekaert et al. 2014). The loss of confidence in financial markets has severe consequences, such as asset price bubbles, financial market meltdowns and deep recessions. In 2011, the managing director of the International Monetary Fund (IMF), Christine Lagarde, said:

"*The world is collectively suffering from a crisis of confidence, in the face of a deteriorating economic outlook and rising concerns about the health of sovereigns and banks*".[8]

In response to such a crisis, the central banks in many countries focused on monetary policy to restore confidence in financial markets. Monetary policy achieves its objectives by altering investor expectations and behaviour in financial markets, which subsequently affects the prices of assets (Bernanke and Kuttner, 2005). Previous studies document that an unanticipated change in policy rate has a significant impact on aggregate and cross-sectional stock returns as monetary policy alters investment behaviour (Thorbecke, 1997; Patelis, 1997; Rigobon and Sack, 2004; Bredin et al. 2009; and Haitsma, Unalmis and de Haan, 2016). Wongswan (2009), Ehrmann and Fratzscher (2009) and Lutz (2014) find that US monetary policy has a significant impact on international equity markets. Fratzscher, Duca and Straub (2016) find that the monetary policy decreases the uncertainty and restores confidence in domestic and international financial markets subsequently moving asset prices.

In the aftermath of the global financial crisis and economic meltdown, scholars and policymakers were paying more attention to the impact of monetary policy on investor confidence. For instance, Galí and Gambetti (2015) argue that, since the global financial crisis, the central banks in many countries have become more concerned about dealing with large fluctuations in confidence and asset prices than controlling inflation and output gap. In addition, Lutz (2015) and Galariotis, Makrichoriti and Spyrou (2018) investigate the impact of monetary policy shock on sentiment and confirm that expansionary monetary policy has a favourable impact on investor sentiment. Specifically, Lutz (2015) documents that the surprise decreases in the Fed funds rate and an unanticipated monetary easing decision has a positive impact on the US investor sentiment during conventional and unconventional policy periods

[8] In her opening remarks of the speech titled "Challenges to the Global Economy" at the Royal Institute of Economic Affairs on 9 September 2011.

respectively.[9] Likewise, Galariotis, Makrichoriti and Spyrou (2018) investigate the impact of the European Central Bank's (ECB) monetary policy on economic sentiment[10] in the euro area during the US sub-prime and euro area sovereign debt crises. Galariotis, Makrichoriti and Spyrou (2018) find that the ECB's conventional policy shock has a positive impact on the economic sentiment indicator in nine euro area countries; however, the unconventional monetary policy has a negative short-term impact on such an indicator. Understanding the link between monetary policy and expectations about future market conditions is useful for explaining the behaviour of consumers and managers in financial markets, this chapter aims to fill in his gap.

More specifically, this chapter contributes to the existing literature in the following ways. First, this study analyses the impact of conventional and unconventional monetary policy shocks on both consumer and manager confidence in the euro area and the UK. Previous studies measure the response of sentiment indexes to monetary policy shocks without distinguishing between consumer and manager sentiment. However, unlike consumers, managers form their expectations about economic and market conditions based on a different set of information. For instance, regarding confidence indicators compiled by the European Commission Salhin, Sherif and Jones (2016) argue that business confidence represents the more knowledgeable opinion of managers as compared to consumers. Furthermore, business confidence describes the belief of managers about past and current performance, along with future expectations, while consumer confidence depicts merely future expectations about financial and macroeconomic conditions. In addition, Mahani and Poteshman (2008) find that individuals are more sensitive to macroeconomic financial news compared to more sophisticated investors and managers. Therefore, this study investigates the response of household and manager sentiment separately to monetary policy shock using the consumer and business confidence indicators of the European Commission.

Second, to the best of our knowledge, this study is amongst the first attempts to examine the potential spillover impact of US monetary policy on sentiment in other countries. One exception is the study of Galariotis, Makrichoriti and Spyrou (2018) who investigates the effect of US monetary policy shock on the economic sentiment indicator in the euro area during the crisis period from 2007 to 2012. However, this study differs from Galariotis, Makrichoriti and Spyrou (2018) in the following ways. First, compared to Galariotis, Makrichoriti and Spyrou (2018), our sample period is relatively long and covers both crisis and non-crisis periods.

[9] Lutz (2015) analyses the impact of the Fed's monetary policy on various US sentiment proxies, such as Michigan consumer confidence, the investor intelligence index, and the Baker and Wurgler (2006, 2007) sentiment index.
[10] The economic sentiment indicator of the European Commission is the weighted average of five confidence indicators: industry, services, consumer, retail and construction.

Galariotis, Makrichoriti and Spyrou (2018) examine the effect of US monetary policy on the economic sentiment indicator during the sub-prime and European sovereign debt crisis periods. This study investigates the effect of the Fed's monetary policy on confidence in the UK and euro area before, during and after the crisis period.

Second, this study adopts a rather different and more widely used policy instrument as a proxy.[11] Specifically, following Kuttnner (2001), this chapter uses the change in the Fed funds futures rate to identify monetary policy shock during the conventional policy period. For the unconventional policy period, this study follows Rogers, Scotti and Wright (2014) and identifies monetary policy surprise using changes in Treasury futures prices.[12] Third, unlike Galariotis, Makrichoriti and Spyrou (2018), this study investigates the impact of US monetary policy on consumer and manager expectations separately. In particular, this chapter focuses on addressing the following research questions for conventional and unconventional policy periods:

1. Does the domestic monetary policy shock has a significant impact on consumer confidence in the UK and euro area?
2. Does the domestic monetary policy shock has a significant impact on manager confidence in the UK and euro area?
3. Does the US monetary policy shock has a significant (spillover) impact on consumer and manager confidence in the UK and euro area?

To answer these questions, this study investigates the impact of domestic and US monetary policy on the European Commission's confidence indicators. The consumer and business confidence indicators depict the expectations related to future financial conditions of householders and managers respectively. Policymakers consider a large set of economic and financial variables before deciding about policy rate. In this chapter, we investigate the impact of conventional policy using the Factor-augmented Vector Autoregressive (FAVAR) model of Bernanke, Boivin and Eliasz (2005). This study uses the changes in the Federal funds rate to measure the surprise changes during the conventional policy period before 2008. For the unconventional policy times when policy rate reached near-zero lower bound, we use the changes in the Treasury futures prices in an OLS regression methodology to measure the

[11] Galariotis, Makrichoriti and Spyrou (2018) use Main Operations Refinancing rate (MRO) and the shadow Fed funds rate to measures the policy instrument of European Central Bank and the Federal Reserve respectively.
[12] Wright (2012) advocates that changes in Treasury futures prices is better to identify unexpected monetary policy change during an unconventional policy period.

response of confidence to monetary policy,[13] as suggested by Krishnamurthy and Vissing-Jorgensen (2011).

The results of the FAVAR model suggest that the ECB's expansionary monetary policy shock has a significant short-term favourable effect on consumer and manager confidence across the ten euro area countries. Similarly, an unanticipated decrease in the policy rate by the Bank of England (BOE) improves the consumer and the manager confidence in the UK. In addition, the results of this study suggest that the Fed's conventional monetary policy has a significant spillover impact on both consumer and manager confidence in the UK and ten euro area countries. The results of regression analyses suggest that the ECB's unconventional monetary policy explains the variation in consumer confidence only in Belgium, Finland, France and Italy. More specifically, the unanticipated monetary easing announcements decrease consumer confidence in the above four countries. Similarly, ECB's unconventional policy easing announcement has a significantly negative impact on manager confidence only in Austria, Finland, Germany and Italy. However, unconventional BOE's monetary policy has no significant impact on consumer and manager confidence in the UK. The US monetary policy also has a significant spillover impact only on consumer confidence in Austria, Finland, France and Germany and manager confidence in Greece, Germany, Italy and Netherland. The confidence in the above-mentioned countries decreases significantly after a monetary easing announcement of the Fed during the unconventional policy period. This study reports the shift in the impact of monetary policy after the global financial and sovereign debt crisis periods.

The "Signalling Effect" of the central bank's decision may explain the rationale for this shift in the relationship between monetary easing and confidence indicators. The consumers and managers may perceive expansionary monetary policy announcement as the signal for worse economic and financial conditions in future after the global financial crisis consequently declining the confidence of households and managers. Monetary policy announcements influence the perception of market participants about future market conditions. For example, Kohn and Sack (2003) argue that monetary policy announcements contain signals about the central bank's assessments of future economic conditions. Melosi (2016) also points out that the policy rate contains meaningful information for market participants, which influences their beliefs and expectations about the macroeconomic outlook. Moreover, Fratzscher, Duca and Straub (2016) suggest that the policy actions of a central bank in an economy are transmitted to financial markets through the "Confidence Channel". The confidence channel of monetary

[13] Lutz (2015) also uses simmilar methodology to examine the effect of the Fed's large scale asset purchase announcements on investment sentiment in US during the unconventional policy period.

policy transmission boosts confidence in the financial markets after decisive actions of the central bank, subsequently increasing the asset prices (Fratzscher, Duca and Straub, 2016).

The rest of this chapter is organized as follows: Section 2.2 provides a review of the previous literature; section 2.3 describes the methodology; Section 2.4 presents the data and results of the study along with a discussion on key findings; finally, section 2.5 concludes this chapter with a summary of main findings and some suggestions for further research.

2.2 Literature Review

This section first explains the transmission channels through which monetary policy affects the confidence of consumers and managers about future macroeconomic and financial conditions. Next, we summarize the findings of empirical studies on the role of monetary policy and investor sentiment in influencing asset prices. Finally, this section reviews some of the studies investigating the impact of monetary policy on investor sentiment.

2.2.1 The Monetary Policy Transmission Channels

2.2.1.1 Wealth Effect

Several theoretical frameworks have been put forward in explaining the channels through which monetary policy may influence the expectations and behaviour of economic agents in financial markets. For example, the monetary portfolio model of Brunner (1961) suggests that an unanticipated change in the money supply leads to a change in the value of a private portfolio. In the monetary portfolio model, the economic agent shifts his/her investments from risk-free to risky assets in response to an unexpected increase in the money supply. In addition, Rozeff (1974) also argues that an unanticipated monetary policy stance provides additional information, leading to a change in asset prices and affecting the value of private portfolios. Mushkin (1995) describes the transformation mechanism of the monetary policy through interest rate, exchange rate, asset price effect and credit channels. The interest rate and the credit channel transmit the effects of the contractionary policy through increasing the cost of capital and lessening the accessibility of loans. On the other hand, the asset price channel drives the asset prices subsequently affecting the wealth of an individual holds. In addition, Bernanke and Kuttner (2005) point out that monetary policy influences equity markets through the "Wealth Effect". The "Wealth Effect" of the monetary policy is transmitted to financial markets through a change in the value of private portfolios, subsequently affecting investment behaviour.

There are two potential reasons for a change in the value of private portfolios after an unexpected monetary policy. First, an unexpected contractionary monetary policy decreases the value of private portfolios either by decreasing the expected future cash flow or by increasing the estimated future real interest rate. The second possible explanation of monetary policy transmission in equity markets is through changing the expectations of individuals about future required excess returns, as an unanticipated increase in policy rate leads to an increase in the future excess equity risk premium on securities (Bernanke and Kuttner, 2005). Overall, the change in the expected future risk and the return of security following an unexpected monetary policy decision affects asset prices in financial markets. The shift in asset prices

leads to a change in the expected value of private portfolios, subsequently influencing the expectations of individuals and firms about their future financial conditions.

2.2.1.2 Signalling Effect

The monetary policy stance of the central bank conveys important information to the market participants about the future financial and economic outlook. Kurov (2012) proposes that monetary policy decisions influence equity markets by providing additional information about future economic conditions. In addition, Kohn and Sack (2003) argue that the decisions of the central bank influence the expectations of investors about the future outlook of the economy. Melosi (2016) also suggests that policy rate decisions contain signals about the central bank's opinion about future macroeconomic developments and this "Signalling Effect" of monetary policy has an important role in financial markets and economic stability. The signalling also influences the expectations of market participants about the future path of short-term interest rates. According to Woodford (2001), monetary policy affects the asset prices in the market through the market expectations about the future path of short-term interest rates. Monetary policy decisions drive the expected term spread and default spread. The term spread represents the expectations of the market about the future path of interest rate, and the default spread measures differences between yields of corporate and Treasury bonds with a similar maturity.

Collin-Dufresne, Goldstein and Martin (2001) point out that, although the spot rate determines the value of firms, the spot rate itself depends upon expected future short-term rates. The expected recovery rate of the business cycle is an important factor in the estimation of the expected default spread (Collin-Dufresne, Goldstein and Martin, 2001). In addition, the expectation about macroeconomic conditions plays an important role in the estimation of the default spread in financial markets. The empirical studies also confirm that unexpected monetary policy significantly influences the default spread in financial markets. For instance, Eser and Schwaab (2016) find that the ECB's unconventional monetary policy transmits to financial markets via a reduction in the default risk premium. Similarly, Chen et al. (2016) show that US unconventional monetary policy, mainly through reducing the default spread, has a significant and strong impact on global equity prices. It is evident from the above discussion that monetary policy carries vital signals for market participants about the central bank's assessment of future economic and financial conditions, hence affecting the expectations and confidence in markets.

Previous studies also propose some channels through which the effect of US monetary policy may transmit to financial markets in other countries. For example, Bauer and Neely (2014) and Neely (2015) point out that the international signalling and portfolio rebalancing

effect influences the international bond risk premium. Bauer and Neely (2014) show that the international signalling effect of US monetary policy explains the impact of the Fed's monetary policy in international financial markets. For instance, after a surprise expansionary monetary policy decision in the US, market participants would also expect the monetary easing decision by the central banks in other countries. In addition, Neely (2015) documents that US monetary policy shock has significant portfolio rebalancing effects in international bond markets. The portfolio rebalancing channel of monetary policy reduces the term premium on long-term securities after the purchase of long-term assets by a central bank. For instance, the "Preferred Habitat Theory" of Modigliani and Sutch (1966) suggests that the investor has a preference for securities with a specific maturity period. After unconventional US monetary policy announcements, such as large-scale asset purchases (LSAP) programme, the investors shift their investment to riskier assets with a similar maturity. US investor search for international securities with similar maturities having similar risk characteristics. Hence increasing the prices of assets in other developed countries with similar credit ratings.

Chen et al. (2016) argue that the US monetary policy influences the equity markets in developed economies through the "Confidence Channel". A clear monetary policy stance eliminates the uncertainty in the economy and boosts the confidence of market participants (Fratzscher, Duca and Starub, 2016).

2.2.2 Impact of Monetary Policy on Asset Prices

Several studies investigate the impact and potential rationale for monetary policy impact on equity prices. One of the vital efforts is that of Thorbecke (1997), who finds that the monetary policy shock affects ex-ante and ex-post equity prices. According to the results of Thorbecke (1997), a monetary policy shock has more impact on small-capitalization stocks compared to large companies' stocks. In another study, D'Amico and Farka (2011) document that a 1% increase in unanticipated policy rate leads to a 4.91% decrease in prices in the equity market. The unanticipated change in the Fed funds rate is identified by D'Amico and Farka (2011) using the Fed funds future contracts. Using a different identification technique of heteroskedastic variance of monetary policy shock, Rigobon and Sack (2004) confirm the negative relationship between the Fed funds rate and stock prices. Similarly, Bernanke and Kuttner (2005) also find that a 25 basis point decline in the Fed funds rate increases stock prices by almost 1%.

The literature also put forward several explanations for the impact of monetary policy shock on stock returns. Using the variance decomposition technique, Patelis (1997) shows that a higher future expected dividend yield is the main reason for the impact of monetary policy on stock returns, In addition, Bernanke and Kuttner (2005) suggest that the expected

excess equity return is the main contributing factor in the response of equity prices to a monetary policy shock. There are three potential explanations for the increase in expected excessive equity returns in response to an unexpected increase in the policy rate. The first possible reason is that the investors require a higher risk premium after a decline in the value of a firm. The decline in a firms' value comes from either a rise in the cost of external finance or a decrease in the worth of the firms' collateral assets after an increase in the policy rate. The second possible reason is the decline in investors' willingness to tolerate risk after a contractionary monetary policy shock. For example, the increase in precautionary savings after a surprise tight monetary policy reduces the risk tolerance of market participants. Third, a potential rationale for high future excess returns is an overreaction of investors to monetary policy shock (Bernanke and Kuttner, 2005).

Several studies validate the findings of Bernanke and Kuttner (2005) in other developed economies i.e. the effect of BOE's and the ECB's monetary policy on equity markets in the UK and the euro area. For instance, Bredin et al. (2007) find a significant impact of the BOE's monetary policy shock on aggregate and industrial level equity prices. Bredin et al. (2007) also confirm the role of future excess return in explaining the effect of monetary policy on the stock market in the UK. Similarly, Bohl, Siklos and Sondermann (2008) find that ECB's monetary policy shock has a significant negative impact on many European stock indices. According to Bohl, Siklos and Sondermann (2008), the ECB's monetary policy affects the firms' risk by increasing the cost of credit, subsequently affecting stock prices.

Many studies investigate and compare the impact of unexpected domestic monetary policy shock on equity markets in the developed countries. Using the high-frequency data and event study framework, Hussain (2011) investigates the response of the S&P 500 and four major European equity index returns and volatilities to conventional domestic monetary policy announcements, and find that the US and European stock markets respond significantly to their respective domestic monetary policy announcements. Furthermore, Rogers, Scotti and Wright (2014) study the effect of unconventional monetary policy announcements on bond yields, exchange rates and equity prices in the US, UK, euro area and Japan. Their findings suggest that an expansionary monetary shock increases the stock prices in the US, UK and euro area. However, the effect of the BOE's unconventional monetary policy is less than the corresponding impact of the Fed and ECB.

There are also some empirical investigations into the potential effect of the US monetary policy in the financial markets of other countries. For example, Bauer and Neely (2014), Neely (2015) and Georgiadis (2016) document a significant spillover impact of US monetary policy on international bond markets. The findings of these studies suggest that the

effect of US monetary policy on fixed income securities yields depends upon the degree of integration in financial markets. Lutz (2014) also finds that an expansionary unconventional policy announcement in the US raises stock returns in the UK and Germany. The above discussion is related to the potential link between monetary policy and asset prices, along with the relevant empirical evidence in the area. Before reviewing some of the previous studies on the impact of monetary policy on investor sentiment, it is imperative to get a better understanding of the role of investor sentiment in asset prices.

2.2.3 Investor Sentiment and Asset Prices

History shows a dramatic asset price decrease in markets during all financial crises, from the great crash of 1929 up to the global financial crisis of 2007-2008. Baker and Wurgler (2007) argue that the pricing model based on macroeconomic fundamental factors alone cannot explain high fluctuations in asset prices, and investor sentiment also plays a vital role. There are two main reasons why investor sentiment could be important in asset prices. The first is the existence of noise traders in the market, as suggested by De Long et al. (1990); the second is the limits to arbitrage mentioned by Shleifer and Vishny (1997). Noise traders generate stochastic demand and supply shocks in the market based on their beliefs compared to fundamental risk factors (De Long et al. 1990). In addition, the rational investor cannot eliminate noise traders' risk in the market due to financial market frictions (Shleifer and Summers, 1990). As a result, Shefrin and Statman (1994) argue that the equilibrium price is formed by the interaction of noise traders and rational investors in the market.

The literature provides clear evidence that investor sentiment has a significant effect on aggregate and cross-sectional stock prices (De Long et al. 1990; Fisher and Statman, 2003; Baker and Wurgler, 2006; Brown and Cliff, 2004; Schmeling, 2009; and Garcia, 2013). Specifically, Baker and Wurgler (2006) find that the change in investor sentiment explains the aggregate and cross-sectional stock returns. The positive investor sentiment leads to lower equity returns, particularly for the stocks that are difficult to arbitrage. In addition, Chen (2011) finds that consumer confidence forecasts the fluctuations in the S&P 500. Using the Markov-switching model, Chen (2011) also documents that loss of confidence not only increases the probability of switching from a bull market to a bear market but also increases the length of a bear market period. Furthermore, studies show that US investor sentiment has a significant effect on the movement of international equity markets. For instance, Bathia, Bredin and Nitzsche (2016) find that US investor sentiment has a significant impact on the stock returns of other G-6 countries on an aggregate level as well as across the growth and value stocks.

Lee, Jiang and Indro (2002) find that the changes in the investor sentiment index explain excess return and market volatility in major stock indices in the US. In addition, Chau,

Deesomsak and Koutmos (2016) find that investor sentiment plays a vital role in equity prices. Sentiment extracted from the consumer surveys influences individual trading behaviour and affect the stock prices (Chau, Deesomsak and Koutmos, 2016). Furthermore, Brown and Cliff (2004) document that both direct and indirect investor sentiment proxies explain the contemporaneous changes in stock returns.[14] Using consumer confidence as a proxy for the sentiment, many studies document the important role of investor sentiment in explaining the variation in equity prices. For instance, Fisher and Statman (2003) find that the consumer confidence index explains substantial changes in S&P 500 return. Similarly, Jansen and Nahuis (2003) identify a positive correlation between changes in consumer confidence and stock returns in nine out of eleven European countries. The main reason behind the correlation between consumer confidence and equity returns is the future expectations about macroeconomic development (Jansen and Nahuis, 2003). Corredor, Ferrer and Santamaria (2013) present similar findings for Germany, Spain, France and the UK using the consumer confidence indicators published by the European Commission. Moreover, Schmeling (2009) finds that the European Commission's consumer confidence indicator significantly predicts the short- and medium-term equity returns in 18 industrial countries.

Previous studies state that the confidence indicators represents both the rational and irrational expectations of market participants. For instance, Brown and Cliff (2004) argue that consumer confidence provides individuals' views about future macroeconomic and financial conditions based on both fundamental factors and hopeful thinking. In addition, Lemmon and Portniaguina (2006) demonstrate that the consumer confidence indicator can be decomposed into fundamental and sentiment portions. The optimistic (pessimistic) sentiment of households and businesses represent their anticipations about the future macroeconomic outlook as well as their personal beliefs. In the next section, we review some studies showing the role of monetary policy in framing household and business sentiment.

2.2.4 Impact of Monetary Policy on Sentiment

The option-based implied volatility index and expected volatility measure the market expectations about future market conditions. For example, an increase in expected volatility represents bearish expectations of market participants. A number of studies investigate the impact of monetary policy on the realized and implied volatility (Gospodinov and Jamali, 2012; Bekaert, Hoerova and Duca, 2013; and Fratzscher, Duca and Straub, 2016). Using the vector-autoregressive model, Bekaert, Hoerova and Duca (2013) analyse the effect of monetary

[14] The direct investor sentiment proxies are based on survey-based responses of the individual, whereas the indirect sentiment proxies are generated from trading activity in the markets.

policy shock on the uncertainty and risk aversion components of the implied volatility[15] (VIX) and find that an expansionary monetary shock reduces risk aversion while the uncertainty component shows a similar but weaker response.

Lutz (2015) and Galariotis, Makrichoriti and Spyrou (2018) examine the impact of monetary policy shock on investor sentiment. Lutz (2015) investigates the response of investor sentiment to the Fed's conventional and unconventional monetary policy using the factor-augmented vector autoregressive model and an OLS regression model, respectively. Lutz (2015) finds that an expansionary monetary policy shock increases investor optimism in the short term. More specifically, a 25-basis point cut in the Fed funds rate has positive effects of up to 0.15 standard deviation in the University of Michigan consumer confidence index, investor intelligence index, Baker and Wurgler (2006, 2007) sentiment index, and mutual fund flow during a conventional policy period. For an unconventional policy period, Lutz (2015) documents a significant positive impact of an unexpected easing announcement on the daily Gallup's Economic Confidence Index. In another effort along this line, Galariotis, Makrichoriti and Spyrou (2018) study the impact of the ECB's monetary policy on economic sentiment in nine euro area countries. Using latent propensity in a Qual vector-autoregressive model, Galariotis, Makrichoriti and Spyrou (2018) find that a conventional policy shock has a positive impact on economic sentiment.[16] However, monetary policy shock has a negative impact on economic sentiment in the euro area during the unconventional policy period. Galariotis, Makrichoriti and Spyrou (2018) argue that the negative impact was caused by the European sovereign debt crisis during the period under study.

Motivated by the above literature, this chapter aims to investigate the effect of monetary policy shock on consumer and manager confidence in the UK and across the euro area countries, during the conventional and unconventional policy periods. Taken together, this chapter adds to the existing literature in the following ways. First, we investigate the impact conventional and unconventional on both consumer and manager confidence in UK and euro area countries. Whereas the previous studies failed to clearly distinguish the difference between consumer and manager confidence and analyse the impact on the economic sentiment Index. Second, this study also examines the potential spillover effect of US monetary policy shock on consumer and manager confidence in the UK and euro area. Finally, we investigate the impact of monetary policy on consumer and manager confidence before, during, and after the global financial crisis.

[15] The study uses the decomposition technique developed by Carr and Wu (2009) to decompose the VIX index into uncertainty and risk version components.

[16] Dueker (2005) suggests that a Qual vector-autoregressive model is particularly useful in measuring dynamic responses to qualitative variables.

2.3 Methodology

This study examines the impact of monetary policy shock on consumer and manager confidence in the UK and the euro area, with the Factor-augmented vector autoregressive (FAVAR) model (for the conventional policy period) and the regression analysis (for both conventional and unconventional periods) being the employed method.

2.3.1 Factor-augmented VAR Model

The vector autoregressive (VAR) models are widely used in the literature to study the impact of monetary policy shocks on financial markets. However, the degree of freedom problem in the VAR model limits the maximum number of variables. Each endogenous variable is a function of lags of its own and all other variables in the model. The degree of freedom problem becomes severe with an increasing number of variables and lags in the VAR model. A possible solution to the degree of freedom problem is using the VAR model with fewer variables. However, as pointed out by Bernanke, Boivin and Eliasz (2005), selecting a few variables based on subjective judgment creates a problem in measuring the impact of monetary policy shock on economic activity as a VAR model with fewer variables may suffer from omitted variable bias. As policymakers take into account a wide range of macroeconomic and financial variables while deciding about monetary policy. A potential solution to this problem is the FAVAR model of Bernanke, Boivin and Eliasz (2005), which can accommodate several macroeconomic and financial variables considered in the decision-making process. Lutz (2015) confirms that the FAVAR model better identifies the monetary policy shock compared to standard VAR models.

Therefore, following Bernanke, Boivin and Eliasz (2005), this study employs the two steps FAVAR modelling approach. In the first step, we estimate the latent factors using principal component analysis from a large array of financial and macroeconomic variables. Stock and Watson (2002) suggest that a dynamic factor model with few uncorrelated factors can efficiently represent a wide range of variables. The second step involves the estimation of the following standard VAR model comprising the monetary policy instrument and latent factors estimated in the first step:

Let X_t be the matrix of macroeconomic and financial variables and C_t being the vector containing factors extracted in the first step and monetary policy instrument.

$$X_t = \Lambda C_t + \varepsilon_t \tag{2.1}$$

Suppose F_t represents latent factors extracted from the X_t a balanced panel of macroeconomic and financial variables, R_t represents the monetary policy instrument, $\Phi(L)$

is a lag polynomial to finite order and υ_t is the error term with mean zero and covariance matrix Q.

$$C_t = \Phi(L)C_{t-1} + \upsilon_t \tag{2.2}$$

$$C_t = \begin{bmatrix} F_t \\ R_t \end{bmatrix} \tag{2.3}$$

Specifically,

$$\begin{pmatrix} X_{1,t} \\ X_{2,t} \\ X_{K,t} \end{pmatrix} = \begin{pmatrix} \Lambda^{11} & \Lambda^{21} & \Lambda^{K1} \\ \Lambda_{12} & \Lambda_{22} & \Lambda_{K2} \\ \Lambda_{1N} & \Lambda_{2N} & \Lambda_{Kn} \end{pmatrix} \begin{pmatrix} F_{1,\mathrm{t}} \\ F_{2,\mathrm{t}} \\ F_{k,t} \end{pmatrix} \tag{2.4}$$

where Λ is the factor loading of each factor with each variable in the information dataset and ε_t is the vector of mean zero and weakly correlated error terms.

Equation (2.1) requires the estimation of latent factors from the information set X_t. This study follows Bernanke, Boivin and Eliasz (2005) to estimate latent factors from balanced macroeconomic and financial time series. Specifically, we extract factors representing the information that covers all the macroeconomic and financial variables apart from the monetary policy variable. The central banks observe a wide range of macroeconomic and financial variables while setting up the monetary policy rate. On one hand, considering a few variables to represent all the dataset under the consideration of policymaker leads to omitted variable bias. On the other hand, including too many variables creates degree of freedom problem. To resolve this problem, this study extracts the latent factors representing the all the variables in the central banks' information box and estimate the VAR model using these factors and our policy instrument.

The macroeconomic and financial variables respond contemporaneously to the changes in the interest rate. This implies another issue is to remove the direct dependency of the latent factors on the policy rate. To achieve this goal all the information time series are divided into fast-moving and slow-moving categories. The fast-moving variables are assumed to move contemporaneously with the monetary policy shock or economic news. The fast-moving variables are highly sensitive to monetary news such as money supply, interest rates, stock returns, exchange rates and money market instruments. Whereas, slow-moving variables cannot respond to policy changes in the current period. The slow-moving variables such as unemployment rate and economic growth respond to the monetary policy shock after a time lag.[17]This study first estimates the common components f^t using principal component

[17] The table (A1) in appendix A, comprises of the list of all the variables, the steric next to variable name represents the variable belongs to slow-moving variables. Contrary to variables which moves contemporaneously, the slow-moving variables respond to policy rate changes after some time lag.

analysis from all variables of X_t.[18] Then we estimate the factors f_t^s from only slow-moving variables. After regressing the common components (f_t^c) extracted from all variables on factors obtained from slow-moving variables (f_t^s) and the policy instrument (R_t) in equation (2.5). This study eliminates the direct dependence of common factors on policy instrument by estimating factors $\widehat{f_t}$ after subtracting the product of policy instrument and is the beta coefficient from common components ($\widehat{f_t} = f_t^c - \beta^r R_t$):

$$f_t^c = \propto_t + \beta^s f_t^s + \beta^r R_t + \varepsilon_t \tag{2.5}$$

We estimate the response to the monetary policy shock using Cholesky decomposition by ordering the policy instrument to be the last variable. We measure the impact of the policy shock on confidence indicators using the Impulse Response Function (IFR). More specifically, we multiply the IFR of latent variables with the corresponding factor loading to estimate the Impulse Response Function for the confidence indicators. We use a 90% bootstrapping algorithm procedure to generate confidence intervals for IRFs with 1000 iteration of Gibb's sampling procedure:

$$\begin{pmatrix} IRF_{X_1,t} \\ IRF_{X_2,t} \\ IRF_{X_K,t} \end{pmatrix} = \begin{pmatrix} \Lambda^{11} & \Lambda^{21} & \Lambda^{K1} \\ \Lambda_{12} & \Lambda_{22} & \Lambda_{K2} \\ \Lambda_{1N} & \Lambda_{2N} & \Lambda_{Kn} \end{pmatrix} \begin{pmatrix} IRF_{F_1,t} \\ IRF_{F_{2,t}} \\ IRF_{F_{K,t}} \end{pmatrix} \tag{2.6}$$

In addition to the Impulse Response Function, variance decomposition is another common method used to analyse the impact of the monetary policy shock within the VAR modelling framework. The forecast error variance decomposition measures the portion of variance explained by a policy shock at a given time horizon:

$$\frac{var\ (C_{t+k} - \widehat{C_{t+k}} | \varepsilon_t^R)}{var\ (C_{t+k} - \widehat{C_{t+k|t}})} \tag{2.7}$$

2.3.2 Regression Analysis

In response to the global financial crisis, the Federal Open Market Committee (FOMC) decreased the Fed funds rate to a zero lower bound and started purchasing long-term securities. Similarly, the Monetary Policy Committee of the BOE and the Governing Council of the ECB introduced an asset purchase programme and long-term refinancing respectively. Lenza, Pill and Reichlin (2010) argue that the quantitative easing programmes of the Fed, BOE and ECB have structural differences but share a common goal of an expansionary

[18] The FAVAR model of Bernank, Boivin and Eliansz (2005) does not include monetary policy instrument explicitly as on the factor in the first step of the estimation. On the contrary, Boivin, Giannoni and Mihov (2009) estimate the FAVAR impose additional condition and include policy instrument as a factor in the first step.

monetary policy to restore economic growth. The unconventional policy announcement decisions consist of banking lending support programmes, asset purchase programmes and forward guidance. Wright (2011) suggests that the short-term rate can no longer represent the monetary policy decisions after being reduced to near-zero lower bound. Moreover, Rogers, Scotti and Wright (2014) also point out that the policy rate itself is unable to measure policy stance after an introduction of the unconventional monetary policy framework.

To analyse the impact of unconventional monetary policy announcements on sentiment, we follow Bredin et al. (2009) and employ an investigation using unconventional monetary policy events. Specifically, the following Ordinary Least Square (OLS) regression is used to investigate the impact of a surprise change in the monetary announcement on confidence indicators:[19]

$$Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \epsilon_t \quad (2.8)$$

$$Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \sum \beta_{5i}\, \Delta r_{d,t-i} + \epsilon_t \quad (2.9)$$

where $Conf_t$ is the change in the confidence indicator, Δr_d^u is the change in the first principal components of 2-, 5- and 10-year Treasury futures prices on the policy announcement days. The sum of the beta coefficient of the monetary policy variable indicates the cumulative impact of the lagged monetary policy stance. We identify the optimal number of lags (n) using Akaike Information Criteria (AIC). The joint significance test (Wald Test) is used to determine the overall significance of the lags of the monetary policy variables. The macroeconomic variables consist of growth in private consumption (CON), the employment rate (EMPL), growth in industrial production (IP) and OECD-based recession indicator (REC). Baker and Wurgler (2007) suggest these macroeconomic variables represent business cycle fluctuations. We estimate the incremental explanatory power of the monetary policy variable in explaining confidence by comparing the adjusted R^2 of equation (2.8) and equation (2.9).[20]

To measure the incremental power of US monetary policy in explaining the confidence in the United Kingdom and the euro area, this study uses the following regressions:

$$Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \beta_5\, \Delta r_{d,t-1}^{domestic} + \epsilon_t \quad (2.10)$$

[19] Lutz (2015) uses a similar regression specification to analyse the impact of an unanticipated change in quantities-easing decisions of FOMC on the change in daily closed-end discounts in the US.

[20] Chau and Deesomsak (2014) also estimate an incremental explanatory power of their financial stress spill-over index (FSSI) by comparing the adjusted R^2 of the two models: the first model includes only macroeconomic control variables, whereas the second model consists of control variables and the FSSI index.

$$Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \beta_5 \Delta r_{d,t-1}^{domestic} + \sum \beta_{6i} \Delta r_{d,t-i}^{us} + \epsilon_t \quad (2.11)$$

where r_d^{us} represents the unexpected change in the Federal Reserve monetary policy stance and $r_d^{domestic}$ indicates the European Central Bank (ECB) surprise policy instrument for ten euro area countries and the Bank of England's (BOE's) policy instrument for the United Kingdom. However, as the monetary policy of BOE and ECB may linearly depend on the Fed's monetary policy, the equation (2.11) may suffer from an endogeneity problem. To address this problem, we use Hausman (1978) test to check this potential endogeneity issue in section 2.4.2. More specifically, by comparing the equation (2.8) and (2.9) this chapter estimates the incremental power of the domestic monetary policy shock in explaining the confidence. Whereas, after comparing the explanatory power of equation (2.10) and (2.11) this study investigates the incremental spillover impact of the US monetary policy shock on confidence in the United Kingdom and the euro area.

2.3.3 Unexpected Monetary Policy Change

2.3.3.1 Conventional Policy Period

This chapter identifies the unanticipated monetary policy using futures contracts on overnight interbank rates in the US, UK and euro area. More specifically, following Bernanke and Kuttner (2005), the unanticipated change in monetary policy is measured through the difference in the current month's Fed funds futures prices[21] and their respective settlement price:

$$R_m^u \equiv \frac{1}{D}\sum_{d=1}^{D} i_{m,d} - f_{m-1,D}^1 \quad (2.12)$$

where R_m^u is the unanticipated change in the policy rate, $i_{m,d}$ is the daily effective Fed funds rate on the day (d) of the month (m), and $f_{m-1,D}^1$ is the 30-day corresponding Fed funds futures rate on the last day (D) of the month $(m-1)$.[22] The closest proxy to measure the unanticipated change in the policy rate in the UK and euro area is a three-month futures contract on LIBOR and Euribor respectively. Using longer maturity futures contracts to represent expectations of the market about short-term rates may not be appropriate. As the changes in three-month LIBOR/Euribor futures contracts price may depend upon longer-term future expectations about the interest rate. However, Rigobon and Sack (2004) suggest that longer-term maturity futures contracts are better to distinguish between the policy rate surprise and the policy timing

[21] The settlement price for the Fed funds futures contracts is the monthly average of daily effective fund rate.
[22] The Fed funds futures rate on the future contracts is calculated after subtracting 100 from the future contract price.

surprise. Bernanke and Kuttner (2005) argue that investors are sensitive to policy rate changes rather than changes in the timing of policy announcements.

Many previous studies also use three-month futures on interbank rates to measure unexpected monetary policy. For example, Rosa and Verga (2008) suggest that the three-month Euribor futures contract is an efficient measure of an unanticipated change in the European Central Bank's policy. Bredin et al. (2009) study the monetary policy shock on equity returns in the UK using the three-month LIBOR futures contract. Equation (2.13) explains the identification of unexpected monetary policy instrument for the UK and euro area:

$$R_m^u \equiv f_{m,d}^3 - f_{m-1}^3 \tag{2.13}$$

where R_m^u represents the unanticipated change in the policy rate, $f_{m,d}^3$ is the three-month Euribor rate on the settlement day of the delivery month, and f_{m-3}^3 represents the corresponding three-month Euribor futures rate on the last day (d) of the month (m). This chapter uses monthly changes in the Euribor to gauge the unexpected monetary policy changes in the euro area. Similarly, to measure unanticipated changes in the BOE's policy rate, we replace the Euribor with the LIBOR futures rate. The estimation of an unanticipated change in policy rate for BOE and ECB monetary policy is similar to the Fed, as indicated in equation (2.12). The difference is that the settlement price of LIBOR and Euribor is the third Wednesday of the delivery month, whereas the Fed funds settlement price is the monthly average Fed funds rate.

2.3.3.2 Unconventional Policy Period

A few studies investigate the impact of policy announcements on asset prices without distinguishing between the expected and unexpected portions during the unconventional policy period. For example, Joyce and Tong (2012) consider the unconventional monetary announcements that were completely unexpected. This chapter identifies the unanticipated unconventional monetary policy using the change in the prices on Treasuries futures following a policy announcement. More specifically, following Rogers, Scotti and Wright (2014), we use the change in the first principal component of Treasury futures prices of 2 years, 5 years and 10 years to identify unconventional monetary policy instrument.

This chapter uses the change in the first principle component of US and UK Treasuries to measure the Fed and the BOE unconventional monetary policy. To measure the ECB's unconventional unexpected policy stance, this study uses the difference in the return on Italian and German 10-year Treasury futures. The spread between the future yield on Italian and German Treasuries represents ECB's surprise change in unconventional monetary policy. The

main objective of ECB's unconventional monetary policy is to reduce sovereign spread among the euro area countries:

$$\Delta r_d^u = f_d^i - f_{d-1}^i \tag{2.14}$$

where Δr_d^u is the first principle component of one-day change in return on 2, 5 and 10-year Treasuries futures on announcement day, following Bredin et al. (2009). The selection of an event window to estimate the surprise change in monetary announcements is crucial (Haitsma, Unalmis and de Haan, 2016); too wide a window suffers from contamination by other important events, whereas too narrow a window may omit the relevant reactions in Treasury prices. Haitsma, Unalmis and de Haan (2016) find that the one-day window can efficiently measure the unanticipated change in the policy stance.[23]

[23] Haitsma, Unalmis and de Haan (2016) produce similar results using the heteroscedasticity-based approach of Rigobon and Sack (2004).

2.4 Data Description and Main Findings

This section first presents the features of key variables and rationale for our investor sentiment proxy. Next, we describe the main findings along with a discussion on key results.

2.4.1 Key Variables Identification

This sub-section explains the construction and importance of the European Commission's confidence indicators. In addition, we further elaborate on the data on the unexpected change in conventional and unconventional monetary policy.

2.4.1.1 Investor Sentiment

The literature thus far has failed to provide a single agreed-upon proxy for investor sentiment. The behavioural finance researchers use different indirect (market-based), direct (survey-based) and media content (news-based) measures to capture investors' optimistic or pessimistic expectations. The indirect sentiment proxies such as option implied volatility, mutual fund flows, market turnover, dividend premium, initial public offering volumes and closed-end fund discounts measure sentiment through market trading activities (Baker and Wurgler, 2007). On the other hand, many studies use survey-based responses to measure investor and manager sentiment (Brown and Cliff, 2004; Lemmon and Portniaguina, 2006; and Salhin, Sherif and Jones, 2016). The survey-based sentiment proxy describes the expectations of consumers and managers about future financial conditions. Barsky and Sims (2012) suggest that survey-based confidence indicators provide vital information related to the perception of future economic developments. Several studies measure investor sentiment from news and media contents. For instance, Gracia (2013) constructs the investor sentiment proxy from positive and negative words mentioned in two columns of the New York Times.[24] Furthermore, the increase in the number of internet users and more use of search engines for inquiries provides a novel search-based sentiment measure for investor sentiment. For example, Da, Engelberg and Gao (2014) develop a market sentiment proxy using the aggregate search queries from search engines.[25] The selection of investor sentiment proxy depends upon the scope and objective of the study.

The objective of this study is to investigate the impact of the monetary policy shock on individual and manager sentiment in the UK and the euro area. Lemmon and Portniaguina (2006) discuss the several advantages of using consumer confidence as an investor sentiment proxy in an international study. Using the European Commission's consumer confidence

[24] Gracia (2013) focuses on two columns publishing news about financial markets and macroeconomic activities.
[25] Da, Engelberg and Gao (2014) use the search queries of specific words representing the economic downturn, such as unemployment, recession and bankruptcy.

indicator in a cross country analysis, Corredor, Ferrer and Santamaria (2013) find that investor sentiment significantly affects the expected return of four European equity markets. In addition, Schmeling (2009) finds that the European Commission's consumer confidence indicator is a useful proxy for investor sentiment for 18 European countries. Furthermore, Salhin, Sherif and Jones (2016) document that the consumer and business confidence of the European Commission accurately represents the expectations of consumers and managers respectively.

2.4.1.2 Confidence Indicators

There are two advantages of using the consumer and business confidence indicators of the European Commission as proxies for the sentiment. First, the European Commission's confidence indicators have been available for most of the European Union member states at monthly frequency since 1985. Second, the consumer and business confidence indicators offer standard and comparable sentiment proxies across the countries, as the European Commission uses identical questions and a harmonized procedure to measure consumer and business confidence.

Both consumer and business confidence indicators depict the expectations of respondents about financial and macroeconomic conditions. The consumer confidence in each country represents their opinion about general economic conditions, unemployment rate and personal financial position for the next twelve months. Business confidence represents managers' views about the past, current and future performance of businesses. The European Commission survey asks managers from the manufacturing, service, construction, retail and financial sector about their current business performance and expectations for future business conditions. This study focuses on the first four sector confidence indicators as the financial sector survey starts only in May 2006. Using the associated weights provided in the user guide of the Joint Harmonized European Commission surveys, we construct the weighted average business confidence index from confidence indicators data for the four sectors.[26] The survey questions are available in theppendix (A3) and further detail about the calculation of the confidence index is available at the European Commission website (https://ec.europa.eu).

Table (2.1) presents the descriptive statistics of key variables. During the sample period, consumers are more pessimistic than managers across the countries in the sample. Panel A of Table (2.1) also indicates that, on average, consumer confidence decreases for countries facing sovereign debt crisis after the global financial crisis. Greece has the lowest average consumer confidence among the ten euro area countries. Finland consumer confidence is on average highest during the sample period as compared to other countries.

[26] This study standardized the confidence scores of confidence indicators of each sector and multiplied the weights according to steps explained in user guide of Joint Harmonized European Commission surveys.

Consumer confidence highly deviates in Greece, Netherlands and Spain. Both Finland and Greece have more deviation in the manager confidence indicator compared to the other countries. Panel B of (2.1) reports the descriptive statistics of the unexpected change in the monetary policy of the Federal Reserve, the Bank of England and the European Central Bank. The standard deviation indicates high variation in the policy stance of ECB during the sample period. Table (2.2) indicates that there is a high correlation between confidence indicators across the countries. In general, managers' views regarding the current and future business activity is also highly consistent across the countries.

2.4.1.3 Surprise Change in Monetary Policy

This chapter analyses the impact of the BOE's and the Fed's monetary policy on consumer and business confidence in the UK for the period from January 1990 to December 2016. We focus on the period after the central bank starts its inflation-targeted monetary policies. This study also investigates the response of consumer and business confidence in ten euro area countries to the ECB's and the Fed's monetary policy from January 1999 to December 2016. We include all the euro area countries that adopted the Euro as their official currency before 2004 to get ample observations for analysis. More specifically, our sample includes Austria, Belgium, Finland, France, Germany, Greece, Italy, the Netherlands, Portugal and Spain. The consumer and business confidence data for Ireland and Luxemburg is missing for the initial years; therefore, both countries were dropped from the sample.

For the conventional monetary policy period, this chapter measures the unanticipated change in monetary policy using prices of futures contracts on policy rate. The monthly prices of futures contracts on the Fed funds futures, London Interbank Offered Rate (LIBOR) and Euro Interbank Offered Rate (Euribor) are obtained from Bloomberg. For each country, the dataset also includes several macroeconomic and financial variables relating to output, employment, interest rates, money supply, price indices, equity indices and exchange rates. The monthly time series data of macroeconomic and financial variables are downloaded from DataStream. We use the Augmented Dickey-Fuller (ADF) test to check the stationarity in each time series. We also standardized all the time series to mean zero and unit variance. The details about variables and transformation processes are given in the appendix (A1) for the UK.[27]

At the end of 2008, the Fed lowered the Fed funds rate to near-zero lower bound and introduce the LSAP programme. Similarly, the BOE and ECB reduced policy rates and

[27] The transformation process of our data follows closely to that of Stock and Watson (2004) and Bernanke, Boivin and Eliasz (2005). The dataset and transformation process for each euro area country in the sample is similar.

introduced an asset purchase programme and long-term refinancing operations respectively in early 2009. After the policy rate reduced to near-zero lower bound, this chapter uses the daily change in the Treasury futures on the policy announcement day to measure the monetary policy unexpected change. DataStream contains historic daily prices of continuous futures contracts on 2, 5 and 10-year Treasuries for the US, UK, Germany and Italy. To identify the ECB's unexpected unconventional monetary policy, this study calculates the difference between the change in prices of German and Italian Treasuries futures. We extract Fed, BOE and ECB unconventional monetary policy announcement events from the previous studies of Rogers, Scotti and Wright (2014) and Wright (2012), up to April 2014.[28] After that, we verify the announcement dates using the Bloomberg World Economic Calendar.[29] This chapter also verifies all the announcement dates using the details published on each of the central bank's websites.[30] Appendix (A2) enlists the unconventional monetary policy announcement dates. The macroeconomic data, such as growth in industrial production, growth in consumption, employment rate and OECD based recession indicator data, are also obtained from DataStream.

2.4.2 Results and Discussion

In the first part of this section, we discuss the results for only the conventional policy period, using the FAVAR model. Then, we present the findings of a regression analysis showing the impact of both conventional and unconventional monetary policy on the confidence indicators.

2.4.2.1 Convectional Policy Period (FAVAR Results)

This study uses the latent factors extracted from macroeconomic and financial time series to estimate the FAVAR model for each country in the sample. The appropriate lag length of the VAR model is identified using Hannan-Quinn Information Criteria (HQIC). As a robustness check, we also use Schwartz Information Criteria (SIC) for the selection of the appropriate lag length. The results in Figures (2.9) to (2.12) verify our main findings using alternative lag length selection criteria. This chapter identifies the number of factors to include in the FAVAR model on the basis of a cumulative percentage to represent all the macroeconomic and financial time series. Again, to check the robustness of the results this chapter estimates the FAVAR model using five latent factors, which represents more than 60% of information content. Figures (2.5) to (2.8) show the results of the robustness check exercise with the five-factor model. An alternative number of factors in the FAVAR model does not change our main results. This

[28] The case of two monetary policy announcements in one month, this study selects the later announcement event in the month.

[29] Hussain (2011) identifies monetary policy announcement days for the US and euro area using the Bloomberg World Economic Calendar.

[30] The central bank websites event calendars contain detailed decisions about monetary policy announcements.

study also standardized the monetary policy instrument to have mean zero and unit variance. The impulse responses show the dynamic impact of the monetary policy shock on the confidence indicators for each country using Cholesky decomposition. Figure (2.1) displays that consumer confidence increases in response to a one standard deviation expansionary shock across the countries in the euro area countries and the UK. However, the consumer confidence in Belgium, Germany and France exceptionally displays the opposite response to the expansionary policy shock. On average the results indicate that after a rise in confidence in response to the expansionary policy shock, the impulse response function (IRFs) dies out on average 6 to 9 months. These results are consistent with those reported by Lutz (2015) for the University of Michigan Sentiment Index, investors' intelligence and other sentiment proxy response to US monetary policy shock. Lutz (2015) finds that an almost 0.2 and 0.15 standard deviation increase the Michigan Sentiment Index and Investors Intelligence respectively after one standard deviation decrease in the policy rate (expansionary policy shock).[31] The results of this chapter document that one standard deviation expansionary monetary policy shock leads to an increase in consumer confidence to almost 0.1 standard deviations in Austria, Greece, Italy and the Netherlands. Moreover, the response of aggregate euro area and United Kingdom consumer confidence is more than 0.1 standard deviations. In addition, the IRFs indicate that consumer confidence in Finland, France, and Portugal increase up to 0.05 standard deviations. The findings of this chapter also demonstrate that the impact of ECB's monetary policy is heterogeneous across the euro area countries. The results endorse that the dynamic impact of monetary policy shock on consumer confidence indicators is similar to the response of macroeconomic variables to monetary policy. Specifically, the monetary policy shock affects consumer confidence in the short-run but there is no significant impact in the medium and long-term.

Figure (2.2) shows the impact of domestic monetary policy on manager confidence. The impact of the expansionary shock on consumer and manager confidence indicators seems to be dissimilar. Contrary to the consumers, the impact on the managers' confidence dies out quickly after an increase in response to an expansionary monetary policy. Specifically, the response of manager confidence to monetary policy shock dies out rapidly in an average of 4 to 6 months. In terms of magnitude Austria, Belgium, Germany, Greece, Italy and Netherland show more than 0.1 standard deviation impact of monetary policy shock on manager confidence. The manager confidence in the euro area on aggregate and the United Kingdom also show 0.1 standard deviation change after one standard deviation expansionary

[31] The investor intelligence is the ratio of bullish divided by the total bullish and bearish newsletters. On the other hand, the Michigan sentiment index measures the long-term expectations of households.

policy shock. A potential reason for this discrepancy is the professional ability and accesses to superior information for managers compared to households.

The results of US monetary policy spillover impact on confidence in the UK and euro area during conventional policy period also show that an expansionary shock improves consumer confidence. Figure (2.3) indicates the impact of the US expansionary policy shock on consumer confidence. A surprise decrease in the Fed funds rate increases the consumer confidence in the euro area in aggregate and in the eight out of the ten euro area countries in the short run. Specifically, a one standard deviation innovation in US expansionary policy shock leads to an initial of 0.18 standard deviations change in the consumer confidence in the euro area. More specifically, across the euro area countries Belgium, Finland, Germany, Portugal and Spain show the change of more than 0.1 standard deviations to monetary policy shock. However, consumer confidence in the United Kingdom decreases in response to an expansionary shock. Figure (2.4) describes that the manager confidence in Austria, Germany, Greece and France has the highest response of 0.2 standard deviations to a surprise change in US monetary policy. The impact of US monetary policy on manager confidence in the euro area in aggregate and across the countries is higher than that of domestic monetary policy. Similarly, in the United Kingdom managers are more sensitive to change in US monetary policy as compared to domestic monetary policy change.

The variance decomposition offers an alternative way to measure the impact of monetary policy shock on confidence. Tables (2.3) (2.4) show the variance decomposition of consumer and manager confidence indicators in response to domestic and US monetary policy shocks respectively. The results in Tables (2.3) and (2.4) show the percentage of variance in confidence indicators explained by the monetary policy shock at 3, 6, 12, 24 and 36 months. Panel A of Table (2.3) indicates that the monetary policy explains on average 2% of the variance in consumer confidence. Panel B shows that monetary policy shock explains on average 1.5% to 3% of the variance in manager confidence in Austria, France and Netherland. The variance decomposition shows that monetary policy shock defines less the 1% of the variation in manager confidence in Greece, Germany, Italy and Spain. The unexpected change in the monetary policy defines the 7.5% variation in consumer confidence in Portugal in three years. Panel B of Table (2.3) indicates that the US monetary policy shock explains variance up to 3.2, 4.6, 6.8 and 7% in confidence in France, Belgium, Finland and Portugal respectively. Similarly, Table (2.4) shows the results of variance decomposition of each country consumer and manager confidence caused by the US monetary policy shock. The US monetary policy change explains more than 1% of the variation in consumer and manager confidence in the euro area and the United Kingdom.

2.4.2.2 Conventional Policy Period (1999-2016)-Regression Analysis

We study the explanatory power of monetary policy in explaining the variation in confidence indicators by comparing the adjusted R^2 of two Ordinary Least Square (OLS) regressions. The first regression consists of only macroeconomic variables such as growth in consumption (CON), the employment rate (EMPL), growth in industrial production (IP) and OECD-based recession indicator (REC). The second equation includes an additional independent variable (an unanticipated change in monetary policy) as a policy instrument along with other macroeconomic variables. For comparison purposes, this chapter employs the same methodology for the unconventional policy period. More specifically, this study investigates the incremental explanatory power of monetary policy shock in explaining confidence by comparing the adjusted R^2 of both models.

Table (2.5) shows the impact of domestic conventional monetary policy on consumer confidence. We first regress consumer confidence on one-month lag macroeconomic variables only. The results of the first model are given in panel A of Table (2.5). In the second model, we regress consumer confidence on one lagged macroeconomic variables and a lagged monetary policy variables. The literature suggests that an unanticipated monetary policy can influence variables after several months. We included several monetary policy instrument lags according to Akaike Information Criteria (AIC). The results suggest that ECB's expansionary monetary policy has a significant positive impact on consumer confidence in the euro area on an aggregate level. Particularly, the results in the Table indicate that ECB's monetary policy has a significant impact on consumer confidence in the euro area, Austria, Belgium, France, Greece, Germany, Netherland, Portugal and Spain. The results further document that there is a significant negative impact of BOE's monetary decisions on consumer confidence in the UK. The increment in the adjusted R^2 suggests that the model fits improved after incorporating monetary policy variable in the model. There is an almost 12% to 25% increase in the model fit for the above-mentioned euro area countries. Similarly, Table (2.6) reports the results for manager confidence for the conventional period. The Table indicates that ECB's conventional expansionary monetary policy has a significant favourable impact on manager confidence in the case of the euro area, Finland, France, Germany, Italy, Netherland, Portugal and Spain. The Table also shows an unexpected decrease in the policy rate by BOE has a favourable impact on manager confidence in the UK. The value of the adjusted R^2 reported in the last column indicates that the model fit improves 11% to 27% for Greece, Germany, Netherland and Portugal.

Tables (2.7) and (2.8) show the results for the impact of US conventional monetary policy on consumer and manager confidence respectively. The Fed's surprise change in policy

rate influences the consumer and manager confidence across the euro area countries. More specifically, the Fed's monetary policy has a significant impact on consumer confidence in the euro area, Belgium, Finland, France, Greece and Italy. The US monetary policy also affects the manager confidence in the euro area, Austria, Belgium, Finland, France, Greece, Germany, Italy, Portugal and Spain. The adjusted R^2 improved up to 5 to 15% on average after incorporating US monetary policy to explain confidence in the above-mentioned countries.

A potential explanation of spillover impact is the "Push Channel" of monetary policy which advocates that an expansionary monetary policy in a foreign country reduces the capital flow to an integrated open economy (Sousa and Zaghini, 2008). Furthermore, Georgiadis (2016) documents that the intensity of impact depends on the level of financial integration between the US and an open economy. Therefore, the US monetary policy is more likely to influence consumer and manager expectations on future market conditions in countries with highly integrated economies with the US.

2.4.2.3 Unconventional Policy Period Results (2008-2016)

Now we turn to the results for the unconventional policy period. The ECB's unconventional monetary policy announcement significantly influences consumer confidence only in Belgium, Finland and France. The unconventional expansionary monetary policy reduces consumer confidence in Belgium, Finland and France. Table (2.9) shows that ECB's unconventional monetary announcements have an insignificant impact on consumer confidence in the euro area, Austria, Greece, Germany, Netherland, Portugal and Spain. The results of Table (2.9) further document an insignificant effect of BOE's monetary policy on consumer confidence in the UK during the unconventional period. Similarly, Table (2.10) indicates that the unexpected monetary policy announcement of ECB has an insignificant impact on manager confidence in Belgium, France Greece, Netherland, Portugal and Spain. In addition, the BOE's monetary policy does not appear to explain consumer or manager confidence in the United Kingdom.

The above results document a dramatic shift in the impact of monetary policy on sentiment after the introduction of unconventional policy tools and decreasing the policy rate to the lower bound. This is perhaps not surprising as there is a growing number of studies showing that the impact of monetary policy on stock prices is asymmetric during a crisis period. For instance, Galí and Gambetti (2015) find that an expansionary monetary policy shock surprisingly decreases asset prices during crisis periods. Moreover, the results of Kontonikas, MacDonald and Saggu (2013) indicate that there is a structural break in the effect of monetary policy on stock returns. Specifically, during the global financial crisis period, an expansionary policy shock decreases the stock prices significantly in the US. The rationale provided by Kontonikas, MacDonald and Saggu (2013) for these surprising results is the market perception

of monetary policy during crisis periods. For example, an expansionary monetary policy during a crisis period is perceived as a signal for worse future macroeconomic conditions, subsequently decreasing stock prices. Guo, Hung and Kontonikas (2020) find that the state of investor sentiment plays a conditional role in the influence of monetary policy shock on stock prices. Guo, Hung and Kontonikas (2020) find that an unexpected monetary policy shock increases the stock return during positive sentiment periods. Moreover, Galariotis, Makrichoriti and Spyrou (2018) find that the ECB's conventional monetary policy shock has a positive impact on economic sentiment indicator in nine euro area countries. However, they find that the ECB's unconventional monetary policy has a negative short-term impact on economic sentiment.

The results of this chapter support the findings of Galariotis, Makrichoriti and Spyrou (2018), documenting an insignificant impact of ECB's unconventional monetary policy in Greece, Italy, Portugal and Spain during the crisis period. This study confirms that the impact of monetary policy on confidence remained muted not only during the crisis period but also during the recovery phase. The monetary easing announcements are futile to improve the confidence even beyond the sovereign debt crisis period. Tables (2.11) and (2.12) show the results for the spillover impact of US monetary policy on consumer and manager confidence respectively. Table (2.11) documents that consumer confidence in only Austria, Finland, France, Germany and Portugal responds to the Fed's monetary easing decisions. However, there is no improvement in the adjusted R^2 after incorporating the US unconventional monetary policy variable in the model. Similarly, Table (2.12) documents that US monetary policy has a significant impact on manager confidence in Greece, Germany, Italy and the Netherland but the magnitude of the impact is relatively small.

As discussed in section 2.3.2, the potential endogeneity issue may cause a bias in our estimations due to the linear dependence of independent variables. The linear dependence of ECB's or BOE's monetary policy on the Fed's policy stance may lead to an endogeneity problem. This chapter checks this endogeneity issue in the estimation of US monetary policy impact on confidence. We follow the two-step Hausman (1978) test to detect any endogeneity in the model. First, we regress the domestic monetary policy variable on macroeconomic variables and an instrumental variable to obtain the residual from regression. In the second step, we regress the confidence indicator on the macroeconomic variables, the policy instrument and the residuals obtained in the first step. The p-values of the residual for the country such as euro Area (0.6209), Austria (0.8424), Belgium (0.9649), Finland (0.9631), France (0.907), Germany (0.5934) and Netherlands (0.1906) are not significant at any significance level. Hence the test concludes that there is no significant endogeneity problem in the model. We use the first difference of the domestic monetary policy variable as an

instrumental variable. However, the results remain unchanged using alternative instrumental variables such as money supply and bank lending rate.

Table (2.13) summarises the results of the impact of monetary policy during conventional and unconventional policy periods on consumer and manager confidence. Overall, the results of this study suggest that an expansionary conventional domestic monetary has a positive significant impact on consumer and manager confidence in euro area countries and the UK. Furthermore, the US conventional monetary policy has more impact on manager confidence compared to domestic monetary policy in the euro area and the UK. After the policy rates reach the zero lower bound the domestic and US unconventional monetary policy has no or weak impact on the consumer confidence and manager confidence across the euro area countries. The results of this chapter confirm that there is a significant change in the impact of monetary policy on confidence after the introduction of the unconventional monetary policy. After the global financial crisis, central banks in developed markets emphasis on the role of monetary policy in restoring the confidence of market participants. However, the results of this study suggest that the consumers and the manager confidence do not respond significantly to the unconventional monetary easing policies.

2.5 Conclusion

Central Banks in developed countries started to focus more on the impact of monetary policy decisions in response to the global financial crisis and loss of confidence in financial markets. The monetary policy stance of the central bank has a large impact on macroeconomic and financial variables. This study extends the literature by investigating the impact of conventional and unconventional monetary policy on consumer and manager confidence. Specifically, this chapter investigates the impact of Fed's, ECB's and BOE's unexpected monetary policy on consumer and manager confidence in the euro area and the UK. The confidence indicators of the European Commission indicate the future expectation of consumers and managers about the future economic and financial outlook. Consumer and manager confidence influence the overall growth in consumption and business activity. While it is evident that confidence plays a vital role in future consumption and output, there are very few attempts in the literature in examining the macro-financial determinants of confidence.

Therefore, this study examines the importance of a wide range of macroeconomic and financial variables in the Factor-augmented VAR model. The results of the conventional policy period suggest that there is a favourable impact of domestic monetary policy shock on consumer and manager confidence in the ten countries of the euro area. There is a significant change in consumer and manager confidence in response to BOE's monetary policy. Galariotis, Makrichoriti and Spyrou (2018) document a sharp difference in the response of the Economic Sentiment Index in Core euro area countries and Peripheral countries to the policy shock. This study also finds that the response of euro area countries to ECB's monetary policy decision is heterogeneous. Moreover, the US monetary policy has also a short-term effect on consumer and manager confidence in the euro area countries. Another finding of this chapter suggests that the impact of monetary policy on confidence tends to die out within a 9 months horizon.

Following the decrease in the policy rate by major central banks to near-zero lower bound, the response of consumer and manager confidence in the euro area to the unexpected monetary policy shock of ECB has become either weak or inverse. The BOE's monetary policy also has no significant impact on consumer and manager confidence in the UK. Moreover, the unconventional Fed's monetary policy has no significant impact on consumer and manager confidence in the euro area at the aggregate level. Overall, the results of this study show that an expansionary conventional domestic monetary policy leads to an increase in consumer and manager confidence during the conventional policy period. The manager confidence responds more to US monetary policy announcements compared to domestic monetary policy. The

response of consumer and manager confidence has shifted dramatically after the global financial crisis and become very weak or in the opposite direction.

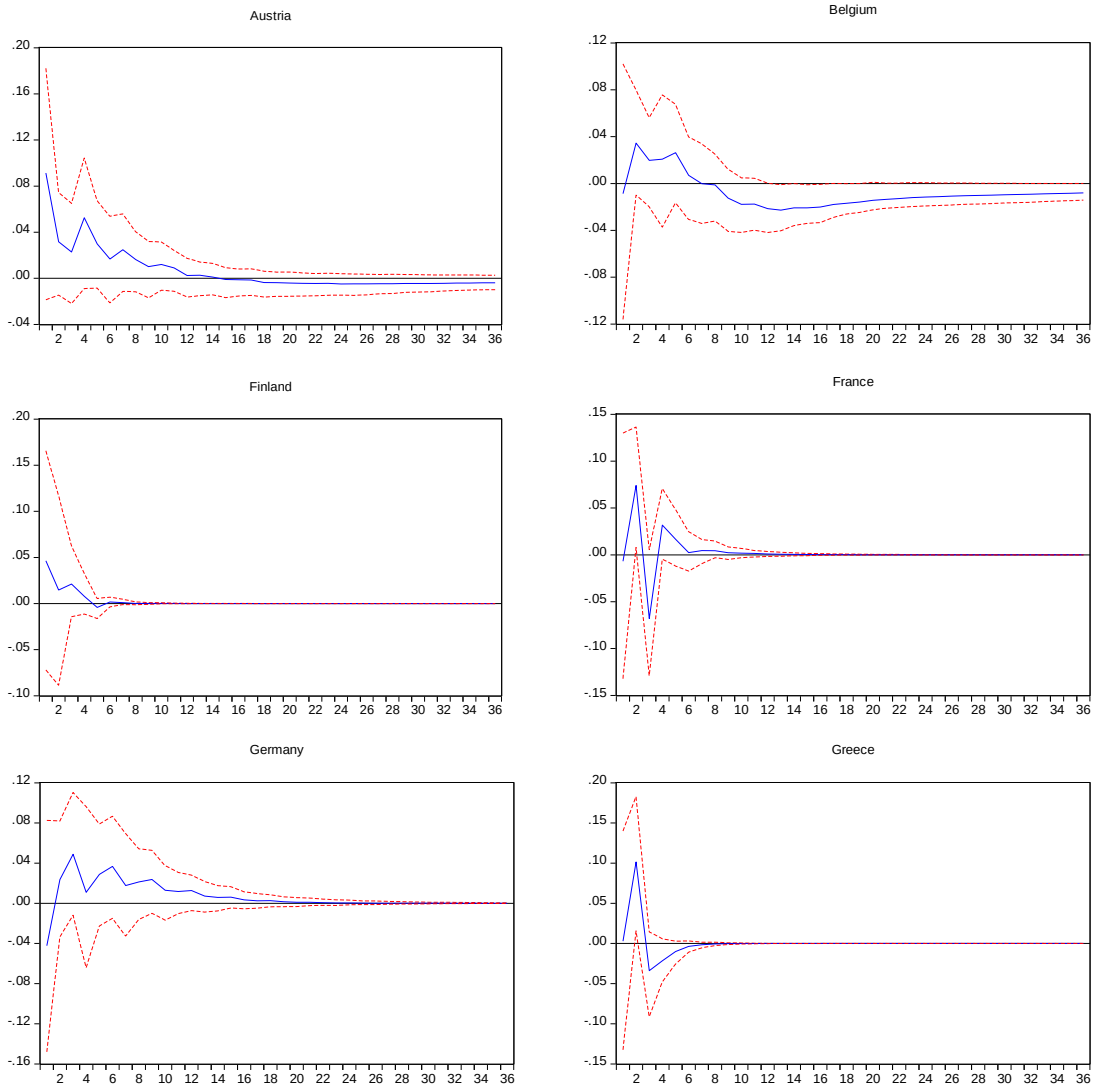
Given that direct and indirect sentiment indexes measure different mood and different forms of expectations regarding the future economic outlook, future research can also consider the impact of monetary policy on other market-based sentiment proxies such as discounts on closed-end funds. In addition, the future scope of research may analyse the role of change in confidence indicators while investigating the impact of monetary policy on asset prices in the financial market. Another possible extension is the investigation of monetary policy influence in driving future expectations after decomposing expectations into rational and irrational components. Finally, a comparative study of the impact of monetary policy decisions (actions) and the central bank's qualitative information (words) on investor sentiment is another interesting topic for further research.

Chapter 2: Figures and Tables

Chapter 2: Figures

Figure 2. 1: The Impact of Domestic Policy Shock on Consumer Confidence

Impulse responses of consumer confidence to unexpected conventional monetary policy shock for 36 months (3 years). An unanticipated change in monetary policy identified through a change in the interbank interest rate and their implied futures contracts. The impulse responses are estimated from the FAVAR model with policy instrument and latent factors extracted from a wide range of macroeconomic and financial variables for each country. The latent factors are estimated using principal component analysis. The selection of the number of factors to include in the FAVAR model are based on the factor's cumulative proportion representing all variables in the dataset. The impact of the policy shock is estimated using the Cholesky decomposition by ordering the monetary policy instrument to be the last variable. The lag length for each country VAR model is identified using the Hannan-Quinn information criteria



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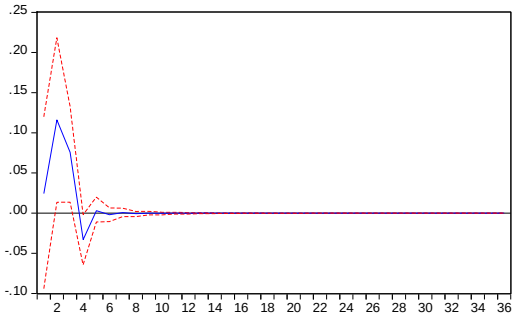

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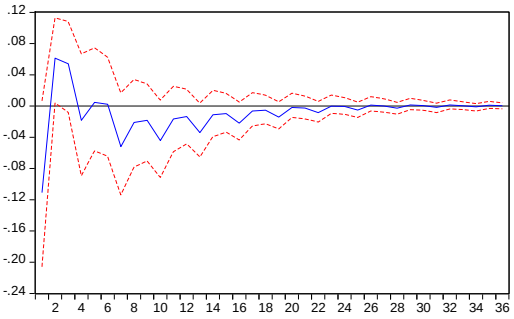

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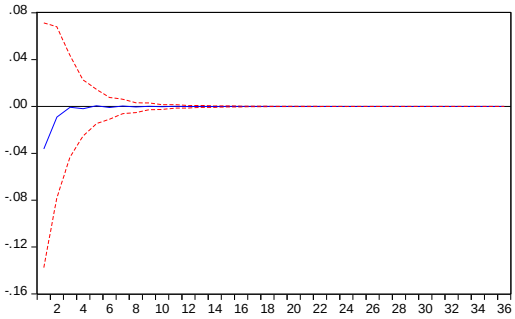
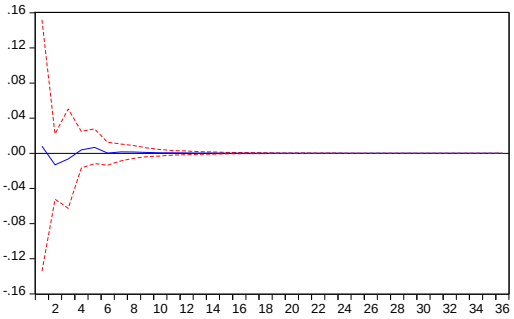
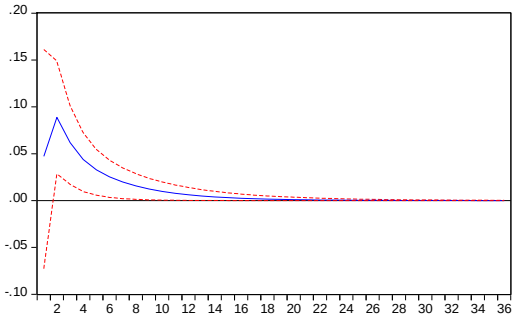


Spain



Euroarea



United Kingdom

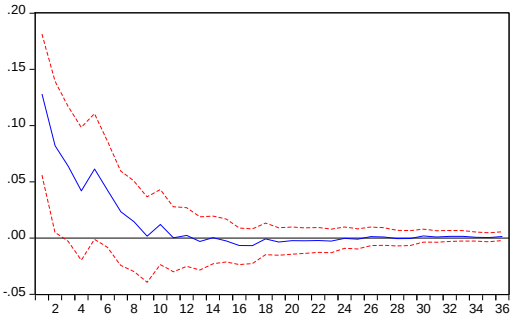


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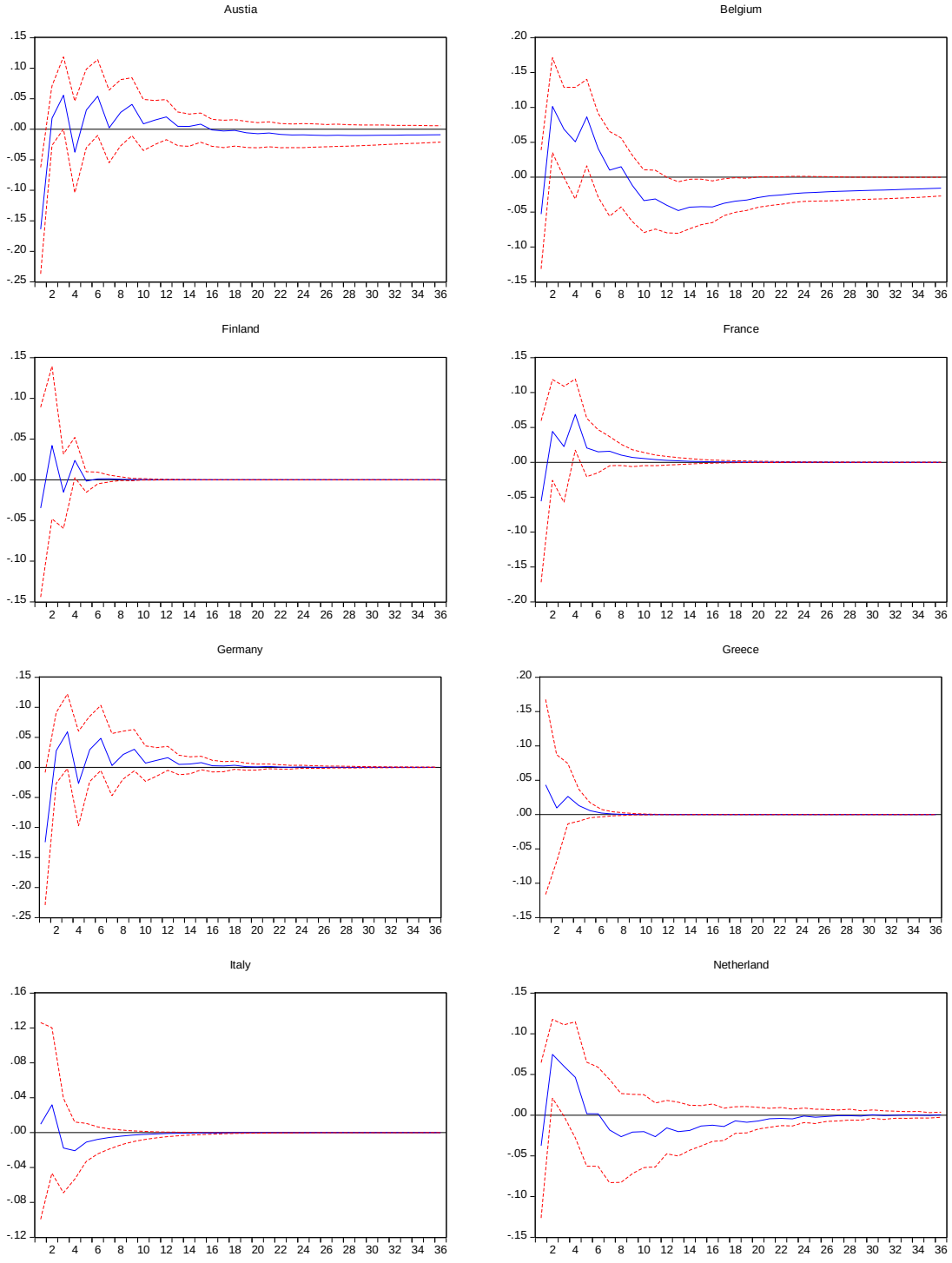
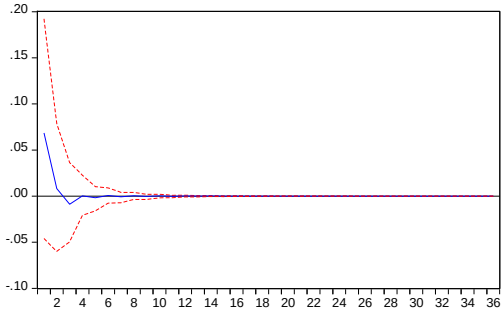
Figure 2. 2: The Impact of Domestic Policy Shock on Manager Confidence

Impulse responses of manager confidence to unexpected conventional monetary policy shock for 36 months (3 years). An unanticipated change in monetary policy is identified through a change in the interbank interest rate and their implied futures contracts. The impulse responses are estimated from the FAVAR model with policy instrument and latent factors extracted from a wide range of macroeconomic and financial variables for each country. The latent factors are estimated using principal component analysis. The selection of the number of factors to include in the FAVAR model are based on the factor's cumulative proportion representing all variables in the dataset. The impact of the policy shock is estimated using the Cholesky decomposition by ordering the monetary policy instrument to be the last variable. The lag length for each country VAR model is identified using the Hannan-Quinn information criteria



Portugal



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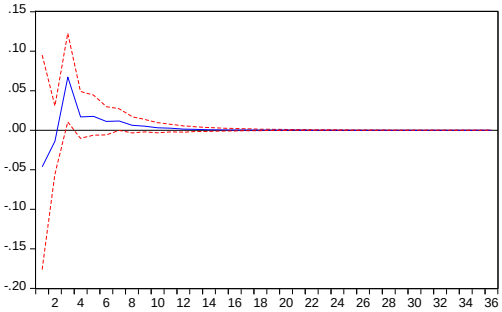
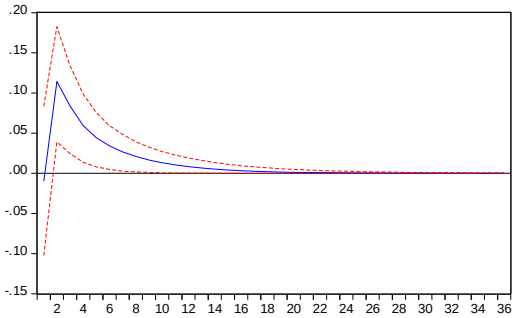


Euroarea



United Kingdom

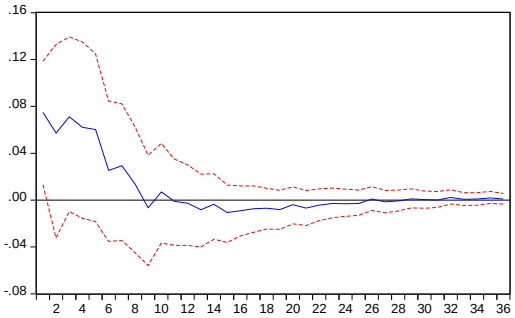
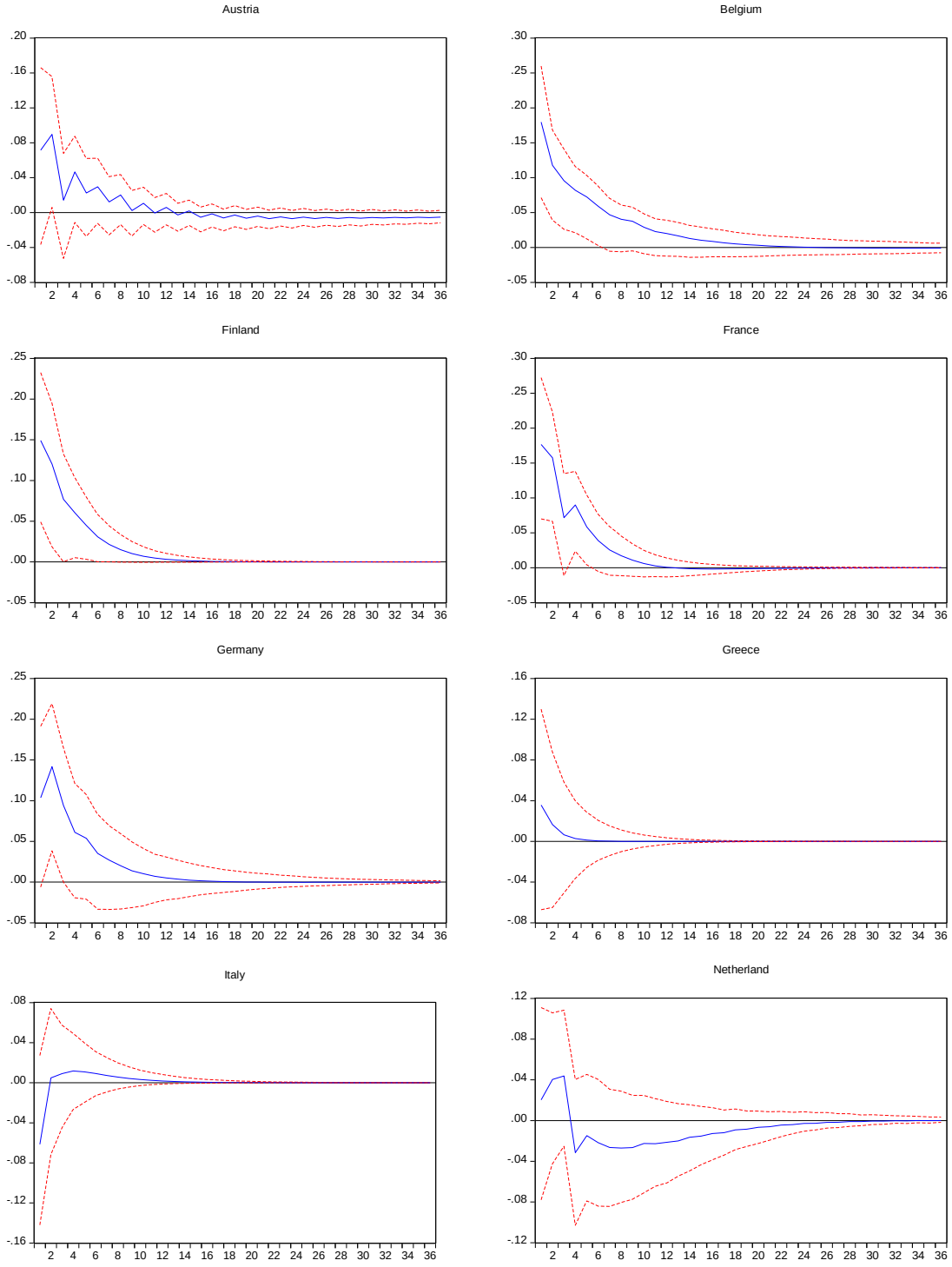
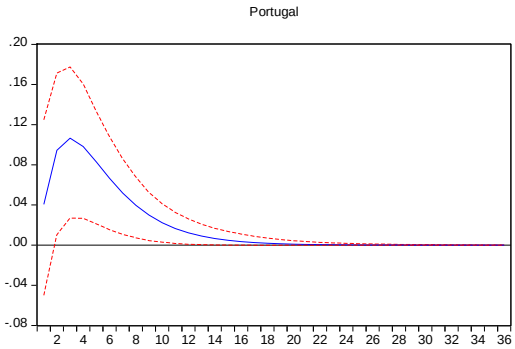


Figure 2. 3: The Spillover Impact of US Policy Shock on Consumer Confidence

Impulse responses of consumer confidence to unexpected conventional monetary policy shock for 36 months (3 years). An unanticipated change in monetary policy identified through a change in the interbank interest rate and their implied futures contracts. The impulse responses are estimated from the FAVAR model with policy instrument and latent factors extracted from a wide range of macroeconomic and financial variables for each country. The latent factors are estimated using principal component analysis. The selection of the number of factors to include in the FAVAR model are based on the factor's cumulative proportion representing all variables in the dataset. The impact of the policy shock is estimated using the Cholesky decomposition by ordering the monetary policy instrument to be the last variable. The lag length for each country VAR model is identified using Hannan-Quinn information criteria.

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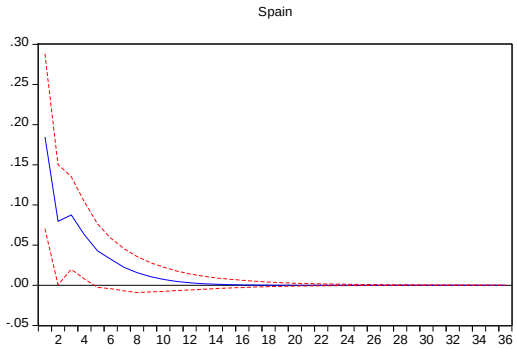
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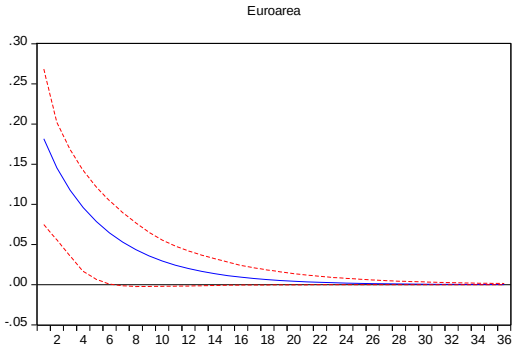
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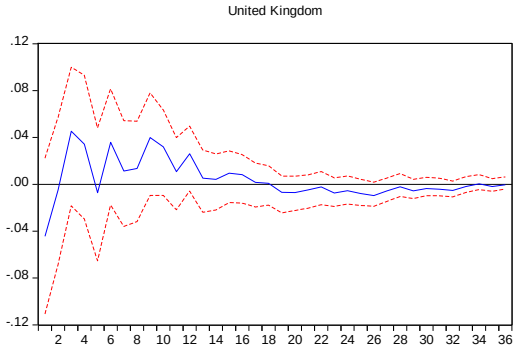
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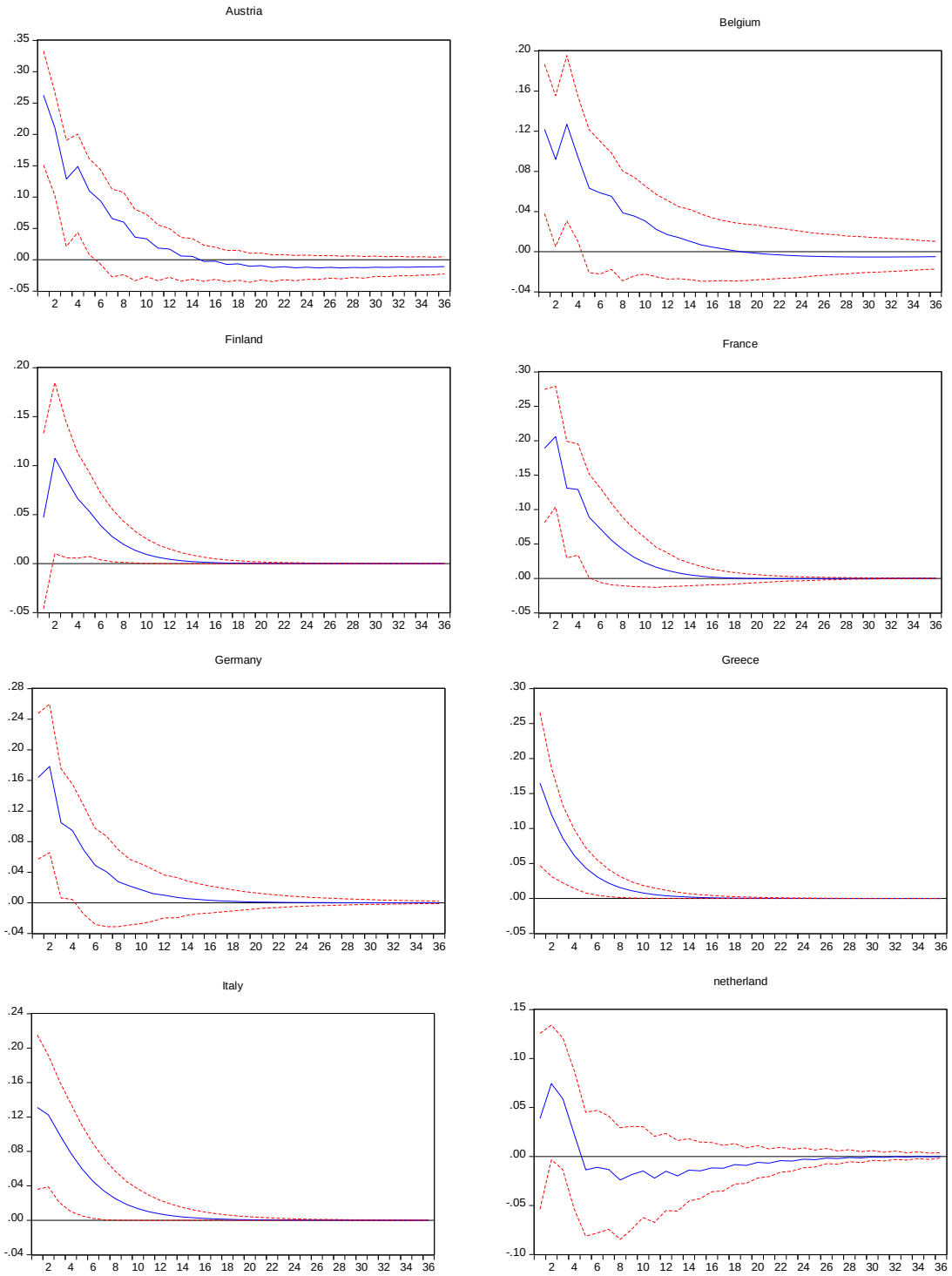
Figure 2. 4: The Spillover Impact of US Policy Shock on Manager Confidence

Impulse responses of manager confidence to unexpected conventional monetary policy shock for 36 months (3 years). An unanticipated change in monetary policy is identified through a change in the interbank interest rate and their implied futures contracts. The impulse responses are estimated from the FAVAR model with policy instrument and latent factors extracted from a wide range of macroeconomic and financial variables for each country. The latent factors estimated using principal component analysis. The selection of the number of factors to include in the FAVAR model are based on the factor's cumulative proportion representing all variables in the dataset. The impact of the policy shock is estimated using the Cholesky decomposition by ordering the monetary policy instrument to be the last variable. The lag length for each country VAR model is identified using Hannan-Quinn information criteria.



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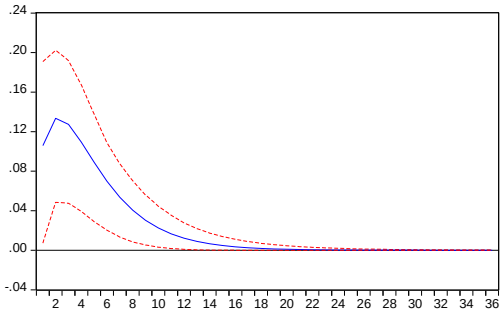

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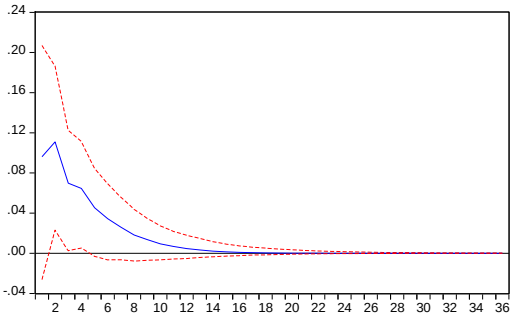

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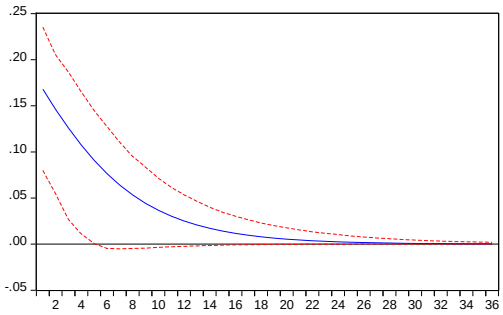

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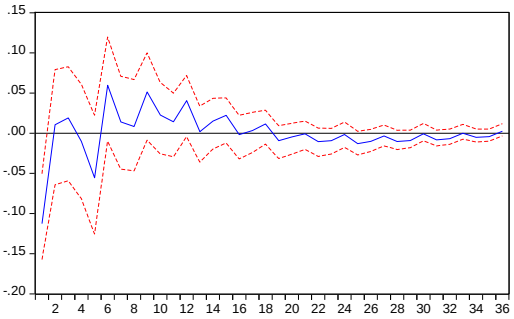
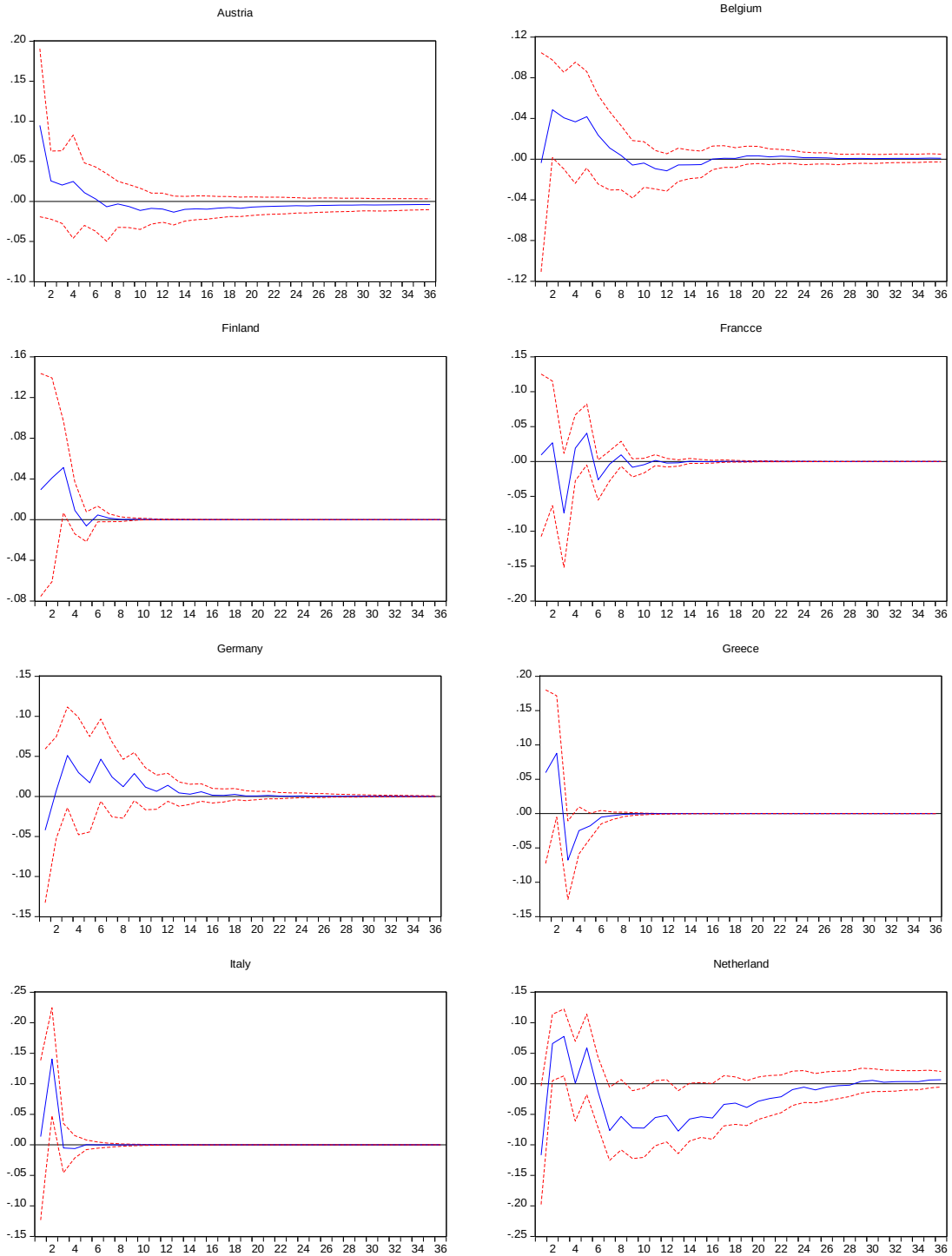


Figure 2. 5: The Impact of Domestic Policy Shock on Consumer Confidence (Five Factors)

For robustness check, we use Factor-augment VAR estimated with five factors. This figure shows impulse responses of consumer confidence to unexpected conventional monetary policy shock for 36 months (3 years). An unanticipated change in monetary policy is identified through a change in the interbank interest rate and their implied futures contracts. The impulse responses are estimated from the FAVAR model with policy instrument and latent factors extracted from a wide range of macroeconomic and financial variables for each country. The five latent factors are estimated using principal component analysis. The impact of the policy shock is estimated using the Cholesky decomposition by ordering the monetary policy instrument to be the last variable. The lag length for each country's VAR model is identified using Hannan-Quinn information criteria.



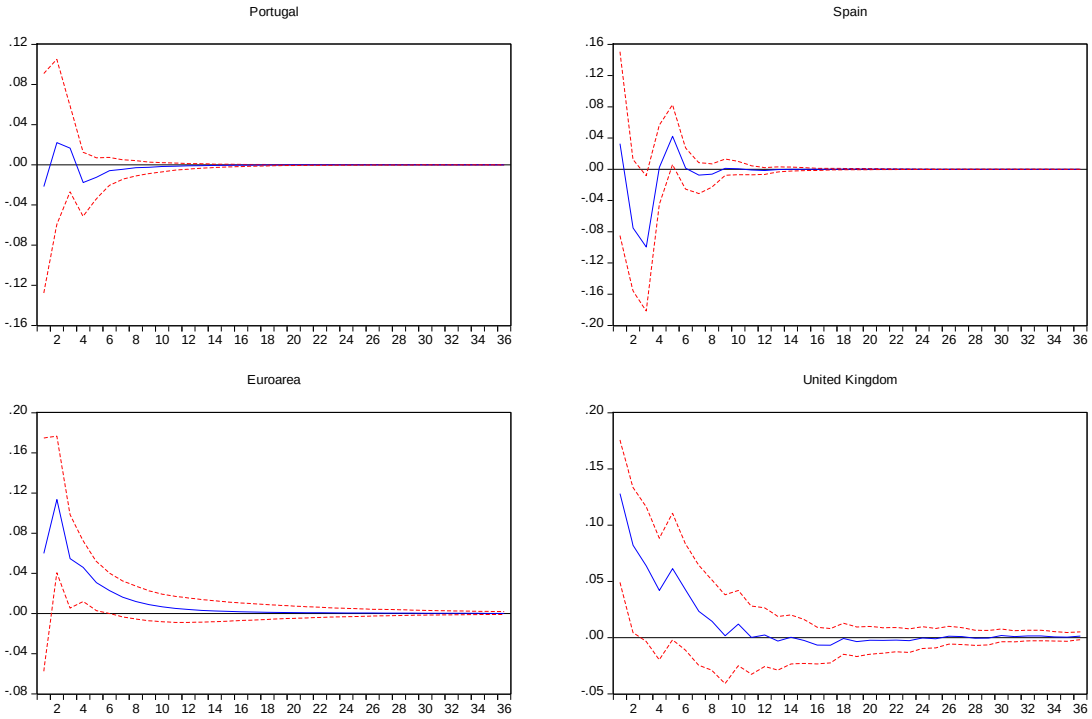

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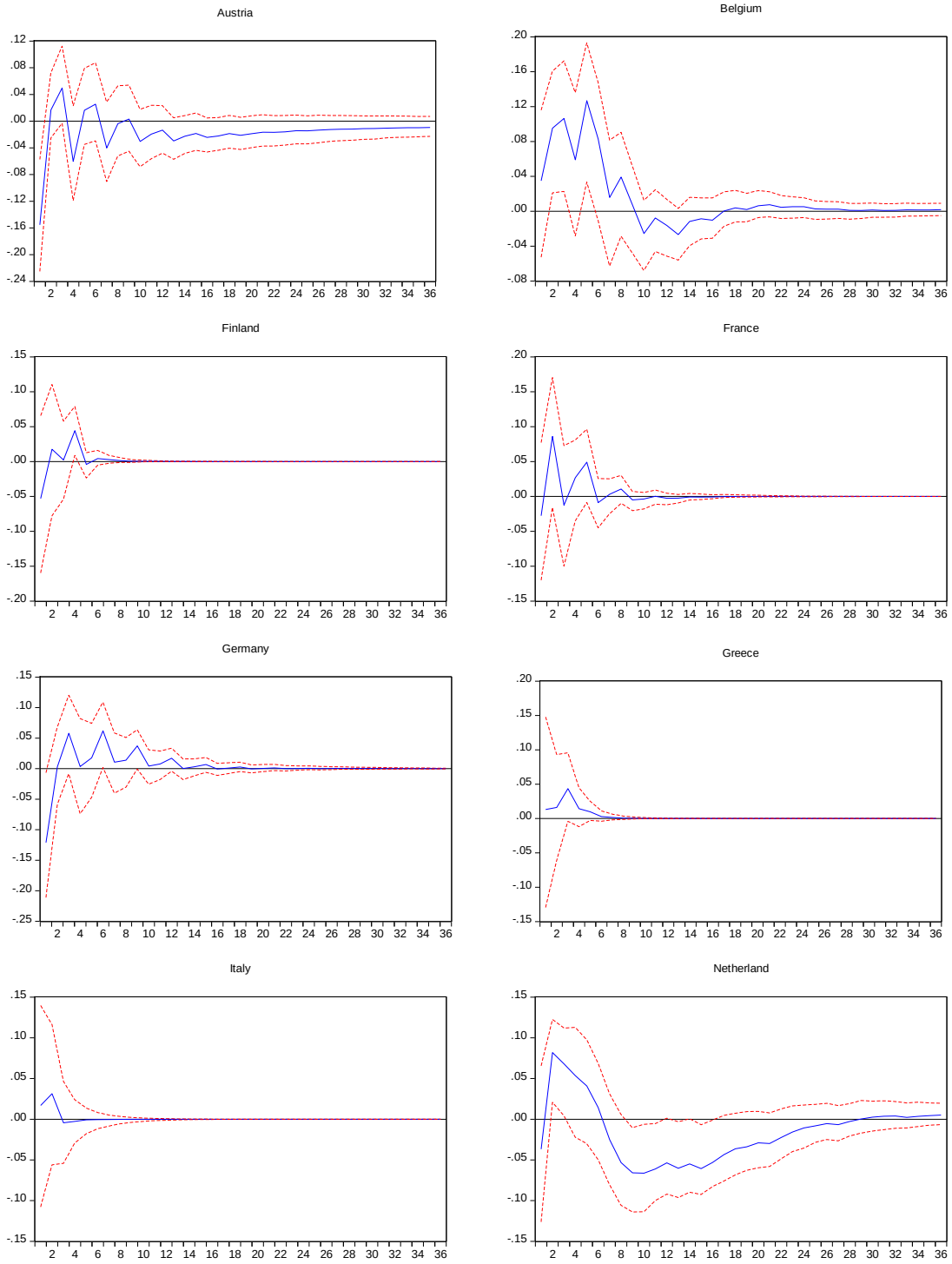
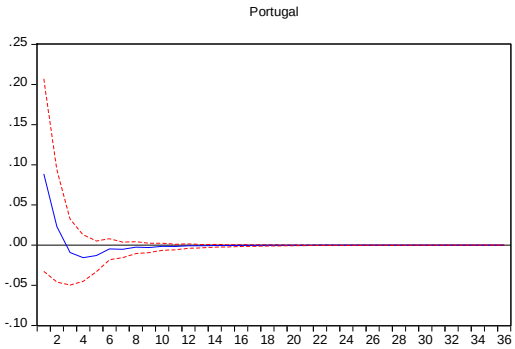
Figure 2. 6: Impact of Domestic Policy Shock on Manager Confidence (Five Factors)

For robustness check, we use Factor-augment VAR estimated with five factors. This figure shows impulse responses of manager confidence to unexpected conventional monetary policy shock for 36 months (3 years). An unanticipated change in monetary policy is identified through a change in the interbank interest rate and their implied futures contracts. The impulse responses estimated from the FAVAR model with policy instrument and latent factors are extracted from a wide range of macroeconomic and financial variables for each country. The five latent factors are estimated using principal component analysis. The impact of the policy shock estimated using the Cholesky decomposition by ordering the monetary policy instrument to be the last variable. The lag length for each country's VAR model is identified using Hannan-Quinn information criteria.

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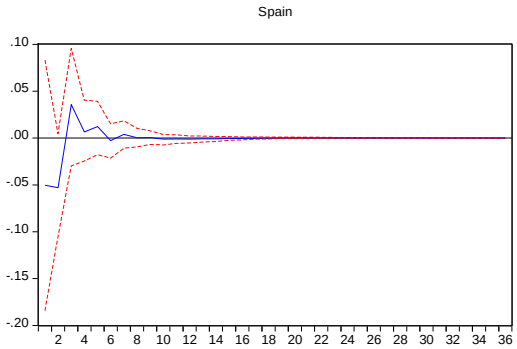
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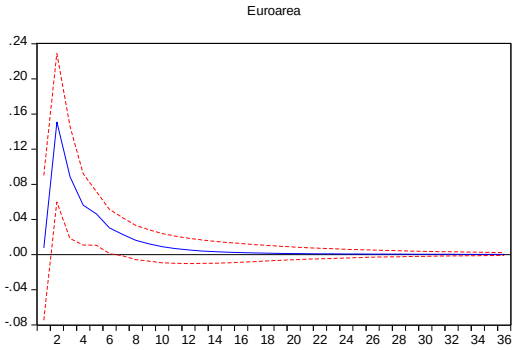
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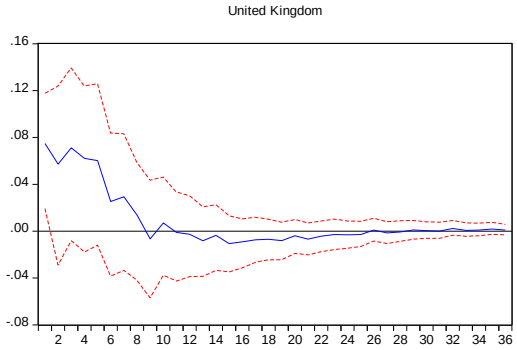
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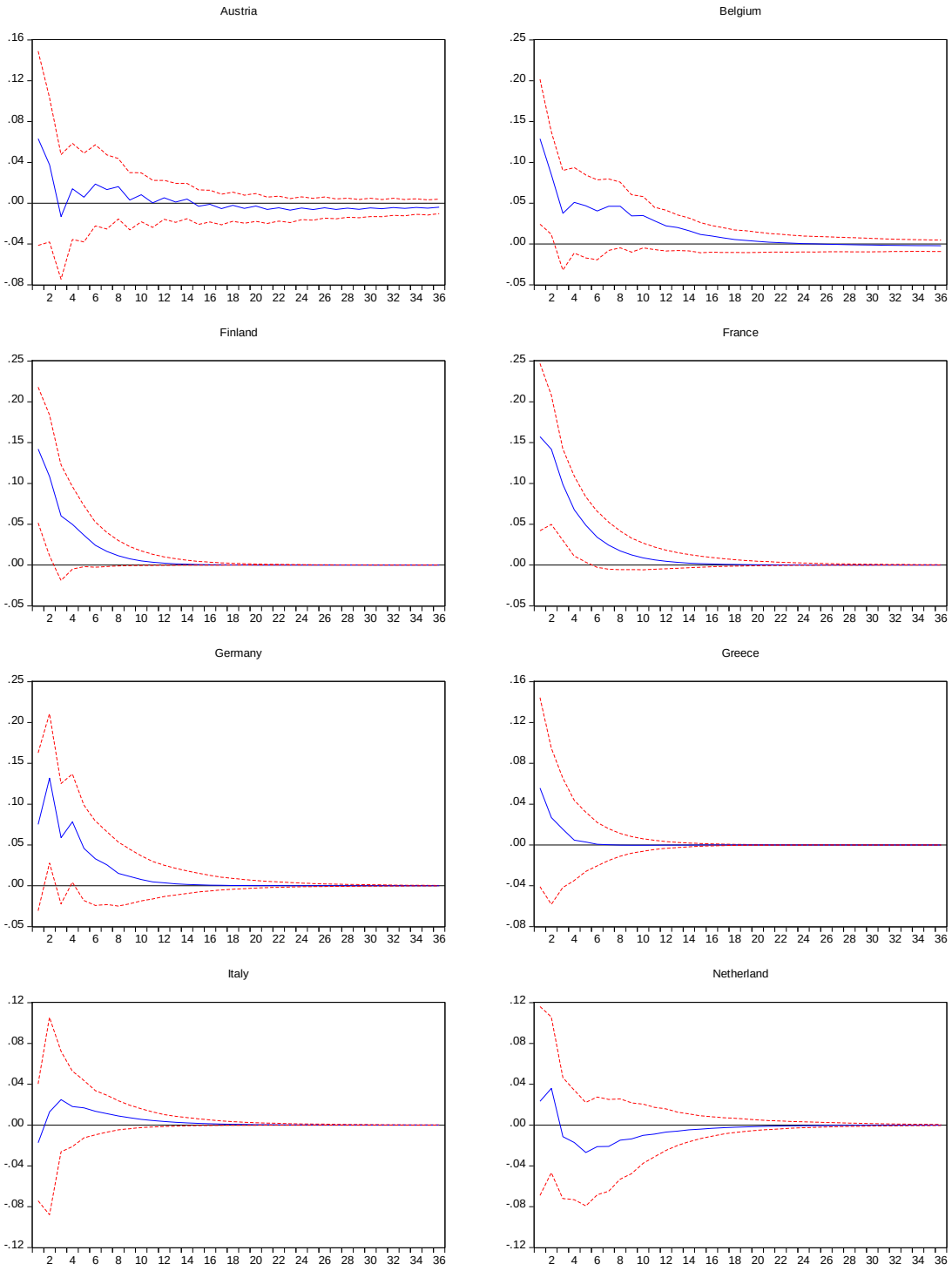
Figure 2. 7: The Spillover Impact of US Policy Shock on Consumer Confidence (Five Factors)

For robustness check, we use Factor-augment VAR estimated with five factors. This figure shows the impulse responses of consumer confidence to unexpected conventional monetary policy shock for 36 months (3 years). An unanticipated change in monetary policy is identified through a change in the interbank interest rate and their implied futures contracts. The impulse responses are estimated from the FAVAR model with policy instrument and latent factors extracted from a wide range of macroeconomic and financial variables for each country. The five latent factors are estimated using principal component analysis. The impact of the policy shock is estimated using the Cholesky decomposition by ordering the monetary policy instrument to be the last variable. The lag length for each country's VAR model identified using Hannan-Quinn information criteria.



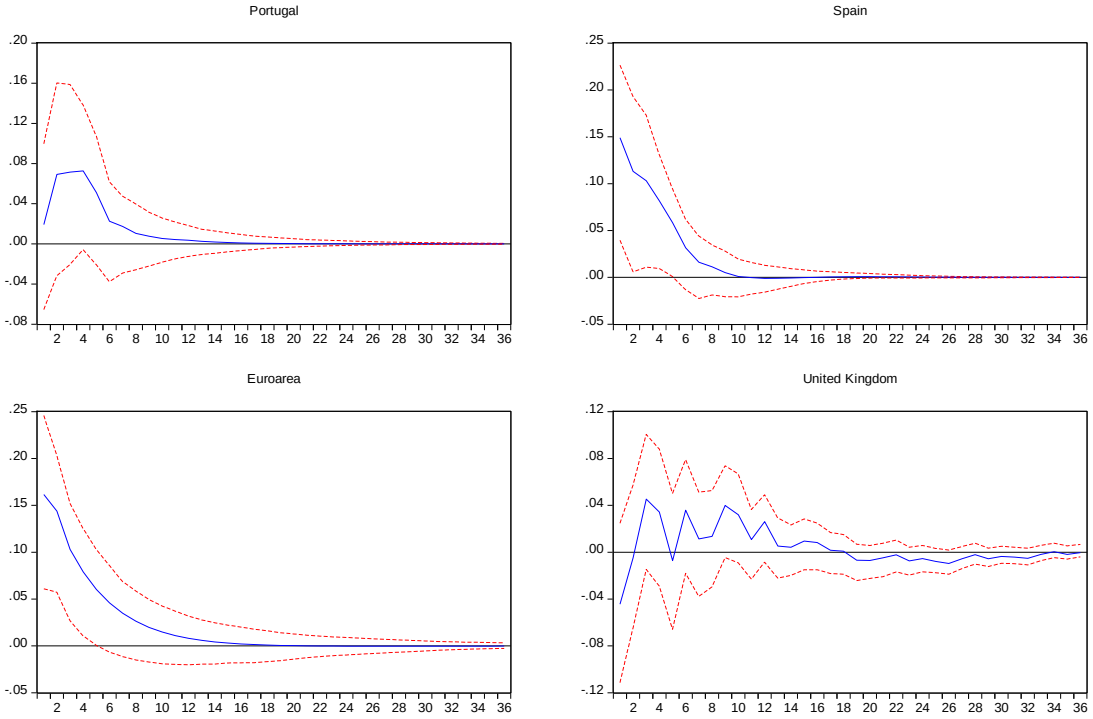

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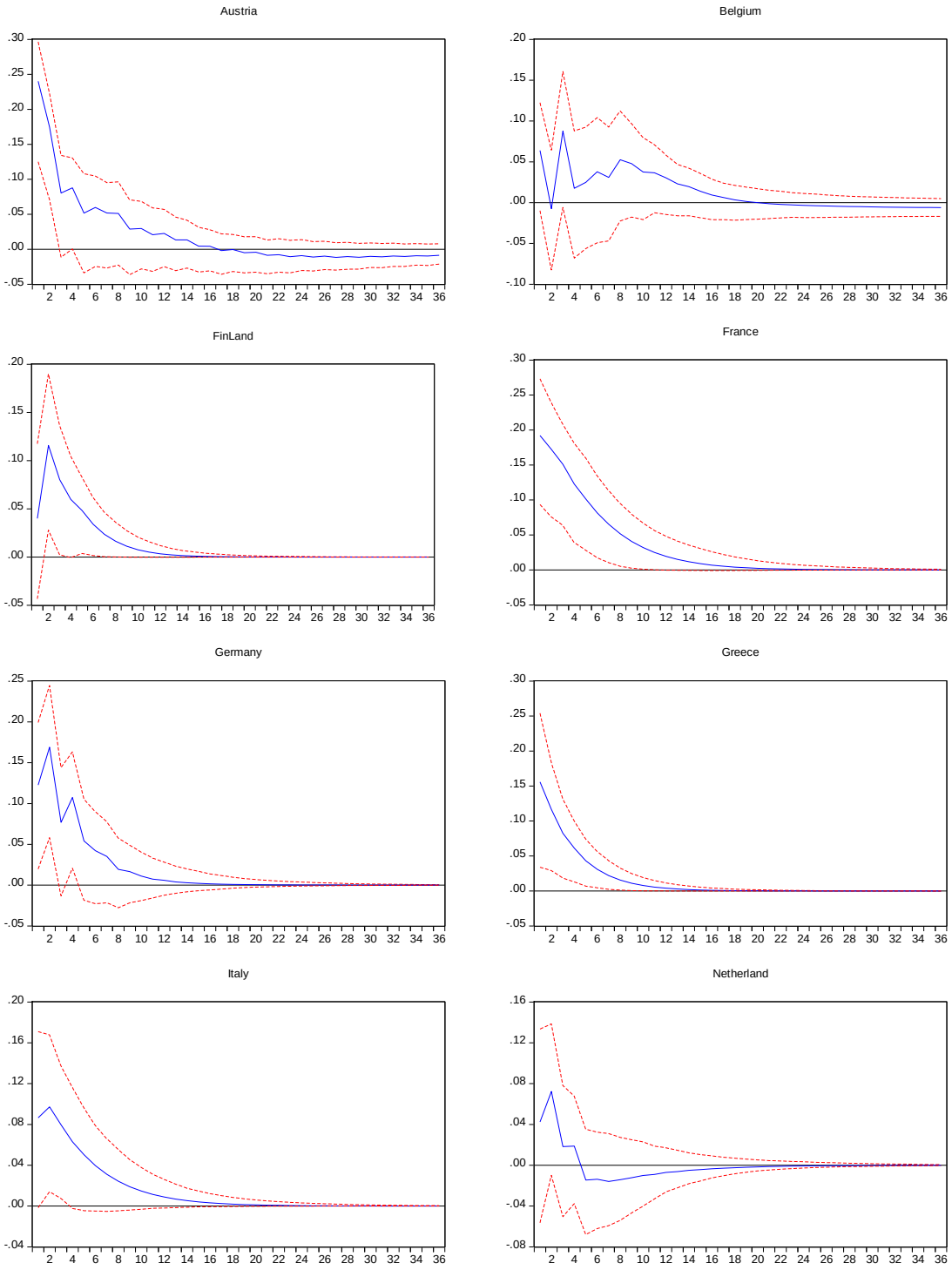
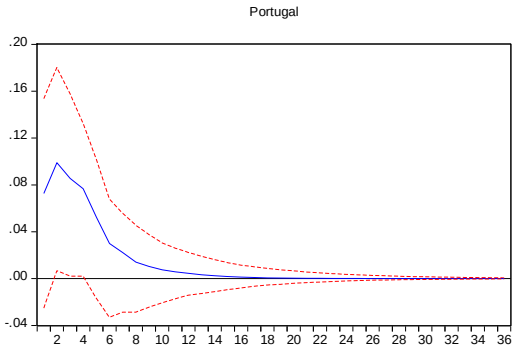
Figure 2. 8: The Spillover Impact of US Policy Shock on Manager Confidence (Five Factors)

For robustness check, we use Factor-augment VAR estimated with five factors. This table shows impulse responses of manager confidence to unexpected conventional monetary policy shock for 36 months (3 years). An unanticipated change in monetary policy identified through a change in the interbank interest rate and their implied futures contracts. The impulse responses are estimated from the FAVAR model with policy instrument and latent factors extracted from a wide range of macroeconomic and financial variables for each country. The five latent factors are estimated using principal component analysis. The impact of the policy shock is estimated using the Cholesky decomposition by ordering the monetary policy instrument to be the last variable. The lag length for each country's VAR model is identified using Hannan-Quinn information criteria.

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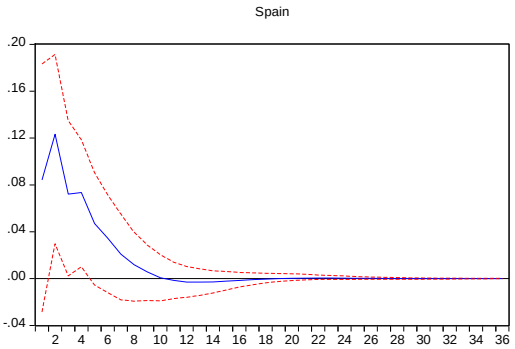
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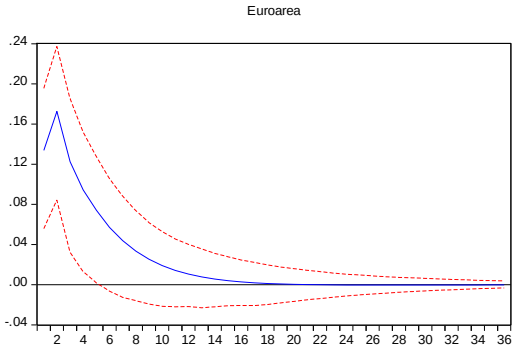
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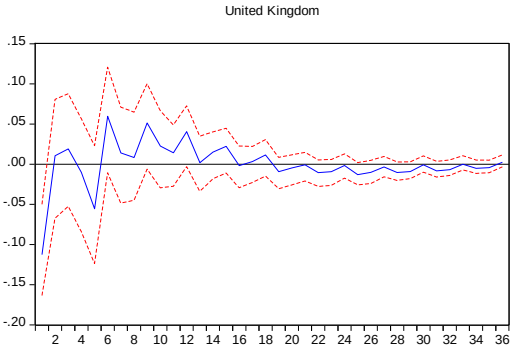
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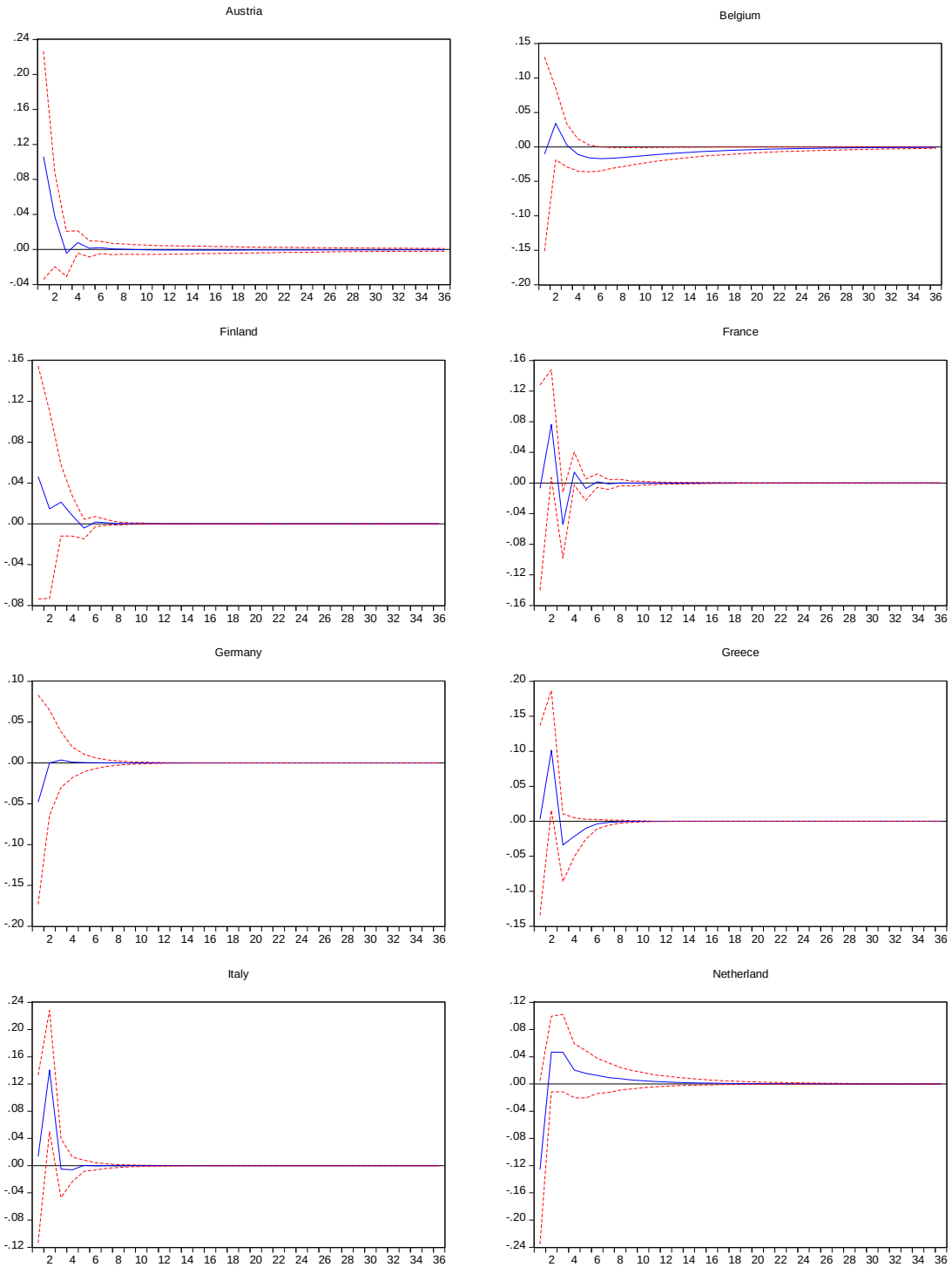
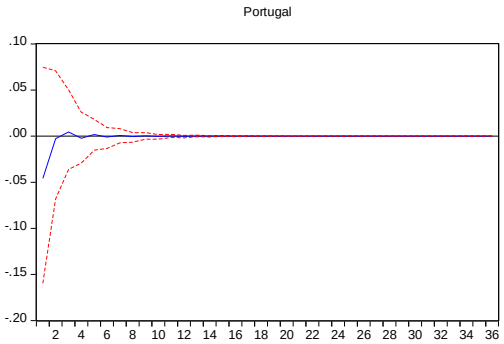
Figure 2. 9: The Impact of Domestic Policy Shock on Consumer Confidence (SIC)

This figure shows the results after applying alternative information criteria i.e. Schwartz Information Criteria for choosing the appropriate lag length. The graphs indicate impulse responses of consumer confidence to unexpected conventional monetary policy shock for 36 months (3 years). An unanticipated change in monetary policy is identified through a change in the interbank interest rate and their implied futures contracts. The impulse responses are estimated from the FAVAR model with policy instrument and latent factors are extracted from a wide range of macroeconomic and financial variables for each country. The selection of the number of latent factors to include in the FAVAR model are based on the factor's cumulative proportion representing all variables in the dataset. The impact of the policy shock is estimated using the Cholesky decomposition by ordering the monetary policy instrument to be the last variable.

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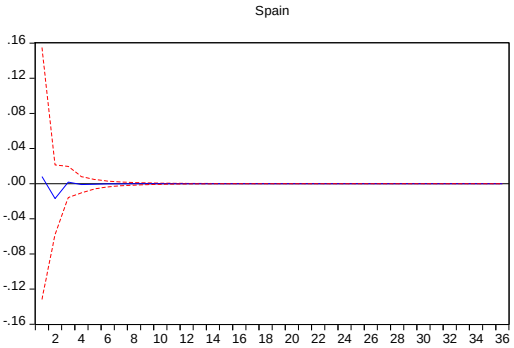
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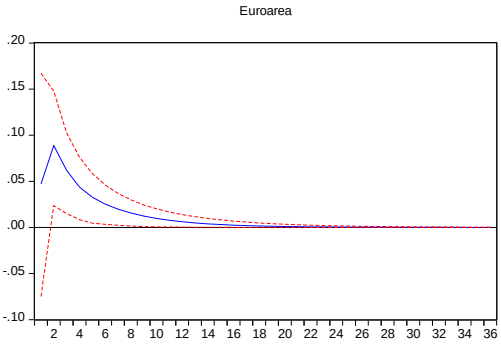
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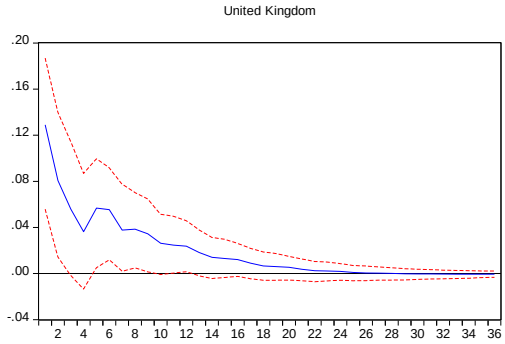
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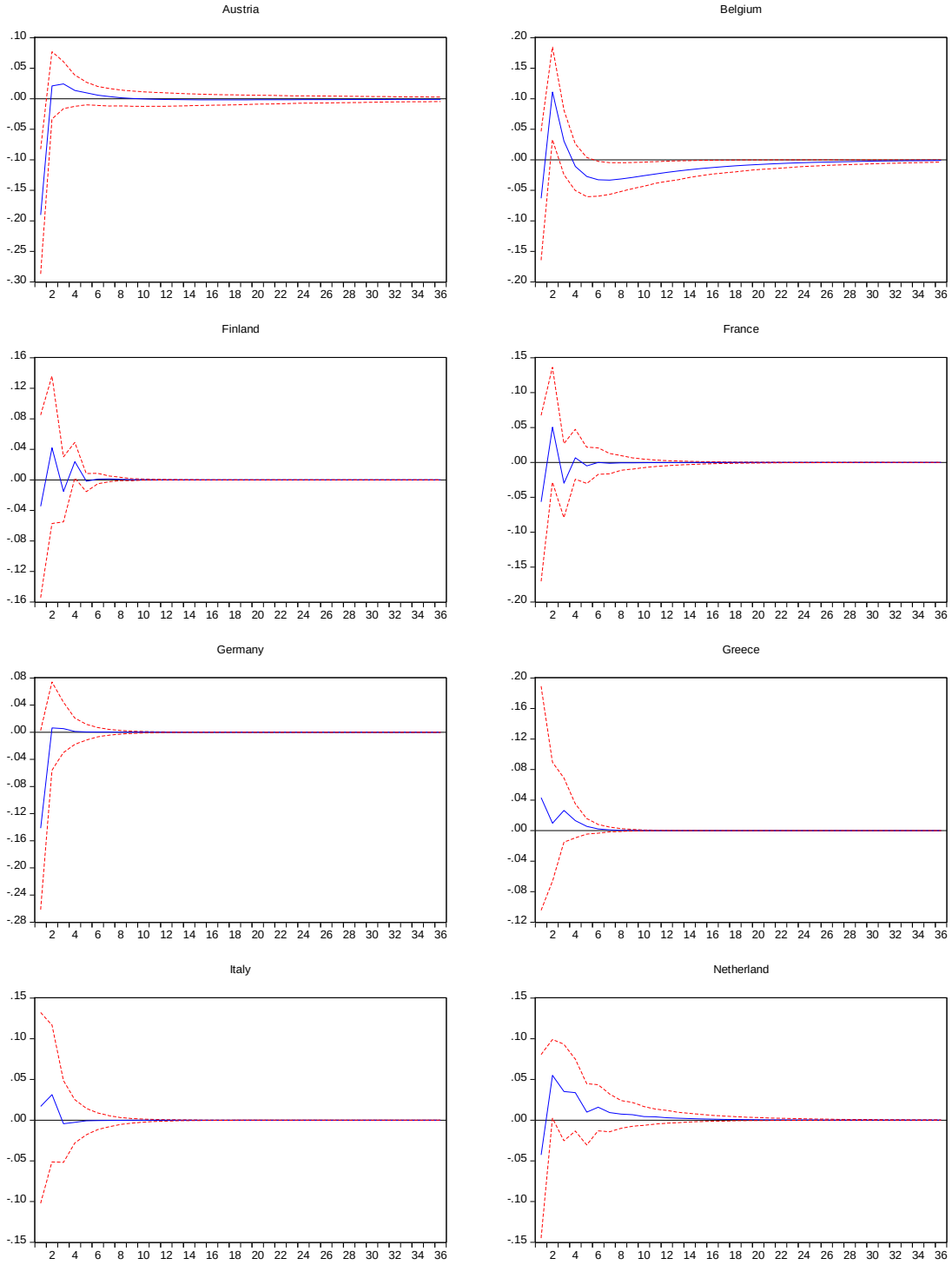
Figure 2. 10: Impact of Domestic Policy Shock on Manager Confidence (SIC)

This figure shows the results after applying alternative information criteria i.e. Schwartz Information Criteria for choosing the appropriate lag length. The graphs indicate impulse responses of manager confidence to unexpected conventional monetary policy shock for 36 months (3 years). An unanticipated change in monetary policy identified through a change in the interbank interest rate and their implied futures contracts. The impulse responses are estimated from the FAVAR model with policy instrument and latent factors are extracted from a wide range of macroeconomic and financial variables for each country. The selection of the number of latent factors to include in the FAVAR model decided through a cumulative percentage of a factor representing all variables. The impact of the policy shock is estimated using the Cholesky decomposition by ordering the monetary policy instrument to be the last variable.



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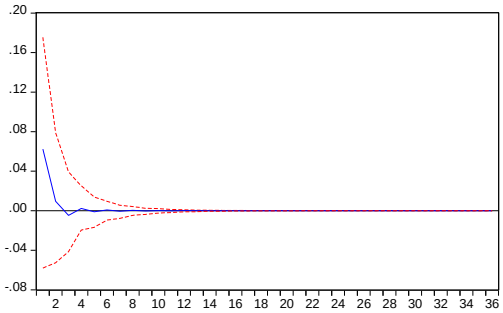

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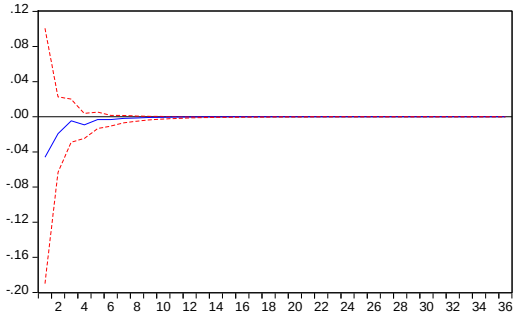

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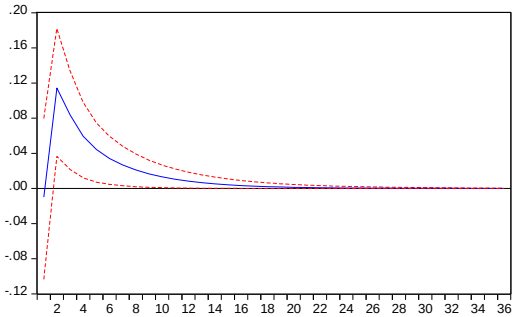

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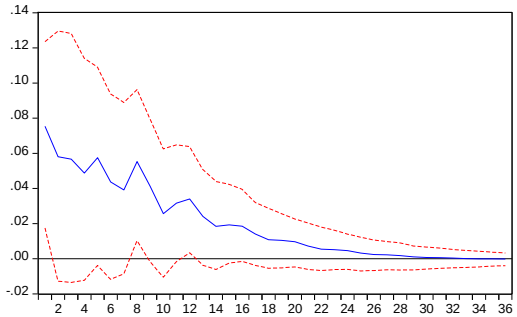
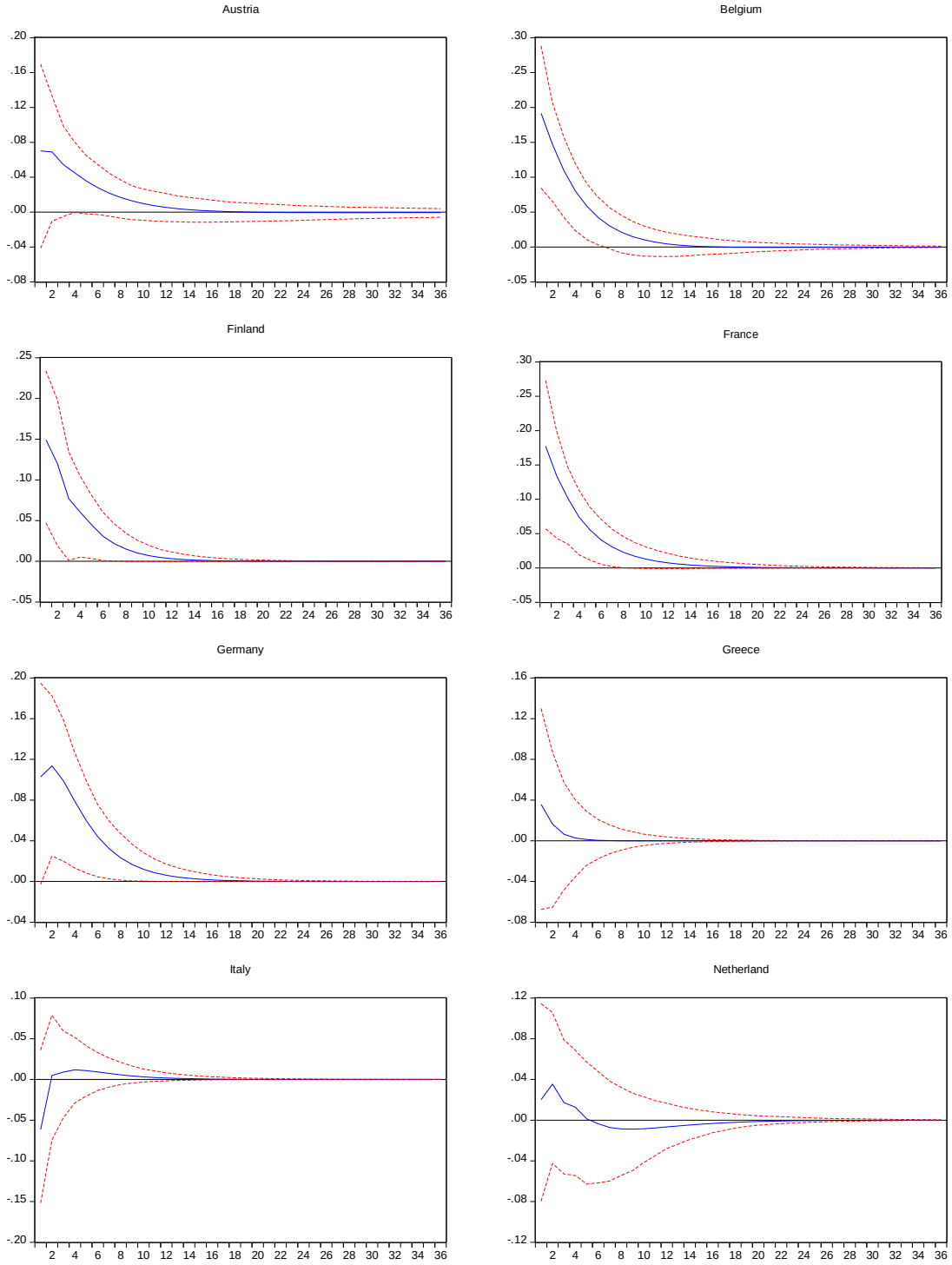


Figure 2. 11: The Spillover Impact of US Policy Shock on Consumer Confidence (SIC)

This figure shows the results after applying alternative information criteria i.e. Schwartz Information Criteria for choosing the appropriate lag length. The graphs indicate impulse responses of consumer confidence to unexpected conventional monetary policy shock for 36 months (3 years). An unanticipated change in monetary policy is identified through a change in the interbank interest rate and their implied futures contracts. The impulse responses are estimated from the FAVAR model with policy instrument and latent factors are extracted from a wide range of macroeconomic and financial variables for each country. The selection of the number of latent factors to include in the FAVAR model decided through a cumulative percentage of a factor representing all variables. The impact of the policy shock is estimated using the Cholesky decomposition by ordering the monetary policy instrument to be the last variable.



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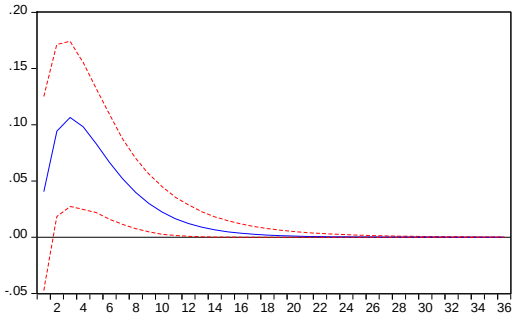

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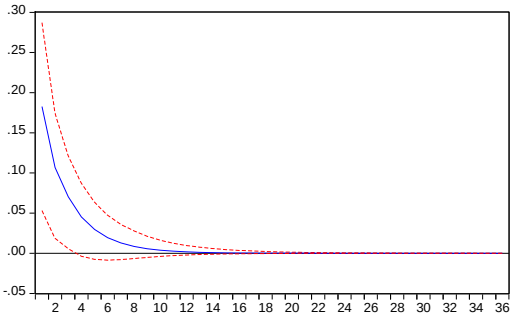

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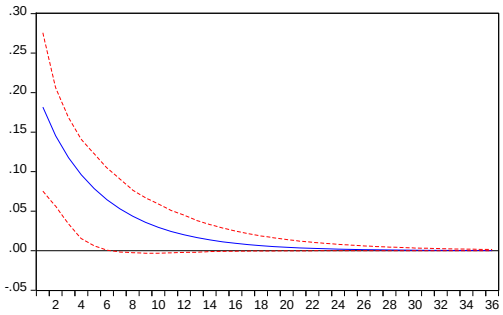

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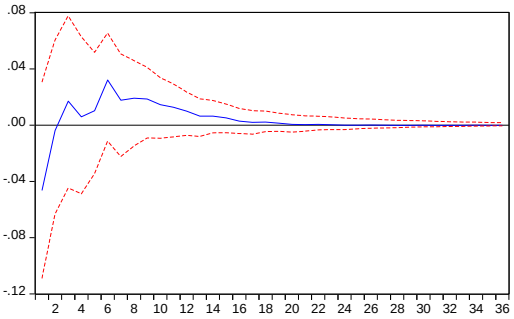
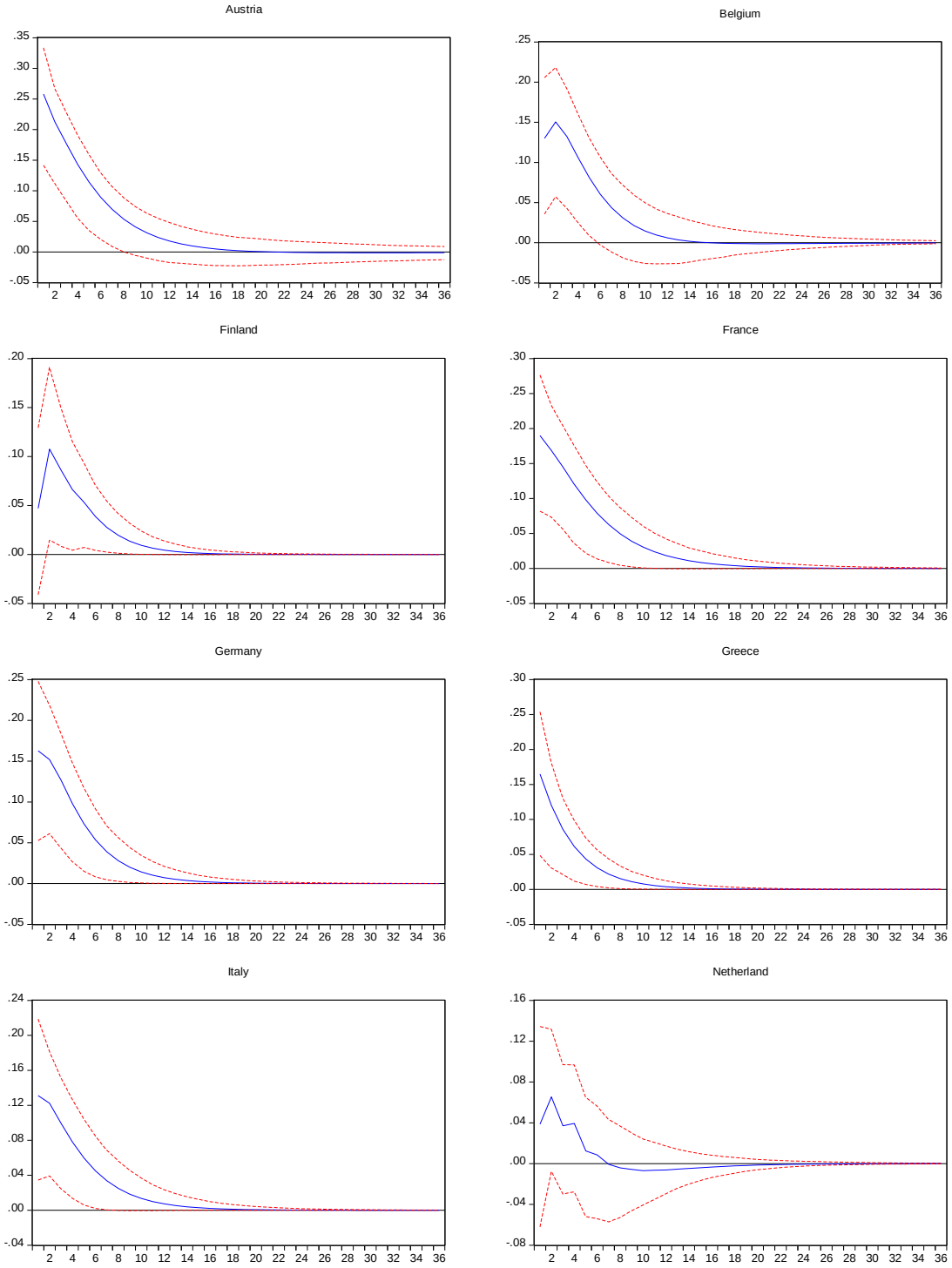
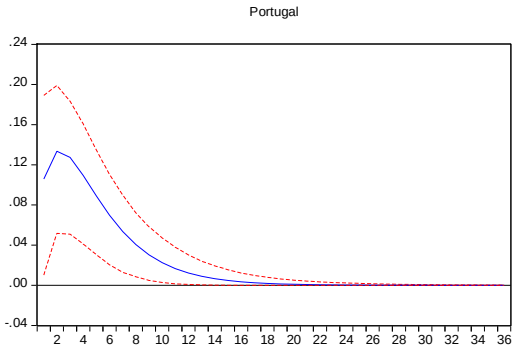


Figure 2. 12: The Spillover Impact of US Policy Shock on Manager Confidence (SIC)

This figure shows the results after applying alternative information criteria i.e. Schwartz Information Criteria for choosing the appropriate lag length. The graphs indicate impulse responses of manager confidence to unexpected conventional monetary policy shock for 36 months (3 years). An unanticipated change in monetary policy is identified through a change in the interbank interest rate and their implied futures contracts. The impulse responses are estimated from the FAVAR model with policy instrument and latent factors extracted from a wide range of macroeconomic and financial variables for each country. The selection of the number of latent factors to include in the FAVAR model decided through a cumulative percentage of a factor representing all variables. The impact of the policy shock is estimated using the Cholesky decomposition by ordering the monetary policy instrument to be the last variable.




Portugal
.24
.20
.16
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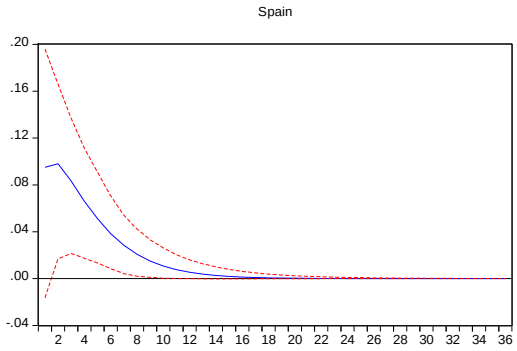
.04
.00
-.04
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36


Spain
.20
.16
.12
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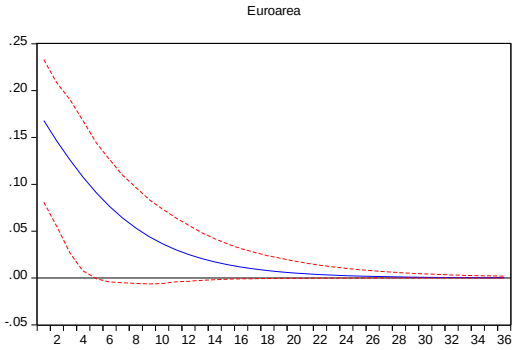
.04
.00
-.04
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36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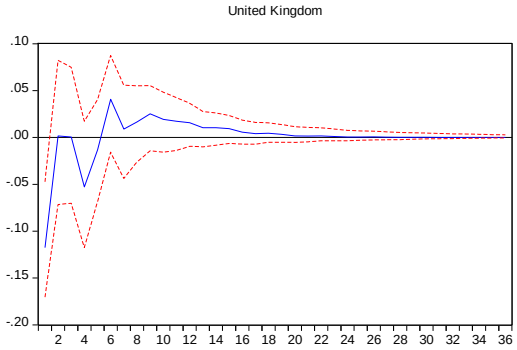
.20
.15
.10
.05
.00
-.05
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36


United Kingdom
.10
.05
.00
-.05
-.10
-.15
-.20
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36

Chapter 2: Tables

Table 2. 1: Descriptive Statistics

Panel A: Confidence indicators						
Country	Indicator	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
EA	CCI	-11.965	7.402	-0.407	3.061	6.004***
	MCI	1.623	8.482	-0.588	3.433	14.150**
Austria	CCI	-1.578	8.302	-0.073	2.368	3.783
	MCI	1.242	9.72	-0.179	3.573	4.112
Belgium	CCI	-5.723	8.431	0.114	3.42	2.057
	MCI	1.06	9.55	-1.131	4.599	69.07
Finland	CCI	12.438	5.889	-0.524	3.021	9.878***
	MCI	8.567	12.579	-0.368	2.714	5.616**
France	CCI	-16.942	8.178	0.111	2.857	0.629
	MCI	-0.275	8.995	-0.529	3.121	10.210***
Germany	CCI	-5.922	9.118	-0.598	3.042	12.875***
	MCI	3.344	8.745	-0.772	3.02	21.458***
Greece	CCI	-44.594	19.268	-0.315	1.871	15.042***
	MCI	1.68	15.075	-0.426	2.053	14.592***
Italy	CCI	-16.665	9.153	-0.494	3.069	8.820**
	MCI	-1.568	8.042	-0.885	3.733	33.068***
Netherlands	CCI	0.054	13.522	-0.01	2.467	2.561
	MCI	5.987	8.448	-0.158	3.621	4.371
Portugal	CCI	-25.788	13.099	-0.183	2.226	6.596**
	MCI	-3.874	6.676	-0.506	2.65	10.311***
Spain	CCI	-13.4	11.579	-0.79	3.388	23.811***
	MCI	1.312	13.604	-0.528	1.93	20.349***
United Kingdom	CCI	-8.623	9.007	-0.479	2.367	17.775***
	MCI	0.83	11.385	-0.827	3.591	41.615***
Panel B: Monetary Policy						
Central Banks		Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
European Central Bank		-0.013	1.054	-1.121	8.36	289.725***
Bank of England		0.024	0.76	-1.45	17.335	2878.720***
Federal Reserve		-0.059	0.679	-0.881	12.476	1122.576***

This table reports the mean, standard deviation, skewness and Kurtosis of the change in the Consumer Confidence Indicator (CCI) and Manager Confidence Indicator (MCI). The sample consist of ten euro area countries and the United Kingdom. For each euro area country the sample period is from January 1999 to December 2016. The sample period for United Kingdom is from January 1990 to December 2016. The *, **, *** indicates the rejection of the null hypothesis of normal distribution at the 10%, 5% and 1% significance levels respectively.

Table 2. 2: Correlation Matrix of Confidence Indicators

Panel A: Consumer Confidence												
	Austria	Belgium	Finland	France	Germany	Greece	Italy	Netherlands	Portugal	Spain	EA	UK
Austria	1											
Belgium	0.661	1										
Finland	0.758	0.702	1									
France	0.671	0.851	0.757	1								
Germany	0.443	0.527	0.399	0.486	1							
Greece	0.492	0.575	0.446	0.612	-0.124	1						
Italy	0.184	0.587	0.364	0.542	0.121	0.563	1					
Netherlands	0.588	0.809	0.707	0.832	0.546	0.542	0.599	1				
Portugal	0.19	0.624	0.459	0.659	0.208	0.589	0.839	0.756	1			
Spain	0.271	0.709	0.507	0.687	0.352	0.489	0.798	0.689	0.82	1		
Euro area	0.565	0.874	0.681	0.884	0.662	0.512	0.729	0.887	0.784	0.856	1	
United Kingdom	0.141	0.467	0.36	0.53	0.164	0.466	0.702	0.491	0.705	0.776	0.654	1
Panel: Manager Confidence												
	Austria	Belgium	Finland	France	Germany	Greece	Italy	Netherlands	Portugal	Spain	EA	UK
Austria	1											
Belgium	0.908	1										
Finland	0.634	0.602	1									
France	0.866	0.906	0.728	1								
Germany	0.757	0.82	0.266	0.623	1							
Greece	0.545	0.626	0.506	0.745	0.268	1						
Italy	0.738	0.816	0.55	0.807	0.536	0.762	1					
Netherlands	0.846	0.823	0.393	0.686	0.744	0.402	0.686	1				
Portugal	0.83	0.822	0.482	0.795	0.608	0.718	0.766	0.788	1			
Spain	0.489	0.603	0.427	0.683	0.292	0.951	0.76	0.356	0.677	1		
Euro Area	0.887	0.951	0.599	0.935	0.778	0.767	0.839	0.754	0.868	0.754	1	
United Kingdom	0.636	0.746	0.404	0.607	0.577	0.63	0.699	0.61	0.622	0.658	0.714	1

Table 2. 3: Variance Decomposition (Response to Domestic Policy Shock)

Horizon in Months	3	6	12	24	36
Panel A: Consumer Confidence					
Austria	0.34081	0.49327	0.57371	0.57958	0.61906
Belgium	0.83016	1.40415	1.63573	1.97704	2.07118
Finland	2.19612	4.5549	5.59804	6.22108	6.53214
France	2.77794	2.85344	2.85389	2.85389	2.85389
Germany	0.40692	0.67905	0.82838	0.83847	0.83848
Greece	1.66975	1.71836	1.71855	1.71855	1.71855
Italy	1.33402	1.31225	1.31091	1.31091	1.31091
Netherlands	1.07289	1.32504	1.4695	1.53436	1.53415
Portugal	0.50594	1.22626	5.83196	6.5134	7.4986
Spain	0.2883	0.30556	0.31024	0.31037	0.31037
Euro area	0.87156	0.90066	0.90095	0.90093	0.90093
United Kingdom	0.32495	0.56017	0.5976	0.6277	0.6268
Panel B: Manager Confidence					
Austria	0.45952	0.94652	1.11135	1.10819	1.1982
Belgium	1.49968	3.23473	3.6725	4.46036	4.66837
Finland	3.40817	5.4605	6.20236	6.42942	6.85593
France	3.14932	3.28349	3.28549	3.28556	3.28556
Germany	0.40988	0.63511	0.77771	0.78809	0.7881
Greece	0.58868	0.63452	0.63473	0.63473	0.63473
Italy	0.51368	0.50359	0.50297	0.50297	0.50297
Netherlands	1.14692	1.28132	1.3894	1.45637	1.45601
Portugal	0.53473	1.19647	5.33277	6.03864	6.90847
Spain	0.53527	0.62994	0.65598	0.65637	0.65637
Euro area	1.15027	1.18977	1.19042	1.19041	1.19041
United Kingdom	0.26605	0.43743	0.46274	0.48248	0.48227

Variance decomposition of confidence indicators explained by domestic monetary policy shock at 3, 6, 12, 24 and 36 months. The values in the table shows portion of forecast error variance due to monetary policy shock. All the values are in percentages. The variance decomposition is estimated using the FAVAR model consisting of five latent factors extracted from the macroeconomic and financial data set and policy instrument.

Table 2. 4: Variance Decomposition (Response to US Policy Shock)

Horizon in Months	3	6	12	24	36
Panel A: Consumer Confidence					
Austria	0.729	0.808	0.844	0.932	1.051
Belgium	0.412	0.450	0.482	0.469	0.474
Finland	0.660	1.080	1.155	1.156	1.156
France	0.681	0.893	0.968	0.973	0.973
Germany	1.823	1.787	1.759	1.765	1.766
Greece	0.028	0.041	0.044	0.044	0.044
Italy	0.159	0.283	0.317	0.318	0.318
Netherlands	0.959	1.456	1.631	1.703	1.703
Portugal	0.711	1.619	1.901	1.909	1.909
Spain	0.255	0.304	0.328	0.329	0.329
Euro area	0.428	0.811	0.997	1.019	1.019
United Kingdom	0.513	1.056	1.426	1.482	1.498
Panel B: Manager Confidence					
Austria	0.743	1.045	1.002	1.192	1.467
Belgium	0.650	1.055	1.136	1.103	1.110
Finland	1.435	2.406	2.583	2.585	2.585
France	1.228	2.145	2.482	2.501	2.501
Germany	1.874	1.812	1.777	1.783	1.784
Greece	0.028	0.044	0.047	0.047	0.047
Italy	0.207	0.373	0.418	0.419	0.419
Netherlands	0.930	0.923	1.059	1.138	1.138
Portugal	0.659	1.473	1.725	1.732	1.732
Spain	0.696	1.027	1.126	1.129	1.129
Euro area	0.574	1.082	1.327	1.356	1.356
United Kingdom	0.622	1.200	1.703	1.826	1.847

Variance decomposition of confidence indicators explained by US monetary policy shock at 3, 6, 12, 24 and 36 months. The values in the table shows portion of forecast error variance due to monetary policy shock. All the values are in percentages. The variance decomposition is estimated using the FAVAR model consisting of five latent factors extracted from macroeconomic and financial data set and policy instrument for the US monetary policy.

Table 2. 5: Domestic Monetary Policy and Consumer Confidence (Conventional Policy)

	Panel A					Panel B						
Country	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	Adj: R^2	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	$\Sigma \mathrm{MP}_{t-i}^{i=n}$	Adj: R^2	ΔAdj: R^2
Euro area	0.1317	4.165***	0.0137	-2.9911**	0.6167	-0.0978	3.9461**	0.5072**	-1.9444	-4.5191***	0.74285	0.1262
	(0.1018)	(1.4432)	(0.2339)	(1.2905)		(0.0950)	(1.3654)	(0.2295)	(1.1941)	<0.0000>		
Austria	0.005*	0.0112	-0.0031	-4.0714*	0.0834	-0.0023	0.0037	0.0499	-0.9507	-5.0485***	0.360612	0.2772
	(0.0029)	(0.0157)	(0.0631)	(2.3862)		(0.0033)	(0.0154)	(0.0546)	(1.8153)	<0.0000>		
Belgium	0.0135***	-0.0141	-0.1492*	-2.2852	0.2965	0.0147***	-0.0666	-0.1114	-1.1294	-5.5619***	0.371314	0.0748
	(0.0043)	(0.0987)	(0.0793)	(1.8458)		(0.0032)	(0.0934)	(0.0740)	(1.8088)	<0.0013>		
Finland	0.0032	0.0015	0.3535***	-2.9238**	0.2797	0.0019	0.0039	0.4412***	-2.505*	-2.1069	0.391596	0.1119
	(0.0028)	(0.0044)	(0.1019)	(1.1069)		(0.0022)	(0.0050)	(0.0806)	(1.2636)	<0.226>		
France	-0.0001	0.0248**	0.6269	-6.2989	0.3635	-0.001	0.0178	1.1475***	-4.2742*	-6.1371***	0.486889	0.1234
	(0.0006)	(0.0102)	(0.2507)	(3.0034)		(0.0006)	(0.0112)	(0.254)	(2.4890)	<0.0001>		
Greece	0.0003	0.0047*	0.0853	-0.3016	0.0189	0.0062***	0.0157	0.1274*	1.8216	-7.7231***	0.257056	0.2381
	(0.0015)	(0.0025)	(0.0792)	(2.1953)		(0.0021)	(0.0097)	(0.0734)	(2.0396)	<0.0003>		
Germany	0.0779	0.0072**	1.094***	-4.6223***	0.5286	-0.3447*	0.0042	1.3003***	-1.1687	-5.193***	0.57392	0.0453
	(0.2050)	(0.0030)	(0.2300)	(1.5499)		(0.1968)	(0.0035)	(0.1800)	(1.5766)	<0.0005>		
Italy	0.001**	0.0001	-0.0747	3.9259**	0.1660	0.001***	0.0002	-0.0803	3.9443**	-0.3281	0.172903	0.0069
	(0.0004)	(0.0005)	(0.1181)	(1.6924)		(0.0004)	(0.0005)	(0.1167)	(1.6667)	<0.2496>		
Netherland	-0.0016	-0.0004***	0.6464***	-5.6251**	0.2514	-0.0004	-0.001**	0.637***	0.1443	-8.648***	0.421131	0.1698
	(0.0019)	(0.0001)	(0.1748)	(2.4271)		(0.0015)	(0.0004)	(0.1547)	(2.4187)	<0.0028>		
Portugal	0.0096***	-0.035	-0.0193	-3.0463**	0.2076	0.0096***	-0.0248	-0.0437	-3.094**	1.4115*	0.250327	0.0427
	(0.0030)	(0.0245)	(0.0491)	(1.4111)		(0.0027)	(0.0233)	(0.0530)	(1.3112)	<0.0731>		
Spain	0.0003***	-0.0012	0.6006***	-4.218**	0.4306	0.0006	-0.0016	0.3715*	-1.8475**	-3.9926***	0.556491	0.1259
	(0.0005)	(0.0044)	(0.1932)	(1.8987)		(0.0004)	(0.0037)	(0.1925)	(0.8738)	<0.0000>		
United Kingdom	0.0006	0.0146**	-0.385	-0.2029	0.1689	0.0005	0.016***	-0.3157	0.2209	0.288***	0.26585	0.0970
	(0.0003)	(0.0054)	(0.3371)	(0.6273)		(0.0003)	(0.0060)	(0.3693)	(0.6545)	<0.0000>		

This table reports the impact of monetary policy on **consumer** confidence from January 1999 to February 2009 for ten euro Area counties. For the United Kingdom (UK) this table shows the results for the period from January 1990 to February 2009. The table shows the results of equation (2.8) and (2.9) in panel A and B respectively. Panel A of this table shows coefficients of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \epsilon_t$). The equation contains the macroeconomic variables consist of consumption growth (CON), the employment rate (EMPL), growth industrial production (IP) and OECD-based recession indicator (REC). Panel B of this table indicates the results of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \sum \beta_5 \Delta r_{d,t-i} + \epsilon_t$) which includes the macroeconomic variables and the sum of the β coefficient of lagged monetary policy variable (MP). The robust standard errors are in the parenthesis and the p-values of Wald Test of joint significance are given inside "< >" for all lags of monetary policy variable. The number of lags determined by using Akaike Information Criteria (AIC). The change in the adjusted R^2 (ΔAdj: R^2) in the last column of this table, reports the increment in model fit after incorporating the monetary policy variable. The asterisks *, ** and *** indicate the level of significance at 10%, 5% and 1% respectively.

Table 2. 6: Domestic Monetary Policy and Manager Confidence (Conventional Policy)

	Panel A					Panel B						
Country	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	Adj: R^2	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	$\Sigma\mathrm{MP}_{t-i}^{i=n}$	Adj: R^2	ΔAdj: R^2
Euro area	0.1741	1.0714	1.0705***	-7.2227***	0.7033	-0.0649	0.7412	1.4457***	-7.0005***	-3.3345**	0.759166	0.0558
	(0.1155)	(1.4724)	(0.3280)	(1.5389)		(0.1399)	(1.7788)	(0.3632)	(1.5570)	<0.0181>		
Austria	0.014***	0.0089	0.0836	-9.923***	0.3921	0.014***	0.009	0.0838	-9.9288***	0.0386	0.386887	-0.0052
	(0.0028)	(0.0218)	(0.0773)	(2.7331)		(0.0028)	(0.0219)	(0.0777)	(2.7325)	<0.3822>		
Belgium	0.0183***	-0.09	0.0567	-3.5402*	0.4587	0.0185***	-0.0918	0.0518	-3.5264*	-0.4338	0.459678	0.0010
	(0.0038)	(0.0668)	(0.0698)	(1.9561)		(0.0038)	(0.0663)	(0.0707)	(1.9457)	<0.3189>		
Finland	0.0032**	0.001536	0.3535***	-2.9238***	0.2931	-0.0024	0.0028	1.0669***	-6.2097*	-2.8842***	0.372363	0.0792
	(0.0016)	(0.0040)	(0.0836)	(0.7915)		(0.0048)	(0.0093)	(0.3026)	(3.4711)	<0.0000>		
France	0.0001	0.0191**	1.2909***	-8.6967***	0.4802	0.006**	0.0357***	0.1627**	-3.4217**	-2.0154***	0.42881	-0.0514
	(0.0006)	(0.0092)	(0.2365)	(2.1245)		(0.0024)	(0.0118)	(0.0769)	(1.7085)	<0.0062>		
Greece	0.0053**	0.003*	0.1746**	-5.6971***	0.2775	0.005**	0.0031*	0.1775**	-5.700***	-0.91	0.427031	0.1496
	(0.0021)	(0.0018)	(0.0805)	(1.7538)		(0.002)	(0.001)	(0.0790)	(1.7505)	<0.5043>		
Germany	0.1500	0.0071**	1.3105***	-4.9849***	0.4123	0.1685	0.0066	1.3699	-5.1469*	-3.9199***	0.585354	0.1731
	(0.2596)	(0.0033)	(0.2233)	(1.8220)		(0.3477)	(0.0049)	(0.1892)	(3.0288)	<0.0083>		
Italy	0.0012**	-0.0009	0.586***	-4.2431***	0.4634	0.0013***	0.0013***	-0.0007	0.5758***	-7.6782**	0.444839	-0.0186
	(0.0005)	(0.0013)	(0.2135)	(1.6071)		(0.0005)	(0.0005)	(0.0013)	(0.2018)	<0.0107>		
Netherland	0.0018	0.0001	0.5787***	-4.6491*	0.2437	0.002	0.0001	0.5204***	0.5773	-1.2612***	0.529384	0.2857
	(0.0018)	(0.0001)	(0.1907)	(2.4831)		(0.0015)	(0.0006)	(0.1498)	(2.0323)	<0.0000>		
Portugal	0.0141***	0.0028	-0.0158	-3.1597***	0.4317	0.0127***	0.0035	-0.0374	-3.0904*	-3.4776***	0.668406	0.2367
	(0.0030)	(0.0268)	(0.0432)	(1.1705)		(0.0030)	(0.0267)	(0.0415)	(1.2110)	<0.0000>		
Spain	-0.0007	0.0043	0.9623***	-2.2891	0.4972	-0.0005	0.006**	0.7254***	0.6733	-3.5885***	0.37005	-0.1271
	(0.0005)	(0.0047)	(0.1608)	(1.8613)		(0.0004)	(0.0029)	(-0.1626)	(0.6939)	<0.0000>		
United Kingdom	0.001**	0.0096	1.8158***	-0.9508	0.3135	0.0008**	0.0209**	1.616***	-0.4434	-3.5885***	0.37005	0.0566
	(0.0004)	(0.0079)	(0.5618)	(0.9761)		(0.0004)	(0.0090)	(0.5333)	(0.9978)	<0.0000>		

This table reports the impact of monetary policy on **manager** confidence from January 1999 to February 2009 for ten euro Area counties. For the United Kingdom (UK) this table shows the results for the period from January 1990 to February 2009. The table shows the results of equation (2.8) and (2.9) in panel A and B respectively. Panel A of this table shows coefficients of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \epsilon_t$). The equation contains the macroeconomic variables consist of growth in consumption (CON), employment rate (EMPL), growth industrial production (IP) and OECD-based recession indicator (REC). Panel B of this table indicates the results of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \sum \beta_5 \Delta r_{d,t-i} + \epsilon_t$) which includes the macroeconomic variables and the sum of the β coefficient of lagged monetary policy variable (MP). The robust standard errors are in the parenthesis and the p-values of Wald Test of joint significance are given inside "< >" for all lags of monetary policy variable. The number of lags determined by using Akaike Information Criteria (AIC). The change in the adjusted R^2 (ΔAdj: R^2) in the last column of this table, reports the increment in model fit after incorporating the monetary policy variable. The asterisks *, ** and *** indicate the level of significance at the 10%, 5% and 1% respectively.

Table 2. 7: US Monetary Policy and Consumer Confidence (Conventional Policy)

	Panel A						Panel B							
Country	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	MP_{t-1}	Adj-R^2	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	MP_{t-1}	$\Sigma\mathrm{MP}_{t-i}^{i=n}$(US)	Adj-R^2	ΔAdj R^2
Euro area	0.137	4.305***	-0.0096	-2.9572**	-0.3113	0.621291	0.1588*	6.2334***	-0.2896	-2.1713	-0.1448	1.1747***	0.722581	0.1013
	(0.1018)	(1.4102)	(0.2370)	(1.2959)	(0.2685)		(0.0834)	(1.2898)	(0.2018)	(1.2809)	(0.1999)	<0.0000>		
Austria	0.005*	0.0114	-0.0017	-4.1078*	0.2399	0.078019	0.005*	0.0115	-0.0005	-4.0499*	0.2497	0.0552	0.070147	-0.0079
	(0.0028)	(0.0156)	(0.0621)	(2.3385)	(0.4865)		(0.0029)	(0.0160)	(0.0588)	(2.3539)	(0.5016)	<0.5016>		
Belgium	0.0139***	-0.0169	-0.157*	-2.2632	-0.6916	0.30722	0.0128***	0.0574	-0.1111	-2.881*	-0.236	1.8762**	0.38939	0.0822
	(0.0041)	(0.0978)	(0.0801)	(1.8166)	(0.4842)		(0.0034)	(0.0833)	(0.0676)	(1.5780)	(0.3879)	<0.0202>		
Finland	0.0025	0.0026	0.3795***	-3.1671***	0.487*	0.293138	0.0037	0.0008	0.4135***	-1.849	0.6394**	1.2321**	0.401776	0.1086
	(0.0016)	(0.0040)	(0.0841)	(0.7957)	(0.2710)		(0.0019)	(0.0042)	(0.0904)	(1.0334)	(0.2663)	<0.0176>		
France	-0.0001	0.0247**	0.6284**	-6.3268**	0.0887	0.35833	-0.0009	0.0463***	0.4881*	-3.9024	0.5883	2.776***	0.453252	0.0949
	(0.0007)	(0.0102)	(0.2522)	(3.0320)	(0.3643)		(0.0007)	(0.0142)	(0.2839)	(3.0765)	(0.3649)	<0.0088>		
Greece	0.0010	0.0051**	0.0945	-0.3122	0.7505	0.026432	0.0006	0.0051**	0.0804	0.0079	0.8821**	0.8733**	0.042661	0.0162
	(0.0014)	(0.0025)	(0.0807)	(2.1877)	(0.4672)		(0.0014)	(0.0025)	(0.0784)	(2.1182)	(0.4237)	<0.4237>		
Germany	0.0816	0.0071**	1.1058***	-4.6545***	-0.1805	0.525839	0.2151	0.0072**	1.207***	-4.132***	-0.0461	0.9104	0.555697	0.0299
	(0.2074)	(0.0031)	(0.2245)	(1.5568)	(0.3598)		(0.2334)	(0.0029)	(0.1849)	(1.4471)	(0.3044)	<0.3044>		
Italy	0.001***	0.0002	-0.0803	3.9443**	-0.3281	0.172903	0.0011**	0.0013	-0.1323	3.07*	-0.4352	-0.421***	0.243242	0.0703
	(0.0004)	(0.0005)	(0.1167)	(1.6667)	(0.2496)		(0.0004)	(0.0008)	(0.1506)	(1.5834)	(0.2202)	<0.0011>		
Netherland	-0.0012	-0.0004**	0.6372***	-5.4847**	-0.8292	0.261821	-0.0004	-0.0003**	0.5833***	-4.5632**	-0.6568	0.9332	0.248487	-0.0133
	(0.0019)	(0.0001)	(0.1700)	(2.4884)	(0.5192)		(0.0024)	(0.0001)	(0.1895)	(2.1874)	(0.5286)	<0.5207>		
Portugal	0.0014	-0.0069	0.7669***	-1.3184**	-0.0363	0.644039	0.0096***	-0.0216	-0.0277	-3.226**	-0.6447	0.3513	0.229235	-0.4148
	(0.0018)	(0.0128)	(0.0714)	(0.6162)	(0.1919)		(0.0029)	(0.0259)	(0.0513)	(1.3650)	(0.3341)	<0.3839>		
Spain	0.0002	-0.0012	0.6015***	-4.2327**	0.0742	0.426141	0.0003	-0.0013	0.5957***	-4.0895**	0.0907	0.1290	0.422615	-0.0035
	(0.0005)	(0.0043)	(0.1957)	(1.9134)	(0.3026)		(0.0005)	(0.0044)	(0.1990)	(1.8511)	(0.3111)	<0.2922>		
United Kingdom	0.0006	0.0134**	-0.331	-0.2281	0.3029	0.170224	0.0007**	0.0177***	-0.4049	0.213	0.4091	-0.3919**	0.2246	0.0544
	(0.0003)	(0.0056)	(0.3390)	(0.6242)	(0.2675)		(0.0003)	(0.0055)	(0.3605)	(0.6405)	(0.3095)	<0.0401>		

The table reports the impact of US monetary policy on **consumer** confidence from January 1999 to February 2009 for ten euro Area counties. For the United Kingdom (UK) this table shows the results for the period from January 1990 to February 2009. The table shows the results of equation (2.10) and (2.11) in panel A and B respectively. Panel A of this table shows coefficients of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \beta_5 \Delta r_{d,t-1}^{domestic} + \epsilon_t$) which includes one-month lag macroeconomic variables and the domestic monetary policy variables (MP). The macroeconomic variables consist of change in consumption (CON), employment rate (EMPL), change in industrial production (IP) and OECD-based recession indicator (REC). Panel B of this table indicates the results of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \beta_5 \Delta r_{d,t-1}^{domestic} + \sum \beta_6 \Delta r_{d,t-i}^{us} + \epsilon_t$) which includes macroeconomic variables, domestic monetary policy and the sum of β coefficients of lagged the US Monetary Policy (MPUS) variable. The change in the adjusted R^2 (ΔAdj: R^2) in the last column of this table, reports the increment in model fit after incorporating the monetary policy variable. The number of lags determined by using Akaike Information Criteria (AIC). The values in parenthesis are robust standard errors and values inside <> are p-values obtained from Wald test of joint significance. The asterisks *, ** and *** indicate the level of significance at the 10%, 5% and 1% respectively

Table 2. 8: US Monetary Policy and Manager Confidence (Conventional Policy

	Panel A						Panel B							
Country	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	MP_{t-1}	Adj-R^2	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	MP_{t-1}	$\Sigma\mathrm{MP}_{t-i}^{i=n}$(US)	Adj-R^2	ΔAdj R^2
Euro area	0.1826	1.2992	1.0326***	-7.1676***	-0.5065	0.710445	-0.0621	6.4753***	0.437*	-5.5776***	-0.2898	2.7165***	0.831255	0.1208
	(0.1167)	(1.3839)	(0.3231)	(1.5372)	(0.3202)		(0.1369)	(1.3696)	(0.2409)	(1.3015)	(0.1969)	<0.0000>		
Austria	0.014***	0.009	0.0838	-9.9288***	0.0386	0.386887	0.0141***	0.0094	0.0936	-9.4512***	0.1193	0.4555***	0.387649	0.0008
	(0.0028)	(0.0219)	(0.0777)	(2.7325)	(0.3822)		(0.0030)	(0.0226)	(0.0756)	(2.6391)	(0.4022)	<0.0000>		
Belgium	0.0185***	-0.0918	0.0518	-3.5264*	-0.4338	0.459678	0.0172***	-0.0135	0.0951	-4.1592**	0.1	1.9923**	0.539707	0.0800
	(0.0038)	(0.0663)	(0.0707)	(1.9457)	(0.3189)		(0.0029)	(0.0555)	(0.0581)	(1.7565)	(0.2772)	<0.0432>		
Finland	0.0008	0.0079	1.0089***	-7.9393**	1.0571*	0.258081	0.002	0.0179	1.1229**	-3.8415	1.1447*	6.3738***	0.449769	0.1917
	(0.0051)	(0.0109)	(0.2828)	(3.2004)	(0.5465)		(0.003)	(0.0115)	(0.2102)	(3.1279)	(0.6203)	<0.0000>		
France	0.0001	0.0191**	1.2906***	-8.6915***	-0.0167	0.616947	-0.0014***	0.0418	1.1298	-7.507***	0.6234***	2.7696***	0.751439	0.1345
	(0.0006)	(0.0092)	(0.2367)	(2.1484)	(0.2775)		(0.0005)	(0.0068)	(0.2457)	(1.5142)	(0.2352)	<0.0000>		
Greece	0.0052**	0.0031*	0.1775**	-5.7003***	0.2296	0.272405	0.0043*	0.0359**	0.1134	-5.1208***	0.5822	0.5384*	0.39206	0.1197
	(0.0022)	(0.0018)	(0.0790)	(1.7505)	(0.5842)		(0.0022)	(0.0160)	(0.0769)	(1.8168)	(0.4517)	<0.0855>		
Germany	0.1685	0.0066	1.3699***	-5.1469*	-0.91*	0.427031	0.0469	0.0088*	1.6279***	1.3788	-0.6172**	3.856***	0.591104	0.1641
	(0.3477)	(0.0049)	(0.1892)	(3.0288)	(0.5043)		(0.2411)	(0.0052)	(0.1672)	(2.1081)	(0.3061)	<0.0000>		
Italy	0.0013***	-0.0007	0.5758***	-4.2095***	-0.6	0.471965	0.002***	-0.0081**	0.6747***	-1.4359	-0.5211*	0.6503***	0.592379	0.1204
	(0.0005)	(0.0013)	(0.2018)	(1.5551)	(0.3679)		(0.0007)	(0.0037)	(0.1956)	(2.0193)	(0.2966)	<0.0000>		
Netherland	0.0021	0.0001*	0.5713***	-4.5353*	-0.6723	0.252157	0.001	0.0006	0.6211***	-4.2126*	-0.4765	1.8967	0.437526	0.0093
	(0.0018)	(0.0001)	(0.1791)	(2.4915)	(0.4067)		(0.0019)	(0.0005)	(0.1699)	(2.3891)	(0.4869)	<0.2658>		
Portugal	0.0141***	0.004	-0.0194	-3.1733***	-0.1697	0.428211	0.0139***	0.0157	-0.011	-3.3386**	-0.1132	0.4656***	0.433015	0.1809
	(0.0030)	(0.0270)	(0.0416)	(1.1845)	(0.3235)		-0.003	-0.0335	-0.0423	-1.2968	-0.3035	<0.0000>		
Spain	-0.0007	0.0045	0.9651***	-2.3314	0.2141	0.496024	-0.0007*	0.0067	0.7916***	-0.6679	0.0284	1.3142***	0.58101	0.0850
	(0.0006)	(0.0046)	(0.1654)	(1.8367)	(0.1987)		(0.0004)	(0.0040)	(0.1490)	(1.4047)	(0.2400)	<0.0000>		
United Kingdom	0.0009**	0.0084	1.8707***	-0.9765	0.3081	0.312196	0.0009**	0.0095***	1.7556***	-0.8938	0.2473	0.7059	0.314395	0.0022
	(0.0004)	(0.008)	(0.5662)	(0.9751)	(0.3952)		(0.0078)	(0.5726)	(0.9753)	(0.3901)	(0.2065)	<0.5517>		

The table reports the impact of US monetary policy on **manager** confidence from January 1999 to February 2009 for ten euro Area counties. For the United Kingdom (UK) this table shows the results for the period from January 1990 to February 2009. The table shows the results of equation (2.10) and (2.11) in panel A and B respectively. Panel A of this table shows coefficients of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \beta_5 \Delta r_{d,t-1}^{domestic} + \epsilon_t$) which includes one-month lag macroeconomic variables and the domestic monetary policy variables (MP). The macroeconomic variables consist of a change in consumption (CON), the employment rate (EMPL), change in industrial production (IP) and OECD-based recession indicator (REC). Panel B of this table indicates the results of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \beta_5 \Delta r_{d,t-1}^{domestic} + \sum \beta_6 \Delta r_{d,t-i}^{us} + \epsilon_t$) which includes macroeconomic variables, domestic monetary policy and the sum of β coefficients of lagged the US Monetary Policy (MPUS) variable. The change in the adjusted R^2 (ΔAdj: R^2) in the last column of this table, reports the increment in model fit after incorporating the monetary policy variable. The number of lags determined by using Akaike Information Criteria (AIC). The values in parenthesis are robust standard errors and values inside <> are p-values obtained from Wald test of joint significance. The asterisks *, ** and *** indicate the level of significance at the 10%, 5% and 1% respectively

Table 2. 9: Domestic Monetary Policy and Consumer Confidence (Unconventional Policy)

	Panel A					Panel B						
Country	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	Adj: R^2	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	$\Sigma \mathrm{MP}_{t-i}^{i=n}$	Adj: R^2	ΔAdj: R^2
Euro area	-0.2455***	-0.0049***	0.7859***	-7.3053***	0.664598	-0.2439***	-0.0049***	0.7965***	-7.2322***	0.1992	0.427719	-0.236879
	(0.0866)	(0.0012)	(0.2666)	(1.1753)		(0.0877)	(0.0012)	(0.2567)	(1.1452)	<0.2340>		
Austria	-0.0049**	0.0083	-0.3965*	-6.9605***	0.431653	-0.0049**	0.0096*	-0.391	-6.953***	0.2896	0.431101	-0.000552
	(0.0024)	(0.0214)	(0.2284)	(1.6544)		(0.0025)	(0.0210)	(0.2225)	(1.6568)	<0.4352>		
Belgium	0.0002	-0.0097	1.0632***	-4.406**	0.377814	-0.0013	0.0022	1.206***	-4.8946***	2.8318***	0.663026	0.285212
	(0.0026)	(0.0599)	(0.2873)	(1.9624)		(0.0024)	(0.0565)	(0.2515)	(1.7646)	<0.0066>		
Finland	0.0012	-0.0142	0.2208	-3.9101**	0.15662	0.0014	-0.0061	0.1391	-3.3583**	3.8953***	0.215155	0.058535
	(0.0019)	(0.0097)	(0.3178)	(1.8010)		(0.0019)	(0.0120)	(0.4207)	(1.6707)	<0.0011>		
France	0.0007**	-0.0266**	0.2852	-1.4778	0.171149	0.0004	-0.0181	0.0998	-1.2025	3.3281***	0.173949	0.0028
	(0.0003)	(0.0127)	(0.3406)	(1.3093)		(0.0003)	(0.0145)	(0.3823)	(1.2577)	<0.0021>		
Greece	0.0057**	-0.0516**	-0.1135	0.6116	0.151127	0.0058**	-0.0515**	-0.1309	0.6115	-0.3052	0.142078	-0.009049
	(0.0022)	(0.0243)	(0.3276)	(6.3179)		(0.0022)	(0.0244)	(0.3273)	(6.2574)	<0.5971>		
Germany	-0.5235	-0.0091	1.7649***	-1.0529	0.454443	-0.5419	-0.0082	1.7668***	-1.0244	0.4064	0.453065	-0.001378
	(0.3825)	(0.0076)	(0.3898)	(1.3697)		(0.3823)	(0.0075)	(0.3901)	(1.3870)	<0.5249>		
Italy	0.0013***	-0.028***	-0.6732	-5.7887***	0.465302	0.0013***	-0.0276***	-0.6277	-5.5779***	0.5333*	0.469427	0.004125
	(0.0004)	(0.0060)	(0.4737)	(2.0019)		(0.0004)	(0.0060)	(0.4988)	(2.0446)	<0.2729>		
Netherland	0.0085***	-0.0969***	0.2668	-6.9096***	0.614578	0.0086***	-0.0972***	0.2559	-6.9403***	-0.1645	0.610283	-0.004295
	(0.0018)	(0.0201)	(0.4093)	(2.2525)		(0.0018)	(0.0202)	(0.4171)	(2.2901)	<0.4758>		
Portugal	0.0008	0.0248	0.4249*	-8.6272***	0.281049	0.0018	0.0183	0.1276	-6.8648***	6.7053	0.272274	-0.008775
	(0.0020)	(0.0162)	(0.2103)	(2.3006)		(0.0024)	(0.0177)	(0.2681)	(2.1116)	<0.1989>		
Spain	-3.0675***	0.0107*	2.365***	-4.6694**	0.34326	-3.156**	0.0112	2.4233***	-4.2821**	0.9082	0.308869	-0.034391
	(1.0779)	(0.0055)	(0.5377)	(2.0103)		(1.1116)	(0.0057)	(0.5608)	(2.0219)	<0.5140>		
United Kingdom	-0.0002	0.0022	0.0478	-9.1145**	0.134873	-0.0002	0.0023	0.0422	-9.0501**	-0.1067	0.125568	-0.009305
	(0.0004)	(0.0051)	(0.5623)	(3.5213)		(0.0004)	(0.0053)	(0.5702)	(3.5988)	<0.4467>		

This table shows impact of monetary policy on **consumer** confidence from March 2009 to December 2016 for ten euro Area counties. For the United Kingdom (UK) this table show the results for the period from January 1990 to February 2009. The table shows results of equation (2.8) and (2.9) in panel A and B respectively. The panel A of this table shows coefficients of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \epsilon_t$). The equation contains the macroeconomic variables consist of the growth in consumption (CON), employment rate (EMPL), growth in industrial production (IP) and OECD-based recession indicator (REC). Panel B of this table indicates the results of equation $Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \sum \beta_5 \Delta r_{d,t-i} + \epsilon_t$ which includes the macroeconomic variables and the sum of the β coefficient of lagged monetary policy variable (MP). The robust standard errors are in the parenthesis and the p-values of Wald Test of joint significance are given inside "< >" for all lags of monetary policy variable. The number of lags determined by using Akaike Information Criteria (AIC). The change in the adjusted R^2 (ΔAdj: R^2) in the last column of this table, reports the increment in model fit after incorporating the monetary policy variable. The asterisks *, ** and *** indicate the level of significance at the 10%, 5% and 1% respectively.

Table 2. 10: Domestic Monetary Policy and Manager Confidence (Unconventional Policy)

	Panel A					Panel B						
Country	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	Adj: R^2	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	$\Sigma\mathrm{MP}_{t-i}^{i=n}$	Adj: R^2	ΔAdj: R^2
Euro area	-0.0091	-0.0005***	0.1065***	-0.625***	0.739926	-0.0097	-0.0005***	0.1139***	-0.5529***	0.1481*	0.745199	0.005273
	(0.0083)	(0.0002)	(0.0328)	(0.1434)		(0.0087)	(0.0001)	(0.0294)	(0.1207)	<0.0845>		
Austria	0.0001	0.0013	-0.0715**	-0.3907*	0.217096	0.0001	0.0016	-0.0703**	-0.389	0.0637*	0.226899	0.009803
	(0.0002)	(0.0021)	(0.0315)	(0.2129)		(0.0002)	(0.0021)	(0.0299)	(0.2133)	<0.0383>		
Belgium	0.001***	0.0023	0.1083***	-0.4087*	0.509015	0.0009***	0.0032	0.1239***	-0.4813**	0.2552	0.538922	0.029907
	(0.0003)	(0.0071)	(0.0255)	(0.2192)		(0.0003)	(0.0070)	(0.0261)	(0.2008)	<0.422>		
Finland	0.0003*	-0.0013	0.1555***	-0.3222*	0.38611	0.0002*	-0.0012	0.1586***	-0.312*	0.3564***	0.388727	0.002617
	(0.0001)	(0.0008)	(0.0397)	(0.1639)		(0.0002)	(0.0008)	(0.0391)	(0.1688)	<0.0007>		
France	0.0001***	-0.0007	0.1591***	-0.196	0.44448	0.0001***	-0.0006	0.1601***	-0.1927	0.0499	0.446556	0.002076
	(0.0001)	(0.0020)	(0.0461)	(0.1696)		(0.0001)	(0.0020)	(0.0458)	(0.1663)	<0.0354>		
Greece	0.0002***	0.0011	-0.0215*	0.1168	0.397957	0.0002***	0.0011	-0.0203*	0.1168	0.0208	0.397321	-0.000636
	(0.0000)	(0.0007)	(0.0114)	(0.1237)		(0.0000)	(0.0007)	(0.0107)	(0.1221)	<0.0185>		
Germany	-0.0199	-0.0009	0.1066***	-0.2378**	0.466495	-0.0184	-0.0008	0.1076***	-0.2001	0.1563*	0.411123	-0.055372
	(0.0274)	(0.0006)	(0.0261)	(0.1039)		(0.0258)	(0.0006)	(0.0257)	(0.1033)	<0.0625>		
Italy	0.0001***	-0.0011**	0.0473	-0.0054	0.675361	0.0002***	-0.0014***	0.0524	0.0715	0.2171**	0.721421	0.04606
	(0.0000)	(0.0004)	(0.0388)	(0.1248)		(0.0000)	(0.0005)	(0.0312)	(0.1358)	<0.0138>		
Netherland	0.0004***	-0.005***	0.064	-0.7486***	0.494197	0.0004***	-0.0051***	0.0596	-0.7609***	-0.0662	0.497882	0.003685
	(0.0002)	(0.0017)	(0.0492)	(0.1916)		(0.0002)	(0.0018)	(0.0503)	(0.1945)	<0.0431>		
Portugal	0.0009***	0.0011	0.0242	-0.2752**	0.641204	0.0009***	0.0012	0.0242	-0.2719**	0.0122	0.63728	-0.003924
	(0.0001)	(0.0010)	(0.0193)	(0.1264)		(0.0001)	(0.0010)	(0.0198)	(0.1291)	<0.0351>		
Spain	-0.0785	0.0002	0.071***	-0.2908**	0.257822	-0.082	0.0002	0.0733***	-0.2757**	0.0356	0.265777	0.007955
	(0.0645)	(0.0003)	(0.0245)	(0.1207)		(0.0644)	(0.0003)	(0.0248)	(0.1243)	<0.0235>		
United Kingdom	0.0001	0.0004	0.1599***	-1.0662***	0.323437	0.0000	0.0004	0.1602***	-1.0696***	0.0057	0.315945	-0.007492
	(0.0000)	(0.0004)	(0.0350)	(0.2353)		(0.0000)	(0.0004)	(0.0353)	(0.2373)	<0.0277>		

The table shows impact of monetary policy on **manager** confidence from March 2009 to December 2016 for ten euro Area counties. For the United Kingdom (UK) this table show the results for the period from January 1990 to February 2009. The table shows results of equation (2.8) and (2.9) in panel A and B respectively. The panel A of this table shows coefficients of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \epsilon_t$). The equation contains the macroeconomic variables consist of the growth in consumption (CON), employment rate (EMPL), growth industrial production (IP) and OECD-based recession indicator (REC). Panel B of this table indicates the results of equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \sum \beta_5 \Delta r_{d,t-i} + \epsilon_t$) which includes the macroeconomic variables and the sum of the β coefficient of lagged monetary policy variable (MP). The robust standard errors are in the parenthesis and the p-values of Wald Test of joint significance are given inside "< >" for all lags of monetary policy variable. The number of lags determined by using Akaike Information Criteria (AIC). The change in the adjusted R^2 (ΔAdj: R^2) in the last column of this table, reports the increment in model fit after incorporating the monetary policy variable. The asterisks *, ** and *** indicate the level of significance at the 10%, 5% and 1% respectively.

Table 2. 11: US Monetary Policy and Consumer Confidence (Unconventional Policy)

	Panel A						Panel B							
Country	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	MP_{t-1}	Adj-R^2	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	MP_{t-1}	$\Sigma\mathrm{MP}_{t-i}^{i=n}$(US)	Adj-R^2	Δ Adj R^2
Euro area	-0.299***	-0.006***	0.5757***	-8.8269***	-0.0172	0.728576	-0.3477***	-0.006***	0.7934***	-8.7533***	0.0234	1.6815	0.748717	0.020141
	(0.0939)	(0.0012)	(0.1882)	(0.8888)	(0.2183)		(0.0880)	(0.0012)	(0.2312)	(0.8401)	(0.2080)	<0.1742>		
Austria	-0.0012	-0.0152	-0.6177*	-7.2412***	0.0277	0.361977	-0.0012	-0.0227	-0.5071	-6.3584**	0.2715	1.0509*	0.304091	-0.05788
	(0.0023)	(0.0273)	(0.3471)	(2.3857)	(0.3924)		(0.0021)	(0.0309)	(0.3307)	(2.4105)	(0.3862)	<0.0557>		
Belgium	-0.0014	-0.0321	1.1607***	-4.3124*	0.0694	0.431283	-0.0021	-0.0356	1.336***	-4.8289*	0.0966	2.5829	0.467636	0.036353
	(0.0031)	(0.0481)	(0.2707)	(2.2835)	(0.4041)		(0.0025)	(0.0540)	(0.2704)	(2.4805)	(0.3631)	<0.387>		
Finland	0.0001	-0.0116	-0.0362	-4.929**	0.4557	0.231084	0.0001	-0.0112	-0.0409	-4.9463**	0.4479	4.7141**	0.263709	0.032625
	(0.0032)	(0.0100)	(0.3413)	(1.9024)	(0.4156)		(0.0033)	(0.0105)	(0.3459)	(1.9289)	(0.4125)	<0.0311>		
France	0.001***	-0.0394***	0.1293	-1.1908	0.082	0.303503	0.001***	-0.0397***	0.116	-1.1583	0.0597	5.1272*	0.325107	0.021604
	(0.0004)	(0.0111)	(0.2859)	(1.2722)	(0.4139)		(0.0004)	(0.0112)	(0.2897)	(1.2700)	(0.4220)	<0.059>		
Greece	0.0077***	-0.0463*	-0.785	-9.948	0.3136	0.30859	0.0078***	-0.0463*	-0.7764	-9.9777	0.268	-0.2665	0.296701	-0.01188
	(0.0025)	(0.0266)	(0.4602)	(8.2733)	(0.7945)		(0.0025)	(0.0269)	(0.4704)	(8.3228)	(0.8176)	<0.8310>		
Germany	0.3545	-0.0295***	1.8249***	0.2065	0.0347	0.568925	-0.1432	-0.0283***	2.2759***	-0.1732	0.2623	5.2635***	0.648541	0.079616
	(0.4920)	(0.0095)	(0.3960)	(1.2805)	(0.4014)		(0.5090)	(0.0084)	(0.4627)	(1.4011)	(0.4746)	<0.0000>		
Italy	0.0019***	-0.0306***	-1.7568***	-9.307***	-0.6742*	0.562077	0.002***	-0.0363***	-1.418***	-9.4603***	-0.603*	-0.4248	0.627653	0.065576
	(0.0005)	(0.0082)	(0.5547)	(2.0425)	(0.3714)		(0.0006)	(0.0087)	(0.4934)	(1.7834)	(0.3451)	<0.1698>		
Netherland	0.0109***	-0.0896***	-0.6516	-8.9041***	0.254	0.608417	0.0113***	-0.0897***	-0.7875	-8.9103***	0.1298	-0.816	0.609148	0.000731
	(0.0024)	(0.0236)	(0.5189)	(3.0677)	(0.8457)		(0.0024)	(0.0234)	(0.5674)	(3.0706)	(0.8080)	<0.6417>		
Portugal	-0.0014	0.0424*	0.6558*	-11.117***	0.1289	0.422964	-0.0016	0.0478**	0.5695	-11.878***	-0.0755	-1.3495*	0.441082	0.018118
	(0.002)	(0.0223)	(0.3804)	(2.8676)	(0.5313)		(0.0023)	(0.0231)	(0.3795)	(2.9158)	(0.4973)	(0.7284)		
Spain	-3.978***	0.0139**	2.5008***	-7.6815***	-0.301	0.435813	-4.1239***	0.0151**	2.4772***	-7.858***	-0.4257	-0.8732	0.43937	0.003557
	(1.2229)	(0.0061)	(0.6946)	(2.5545)	(0.8898)		(1.2544)	(0.0065)	(0.6898)	(2.4853)	(0.9098)	(0.6539)		
United Kingdom	0.0004	0.0051	1.8741***	-16.067***	-1.8268***	0.384524	0.001	0.0061	1.8498***	-16.135**	-0.8101	-4.8187	0.284915	-0.09960
	(0.0009)	'(0.0058)	(0.6538)	(4.9377)	(0.6259)		(0.0009)	(0.0057)	(0.5724)	(7.5676)	(1.5943)	<0.3651>		

This table shows spill-over impact of US monetary policy on consumer confidence in each country from March 2009 to December 2016. The table shows the results of equation (2.10) and (2.11) in panel A and B respectively. Panel A of this table shows coefficients of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \beta_5 \Delta r_{d,t-1}^{domestic} + \epsilon_t$) which includes one-month lag macroeconomic variables and the domestic monetary policy variables (MP). The macroeconomic variables consist of the growth in consumption (CON), employment rate (EMPL), growth in industrial production (IP) and OECD-based recession indicator (REC). Panel B of this table indicates the results of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \beta_5 \Delta r_{d,t-1}^{domestic} + \sum \beta_6 \Delta r_{d,t-i}^{us} + \epsilon_t$) which includes macroeconomic variables, domestic monetary policy and the sum of β coefficients of lagged the US Monetary Policy (MPUS) variable. The change in the adjusted R^2 (ΔAdj: R^2) in the last column of this table, reports the increment in model fit after incorporating the monetary policy variable. The number of lags determined by using Akaike Information Criteria (AIC). The values in parenthesis are robust standard errors and values inside <> are p-values obtained from Wald test of joint significance. The asterisks *, ** and *** indicate the level of significance at the 10%, 5% and 1% respectively.

Table 2. 12: US Monetary Policy Impact and Manager Confidence (Unconventional Policy)

	Panel A						Panel B							
Country	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	MP_{t-1}	Adj-R^2	CON_{t-1}	EMPL_{t-1}	IP_{t-1}	REC_{t-1}	MP_{t-1}	$\Sigma\mathrm{MP}_{t-i}^{i=n}$(US)	Adj-R^2	ΔAdj R^2
Euro area	-0.0173*	-0.0005***	0.1405***	-0.6758***	0.0078	0.815067	-0.018**	-0.0006***	0.1366***	-0.67***	0.0018	-0.0461	0.81878	0.003713
	(0.0080)	(0.0001)	(0.0193)	(0.1184)	(0.0233)		(0.0077)	(0.0001)	(0.0194)	(0.1216)	(0.0243)	<0.0310)		
Austria	0.0003	0.0012	-0.101***	-0.3794	0.0094	0.207671	0.0003	0.0014	-0.0982**	-0.3694	0.0039	-0.0425	0.198764	-0.00891
	(0.0003)	(0.0026)	(0.0377)	(0.2698)	(0.0378)		(0.0002)	(0.0026)	(0.0381)	(0.2657)	(0.0404)	<0.0830>		
Belgium	0.001***	-0.0011	0.1358***	-0.3506	0.0472	0.681567	0.0011***	-0.0015	0.1454***	-0.3944*	0.038	0.075	0.675687	-0.00588
	(0.0002)	(0.0063)	(0.0271)	(0.2160)	(0.0673)		(0.0003)	(0.0064)	(0.0297)	(0.2340)	(0.0688)	<0.3168>		
Finland	0.0003	-0.0008	0.1455***	-0.5753***	-0.0474	0.593221	0.0004**	-0.001	0.1298***	-0.5764***	-0.0579	-0.256	0.584597	-0.00862
	(0.0002)	(0.0008)	(0.0412)	(0.1739)	(0.0457)		(0.0002)	(0.0009)	(0.0402)	(0.1809)	(0.0439)	<0.1382>		
France	0.0002***	-0.0018	0.19***	-0.2351	-0.035	0.641041	0.0002***	-0.0018	0.1863***	-0.2262	-0.0411	-0.0376	0.637457	-0.00358
	(0.0001)	(0.0020)	(0.0409)	(0.1781)	(0.0417)		(0.0001)	(0.0021)	(0.0407)	(0.1755)	(0.0436)	<0.0590>		
Greece	0.0002***	0.0003	-0.052***	-0.0385	0.0025	0.402479	0.0002***	0.0004	-0.0505***	-0.0436	-0.0054	-0.0463**	0.415812	0.013333
	(0.0001)	(0.0007)	(0.0179)	(0.1642)	(0.0255)		(0.0001)	(0.0007)	(0.0176)	(0.1655)	(0.0260)	<0.0200>		
Germany	0.0474	-0.0024***	0.1093***	-0.1549	0.0031	0.549872	0.0292	-0.0024***	0.1442***	-0.1716	-0.0038	0.8223***	0.705673	0.155801
	(0.0311)	(0.0008)	(0.0239)	(0.1116)	(0.0352)		(0.0344)	(0.0005)	(0.0290)	(0.0952)	(0.0350)	<0.0000>		
Italy	0.0002***	-0.0014**	0.0281	-0.0719	0.03	0.732345	0.0002***	-0.002***	0.0362	-0.0605	0.009	-0.454***	0.836857	0.104512
	(0.0000)	(0.0006)	(0.0472)	(0.1174)	(0.0301)		(0.0000)	(0.0006)	(0.0411)	(0.1189)	(0.0282)	<0.0000>		
Netherland	0.0005***	-0.0044***	0.0884*	-0.8604***	0.0101	0.621419	0.0005***	-0.0044***	0.085	-0.8605***	0.007	0.7163***	0.612838	-0.00858
	(0.0002)	(0.0016)	(0.0447)	(0.2042)	(0.0713)		(0.0002)	(0.0016)	(0.0462)	(0.2053)	(0.0742)	<0.0002>		
Portugal	0.0009***	-0.0007	0.0377	-0.3231**	-0.0028	0.679023	0.0009***	-0.0002	0.0309	-0.3825**	-0.0188	-0.1054	0.698591	0.019568
	(0.0001)	(0.0012)	(0.0238)	(0.1468)	(0.0337)		(0.0001)	(0.0011)	(0.0243)	(0.1581)	(0.0336)	<0.0658>		
Spain	-0.1518**	0.0005	0.0667**	-0.4923***	-0.0038	0.379798	-0.1536**	0.0005	0.0664**	-0.4945***	-0.0054	-0.011	0.369578	-0.01022
	(0.0719)	(0.0003)	(0.0325)	(0.1397)	(0.0219)		(0.0727)	(0.0003)	(0.0327)	(0.1387)	(0.0226)	<0.0275>		
United Kingdom	0.0001	0.0146***	-0.4112	-9.3996**	-0.8966	0.136773	0.0014	0.0138**	-0.189	-6.2135	1.5753	-2.179***	0.136413	-0.00036
	(0.0007)	(0.0053)	(0.6454)	(4.4047)	(0.5386)		(0.0012)	(0.0059)	(0.7408)	(3.9369)	(1.8872)	<0.0042>		

This table shows spill-over impact of US monetary policy on manager confidence in each country from March 2009 to December 2016. The table shows the results of equation (2.10) and (2.11) in panel A and B respectively. Panel A of this table shows coefficients of the equation ($Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \beta_5 \Delta r_{d,t-1}^{domestic} + \epsilon_t$) which includes one-month lag macroeconomic variables and the domestic monetary policy variables (MP). The macroeconomic variables consist of change in consumption (CON), employment rate (EMPL), change in industrial production (IP) and OECD-based recession indicator (REC). Panel B of this table indicates the results of the equation $Conf_t = \alpha + \beta_1 CON_{t-1} + \beta_2 EMPL_{t-1} + \beta_3 IP_{t-1} + \beta_4 REC_{t-1} + \beta_5 \Delta r_{d,t-1}^{domestic} + \sum \beta_6 \Delta r_{d,t-i}^{us} + \epsilon_t$ which includes macroeconomic variables, domestic monetary policy and the sum of β coefficients of lagged the US Monetary Policy (MPUS) variable. The change in the adjusted R^2 (ΔAdj: R^2) in the last column of this table, reports the increment in model fit after incorporating the monetary policy variable. The number of lags determined by using Akaike Information Criteria (AIC). The values in parenthesis are robust standard errors and values inside <> are p-values obtained from Wald test of joint significance. The asterisks *, ** and *** indicate the level of significance at the 10%, 5% and 1% respectively.

Table 2. 13: Summary of Results

	Panel A				Panel B			
	Conventional Policy Period				Unconventional Policy Period			
	Domestic Monetary Policy		US Monetary Policy		Domestic Monetary Policy		US Monetary Policy	
Country	Consumer	Manager	Consumer	Manager	Consumer	Manager	Consumer	Manager
Euro area	-***	-**	+***	+***		+*		
Austria	-***			+***		+*	+*	
Belgium	-***		+**	+**	+***			
Finland		-***	+**	+***	+***	+***	+**	
France	-***	-***	+***	+***	+***		+*	
Greece	-***		+**	+*				-**
Germany	-***	-***		+***		+*	+***	+***
Italy		-**	-***	+***	+*	+**		-***
Netherlands	-***	-***						+***
Portugal	+*	-***		+***			-*	
Spain	-***	-***		+***				
United Kingdom	+***	-***	-**					-***

This table summarises the results of the second chapter. The positive (**+**) and negative (**-**) signs indicate the positive and negative impact of the domestic and the US monetary policy on consumer and manager confidence in the United Kingdom and the euro area respectively. Panel A shows the impact during the conventional policy period (1999-2008) and the panel B contains the results for the unconventional policy periods (2008-2016). The asterisks*, ** and *** indicates the level of significance at the 10%, 5% and 1% respectively.

Appendix A:

Appendix A 1: Variables and Transformation Process

S. N	Category	Name	Code
1	Employment	LFS: ILO UNEMPLOYMENT RATE - GREAT BRITAIN, ALL SADJ*	**1**
2		LMT: ECONOMIC INACTIVITY RATE: UK: ALL: AGED 25-34: %: SA*	**2**
3		LMT: ECONOMIC INACTIVITY RATE: UK: ALL: AGED 35-49: %: SA*	**2**
4		LFS: ECONOMIC ACTIVITY RATE, ALL, AGED 16-59/64(DISC.) SADJ*	**2**
5		LFS: EMPLMT.RATE-GREAT BRITAIN, AGED 16-59/64, ALL (DISC.) SADJ*	**2**
6		LFS: IN EMP.: AGED 16+: ANNUAL = SPRING QUARTER(MAR-MAY) VOLA*	**5**
7		LFS: UNEMPLOYED UP TO 6 MONTHS, ALL, AGED 16 AND OVER VOLA*	**5**
8		LFS: EMPLOYEES: ANNUAL = SPRING QUARTER (MAR - MAY) VOLA*	**5**
9		TOTAL CLAIMANT COUNT VOLA*	**5**
10		CLAIMANT COUNT - STANDARDISED INFLOWS - WOMEN (DISC.) VOLA*	**5**
11		CLAIMANT COUNT - STANDARDISED OUTFLOWS - MEN (DISC.) VOLA*	**5**
12		CLAIMANT COUNT - STANDARDISED OUTFLOWS - WOMEN (DISC.) VOLA*	**1**
13		CLAIMANT COUNT - STANDARDISED INFLOWS - MEN (DISC.) VOLA*	**2**
14		CLAIMANT COUNT RATE SADJ*	**2**
15		UNEMPLOYMENT: TOTAL - TOTAL VOLN*	**2**
16		LFS: UNEMPLOYMENT RATE, ALL, AGED 16 & OVER SADJ*	**1**
17		UNEMPLOYMENT CLAIMANT COUNT VOLA*	**5**
18		LFS: UNEMPLOYED: AGED 16+ VOLA*	**2**
19	GOVT FIN	EXPORT VOLUME INDEX: TOTAL (DISC.) VOLN*	**2**
20		IMPORT VOLUME INDEX: TOTAL(DISC.) VOLN*	**2**
21		TAX & PRICES INDEX (TPI) (JAN 1987=100) NADJ*	**5**
22	OUTPUT	INDUSTRIAL CONFIDENCE INDICATOR - UK (DISC.) SADJ	**5**
23		INDUSTRIAL PRODUCTION INDEX - MANUFACTURING VOLA*	**5**
24		INDUSTRY SURVEY: PROD.EXPECTATION FOR MTH.AHEAD-UK(DISC) SADJ	**2**
25		INDUSTRY SURVEY: ORDER BOOK POSITION - UK NADJ	**5**
26		INDUSTRY SURVEY: PROD. EXPECTATION FOR MTH. AHEAD - UK NADJ	**5**
27		INDUSTRY SURVEY: PRODUCTION TRENDS IN RECENT MTH. - UK NADJ	**2**
28		UK INDUSTRY SURVEY: STOCKS OF FINISHED GOODS - UK NADJ	**2**
29		EXPORTS CURN*	**2**
30		INDUSTRIAL PRODUCTION - INTERMEDIATE GOODS (DISC.) VOLA*	**2**
31		INDEX OF PRODUCTION - ALL PRODUCTION INDUSTRIES VOLA*	**2**
32		INDUSTRIAL PRODUCTION INDEX (% MOM, STANDARDIZED) VOLA*	**2**
33		STERLING MEDIUM TERM NOTES-12 MONTH GROWTH RATE (DISC.) CURN	**2**
34		INDUSTRIAL PRODUCTION: INTERMEDIATE GOODS - TOTAL (DISC.) VOLN	**5**
35	Confidence Indicators	CONSUMER CONFIDENCE INDICATOR - UK SADJ	**2**
36		GFK CONSUMER CONFIDENCE INDEX NADJ	**2**
37		CONSUMER CONFIDENCE INDICATOR SADJ	**2**
38		ECONOMIC SENTIMENT INDICATOR VOLA	**2**
39		MONEY STOCK: OTHER BANK RETAIL DEPOSITS IN M4 (DISC.) CURN	**2**

40	Money and Loan	MONEY STOCK: CHANGES: RETAIL SHARES & CASH IN M4 CURN	**5**
41		MONEY STOCK: CHANGES: INT.BEARING BANK DEPS. IN M (DISC.) CURN	**2**
42		MONEY STOCK: RETAIL DEPOSITS AND CASH IN M4: NSA (DISC.) CURN	**1**
43		MONEY STOCK: CHANGES: BLDG.SOCIETY RETAIL SHARES & DEPS(CURN	**5**
44		M0 WIDE MONETARY BASE (END PERIOD): LEVEL (DISC.) CURN	**2**
45		NOTES & COIN - 1 MONTH CHANGE SADJ	**5**
46		NOTES & COIN - 12 MONTH CHANGE SADJ	**5**
47		NOTES AND COIN - 6 MONTH ANNUALISED CHANGE (DISC.) NADJ	**1**
48		M0 - 6 MONTH ANNUALISED CHANGE (DISC.) NADJ	**5**
49		MO: THE WIDE MONETARY BASE: CHANGES (DISC.) CURN	**2**
50		MONEY SUPPLY M4 (EP) (METHOD BREAK JAN 2010) CURA	**2**
51		MONEY STOCK: CHANGES: BLDG.SOCIETY RETAIL SHARES & DEPS(CURN	**1**
52		INTER-BANK: 3 MONTH INTEREST RATE - % PER ANNUM NADJ	**2**
53		3-MONTH MONEY MARKET (MEAN) NADJ	**2**
54		MAJOR BANKS PRIME LENDING RATE (EP) NADJ	**2**
55		STERLING ONE WEEK INTERBANK RATE NADJ	**2**
56		UK STERLING ONE YEAR INTERBANK RATE NADJ	**1**
57		3 MONTHS TREASURY BILLS YIELD (EP) NADJ	**2**
58	Interest Rate	INTEREST RATES: MONEY MARKET RATE NADJ	**2**
59		STERLING ONE MONTH INTERBANK RATE NADJ	**2**
60		CLEARING BANKS BASE RATE - MIDDLE RATE	**2**
61		BOE LIBID/LIBOR 3 MONTH - MIDDLE RATE	**1**
62		BOE LIBID/LIBOR 1 MONTH - MIDDLE RATE	**5**
63		TREASURY BILLS: DISCOUNT RATE 3M NADJ	**1**
64		TREASURY BILL RATE - DISCOUNT, 3 MONTH (EP) NADJ	**5**
65		TREASURY BILL RATE BOND EQU NADJ	**2**
66		INTEREST RATES: GOVERNMENT SECURITIES, TREASURY BILLS NADJ	**5**
67		PREMIUM/DISCOUNT RATE:DISCOUNT,3M TREASURY BILLS,STERLING	**5**
68	Housing	HOUSING STARTS: HOUSING ASSOCIATIONS: GB (DISC.) SADJ	**1**
69		HOUSING STARTS: PRIVATE SECTOR: GB (DISC.) SADJ	**2**
70	Composite Leading Ind.	COMPOSITE LEADING INDICATOR (AMPLITUDE ADJUSTED) (DISC.) NADJ	**2**
71		COMPOSITE LEADING INDICATOR - TREND RESTORED SADJ	**2**
72		COMPOSITE LEADING INDICATOR: 6-MONTHS RATE CHANGE AT ANN NADJ	**1**
73		COMPOSITE LEADING INDICATOR: CONSUMER CONFIDENCE INDICAT SADJ	**1**
74		COMPOSITE LEADING INDICATOR: 3MTH PRIME BANK BILLS(DISC) NADJ	**5**
75		COMPOSITE LEADING INDICATOR: NEW CAR REGISTRATIONS(DISC) VOLA	**1**
76		COMPOSITE LEADING INDICATOR: FTSE-A NON FIN SHARE PRICE NADJ	**2**
77	Price Indexes	AEI: PRIVATE SECTOR INCL. BONUS (%MOM) (DISC.) NADJ*	**2**
78		RPI: ALL ITEMS RETAIL PRICES INDEX NADJ*	**2**
79		RPI: ALL ITEMS RETAIL PRICES INDEX (%YOY) NADJ*	**2**
80		RPI: ALL ITEMS EXC. MIPS & INDIRECT TAXES (%MOM) NADJ*	**2**

81		RPI: ALL ITEMS EXC.MTG.INT.PMTS. & INDIRECT TAXES (RPIY) NADJ*	**5**
82		RPI: PERCENTAGE CHANGE OVER 12 MONTHS- ALCOHOL & TOBACCO NADJ*	**2**
83		AEI - WHOLE ECONOMY INCL. BONUS (DISC.) SADJ*	**5**
84		RPI: CONSUMER DURABLES NADJ*	**5**
85		CPI ALL ITEMS NADJ*	**1**
86		HALIFAX HOUSE PRICE INDEX - ALL HOUSES (SEASONALLY ADJ.) SADJ*	**2**
87		CPI INDEX 00 : ALL ITEMS- ESTIMATED NADJ*	**2**
88		RPI: PERSONAL EXPENDITURE NADJ*	**5**
89		RPI: PERSONAL GOODS & SERVICES (%MOM) NADJ*	**2**
90		CPI INDEX 00 : ALL ITEMS- ESTIMATED PRE-1997 NADJ*	**5**
91		CPI INDEX 07 : TRANSPORT- ESTIMATED PRE-97 NADJ*	**2**
92		CPI INDEX 10 : EDUCATION- ESTIMATED PRE-97 NADJ*	**2**
93		CPI INDEX 01.1 : FOOD NADJ*	**2**
94		CPI INDEX 04.5 : ELECTRICITY, GAS AND OTHER FUELS NADJ*	**2**
95	Exchange Rate and Stock Market	US $ TO £1 NADJ	**5**
96		EXCHANGE RATE END MONTH - JAPANESE YEN TO £1 NADJ	**2**
97		SWISS FRANC NOMINAL EFFECTIVE EXCHANGE RATE NADJ	**6**
98		CANADIAN $ NOMINAL EFFECTIVE EXCHANGE RATE NADJ	**5**
99		FTSE 100 SHARE PRICE INDEX NADJ	**5**
100		FT30 SHARE PRICE INDEX (EP) NADJ	**2**
101		FT30 DIVIDEND YIELD (EP) NADJ	**2**
102		STOCK EXCHANGE TURNOVER: VALUE (DISC.) CURN	**2**

This table provides details of variables included in Principle component analysis in the Factor-autoregressive model for the UK. Similarly, macroeconomic and financial variables for each country downloaded for each country in the sample. The number of variables differs across the countries due to the availability of monthly time series for each country. The transformation coding is similar to Stock and Watson (2004) such as 1= No transformation, 2= first difference of the variable, 4=logarithm of the variable, 5=first difference and logarithm of the variable. We follow Bernanke, Boivin and Eliasz (2005) in transforming the variable before the analysis. The asterisk (*) next to the variable indicates that the variable is one from a slow-moving variable and the variables without an asterisk considered as a fast-moving variable during the analysis. The fast-moving variables contemporaneously respond to the monetary policy decision in the current month. On the other hand, slow-moving variables respond to the monetary policy with a time lag.

Appendix A 2 : Unconventional Policy Announcements Dates

S. No:	Federal Reserve	Bank of England	European Central Bank
1	29 October 2008	09 April 2009	02 April 2009
2	16 December 2008	07 May 2009	07 May 2009
3	28 January 2009	04 June 2009	04 June 2009
4	18 March 2009	09 July 2009	02 July 2009
5	29 April 2009	06 August 2009	06 August 2009
6	24 June 2009	10 September 2009	03 September 2009
7	12 August 2009	08 October 2009	08 October 2009
8	23 September 2009	05 November 2009	05 November 2009
9	16 November 2009	10 December 2009	03 December 2009
10	27 January 2010	07 January 2010	14 January 2010
11	16 March 2010	04 February 2010	04 February 2010
12	28 April 2010	04 March 2010	04 March 2010
13	23 June 2010	08 April 2010	08 April 2010
14	10 August 2010	10 May 2010	10 May 2010
15	21 September 2010	10 June 2010	08 July 2010
16	03 November 2010	08 July 2010	05 August 2010
17	14 December 2010	05 August 2010	02 September 2010
18	26 January 2011	20 September 2010	07 October 2010
19	15 March 2011	07 October 2010	04 November 2010
20	27 April 2011	04 November 2010	02 December 2010
21	22 June 2011	09 December 2010	13 January 2011
22	09 August 2011	13 January 2011	03 February 2011
23	21 September 2011	10 February 2011	03 March 2011
24	02 November 2011	10 March 2011	07 April 2011
25	13 December 2011	07 April 2011	05 May 2011
26	25 January 2012	05 May 2011	09 June 2011
27	13 March 2012	09 June 2011	07 July 2011
28	25 April 2012	07 July 2011	08 August 2011
29	20 June 2012	04 August 2011	06 October 2011
30	01 August 2012	08 September 2011	03 November 2011
31	13 September 2012	06 October 2011	08 December 2011
32	24 October 2012	10 November 2011	12 January 2012
33	12 December 2012	08 December 2011	09 February 2012
34	30 January 2013	12 January 2012	08 March 2012
35	20 March 2013	09 February 2012	04 April 2012
36	01 May 2013	08 March 2012	03 May 2012
37	19 June 2013	05 April 2012	06 June 2012
38	31 July 2013	10 May 2012	05 July 2012
39	18 September 2013	07 June 2012	02 August 2012
40	30 October 2013	05 July 2012	06 September 2012
41	18 December 2013	02 August 2012	04 October 2012
42	29 January 2014	06 September 2012	08 November 2012
43	19 March 2014	04 October 2012	06 December 2012
44	30 April 2014	08 November 2012	10 January 2013
45	18 June 2014	06 December 2012	07 February 2013
46	30 July 2014	10 January 2013	07 March 2013
47	17 September 2014	07 February 2013	04 April 2013
48	29 October 2014	07 March 2013	02 May 2013
49	17 December 2014	04 April 2013	06 June 2013
50	28 January 2015	09 May 2013	04 July 2013
51	18 March 2015	06 June 2013	01 August 2013
52	29 April 2015	04 July 2013	05 September 2013

53	17 June 2015	01 August 2013	02 October 2013
54	29 July 2015	05 September 2013	07 November 2013
55	17 September 2015	10 October 2013	05 December 2013
56	28 October 2015	07 November 2013	09 January 2014
57	16 December 2015	05 December 2013	06 February 2014
58	27 January 2016	09 January 2014	06 March 2014
59	16 March 2016	06 February 2014	03 April 2014
60	27 April 2016	06 March 2014	08 May 2014
61	15 June 2016	10 April 2014	05 June 2014
62	27 July 2016	08 May 2014	03 July 2014
63	21 September 2016	05 June 2014	07 August 2014
64	02 November 2016	10 July 2014	04 September 2014
65	14 December 2016	08 July 2014	02 October 2014
66		04 September 2014	06 November 2014
67		09 October 2014	04 December 2014
68		06 November 2014	22 January 2015
69		04 December 2014	05 March 2015
70		08 January 2015	15 April 2015
71		05 February 2015	03 June 2015
72		05 March 2015	16 July 2015
73		09 April 2015	03 September 2015
74		11 May 2015	22 October 2015
75		04 June 2015	03 December 2015
76		09 July 2015	21 January 2016
77		06 August 2015	10 March 2016
78		10 September 2015	21 April 2016
79		08 October 2015	02 June 2016
80		05 November 2015	21 July 2016
81		10 December 2015	08 September 2016
82		14 January 2016	20 October 2016
83		04 February 2016	08 December 2016
84		17 March 2016	
85		14 April 2016	
86		12 May 2016	
87		16 June 2016	
88		14 July 2016	
89		04 August 2016	
90		15 September 2016	
91		03 November 2016	
92		15 December 2016	

The following unconventional monetary policy dates extracted from Rogers, Scotti and Wrigh (2014) up to April 2014. After April 2014 monetary policy announcement dates identified using Bloomberg World Economic Calendar and verified from central bank websites.

Appendix A 3: Consumer and Manager Confidence Questionnaire

Consumer Confidence:

The consumer confidence indicator is the arithmetic average of the balances (in percentage points) calculated from the answer to the following questions.

1. How do you expect the financial position of your household to change over the next 12 months? It will…
   ++ get a lot better
   + get a little better
   = stay the same
   – get a little worse
   –– get a lot worse
   N do not know

2. How do you expect the general economic situation in this country to develop over next 12 months? It will…
   ++ get a lot better
   + get a little better
   = stay the same
   – get a little worse
   –– get a lot worse
   N do not know

3. How do you expect the number of people unemployed in this country to change over the next 12 months? The number will…
   ++ increase sharply
   + increase slightly
   = remain same
   – fall slightly
   –– fall sharply
   N do not know

4. Over the next 12 months, how likely is it that you save money?
   ++ very likely
   + fairly likely
   – not likely
   –– not at all likely
   N do not know

Source: https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/business-and-consumer-surveys/methodology-business-and-consumer-surveys/national-questionnaires_en.

Manager Confidence:

The business confidence indicator calculated from weighted average of balances on following questions in each sector. The weights are assigned according to contribution of sectors in GDP growth and representativeness of each sector in questions.

Manufacturing Sector:

1. Do you consider your current overall order books to be…?
   + more than sufficient (above normal)
   = sufficient (normal for the season)
   – not sufficient (below normal)

2. Do you consider your current stock of finished products to be…?
   + too large (above normal)
   = adequate (normal for the season)
   – Too small (below normal)

3. How do you expect your production to develop over next 3 months? It will…?
   + increase
   = remain same
   – Decrease

Services Sector:

1. How has your business situation developed over the past 3 months? It has …
   + improved
   = remained unchanged
   – deteriorate

2. How has demand (turnover) for your company's services changed over the past 3 months? It has…
   + increase
   = remain same
   – decrease

3. How do you expect the demand (turnover) for your company's services to change over the next 3 months? It will…
   + increase
   = remain same
   – decrease

Source: https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/business-and-consumer-surveys/methodology-business-and-consumer-surveys/national-questionnaires_en.

Retail Sector:

1. How has (have) your business activity (sales) developed over the past 3 months? It has (They have)…
   + improved (increase)
   = remained unchanged
   – deteriorated (decrease)

2. Do you consider the volume of stock currently hold to be…?
   + too large (above normal)
   = adequate (normal for the season)
   – too small (below normal)

3. How do you expect your business activity (sales) to change over the next 3 months? It (They) will…
   + improved (increase)
   = remained unchanged
   – deteriorated (decrease)

Construction Sector:

1. Do you consider your current overall order book to be…?
   + more than sufficient (above normal)
   = sufficient (normal for the season)
   – not sufficient (below normal)
2. How do you expect your firm's total employment to change over next 3 months? It will…
   + increase
   = remain same
   – decrease

Source: https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/business-and-consumer-surveys/methodology-business-and-consumer-surveys/national-questionnaires_en.

Chapter 3: Federal Reserve's Tone and Uncertainty and Risk Aversion in Global Equity Markets

Abstract

This chapter analyses the impact of the Federal Reserve's (Fed's) communications on investors' risk perception and risk-bearing capacity in the United States, the United Kingdom and the euro area equity markets. We extract the Fed's tone by applying the computational linguistic analysis and the difference between risk-adjusted and risk-free variance of equity market index is then used to measure the market uncertainty and investors' risk aversion. We find the Fed's optimistic (pessimistic) tone decreases (increases) the market uncertainty and investors' risk aversion in global equity markets. Investors also appear to be more responsive to the Fed's communication during recessionary periods and when policy uncertainty is higher than normal. Further analysis reveals that in formulating their expectation and risk tolerance investors are particularly sensitive to the Fed's discussion about the financial market, credit conditions, employment, and economic growth. Finally, investors seem to consider the Fed's conversation about policy stance as an indication of the future path of the policy rate.

Keywords: Fed's Communications, Uncertainty, Risk Aversion, Spillover Effect, Textual Analysis, Topic Modelling

JEL classification: E52, E58, G10, G12,G32

3.1 Introduction

In the wake of the global financial crisis, central banks primarily focused on asset price stability to reduce the uncertainty in financial markets. Central banks in major developed economies decreased the policy rate to near zero lower bound. As a result, central bank communications emerged as the most important instrument to alter investors' risk perception and behaviour in the financial markets.[32] It is therefore imperative to understand the extent to which central bank communications affect the pricing of risk in financial markets to ensure market stabilization and effective implementation of monetary policy.

Investigating the link between monetary policy and equity prices, Bernanke and Kuttner (2005) argue that the monetary policy influences the investors' expected excess returns through either reducing risk perception or increasing their risk tolerance. Several studies find a decline in market uncertainty and risk premium in response to an expansionary policy shock (Chen and Clements, 2007; Gospodinov and Jamali, 2012; Lutz, 2014; Hattori, Schrimpf and Sushko, 2016). In particular, Bekaert, Hoerova and Duca (2013) find that a surprise decrease in the policy rate reduces both market uncertainty and investors' risk aversion in the equity market during the conventional policy period. However, in recent efforts Bekaert, Hoerova and Xu (2020) document that the impact of unexpected policy rate changes on investors' risk perception and appetite fades away after the introduction of unconventional monetary policies. Several studies show that apart from monetary policy decisions (*actions*), the central bank communications (*words*) also play an important role in determining economic activities (Tobback, Nardelli and Martens, 2017; Luangaram and Wongwachara, 2017), term premium (Hansen, McMahon and Tong 2019; Hubert and Labondance 2019), stock returns (Hansen and McMahon, 2016; Schmeling and Wagner, 2019; Apergis and Pragidis, 2019), financial market volatility (Jegadeesh and Wu, 2017; Picault and Renault, 2017), currency risk perception (Dossani, 2019), and inflation expectations (Binder, 2017).

Our study extends the literature by investigating the impact of the Federal Reserve's (Fed's) communications on investors' risk perception and appetite in global equity markets. More specifically, the main objective of this chapter is to analyse the impact of the Fed's tone on market uncertainty and risk aversion in the United States equity market. Using dictionary-based computational content analysis (bag of words method), we first extract the Fed's

[32] Central bank communications are a vital tool to revise investors' expectations, change asset prices and achieve monetary policy objectives. Blinder et al. (2008) document that central bank communications have indeed played a significant role in changing asset prices in financial markets.

optimistic and pessimistic tones from its qualitative communications.[33] Then, we follow Bekaert, Hoerova and Duca (2013) in decomposing the option-based implied volatility into market uncertainty and risk aversion components to analyse the impact of the central bank communications on investors' risk perception and risk-bearing capacity. In addition, we examine the *asymmetric* response of investors' risk appetite to optimism and pessimism in the Fed's tone.[34] For a deeper understanding, we also identify distinct topics in the Fed's communications using the LDA technique and extract the topics' tone from the central bank communications. A topic modelling technique like the LDA identifies different topics along with the relative proportion of each topic using a clustering algorithm on a collection of long text document. Jegadeesh and Wu (2017) argue that the Latent Dirichlet Allocation (LDA) is an effective technique to identify topics along with their relative proportion from the Federal Open Market Committee (FOMC) meeting minutes. The results of Jegadeesh and Wu (2017) show that the Fed's positive discussion about policy, inflation, financial market, and consumption determine changes in equity prices. We extend this literature by investigating the *heterogeneous* impact of the Fed's tone on the market uncertainty and risk aversion.

This chapter also adds to the growing literature by examining the state-dependent response of investors' expectations to central bank communications. Previous studies suggest that investors' response to monetary announcements is stronger during recessions compared to good economic times. For instance, Basistha and Kurov (2008) find that an unexpected change in the policy rate has a larger impact on equity returns during recessions. Kurov (2012) shows that a surprise increase in the future path of the policy rate (path factor) has a positive impact on equity markets during recessions and a negative impact during recoveries.[35] Similarly, the information content of central bank communications may also depend upon the degree of uncertainty regarding future economic and monetary policies. For example, Kurov and Stan (2018) find that monetary policy uncertainty drives the stock market reaction to macroeconomic news. In this study, we seek to examine the difference in response of investors' risk perception and appetite to the Fed's communications during the period when uncertainty regarding future economic and monetary policy is higher than normal. We use the monetary policy uncertainty index of Baker, Bloom and Davis (2016) to identify periods with a higher than normal monetary policy uncertainty.

[33] In particular, we apply Apel and Blix Grimaldi (2012) directional dictionary to estimate the Fed's tone. Hubert and Labondance (2019) find that the directional dictionary effectively gauges the central bank's optimism and pessimism.

[34] Aktar et al. (2011) argue that there exists a "negativity bias" and investors in equity markets may overreact to negative information.

[35] Gurkaynak, Sack and Swanson (2005) provide a more detailed discussion on dividing the Fed's decisions into change in current target rate (target factor) and future path of interest rate (path factor).

The previous studies also provide evidence on the role of the Fed's announcements in changing investors' risk perception in equity markets of other developed nations (Brusa, Savor and Wilson, 2020). Nave and Ruiz (2015), for instance, document a significant reduction in investors' risk aversion in the European stock markets in response to a surprise decrease in the Fed's policy rate. Hayo, Kutan and Neuenkirch (2010) find that information inbound in the Fed's communication influences the European equity market returns. This chapter aims to extend the literature on the spillover effect of the Fed's communication and investigates the impact of the Fed's tone on market uncertainty and investors' risk aversion in the U.K. and the euro area.

Our results show that the Fed's optimism (pessimism) decreases (increases) the market uncertainty and investors' risk aversion across global equity markets. This finding is largely consistent with that of previous studies. For instance, Jegadeesh and Wu (2017) find that a positive Fed's tone decreases the unexpected volatility in the equity market. Similarly, Schmeling and Wagner (2019) show that the European Central Bank's (ECB's) positive tone decreases the credit spreads and volatility risk premia in the euro area. Overall, the results of our study remain statistically significant after controlling for policy rate changes, business cycle variations, macroeconomic fluctuations and the Fed's forecast announcements. Moreover, several robustness checks confirm that the findings of this chapter hold after changing the term weighting scheme, Fed's communication tool, directional lexicon and response window.

This chapter is different from previous studies in several ways. First, unlike Jegadeesh and Wu (2017) which analyses the impact of the Fed's tone on prices and volatility of fixed income assets, this study examines the impact of the Fed's optimism on market uncertainty and risk aversion. Second, our work is also different from Schmeling and Wagner (2019) as we extract the Fed's tone using directional phrases (bigrams), i.e., a combination of noun and adjectives. Schmeling and Wagner (2019) extract the positive tone from the European Central Bank's (ECB's) press conference using merely the frequency of a single word (unigram). However, Picault and Renault (2017) point out that categorizing the tone of central bank communications based on the frequency of a single word may lead to misspecification of context in the text analysis. For example, "high" is a positive word but "high risk" is a negative concept in the context of central bank communication. Thus, in this study, we follow Apergis and Pragidis (2019) and apply directional phrases (bigrams) rather than the frequency of a single word (unigram) to extract the Fed's tone.[36] Third, while many previous studies investigate the impact of a positive tone on the equity market, we examine the impact of both

[36] The phrases are combination of nouns (concepts) and adjectives (tone modifiers) originally developed by Apel and Blix Grimaldi (2012) specifically for the content analysis of central bank communication.

optimistic and pessimistic tones on investors' risk perception and appetite. Akhtar et al. (2011) argue that there exists a "negativity bias" and investors in equity markets may overreact to negative information. Consistent with this notion, our results find that investors are more sensitive to the Fed's pessimism than optimism.

Finally, another distinguishing feature of this chapter is our investigation of the impact of the unique topic's tone on risk perception and risk-bearing capacity in the equity market. We first divide the FOMC discussions into ten distinguished topics using the LDA method and then extracts the topics' tone with the computational content analysis. The results of the Fed topics' tone analysis reveal an interesting finding of the investor response to central bank communications. As expected, the Fed's pessimistic discussion about the financial market, credit conditions and economic growth increases the market uncertainty. However, the Fed's optimism related to the policy stance increases the investors' risk aversion. This suggests that market participants consider the central bank optimism about the policy decision as an indication of future contractionary policy rather than an assessment of future prospering economic conditions. An indication of tightening future monetary policy increases the investors' aversion to risk.

The results of our chapter highlight the importance of signals inbound central bank communications in formulating investors' expectations about future risk and returns. In general, investors perceive the Fed's optimistic (pessimistic) tone as a signal of the good (bad) future economic outlook and financial conditions. The indication of future prospers (worse) economic situation would then decrease (increase) the uncertainty and risk aversion in the equity market. Many previous studies also support this notion that monetary policy announcements contain vital information about future economic conditions (Romer and Romer, 2000; Kohn and Sack, 2003; Kurov, 2010; Melosi, 2016; and Jubinski and Tomljanovich, 2017) which in turn affects the perception of risk in financial markets (Kurov, 2012; Bekaert, Hoerova and Duca, 2013; Nave and Ruiz, 2015; Hahn, Jang and Kim, 2017; and Kaminski and Roberts-Sklar, 2018). In addition, Borio and Zhu (2012) highlight an important "risk-taking" channel through which monetary policy transmits to financial markets i.e., investors change their perception and pricing of risk in response to new information released by the central bank.

The rest of this chapter is organized as follows. Section 3.2 briefly reviews the related literature; section 3.3 contains the identification of key variables and methodology; section 3.4 presents the data and a discussion of the main results; finally, section 3.5 concludes the chapter by summarising the key findings and policy implications.

3.2 Literature Review

This section first discusses the theoretical rationale behind the relationship between central bank communication and risk perception in financial markets. Next, we outline the risk-taking transmission channel of monetary policy through which the central bank can influence the risk-bearing capacity of market participants. Finally, we provide a brief review of the previous empirical studies.

3.2.1 Channels of Central Bank Communications

In this subsection, we first discuss the potential reason for a change in the perception of risk in response to central bank communication. Next, we elaborate on the effect of communication on investors' risk aversion.

3.2.1.1 Signalling Channel

Many studies attempt to understand the reasons for the shift in the financial market's volatility in response to the major macroeconomic announcements. Focusing on monetary policy announcements, the literature suggests that there are two types of signals inbound in central bank communications. Romer and Romer (2000) explain the first, as the "information effect" of the signals about the assessment of near term economic and financial outlook inbound in central bank communications. This information alters the investors' expected risk and returns, subsequently shifting the trading volume and equity prices in the markets.

In a recent study, Nakamura and Steinsson (2018) find that the information related to economic activities drives the impact of the monetary policy shock on the expectations and behaviour of investors. Moreover, the central bank communications also contain a second type of signals indicating the future path of the policy rate. Woodford (2001) documents that the changes in expectations about the future path of the short-term interest rate after a monetary policy announcement affect the perceived risk and returns of an investment. Kohn and Sack (2003) further explain the significance of forwarding guidance and signals about the future macroeconomic outlook in achieving the monetary policy objectives. The "signalling effect" of monetary policy also tends to stabilize the financial markets by providing vital information about the central bank's assessment of future inflation and the output gap (Melosi, 2016).

3.2.1.2 Risk-taking Channel

Some argue that there is a shift in the market participants' risk appetite upon monetary policy announcements which could, in turn, affect risk premium (Borio and Zhu 2012). There are three potential mechanisms through which the risk-taking channel operates. First, an increase in wealth and value of collateral assets in response to a decline in the nominal interest rate

(e.g., an increase in the overall wealth of investors or the value of collateral assets of a firm can lead to a shift in risk appetite). Second, an ambition to achieve a target return after an expansionary monetary policy may increase the risk-bearing capacity of market participant. For instance, a fund manager is ready to take more risk during consistently low policy rate regimes to achieve benchmark returns and earn higher compensation. Third, through increasing transparency and commitment of consistent expansionary policy, central banks reduce the uncertainty in the financial market and subsequently decreases the risk premium.

Bernanke and Kuttner (2005) support the notion that the impact of monetary policy on equity prices is attributed to a shift in either the perceived risk of an investment or the risk-bearing capacity of an investor. Kurov (2012) also points out that central bank announcements contain additional information about the future outlook of the economy, which would affect investors' risk tolerance.[37] Drechsler, Savov and Schnabi (2018) develop a dynamic asset pricing model to describe the effect of change in policy rate on risk aversion and asset prices. In the model two agents with different risk-bearing capacity interact in response to change in nominal interest rate which successively changes the aggregate risk aversion in the economy. As Leombroni et al. (2018) argue, the effectiveness of monetary policy does not solely depend on the control of short-term interest rates but also on central banks' ability to shape market participants' beliefs. Central bank communication has nowadays emerged as a key tool for controlling those beliefs. It is evident that monetary policy affects long-term rates not only through expectations of future short-term rates but also by influencing the risk premium an investor required to hold long-term bonds.

3.2.2 Central Bank Communications and Pricing of Risk

A number of studies have examined the effect of the central bank's decisions and communications on the risk perception and risk-bearing capacity of equity market investors.

3.2.2.1 Impact of Policy Decisions (Actions)

Many studies have investigated the relationship between realized volatility in equity markets and monetary policy decisions. For example, Bomfim (2003) documents that a surprise change in the Fed funds rate leads to higher volatility in the stock market on the day of the Federal Open Market Committee Meetings (FOMC). Chulia, Martins and Dijk (2010) find similar results using high-frequency data, and they also document that positive and negative monetary policy shocks have an asymmetric impact on market volatility. In other words, a surprise increase in the Fed funds rate has more impact on volatility compared to an

[37] Using the technique of Bollerslev, Tauchen and Zhou (2009) to estimate market-wide risk aversion, Kurov (2012) finds that information about the future path of policy and expected free cash flows explains the impact of monetary policy statements on stock returns.

unexpected decrease. Moreover, Kaminska and Roberts-Sklar (2018) find the same results for stock market volatility responses to the policy rate uncertainty in the US, the UK and the euro area.

Option-based implied volatility is one of the most widely used measures to estimate uncertainty in equity markets (Whaley, 2000). Several studies investigate the impact of the Fed's monetary policy decisions on market-wide risk using option-based implied volatility on the S&P 500 index, VIX.[38] Nikkinen and Sahlström (2004), Chen and Clements (2007), and Krieger, Mauck and Chen (2012) investigate the change in the VIX index on the day of the Federal Open Market Committee (FOMC) meeting and find a reduction in implied volatility on policy announcement days. More specifically, the unanticipated change in a macroeconomic announcement in the general and monetary announcement, in particular, increases the implied volatility pre-announcement and decreases the implied volatility on the day of the announcement (Nikkinen and Sahlström, 2004). Nikkinen and Sahlström (2004) confirm that the implied volatility of the S&P 500 index (VIX) increases (decreases) before (on) the day of macroeconomic announcements.[39] Moreover, focusing only on announcements of central banks, Chen and Clements (2007) note a reduction of 2% on the day of committee meetings. Krieger, Mauk and Chen (2012) attribute the decrease in the VIX index on days of FOMC meetings to the decline in the uncertainty in the market. Indeed, Birru and Figlewski (2010) and Hattori, Schrimpf and Sushko (2016) find that monetary policy announcements reduce uncertainty in the financial markets for the conventional monetary policy period and the unconventional monetary policy period, respectively.

The impact of monetary policy on implied volatility depends upon market participants' anticipation about the central bank's decisions. To investigate the impact of anticipated and unanticipated monetary policy announcements on volatility, Gospodinov and Jamali (2012) decompose the change in the policy rate into expected and unexpected components.[40] The results of Gospodinov and Jamali (2012) suggest that the expected change in the Fed funds rate does not cause any significant change in the implied volatility of the S&P 500. However, they also document that a surprise change in the Fed funds rate has a significant impact on implied volatility and volatility risk premium.[41] In other words, an unanticipated change in the

[38] Whaley (2000) argues that the option implied volatility (VIX) index represents the uncertainty in the market as the VIX index is constructed using a wide range of put and call options on the S&P-500 index.
[39] Nikkinen and Sahlström (2004) study the impact of macroeconomic announcements such as consumer price indexes, employment level, producer price index and monetary policy.
[40] Kuttner (2001) uses the Fed funds futures to distinguish expected and unexpected changes in the policy rate.
[41] Gospodinov and Jamali (2012) define volatility risk premium as the difference between implied and realized volatility.

policy rate increases the risk premium on investment and subsequently increases the implied volatility.

Implied volatility indexes such as the VIX index may represent both uncertainty and risk aversion components in the market. Carr and Wu (2009) suggest the difference between risk-neutral expected variance (implied volatility) and expected-realized volatility relates to investors' variance regarding risk averseness. After decomposing VIX into uncertainty and risk aversion components, Bekaert, Hoerova and Duca (2013) find that an expansionary monetary policy shock significantly decreases the uncertainty and risk aversion portions of the VIX index. The results of Bekaert Bekaert, Hoerova and Duca (2013) using the structural vector autoregressive (SVAR) model show that the Fed's conventional expansionary monetary policy shock reduces the risk aversion and uncertainty components of implied volatility.

In addition, using the shadow of the Fed funds rate, Hahn, Jang and Kim (2017) find similar results for unconventional monetary policy for the period after the financial crisis.[42] Using the shadow interest rate to identify the shock during the unconventional policy period, Hahn, Jang and Kim (2017) find that an expansionary monetary policy shock reduces the uncertainty and risk aversion in the equity market in the US. Using the policy rate, Nave and Ruiz (2015) document the similar impact of domestic and global monetary policy on risk aversion in the European stock market.[43] Rompolis (2017) also finds consistent results for the euro area using extensions in the European Central Bank's (ECB) balance sheet to measure monetary policy stance. Overall, the literature suggests that monetary announcements have a significant impact on uncertainty and risk aversion components of implied volatility. Apart from monetary policy decisions, the literature also finds a strong impact of other forms of communication from the central bank such as publication of committee meeting minutes and forecast reports on market volatility.

3.2.2.2 Impact of Central Bank Communications (Words)

As Bernanke (2015, p. 498) suggests central banks communicate 98% of monetary policy through talk and only 2% by policy actions. Using a high-frequency event study methodology, several studies have investigated the impact of central bank's communications (words) such as policy statements, speeches, projection reports, and committee meeting minutes on Treasury yields, stock returns and market volatilities (Gurkaynak, Sack and Swanson, 2005; Andersson, Dillén and Sellin, 2006; Jubinski and Tomljanovich, 2013; El-Shagi and Jung, 2015;

[42] Wu and Xia (2016) suggest that the shadow Fed funds rate provide a suitable proxy for monetary policy stance after the policy rate decreased to near zero lower bound.
[43] Nave and Ruiz (2015) use the Fed funds rate as a proxy for global monetary policy announcements.

Jubinski and Tomljanovich, 2017; and Leombroni et al. 2018).[44] For instance, Jubinski and Tomljanovich (2017) find that FOMC decisions (actions) and publication of FOMC meeting minutes (words) both have a significant impact on the conditional volatility of equity returns in the United States. However, Tsai (2014) states that equity returns respond to only uninformed FOMC statements.[45] In addition, Kohn and Sack (2003) and Reeves and Sawicki (2007) show that volatility in financial markets responds significantly to the release of forecasting reports and committee meeting minutes by the Fed and the BOE. The Fed's communications have a stronger impact on US markets than BOE's communications on UK markets. Moreover, Kohn and Sack (2003) suggest that the forward guidance and signals about future financial market outlook jointly determine the impact of policy statements (words) on asset prices in financial markets.

There are several empirical investigations into the impact of the future path of short-term interest rates reflected in policy statements on asset prices and volatility. For instance, using an intraday event study approach, Gurkaynak, Sack and Swanson (2005) compared the impact of the Fed funds rate shock (Fed's actions) with the effect of path factor shock (Fed's forward guidance) on Treasury and stock prices. They find a change in path factor has a more significant impact on financial asset prices than that of the current rate change. Similarly, El-Shagi and Jung (2015) show that the future path of the short-term interest rate extracted from minutes of the Monetary Policy Committee (MPC) moves the prices of financial assets in the UK. In addition, Apergis (2015) finds that minutes of FOMC meetings have a significant impact on the mean and volatility of asset prices in fixed income, foreign exchange and housing markets.

Using the narrative approach, Rosa (2011) confirms that surprises in communication have made more impact on equity returns and volatility compared to policy rate surprises.[46] In another study, Rosa (2013) also documents the impact of FOMC meeting minutes on prices and volatility in the equity market using a high-frequency event study methodology. In a recent study, Rosa (2016) shows that the Fed policy statements, FOMC meeting minutes, the Fed chair speeches, and testimonies to US Congress influence the prices and volatilities of various assets in financial markets. Considering a wider range of communication events, Rosa (2016)

[44] High frequency event studies estimate the changes in returns and volatility during event windows around the announcements by central banks.

[45] Tsai (2014) uses the methodology of Farka (2011) to categorise the FOMC statements into informed and uninformed groups. The uninformed or unexpected monetary policy statements provide additional information to market participants and create news content compared to informed statements.

[46] To estimate the communication surprise, Rosa (2011) uses the narrative approach and categorise words in policy statements as positive, normal and negative tone.

concludes that the statements and minutes of FOMC, as well as speeches made by the Fed chairman, drive the volatility and trading volume in fixed income and equity markets.

Further studies along this line have focused on the measurement of the central bank's tone from policy statements, chairman speeches, testimonies, FOMC meeting minutes and Summary of Economic Projections (SEP) reports using different content analysis techniques (Lucca and Trebbi, 2009; Amaya and Filbien, 2015; Rosa, 2016; Picault and Renault, 2017; Tadle, 2017; and Schmeling and Wagner, 2019). Focusing on minutes of committee meetings, Boukus and Rosenberg (2006), Dow, Klaes and Montagnoli, (2009), and Jegadeesh and Wu (2017) investigate the impact of the central bank's tone on asset prices. These studies verify that the publication of FOMC minutes three weeks after meetings provide additional detailed information about the economy and financial markets, subsequently affecting the return and volatility in financial markets. In particular, Apergis and Paragidis (2019) find that minutes of FOMC meetings have a significant impact on the mean and volatility of asset prices in fixed income, foreign exchange, and housing markets. There are a number of content analysis techniques available in the literature to quantify the tone from central bank's communication.[47] Using the dictionary-based content analysis method, Schmeling and Wagner (2019) show that the European Central Bank's (ECB) tone captured from press conferences had a significant impact on equity prices, implied volatility, and credit spread in European financial markets even after controlling for fundamental factors. Furthermore, the results of Schmeling and Wagner (2019) also suggest that the tone captured from the Fed chair's testimonies to US Congress moves the equity returns and credit spreads in the US. The semi-annual Fed chair's testimonies have however a very limited number of observations. The main objective of this chapter is to analyse the effect of the Fed's optimistic (pessimistic) tone in FOMC meeting minutes on the investors' risk perception in equity markets of developed economies.

[47] Bholat et al. (2015) describes in detail the various content analysis techniques in the context of central bank communication and it also provides a summary of the findings of previous research in the area.

3.3 Key Variables Measurement and Methodology

In this section, we first explain our dictionary-based content analysis procedure to extract the optimistic (pessimistic) tone from FOMC meeting minutes. Second, we define the Latent Dirichlet Allocation (LDA) a topic modelling technique to identify topics (themes) in the FOMC meetings. Third, we describe our method to decompose the implied volatility index into uncertainty and risk aversion components. Finally, we present our regression model to investigate the impact of the Fed's tone on implied volatility, market uncertainty, and investors' risk aversion in global equity markets.

3.3.1 Quantifying the Central Bank's Tone

Previous studies put forward several content analysis techniques for the central bank's communications. Bholat et al. (2015) provide a comprehensive review of the studies implementing different text analysis techniques in the context of central bank communications. These techniques differ primarily on the subjectivity of the researchers involved. On the one extreme, the narrative approach depends completely upon the subjective interpretation of the researcher. On the other side, a fully automated (computational) content analysis such as the Latent Dirichlet Allocation (LDA), a machine learning content analysis technique, has the lowest human involvement required. The semi-automated methods such as the dictionary-based (bag of the words) approach are in the middle of both extremes.

3.3.1.1 Dictionary-based Content Analysis

We use the bag of words content analysis to extract the Fed's optimism and pessimism from the content of the Fed's communication. Several studies have applied a dictionary-based technique to estimate the central bank communication tone. For example, Jegadeesh and Wu (2017) and Schmeling and Wagner (2019) estimate the central bank tone using a list of negative words in the financial dictionary of Loughran and McDonald (2011). However, Hansen and McMahon (2016) and Luangaram and Wongwachara (2017) extract the central bank tone using the directional dictionary of Apel and Blix Grimaldi (2012). The selection of a suitable lexicon (dictionary) is essential for capturing the tone effectively and avoiding spurious correlations during regression analysis. Unlike Loughran and McDonald' (2011) financial dictionary which was developed primarily to capture the positive and negative tone[48] from corporate reports (10K reports), we use the dictionary of Apel and Blix Grimaldi (2012) that was prepared in the context of central bank communications.

[48] Several studies use the financial dictionary of Loughran and McDonald (2011) to capture the tone from other financial reports. For instance, Thng (2019) captures the managers' optimistic tone from management discussion and analysis section of the corporate prospectuses using Loughran and McDonald (2011) financial dictionary.

Picault and Renault (2017) argue that counting the frequency of words to estimate central bank tone without analysing the context of the word may lead to misinterpretation. For instance, “decrease” is a negative word but “decrease in unemployment” is a positive concept. To mitigate this concern our study follows Apergis and Pragidis (2019) and counts the frequency of the phrases (bigrams) based on the directional words list of Apel and Blix Grimaldi (2012). Specifically, we develop phrases combining positive and negative nouns (concepts) and optimistic and pessimistic adjectives (tone modifiers). A sentence containing an optimistic phrase (a positive noun along with an optimistic adjective) represents optimism in central bank communications. Similarly, a sentence with the pessimistic phrase (a positive noun along with a pessimistic adjective) represents the central bank's pessimistic view about that concept.[49] Next, we count the frequency of the pre-specified directional phrases in each paragraph of the communication document. After counting these phrases in each paragraph, we aggregate the total optimistic and pessimistic phrases in each document. Using Apel and Blix Grimaldi (2012) directional lexicons, Hansen and McMahon (2016) and Hubert and Labondance (2019) extract the Fed's optimistic (pessimistic) tone from FOMC policy statements. Therefore, in this chapter, we follow a similar approach to estimate the Fed's optimistic (pessimistic) tone from FOMC meeting minutes:

$$Optimistic_{(D)} = \sum_{i=1}^{n} Optimistic_{i,(D)} \tag{3.1}$$

$$Pessimistic_{(D)} = \sum_{i=1}^{n} Pessimistic_{i,(D)} \tag{3.2}$$

We aggregate all the optimistic (pessimistic) phrases (*i*) appearing in each FOMC meeting minutes document (D). After that, we calculate the optimistic (pessimistic) tone by dividing the number of optimistic (pessimistic) phrases with the total number of phrases in each FOMC meeting minutes. Next, we also estimate the net optimistic tone by dividing the difference between the number of optimistic and pessimistic phrases with the total number of phrases in each FOMC meeting document:

$$Optimistic\ Tone_{(D)} = \frac{Optimistic_{(D)}}{Total\ Number\ of\ Phrases_{(D)}} \tag{3.3}$$

$$Pessimistic\ Tone_{(D)} = \frac{Pessimistic_{(D)}}{Total\ Number\ of\ Phrases_{(D)}} \tag{3.4}$$

$$Net\ Optimistic\ Tone_{(D)} = \frac{Optimistic_{D} - Pessimistic_{D}}{Total\ Number\ of\ Phrases_{(D)}} \tag{3.5}$$

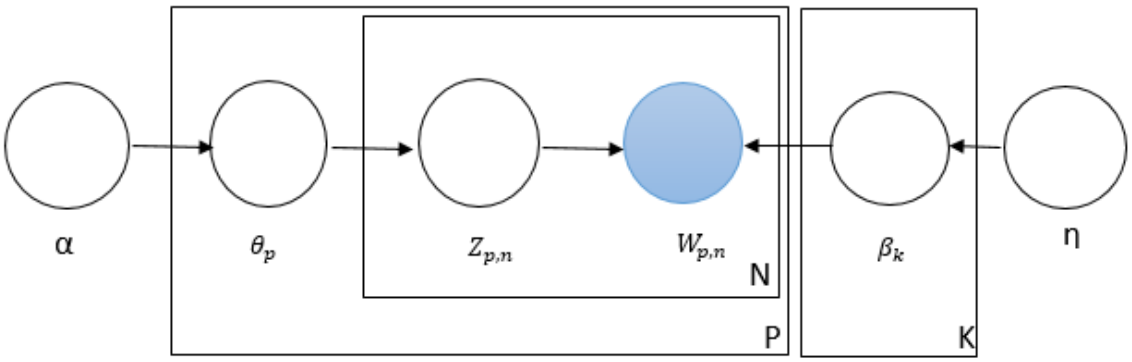
[49] A phrase combining a negative noun and a pessimistic tone modifier will produce an optimistic phrase. For example, “declining risk” is an optimistic phrase.

As all the text documents are in chronological order in our corpus (collection of documents), we estimate a time series measure of the Fed's tone for the period under investigation. To estimate the Fed's optimistic and optimistic tone about a particular topic under the discussion, we extract the unique topics from the Fed's discussion using topic modelling.

3.3.1.2 Topics' Tone

The Fed's communications contain a detailed discussion of committee members' views about a wide variety of topics. Specifically, the FOMC members discuss the current and future economic conditions, the key macroeconomic indicators, exchange rate positions, financial market outlook, trade situations and the rationale for the monetary policy decision and future path of the short-term rate. We use the LDA of Blei, Ng and Jordan (2003) to identify topics (themes) from the discussion in the Fed's communications.[50]

The LDA classifies the large texts into different topics using the latent probabilistic distributions. The process can be explained graphically: the hyperparameters α and η express the Dirichlet distributions which provide topic's distribution over paragraphs θ_p and word's distribution over topics β_K respectively. For the first latent distribution, the LDA assumes that each paragraph is a combination of various topics. The second distribution assumes that each topic is a combination of different words. To estimate the parameters of these two latent distributions, the LDA uses the Bayesian method.



Source: Blei (2012)

The LDA has two main outputs, first, it provides the relative weight of each word (β) which measures the probability of each word appearing in a topic:

[50] Jegadeesh and Wu (2017) suggest that the Latent Dirichlet Allocation is an efficient logarithm-based dimension reduction method to identify unique topics under the discussion in FOMC meetings.

$$\widehat{\beta_{i,s}} \equiv P_{i,s}(Term_1), P_{i,s}(Term_2), \ldots\ldots\ldots, P_{i,s}(Term_n) \quad (3.6)$$

The β is the vector of probabilities for observing each term (*i*) in a specific topic (*s*). For instance, words like employment, labour, factor and wages get higher weights for the employment topic. Similarly, the words such as financial, credit, yield and returns pose higher beta weights for the financial market compared to other topics. The second output of the LDA is known as theta (θ) which estimates the probability of each topic appearing in each paragraph. In other words, the theta measures the proportion of each paragraph allocated to a topic:

$$\widehat{\theta_{p,s}} \equiv P_{p,s}(Topic_1), P_{p,s}(Topic_2), \ldots\ldots\ldots, P_{p,s}(Topic_K) \quad (3.7)$$

Each paragraph (p) in the corpus is a mixture of K topics (s) and the theta (θ) shows the portion of the discussion about a particular topic in each paragraph. More specifically, using term weight (β) we identify the topics under discussion in the Fed's communications and using topic proportion (θ) we measure the relative portion of each paragraph associated with a particular topic:

After identifying unique topics from the Fed's communications, we extract each topic's tone using the Topic-to-Tone approach. Hansen and McMahon (2016) develop this procedure to estimate the topics' tone from the discussion in FOMC policy statements. Similar to Hansen and McMahon (2016), our "Topic to Tone" is a two-step process combining topic modelling and dictionary-based content analysis. In the first step, we identify the unique topics and their relative portion (Theta) in each paragraph of the Fed's communications using the LDA method. Specifically, we identify each paragraph's proportional association with a particular topic using this topic's Theta score.[51] In the second step, we extract the topics' tone by applying the dictionary-based content analysis (as outlined in section 3.3.1.1) to identified paragraphs. In other words, each topics' tone is carefully estimated using a combination of the LDA method and bag-of-words approach.

3.3.2 Measuring Uncertainty and Risk Aversion

This chapter decomposes the option based implied volatility on the equity index into uncertainty and risk aversion components to investigate the impact of the Fed's optimistic (pessimistic) tone on the investors' risk perception and aptitude in the United States (US), the United Kingdom (UK) and the Euro Area (EA). The implied volatility index measures the risk-

[51] Following Hansen and McMahan (2016), we identify paragraphs related to a particular topic if the theta score is greater or equal to a pre-specified threshold.

neutral expected volatility from various put and call European options on the equity index for one month.[52] Carr and Wu (2009) suggest that the Implied Volatility (IV) contains two components i.e. expected conditional volatility (uncertainty) and variance risk premium (risk aversion). We follow Bekaert, Hoerova and Duca (2013) and decompose the IV index into expected conditional volatility and variance risk premium components. The difference between the expected conditional variance and implied variance is a measure of investors' risk aversion in the equity market. To decompose the implied volatility, first, we estimate the monthly realized volatility (RV_t) using a rolling over window of 22 daily returns of the equity index:

$$RV_t = \sum_{i=1}^{22} r_t^2 \tag{3.8}$$

Next, we estimate the expected variance ($\widehat{RV_t}$) using the rolling over lagged daily realized volatility and daily implied volatility for the one-month horizon.[53] The fitted values from equation (3.9) are our measure for an expected variance representing uncertainty (UC) in the equity market:

$$\widehat{RV_t} = \alpha + \beta\, IV_{t-1}^2 + \gamma\, RV_{t-1} + \varepsilon_t \tag{3.9}$$

In the final step, we obtain the variance premium (risk aversion) after subtracting the expected realized variance estimated in the first step from squared implied volatility (IV):

$$RA_t = IV_t^2 - \widehat{RV_t} \tag{3.10}$$

Throughout this study, we use expected conditional variance and variance risk premium as a measure for uncertainty (UC) and risk aversion (RA) respectively. We estimate the implied volatility, uncertainty and risk aversion for a response window "FOMC meeting minutes publishing period" starting from the day when the Fed announces the FOMC meeting minutes and ends on one day before the publication of the next minutes.

3.3.3 Investigating the Impact of Central Bank Communications

We examine the impact of the Fed's tone on market uncertainty and investors' risk aversion using the following regression model. First, we focus on the overall impact of the Fed's tone, where we use Net Optimistic Tone representing FOMC members' optimism over and above pessimistic discussion in the FOMC meetings.

[52] In the United States implied volatility index (VIX) is derived from a large array of S&P-500 put and call options, having maturity in the next 22 trading days.

[53] The implied volatility (IV) represents an annualized monthly percentage calculated after dividing the squared IV with number of months in a year ($IV^2/12$).

$$Y_{i,t} = \alpha_i + \beta_i \, Net \, Optimistic \, Tone_t + \gamma_i \, \mathrm{X}_t + \varepsilon_{i,t} \quad (3.11)$$

We estimate the above regression model separately for each dependent variable (Y_i) relating to the implied volatility (VIX), uncertainty (UC) and risk aversion (RA). We measure the net optimistic tone using computational textual analysis on each document of FOMC meeting minutes. The (X) represents a vector of control variables, including the Fed's policy rate, the growth of industrial production, the unemployment rates, the Fed's forecasts for GDP and inflation. Following Schmeling and Wagner (2019) we control for the policy rate and the Fed's forecasts announcement. In addition, similar to Jegadeesh and Wu (2017) we also include the growth of industrial production and the unemployment rate to control for business cycles and macroeconomic fluctuations. This chapter estimates each variable for the FOMC meeting minutes publishing period. More specifically, the time window (t) starts from the day when FOMC publishes minutes of the meeting and ends on the day before the announcement of the next meeting. The sample period starts from December 2004, before that FOMC published minutes of meeting with irregular intervals and ends in May 2018.

To further investigate the potential asymmetric response of market participants to the Fed's optimism and pessimism we allow both optimistic and pessimistic tones[54] to enter the regression model:

$$Y_{i,t} = \alpha_i + \beta_i \, Optimistic \, Tone_t + \gamma_i \, \mathrm{Pessimistic\ Tone}_t + \delta_i \, X_t + \varepsilon_{i,t} \quad (3.12)$$

To investigate the state-dependent impact of the Fed's tone during recessions, we multiply our Fed's tone with a dummy (D_t^{REC}) which takes value one for NBER-designated recessionary period and zero otherwise.[55]

$$Y_{i,t} = \alpha_i + \beta_i Net \, Opt \, Tone_t * \, D_t^{Rec} + \gamma_i Net \, Optimistic \, \, Tone_t * (1 - D_t^{Rec}) + \, \omega_i \mathrm{X}_t + \varepsilon_{i,t} \quad (3.13)$$

Similarly, we also create two additional dummies to further study the state-dependent impact of the Fed's tone during periods of high economic policy and monetary policy uncertainty. We use the Economic Policy Uncertainty (EPU) and Monetary Policy Uncertainty (MPU) indices of Baker, Bloom and Davis (2016) to identify the periods with high economic and monetary policy uncertainty, respectively. Following the approach of Chau, Deesomsak and Lau (2011), we compare the current month MPU and EPU with their lagged three months rolling averages and identify the period of higher than normal policy uncertainty when the index is higher than

[54] We aggregated the number of optimistic and pessimistic phases in each FOMC meeting using computational context analysis on document containing meeting minutes

[55] The dates for NBER-designated recession period are available at www.nber.org/cycles/cyclesmain.html

its past three months' average. Then, we form two dummies ($D_t^{EPU}$and D_t^{MPU}) taking the value of one for the months when EPU and MPU are higher than their lagged average and zero otherwise. Finally, we interact the EPU (or MPU) dummy with the Fed's tone to assess the impact of central bank communications during episodes of the high ($\beta_{i,t}$) and low ($\gamma_{i,t}$) economic policy and monetary policy uncertainty:

$$Y_{i,t} = \alpha_t + \beta_i Net\ Optimistic\ Tone_t * D_t^{EPU} + \gamma_i Net\ Optimistic\ Tone_t * (1 - D_t^{EPU}) + \omega_i \mathrm{X}_t + \varepsilon_{i,t} \quad (3.14)$$

$$Y_{i,t} = \alpha_t + \beta_i\ Net\ Optimistic\ Tone_t * D_t^{MPU} + \gamma_i Net\ Optimistic\ Tone_t * (1 - D_t^{MPU}) + \omega_i \mathrm{X}_t + \varepsilon_{i,t} \quad (3.15)$$

Next, we estimate the following equations to study the spillover effect of the Fed's communications on implied volatility, market uncertainty and investors' risk aversion in equity markets in the U.K. and the euro area. This study uses the implied volatility index of FTSE-100 and STOXX-50 to estimate the uncertainty and investors' risk aversion for the UK and the euro area respectively.[56] Also, we use the domestic variables to control for business cycle and economic variations for the UK and the euro area. Specifically, to control domestic macroeconomic variations we include in (Z) the growth of industrial production (IP), the growth of gross domestic production (GDP) and the inflation rate in the U.K. and the euro area. We also include the Fed's policy rate to allow for the spillover impact of the Fed's policy decisions while investigating the effect of the tone.

$$Y_{i(UK)\,t} = \alpha_i + \beta_i Net\ Optimistic\ Tone_t + \gamma_{i(UK)}\,\mathrm{Z}_t + \varepsilon_{i,t} \quad (3.16)$$

$$Y_{i(EZ)\,t} = \alpha_i + \beta_i Net\ Optimistic\ Tone_t + \gamma_{i(EA)}\,\mathrm{Z}_t + \varepsilon_{i,t} \quad (3.17)$$

Finally, we also dig a little deeper to understand the information content that drives the investors' expectations and changes the investors' risk perception and appetite. In particular, using the procedure described in section 3.3.1.2 to extract topic tone, we study the impact of each topic's net optimistic tone (s) on market uncertainty and investors' risk aversion. Again, we also analyse the possible asymmetric impact of the topics' optimistic and pessimistic tones.

$$Y_{s,t} = \alpha_s + \beta_s\ Topic's\ Net\ Optimistic\ Tone_{s,t} + \gamma_s\,\mathrm{X}_t + \varepsilon_{s,t} \quad (3.18)$$

$$Y_{s,t} = \alpha_s + \beta_s\ Topic's\ Optimistic\ Tone_{s,t} + \gamma_s \mathrm{Topic's\ Pessimistic\ Tone}_{s,t} + \delta_s X_t + \varepsilon_{s,t} \quad (3.19)$$

[56] The decomposition process of dividing the implied volatility into uncertainty and investors' risk aversion component is given in the section 3.3.2.

Similar to our overall the Fed's overall tone, we extract the topics' optimistic and pessimistic tones using the ratio of optimistic and pessimistic phrases out of the total number of phrases in each communication document.

3.4 Data Description and Key Results

This section first discusses the rationale, features and contents of FOMC meeting minutes and then provides a brief description of other key variables. Next, we present our main empirical results on the impact of the Fed's tone on uncertainty and risk aversion in the global equity markets. Finally, we summarise the results of various robustness checks and additional tests.

3.4.1 Data Description

In this sub-section, we first describe the features of FOMC meeting minutes, the Fed's tone, and topics under the discussion of FOMC members. After that, we present the descriptive statistics of other key variables.

3.4.1.1 Fed's Communications

Like many other central banks, the Fed communicates through several communication tools i.e., policy statements, press conferences, the Federal Open Market Committee (FOMC) meeting minutes, Chairman speeches, Testimonies to Congress, Summary of Economic Projections (SEP) reports, and public speeches. The public speeches include the addresses, media talks, and academic lectures of the Fed's Chair, Vice-Chair, Board of Directors and Regional Reserve Banks' Presidents. Selecting an effective central bank communications tool is important while using a computational linguistic procedure to extract tone. In an event study analysis, Rosa (2016) compares the impact of various Fed's communication tools on volatility in financial markets and finds that policy statements, FOMC meeting minutes, Testimonies to Congress and Chairman's speeches significantly affect the variations in asset prices. Moreover, after comparing the influence of two Chairman's tenures, Rosa (2016) documents that the speeches of Chairman Bernanke have a higher (lower) impact on stock market (bond market) volatility compared to Chairman Greenspan's speeches.

As this study applies the computational content analysis on central bank communications, we need to focus on a well-structured communication tool that is free from the personal attributes of the speaker. The composition of FOMC meeting minutes is well structured and systematic to express the committee members' assessment of current and future economic conditions. Boukus and Rosenberg (2006) point out that the minutes of the committee meetings better describe the view of members and provide a rich source of information about the central bank's assessment for the future economic outlook. The minutes

of the FOMC meeting is the most suitable central bank communication tool to gauge the Fed's views about the future economic and financial conditions. It is well recognised that the FOMC minutes provide an important source of information for market participants and thus they are closely followed in the news. For instance, the Wall Street Journal reports:

''*Federal Reserve officials are debating whether they will need to raise interest rates to levels sufficient to slow down a fast-growing economy to prevent it from overheating, minutes of the central bank's last policy meeting show."*
Source: Wall Street Journal, 17th October 2018.

We prefer FOMC meeting minutes to extract the Fed's tone compared to other alternative communications as the minutes contain each member's detailed view about the economic and financial situation and rationale for policy stance. Other Fed's communication tools on the other hand are not feasible to achieve the objective of this study. For example, the Fed's policy statements are very short compared to minutes and lack detailed information for economic and financial conditions.[57] Furthermore, these policy statements are announced simultaneously with monetary decisions, making it difficult to clearly distinguish the impact of the Fed's actions (decisions) from words (communications). The other alternative Fed's communications such as public speeches of the Fed's Chair and Presidents are also not suitable for analysis due to irregular timings and covering a variety of issues. Furthermore, there are very few numbers of observations for the Fed's Semi-annual testimonies to Congress. Moreover, the Fed started a press conference on the day of the FOMC meeting after April 2011 and there are very few numbers observations.[58]

3.4.1.2 History and Features of FOMC Meeting Minutes

The FOMC is primarily responsible for the development of monetary policy at the Fed. Historically the Fed only publishes the policy actions and the record of policy actions on a periodical basis. These summaries of FOMC meetings were generally referred to as "Policy Records" and published yearly. Initially, the policy records provide a rationale for policy actions in two paragraphs which later extended to five pages after 1965 (Danker and Luecke 2005). Although the committee prepares the exclusive minutes of each meeting comprising the detailed discussion of members, these minutes remained confidential before 1993 to avoid negative consequences of the information inbound in the discussion. It is concerned that the information available in the FOMC meeting minutes may lead to speculative decisions,

[57] In the additional analysis section, we also extract the Fed's tone using policy statements and investigate its impact on uncertainty and risk aversion after controlling for policy decisions.
[58] Using an interaction dummy variable for the period after the Fed started doing press conferences, we also investigate the change in the impact of information in FOMC minutes on market participations' expectations.

imperfect market or damage the objectives of the central bank. Yet, in 1993 the Fed decided to start publishing FOMC meeting minutes.

The Federal Open Market Committee (FOMC) meets eight times on average in a year. The Fed started publishing meeting minutes in February 1993. However, before December 2004, the Fed released minutes with irregular delays and sometimes minutes of the meeting were published after the subsequent FOMC meeting. Jubinski and Tomiljanovich (2017) suggest that FOMC decisions in the subsequent meeting may provide additional new information for market participants before the publication of the previous meeting minutes. Following Jubinski and Tomiljanovich (2017), this chapter focuses only on the minutes of FOMC meetings published after December 2004. From December 2004 and onwards, the Fed publishes meeting minutes after three weeks of each FOMC meeting. Appendix (B1) contains the dates of all FOMC meetings and the publication of their minutes for the period under investigation. The FOMC meeting minutes comprises four major parts. The first part of each meeting minutes (document) outlines the FOMC members' details and assess the previous meeting decisions. The second part provides each member's view about the economic situation and financial outlook. The third section contains the FOMC members' projections for future economic and financial market conditions. Finally, the fourth section elaborates on the rationale for policy stance and the future path of monetary policy.

We collect the dates for FOMC meetings and publication of FOMC minutes from Fed's website. We download the minutes of FOMC meetings from December 2004 to May 2018 in HTML format from the Fed's website.[59] On average, each meeting minutes (document) contains 4000 words and about 10 to 12 pages long. Our sample covers FOMC meetings from December 2004 to May 2018 comprising a total of 108 meetings. As the first part of each document describes the administration details and names of committee members, we eliminate the first part of all the documents before performing content analysis. We arrange all the documents in chronological order and develop a Metadata file that contains all the FOMC minutes documents. Next, we prepare a corpus (collection of documents) comprising 108 FOMC meeting minutes. Afterwards, we strip all the white spaces from the corpus, transfer all the words to the lower cap, eliminate the English stop word, remove punctuations, and numbers.[60] The next step is to stem words to their common linguistic root. Finally, we stem all the unique terms to their common linguistic root using Porter's stemming allocation.[61]

[59] The FOMC meeting minutes are available at www.federalreserve.gov/monetarypolicyfomccalenders.html.
[60] The stop words are the common neutral words such as pronouns, articles, propositions, conjunctions and auxiliary verbs.
[61] The stemming process converts the words to their common linguistic root for example the words such as inflationary, inflation, inflating and inflated has common root "inflat".

Afterwards, we create a matrix of all the unique stemmed terms to form a Document-Term Matrix (DTM). In our DTM, each row represents a document in our case minutes of a particular FOMC meeting and each column represents a unique stemmed term. The values of the matrix indicate the frequency of each unique term in each document (FOMC meeting minutes). Appendix (B3) demonstrates an example to explain each step of the text cleaning process.

The word cloud in Figure (3.1) shows the most frequent words in the FOMC meeting minutes. The font size of the words in the word cloud shows that the most common terms are market, rate, inflation, economy and growth. As we can observe in the appendix (B4) that the terms such as market, inflation, economy, price, financial and growth are among the top ten most frequent words.[62] This confirms the notion that FOMC meeting minutes contain vital new information about economic and financial conditions, driving investors' expectations and changing investors' risk perception and appetite.

3.4.1.3 Fed's Tone

To extract the Fed's tone, this study uses the list of directional phrases combining the positive (negative) nouns and optimistic (pessimistic) adjectives. Our list of phrases is based on a directional dictionary of Apel and Blix Grimaldi (2012) which was primarily developed for central bank communications content analysis. More specifically, we use the phrases combining the concepts (nouns) and tone modifiers (adjectives) to estimate the Fed's optimistic and pessimistic tones. Appendix (B2) contains the complete list of the nouns and adjectives categorizing the Fed's tone into optimistic and pessimistic.

Figure (3.2) presents the graphs of the Fed's net optimistic, optimistic and pessimistic tones from December 2004 to May 2018. It is evident that the Fed's tone is highly pessimistic during the global financial crisis and the sovereign debt crisis in the euro area. Furthermore, there is high pessimism compared to optimism in the conversations of policymakers during the crisis as evident in the graph of net optimistic tone in Figure (3.2). Moreover, Table (3.1) provides the descriptive statistics of the Fed's optimistic and pessimistic tones. The mean and standard deviation show that FOMC members are relatively more pessimistic and there is high variation in the optimism (pessimism) in the FOMC meeting discussions during the sample period.

3.4.1.4 Topics in FOMC Meetings

To better understand the information content of FOMC meeting minutes, we identify distinct topics from the FOMC meeting discussions. Specifically, we perform the LDA using collapsed

[62] The appendix (B4) enlists the fifty most frequent terms along with their relative frequency of appearing in FOMC meeting discussion.

Gibb's sampling to identify ten topics under discussion in FOMC meetings. Selecting the optimal number of topics for the Latent Dirichlet allocation has important implications on the estimated results. The extremely low number of topics leads to a problem in the interpretation of results as topics turn out to be vague. On the contrary choosing, a high number of topics leads to the redundancy of similar concepts in different topics (Goloshchapova et al. 2019).

We use the coherence score of Röder, Both and Hinneburg (2015) to choose the optimal number of topics from FOMC meeting minutes.[63] A high coherence score represents the higher co-occurrence of words in the text and provides the optimal number of topics. Figure (3.3) indicates that the coherence score is highest at the ten topics. For comparison, we also show the top twenty most frequent words along with their beta (probability of appearing) in each topic in the appendix (B5). The FOMC meeting minutes contain discussion about employment, investment, policy rate, growth, financial markets, credit conditions, economic outlook, consumptions, exchange rate, and inflation topics. Figure (3.4) shows the graph of each term's probability of appearing in each topic. Figure (3.5) contains the word clouds of ten topics, the size of fonts representing the frequency of each word in each topic. Figure (3.6) demonstrates the proportion of each topic discussed in FOMC meetings throughout the sampling period. It is evident that the topics' proportion under the discussion in the FOMC meeting changed dramatically after the global financial crisis from growth and policy rate to employment and credit conditions.[64]

Using the topics to tone approach explained in section 3.3.1.2, we estimate the optimistic and pessimistic tones of each topic. Figures (3.7) and (3.8) indicate the net optimistic tone of each topic over the sample period.[65] Comprising of all ten topics in the same graph, Figure (3.7) depicts the change in topic proportional tone throughout the period under the investigation. While figure (3.8) demonstrates the change in proportional tone of each topic in a separate graph during the sampling period. It is evident in Figures (3.7) and (3.8) that during the NBER designated recessionary period the FOMC members' discussion was highly pessimistic about employment, consumption, investments and financial market.

3.4.1.5 Uncertainty and Risk Aversion

To decompose the implied volatility index into uncertainty and risk aversion components, we first estimate the realized monthly variance of the S&P 500 index. We calculate daily realized

[63] Vo (2019) also uses the coherence score to estimate the number of topics while using the LDA on European Central Bank's press conference.
[64] Siklos (2020) describes the changes in the discussion of FOMC meetings over the time.
[65] To estimate the net optimistic tone of each topic, we subtract number of pessimistic phrases from number of optimistic phrases in each FOMC meeting minutes.

volatility using five minutes squared returns on an equity index.[66] For implied volatility in S&P 500, we use the Chicago Board of Trade (CBOT) VIX index. The following equation shows the estimation results for the expected realized variance using daily implied and realized volatility of the S&P 500 index:

$$\widehat{RV}_t = \underset{[0.4316]}{-0.0008} + \underset{[4.138]\ ***}{0.3948\, VIX^2_{t-22}} + \underset{[3.8555]\ ***}{0.3322\, RV_{t-22}} + \varepsilon_t \tag{3.20}$$

The Newey-West t-statistics are given in brackets. The significance of coefficients shows that both lagged realized volatility and implied volatility affects the change in the current volatility of the S&P 500. The fitted values of the estimated RV are a proxy for uncertainty in the market (UC). To measure investors' risk aversion (RA), we subtract the estimated market uncertainty (UC) variable from the squared implied volatility (VIX) index. To investigate the potential spillover effect of the Fed's communications on the equity markets of the United Kingdom (UK) and Euro area (EA), we follow a similar procedure. More specifically we decompose the implied volatility on the FTSE-100 index (VFTSE) and STOXX-50 index (VSTOXX) to estimate market uncertainty and investors' risk aversion in the UK and EA, respectively. Table (3.2) contains the descriptive statistics and Figure (3.12) shows the distribution plots of implied volatility (IV), market uncertainty (UC) and risk aversion (RA) in equity markets of the US, the UK and euro area. One can observe that both uncertainty and risk aversion remained extremely high during the global financial crisis in each region.

3.4.2 Results and Discussion

In this section, we first present the results for the response of the US investors' risk perception and risk appetite to the Fed's tone. Second, we outline the results of the state-dependent response of investors' risk perception and risk-bearing capacity to the Fed's tone. Third, we discuss the spillover impact of the Fed's tone on uncertainty and risk aversion in the United Kingdom and the euro area. Finally, we turn to the results for heterogonous impacts of unique topic's tone on investors' risk perception and appetite. We focus on the "FOMC meeting minutes period" which starts from the day when the Fed announces the FOMC meeting minutes and ends a day before the next meeting minutes published. All the series are standardized to have mean zero and unit standard deviation before investigating the impact.

We control for the other Fed's announcements, economic variations and business cycle effects. To control the monetary policy actions for the period before the global financial crisis, this study uses the Federal Funds Rate. However, the Fed reduced the policy rate to

[66] The five minutes return data is available at the "realized library" of Oxford-Man Institute of Quantitate Finance: https://realized.oxford-man.ox.ac.uk.

near zero lower bound and introduced unconventional measures to stabilize the financial markets. The Fed funds rate does not represent the policy stance after the global financial crisis of 2007-2008. For the period after the policy rate decreased to zero lower bound, we use a shadow interest rate of Wu and Xia (2016). In addition, to control the Fed's other announcements, we use the Fed's projections for Gross Domestic Product (GDP Forecasts) and inflation (INF Forecasts). Furthermore, this study also includes the growth in Industrial Production (IP) to control business cycle variations and the unemployment rate to capture macroeconomic variations.

3.4.2.1 Impact of the Fed's Tone

This study documents that an increase in the Fed's optimism decreases the implied volatility, market uncertainty and investors' risk aversion in the equity market. Panel A of Table (3.3) indicates the results for the impact of the net optimistic tone on the VIX index. These results show that the Fed's optimistic tone decreases the option based implied volatility (VIX) index. The slope coefficient on net optimistic tone is negative and statistically significant at the 5% significance level even after controlling for policy rate decisions, the Fed's forecasts, business cycle and economic variations. The results imply that the central bank's optimistic assessment of current and future financial and economic conditions decreases investors' fear.[67]

Panels B and C show the results for the impact of net optimistic tone on market uncertainty (UC) and investors' risk aversion (RA) respectively. There is a significant decrease in market uncertainty in response to the Fed's optimism. A closer inspection of panel B of Table (3.3) reveals that uncertainty decreases by 0.42% in response to one standard deviation increase in the Fed's optimistic tone. In addition, panel C in Table (3.3) indicates that one standard deviation increase in the Fed's net optimistic tone also decreases the investors' risk aversion (increases the risk-bearing capacity) by 0.38%. However, the impact of the Fed's tone on investors' risk appetite is significant only at the10% level of significance. The adjusted R^2 shows that the Fed's tone defines almost 47% and 15% of the overall variation in market uncertainty and risk aversion, respectively. A comparison of results in panels B and C reveals that the Fed's tone has a relatively higher impact on uncertainty compared to risk aversion.

These results are economically meaningful and consistent with previous studies. For example, Jegadeesh and Wu (2017) find that the Fed's positive tone decreases the unexpected volatility of the S&P 500. Hansen and McMahon (2016) document a decrease in implied volatility in response to the Fed's optimism shown in monetary policy statements. Previous studies also document similar results in other major economies. Apergis and Pragidis

[67] Whaley (2000) argues that the VIX index provides a useful gauge of the investor fear in the equity market.

(2019) find that positivity in the European Central Bank's (ECB's) tone increases the mean and decreases the volatility in major European equity markets. Picault and Renault (2017) discover that equity market volatility decreases in response to ECB's positive tone about economic conditions. Moreover, the results of Schmeling and Wagner (2019) show that the ECB's positive tone decreases the risk premium in the European equity markets. In addition, Adesina (2017) finds that optimism in the Bank of England's (BOE's) monetary committee meeting minutes determines the bond yields and stock returns in the U.K. Hansen, McMahon, and Tong (2019) find that BOE's forecasts for economic indicators (Information Report) carry vital signals for market participants to derive their expectation about future economic conditions.

However, the previous studies express a mixed opinion on the interpretation of the central bank's optimistic and pessimistic tones. On the one hand, some suggest that positivity (optimism) in the central bank's tone is an indication of the future contractionary policy and interpreted as bad news for market participants (Adesina 2017; Neuhierl and Weber 2019). Campbell et al. (2012) distinguish the forward guidance into Odyssean and Delphic in the FOMC statements. The Odyssean forward guidance suggests central bank commitment to the future path of the policy rate. The Delphic forward guidance indicates the forecasts about the macroeconomic fundamentals and potential policy interventions in response to macroeconomic activities. Consistent with the Delphic effect of central bank communications, Hansen, McMahon, and Tong (2019) document that positivity (optimism) in the central bank communications implies future prosperous economic conditions which drive market participants' expectations.

Overall, our results are in line with the signalling and risk-taking effects highlighting the change in risk perception and investors' risk-bearing capacity in response to the central bank's communications. The new information about future economic and financial outlook inbound in the central bank's tone appears to be the primary reason for the effect of communications on equity markets (Romer and Romer 2000). The notion of "Narrative Economics" explained by Shiller (2017) highlights the importance of popular narratives in formatting and spreading expectations in an economy. Our findings highlight the important role of the policy makers' tone in changing investors' expectations and in decreasing uncertainty and risk aversion.

3.4.2.2 Asymmetric Impact of Optimistic and Pessimistic Tones

The results of our investigation into the potential asymmetric effects of the Fed's optimism and pessimism are presented in Table (3.4). As expected, the implied volatility, uncertainty and risk aversion decreases (increases) in response to the Fed's optimistic (pessimistic) tone. Comparative analysis suggests that the Fed's pessimistic tone has a relatively stronger impact

on risk aversion compared to an optimistic tone. In particular, one standard deviation increase in the Fed's pessimistic tone increases investors' risk aversion by 0.30%. Whereas, one standard deviation increase in optimistic tone decreases the risk aversion by only 0.15%. This confirms that there is a "Negativity bias" and investors overreact to bad news compared to good news (Aktar et al. 2011). This finding is also consistent with White (2018) who report a higher impact of negative tone compared to a positive tone on stock returns.

3.4.2.3 Is the Impact of Fed's Tone State-Dependent?

We examine the potential state-dependent response of investors to the Fed's tone during the recessions and the episodes of high policy uncertainty. Table (3.5) reports the slope coefficient of our interaction recession variable which is higher than normal economic times for implied volatility, uncertainty and risk aversion. The state-dependent analysis suggests that investors' response to the Fed's optimism in recessions is almost 4 times higher than in normal economic times. Moreover, the impact is statistically significant at all levels of significance during recessions. The magnitude and significance of our recession dummy demonstrate that investors are more sensitive to the Fed's communications during recessions. These results are consistent with Basistha and Kurov (2008) who document a higher impact of the policy rate during recessions compared to good economic times. In another related study, Apergis and Pragidis (2019) also document a higher impact of ECB's tone on equity returns and volatility during the crisis.

We also analyse the impact of the Fed's tone on uncertainty and risk aversion for periods with high economic and monetary policy uncertainty. Tables (3.6) and (3.7) report results for the impact of the Fed's tone during periods of high Economic and Monetary Policy Uncertainty respectively. Similar to the recession analysis, we interact the Fed's tone variable with a dummy variable which takes the value of unity for periods with high policy uncertainty. Our results show that the Fed's tone has a stronger impact on market uncertainty and risk aversion during the period with high policy uncertainty. During the episodes of high EPU and MPU, market participants are unsure about future economic conditions resulting in a stronger response to the new information in central bank communications (Hubert and Labondance, 2019).

3.4.2.4 Does the Fed's tone have Spillover Effects?

The results reported in Tables (3.8) and (3.9) suggest that the effects of the Fed's communication spillover to other developed economies such as the United Kingdom (U.K) and the euro area (EA). A closer inspection reveals that the impact of the Fed's tone is stronger in the EA than in the U.K. These results confirm the findings of Nave and Ruiz (2015) about the potential impact of the unexpected reduction in the Federal funds rate on the uncertainty and

risk aversion in European equity markets. The results of this study show that apart from monetary policy rate decisions, the Fed's communication also affects the investors' perception and pricing of risk in other developed nations. The Fed's communication is a vital source of information for investors not only in the U.S. but also in the global financial markets. In particular, our results complement the findings of Hayo, Kutan and Neuenkirch (2010) that the equity markets in the European and Pacific regions respond significantly to the Fed's actions and communications.

3.4.2.5 Heterogeneous Impact of Topics' Tone

To further understand the information that drives investors' risk perception and appetite, we examine the impact of the net optimistic tone of certain topics on uncertainty and risk aversion. Table (3.10) reports that the Fed's optimism about consumption and monetary policy is primarily responsible for the changes in investors' risk perception and risk appetite. Specifically, the topics' tone results show that the Fed's optimistic discussion about consumption has a significant negative effect on market uncertainty and investors' risk-bearing capacity in the U.S. Surprisingly, the Fed's optimism about the future path of the policy rate increases the fear in the equity market and investors' risk aversion.

These findings imply that market participants view the FOMC meeting discussion related to policy stance as an indication of the future short-term interest rate. The Fed's optimistic tone about monetary policy indicates future contractionary monetary policy increases the investors' aversion to risk in the market. Jegadeesh and Wu (2017) also find that the Fed's positive tone about the financial market, investments outlook and economic situations reduce the unexpected volatility in S&P 500, but a positive tone about policy stance increases the unexpected potion of the equity market volatility. However, Picault and Renault (2017) document that both ECB's hawkishness about monetary policy stance and positivism about economic conditions decreases the volatility in the European markets. In this study, we find that the Fed's optimistic tone about consumption decreases the market uncertainty and risk aversion. Whereas, the optimistic tone about policy stance increases the market-wide fear and investors' aversion to risk.

Table (3.11) shows that a pessimistic tone for financial market outlook and consumption increases the market uncertainty and investors' risk aversion. In addition, the Fed's pessimism related to economic conditions rises the equity market uncertainty. On the contrary, a pessimistic tone about the investment environment decreases the uncertainty and investors' aversion towards risk. Further, results specify that the Fed's optimism related to the credit conditions and investment environment decreases the equity market uncertainty and

investors' risk aversion. Whereas, the optimistic Fed's discussion on economic outlook increases investors' risk aversion. This chapter summarises the key results in the table (3.21), which contains the direction and significance of the impact.

3.4.3 Robustness Checks

In this section, we examine the robustness of our results by using (i) different scaling for series and tone, (ii) different term weighting scheme, (iii) alternative directional dictionary, (iv) daily measures of uncertainty and risk aversion, and (v) smaller number of topics in the LDA.

3.4.3.1 Volatility Persistence (De-mean Series)

Previous studies identify the issue of time-varying volatility persistence in financial data (Karanasos et al. 2014). Therefore, we repeat our analysis using the De-mean series of all the variables to check that our baseline findings are not sensitive to volatility persistence issue. Table (3.12) confirms the negative relationship between the Fed's optimism and the implied volatility index. Panels B and C also show a similar impact of the Fed's optimistic tone on market uncertainty and investors' risk aversion components. However, the magnitude of the impact is smaller compared to our baseline investigation using standardized series.

3.4.3.2 Net Optimistic Index

Next, we estimate the Fed's net optimistic index by dividing the number of net optimistic phrases by the sum of optimistic and pessimistic phrases in each minute document. This exercise addresses the concern that using the ratio of optimistic and pessimistic phrases out of total phrases in meeting document may cause a bias in the estimation of tone. For example, a lengthy meeting may have a comparatively lower ratio which results in extremely low values for net optimistic tone. Thus, we calculate an index of net optimistic tone that does not penalize the tone measure for the length of the document. Figure (3.10) shows the plot of the net optimism index. The results presented in Table (3.13) are qualitatively similar to those reported in Table (3.3), suggesting that the Fed's optimism reduces market uncertainty and investors' risk aversion.

3.4.3.3 Term Weighting Scheme

In the analysis presented so far, we assign equal weight to each term appearing in the FOMC meeting minutes. However, the terms appearing more frequently add less to the conceptual information. As the third robustness check, we use the weighting scheme which penalizes the most frequent terms in the text. The most commonly known weighting scheme is the Term Frequency-Inverse Document Frequency (tf-idf), which reduces the importance of repetitive terms (Jegadeesh and Wu 2017). The results in Table (3.14) confirm our earlier findings that the Fed's optimism decreases market uncertainty and investors' risk aversion.

3.4.3.4 Fed's Positive Tone

Consideration is also given to the potential influence of using an alternative dictionary to extract the Fed's tone.[68] Hence, we extract the Fed's tone using a list of negative words from the Loughran and McDonald (2011) financial dictionary. We compute the frequency of negative words in each FOMC minute document. As Jegadeesh and Wu (2017) document that positive words are more frequently negated, we only use a list of negative words. Next, we estimate the ratio of negative terms out of total negative and positive terms in each document.

$$Ratio\ of\ Negative\ Terms_D = \frac{Number\ of\ Negative\ Terms\ (N)_D}{Number\ of\ Negative\ and\ Positive\ Terms\ (T)_D} \tag{3.21}$$

To capture optimism in the Fed's communication, we subtract the estimated ratio of negative terms from 1 to measure the Fed's positive tone:

$$Fed's\ \ Positive\ Tone_D = 1 - \ Ratio\ of\ Negative\ terms\ _D \tag{3.22}$$

Figure (3.9) shows the plots of the Fed's positive and the Fed's optimistic tone for the period under the study. These plots confirm that both the Fed's optimistic tone and the Fed's positive tone move together. Similar to the baseline pessimistic tone, it is evident that during the 2007-2008 global financial crisis the Fed's tone was extremely negative. The evidence presented in Table (3.15) shows that the findings in previous sections carry over to this alternative lexicon.

3.4.3.5 FOMC Minutes Announcement Day

Next, this study also estimates the impact of the Fed's tone on the investors' risk perception and risk appetite on the day the Fed releases the FOMC meeting minutes. It can be argued that this is a more conservative approach to examine the impact of the Fed's tone as there is less chance of other macroeconomic announcements on the same day. Table (3.16) contains the results for the response of market uncertainty and investors' risk-bearing capacity to the Fed's tone on the announcement day. The results confirm our findings of the decrease in risk aversion and equity market uncertainty in response to the Fed's optimism on the day FOMC minutes are published. However, for policy decisions, Bekaert, Hoerova and Xu (2020) document a weak impact of the Fed's unconventional monetary policy shock on the daily market uncertainty and investors' risk aversion. Using high-frequency data to capture the monetary policy shock, Bekaert, Hoerova and Xu (2020) report the weak response of investors' risk perception and appetite on the FOMC meeting days after 2008. This chapter finds that

[68] Hubert and Labondance (2019) use both directional dictionaries to assess the impact of Central bank's optimism and pessimism on short-term interest rate expectations.

the Fed's tone influences market uncertainty and investors' risk aversion on the FOMC meeting minutes publication days.

3.4.3.6 Number of Topics in LDA

In our main analysis, we choose 10 topics using the coherence score for identifying topics under discussion in FOMC meetings. In this section, following Jegadeesh and Wu (2017) we identify eight topics from FOMC meeting minutes. Figure (3.11) displays a graphical description of the topics along with each term's beta weights. We assigned names to each topic based on the most frequent terms in each topic. This study extracts the following topics from FOMC meeting discussions: financial market, consumption, inflation, policy, employment, growth, exchange rate and investment. Table (3.17) reports that the Fed's optimism about financial markets, consumption, economic growth and employment are mainly responsible for the impact of the Fed's tone on risk perception and risk appetite.

Finally, Table (3.18) reports the results of the asymmetric impact of each topic's optimistic and pessimistic tones. The results indicate that optimism about the financial market, consumption, employment and exchange rate decrease the market uncertainty and risk aversion in the equity market. Similarly, pessimism about the financial market, inflation and consumption increase the uncertainty and risk aversion in the equity market. These results are consistent with the findings of Jegadeesh and Wu (2017), showing that the Fed's positive tone about inflation, policy and employment determines the unexpected volatility in the S&P 500 index.

3.4.4 Additional Analyses

There is no consensus on the most effective central bank communication tool in influencing market participants' expectation and changing the behaviour of investor in financial markets. For instance, Boukus and Rosenberg (2006) focus on FOMC meeting minutes to extract the information content from the Fed's communication. On the other hand, Hansen and McMahon (2016) and Hubert and Labondance (2019) estimate the Fed's tone from FOMC policy statements. The FOMC meeting minutes provide a much more detailed view of members about the economic outlook, credit conditions and the future path of the policy rate policy compared to policy statements. However, the FOMC minutes are published after three weeks of meeting and investor may respond to contents of policy statements which are released on the day of FOMC meeting. Previous studies also suggest that ECB's press conferences after the Governing Council meetings may affect the changes in equity prices. Thus, in this section, we re-examine the impact of the Fed's tone considering these alternative communication tools.

3.4.4.1 FOMC Policy Statements

We extract the Fed's tone from FOMC policy statements to understand the response of market uncertainty and investors' risk-bearing capacity to the information in these statements. To measure the optimism and pessimism in the policy statement, we use the directional dictionary of Apel and Blix Grimaldi (2012). Table (3.19) indicates that the results for the policy statements' tone are consistent with the findings obtained from meeting minutes. Consistent with our main findings with the meeting minutes, the optimism in policy statements also reduces the market uncertainty and investors' risk aversion.

3.4.4.2 FOMC Press Conferences

Compared to minutes of FOMC meetings which are announced with a lag of three weeks, a press conference provides information to market participants on the same day of the meeting. The press conferences are quite detailed compared to policy statements and similar to FOMC meeting minutes express the views of the FOMC committee about the current and future economic conditions. However, the Fed started press conferences in April 2011 and there are very few numbers of observations up to now.[69] Nevertheless, we create an interaction variable by multiplying the Fed's tone extracted from meeting minutes with a dummy which takes a value of unity for observations after April 2011 and zeros otherwise. The results in Table (3.20) show that the response of investors to FOMC meeting minutes is highly significant for the period before the Fed started press conferences and remained muted for the period after April 2011. These results indicate that the effect of FOMC meeting minutes on the investors' risk perception and appetite decreased after the Fed started press conferences. In the next section, we conclude this chapter by discussing the policy implications of these findings.

[69] There are very few observations as before 2014 the Fed Chairman held press conference quarterly.

3.5 Conclusion

It has long been argued that central bank communication is a key tool to shape market participants' beliefs by simultaneously conveying both optimism and pessimism. Yet, while central bank communication has been regarded as an important policy instrument for decades, it has attracted relatively little academic interests and there are limited studies on the impact of central bank communications on the financial market until recently. This study investigates the link between central bank communications and investors' risk perception and risk-bearing capacity in the global equity markets. First, using a computational linguistic analysis method, we measure the Fed's optimism about the future economic and financial outlook. Then, we examine the impact of the Fed's optimism on market uncertainty and the investors' risk appetite by decomposing the option-based implied volatility into market uncertainty and investors' risk aversion components. In addition, we study the heterogeneous impact of the Fed's tone on each unique topic using the Latent Dirichlet Allocation (LDA) technique. Finally, we also analyse the potential spillover effect of the Fed's communication on uncertainty and risk aversion in the United Kingdom and the euro area.

The results of this chapter show that the Fed's optimistic (pessimistic) tone decreases (increases) the market uncertainty and investors' risk aversion in the US equity market. The investor response to the pessimistic tone is higher compared to the optimistic tone. Furthermore, the impact of the Fed's tone on market uncertainty is four times higher during the recessionary period and twice for the times when policy uncertainty is elevated. The Fed's optimism also has a significant spillover impact on market uncertainty and investors' risk tolerance in the equity market of the United Kingdom and the euro area. Moreover, the topics' tone results show that the Fed's discussions about the economy, financial market, credit conditions, employment and growth are particularly important in driving uncertainty and risk aversion in the US equity market. The central bank's optimism about the macroeconomic outlook and financial market conditions is generally perceived as good news subsequently decreasing the fear in the market. However, an optimistic tone about policy stance may be considered as a signal for the future contractionary policy and tight credit conditions consequently increasing the investors' aversion to risk. These findings support the notion that contrary to the Fed's optimism (pessimism) about the economic outlook, financial markets and credit conditions, the optimistic (pessimistic) discussion related to the future monetary policy stance increases (decreases) the market-wide uncertainty and investors' risk aversion.[70]

[70] These findings are consistent with Jegadeesh and Wu (2017) documenting an increase in the unexpected volatility in response to the Fed's positive tone related to policy rate.

The signalling effect and risk-taking effect are the potential channels through which the central bank communications influence the market participants' perception and appetite of risk in financial markets. The optimistic view of FOMC members about economic and financial outlook contains important signals for the market participants changing the expectations about future risk and return. In addition, the indication of a change in the future path of policy also drives the investor's demand for risk premium subsequently influencing the prices of stocks. Overall, the findings of this chapter are useful for market participants and policymakers. For example, market participants should consider the central bank's tone about the economy and financial conditions while evaluating their investment decisions. The policymakers must provide comprehensive, consistent and transparent communications to ensure market stabilization and effective implementation of monetary policy.

This study also offers several opportunities to extend the research along this line. It is interesting to analyse the effects of central bank tone about economic outlook and policy stance on portfolio rebalancing and arbitrage strategies in the equity market. In addition, a comparative analysis of the impact of FOMC members' tone relative to the Fed Chairman's tone on the financial market would help policymaker to identify efficient communication tool to achieve the central bank's objectives. Finally, exploring the type of information policymaker take into consideration while assessing the future economic outlook and deciding the future path of the policy is also an interesting research topic.

Chapter 3: Figures and Tables

Chapter 3: Figures

Figure 3. 1: FOMC minutes Word Cloud

This word cloud shows the most frequent words in the Federal Open Market Committee (FOMC) minutes from December 2004 to May 2018. The font size of each word represents the frequency of that particular term throughout the sample period. Before applying the textual analysis, we first eliminate all the punctuations, auxiliary verbs, numbers, symbols and common words (stop words). To avoid repetition of words with similar concepts, we stem all the unique words. Stemming refers to removing the suffixes and all the words with the same epistemological root.

Figure 3. 2: Fed's Tone

These plots show the Fed's net optimistic, optimistic and pessimistic tone respectively. We extract the tone from FOMC meeting minutes from December 2004 to May 2018 using the directional lexicon of Apel and Blix Grimaldi (2012) consisting of bigrams (phrases). We count the frequency of optimistic and pessimistic phrases in each document and divide by the total number of phrases in each document (minutes). To estimate net optimistic tone we divide the difference of the optimistic and pessimistic number of phrases by the total number of phrases. The shaded area shows the recession period using NBER-designated recessionary times.

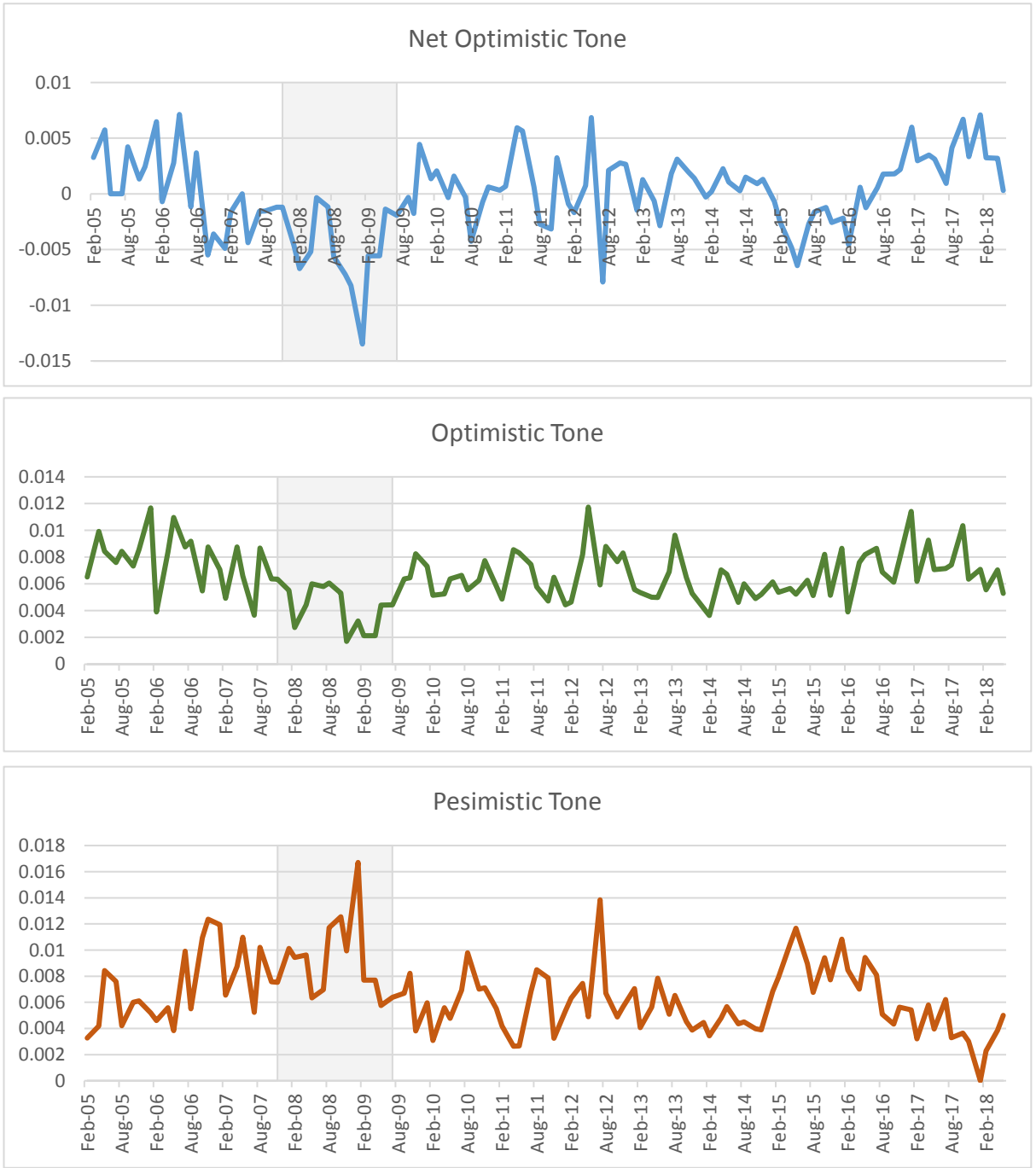


Figure 3. 3: Choosing an Optimal Number of Topics

This plot shows the results for the coherence score to choose an optimal number of topics from the FOMC meeting discussion. The coherence score calculates the association between words using the co-occurrence of words in the text. The plot depicts that the coherence score is maximum at ten number of topics (K).

Coherence Score Plot:

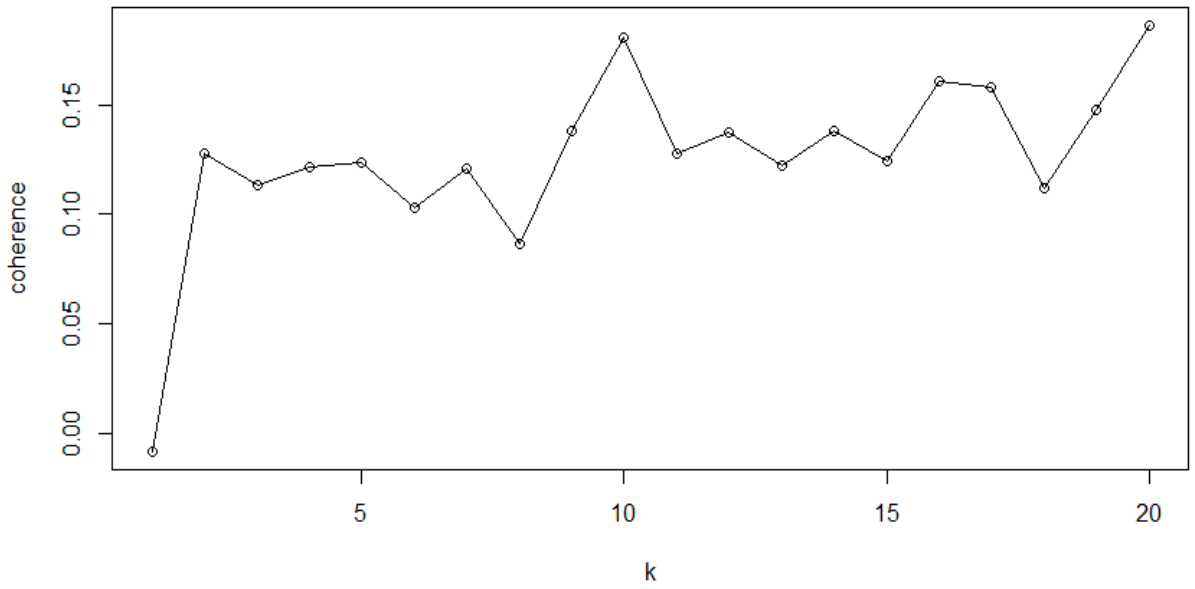


Figure 3. 4: Terms' Probability of Appearing in Each Topic

This figure indicates the most frequent terms along with their probability of occurrence in each topic. The beta shows the probability of each term appearing in each unique topic. This chapter identifies the following ten topics in the discussions of FOMC meetings using the Latent Dirichlet Allocation (LDA). This chapter uses the coherence score to choose the optimal number of topics.

1. Employment
2. Investment
3. Monetary Policy
4. Growth
5. Financial Market
6. Credit Conditions
7. Economy
8. Consumptions
9. Exchange Rate
10. Inflation

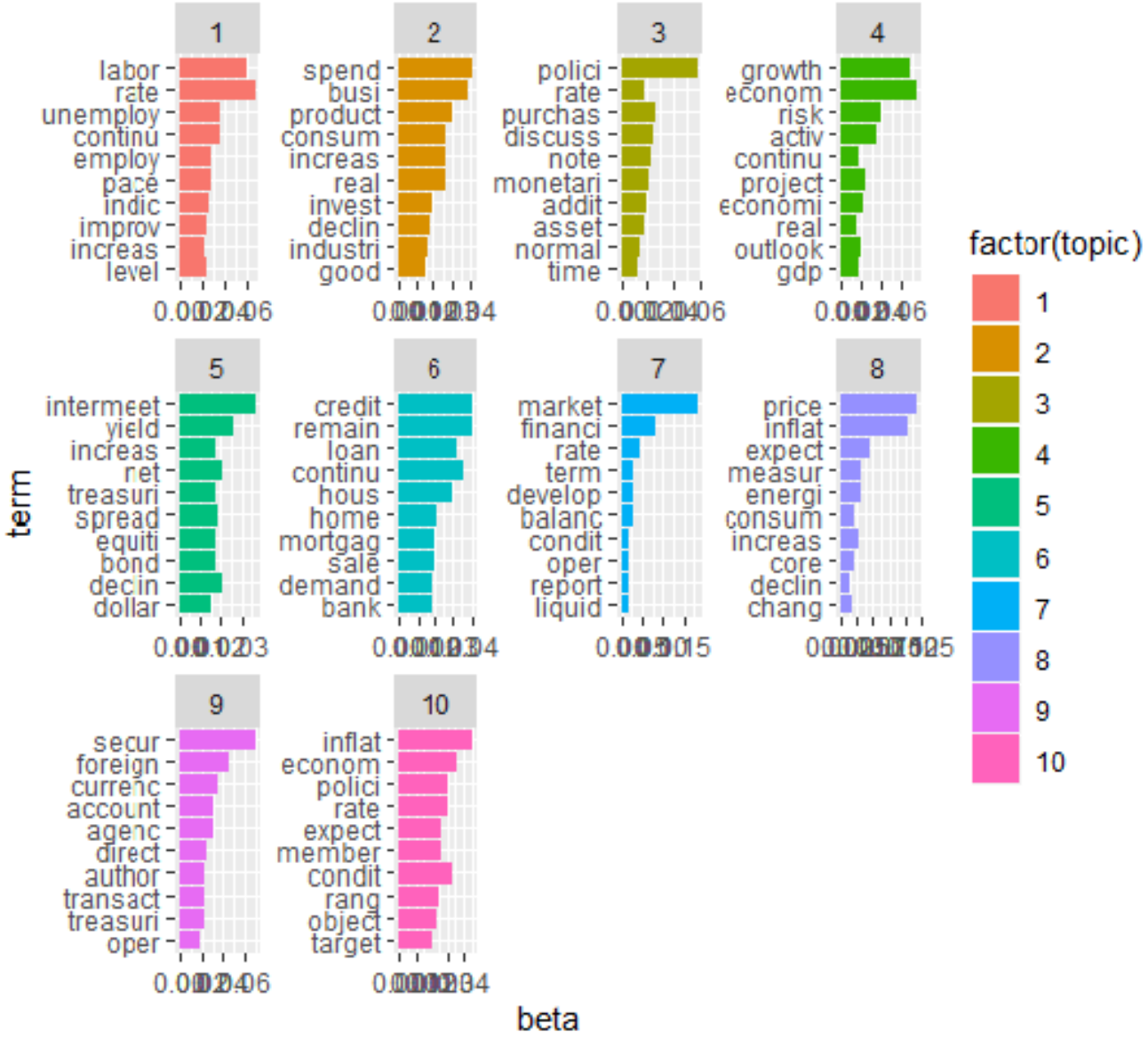


Figure 3. 5: Word Clouds of Ten Unique Topics

Each Word Cloud in this figure shows the 30 stemmed most frequent terms in each topic. Using the Latent Dirichlet Allocation (LDA), we extract ten topics from FOMC meeting minutes. This chapter uses the coherence score to choose the optimal number of topics. The font size represents the frequency of occurrence of each term in each topic.

Topic 1: Employment

Topic 2: Investments

Topic 3: Monetary Policy

Topic 4: Growth

Topic 5: Financial Market

Topic 6: Credit Condition

Topic 7: Economy

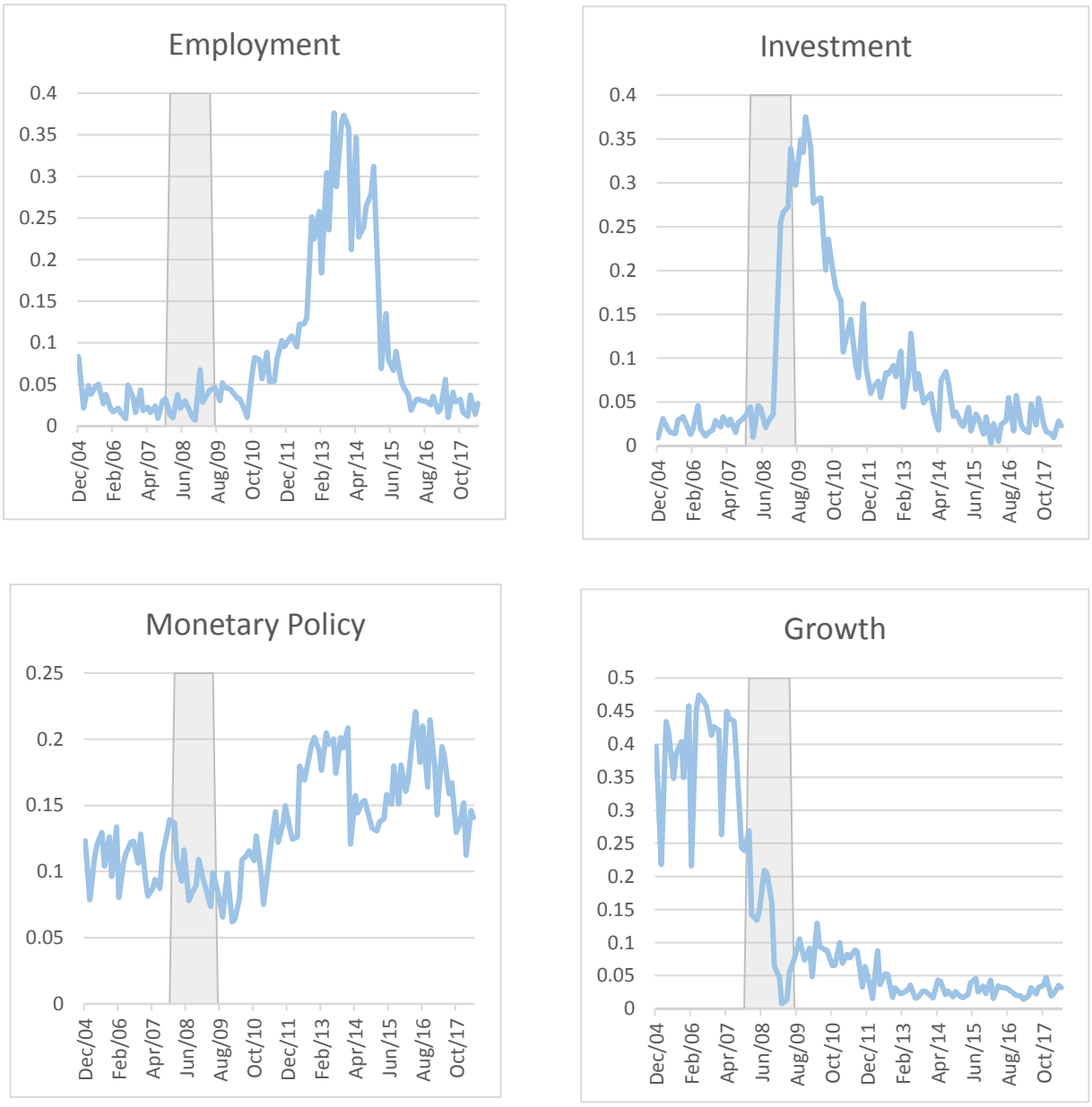
Topic 8: Consumptions

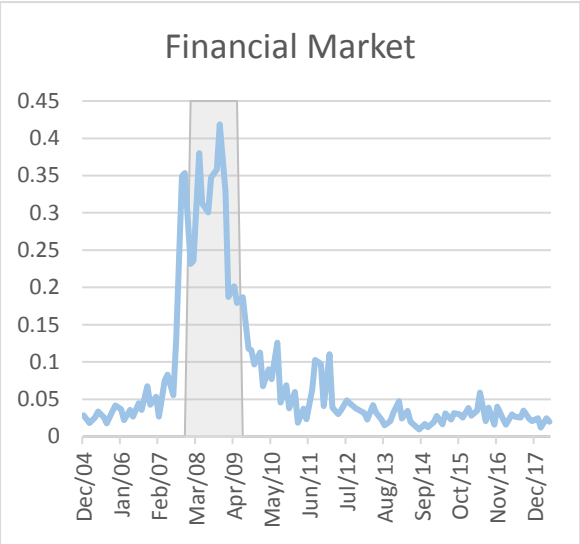
Topic 9: Exchange Rate

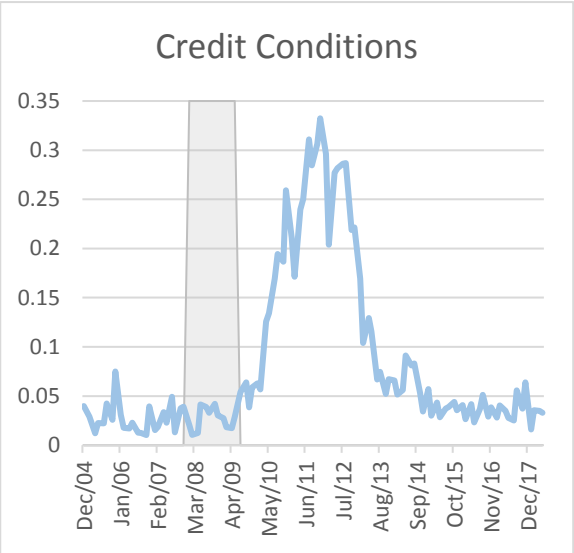
Topic 10: Inflation

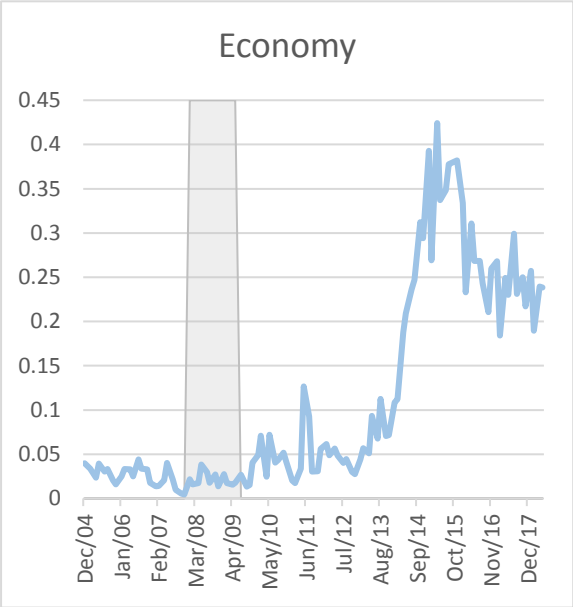
Figure 3. 6: Each Topics' Proportion in FOMC Meeting Discussions

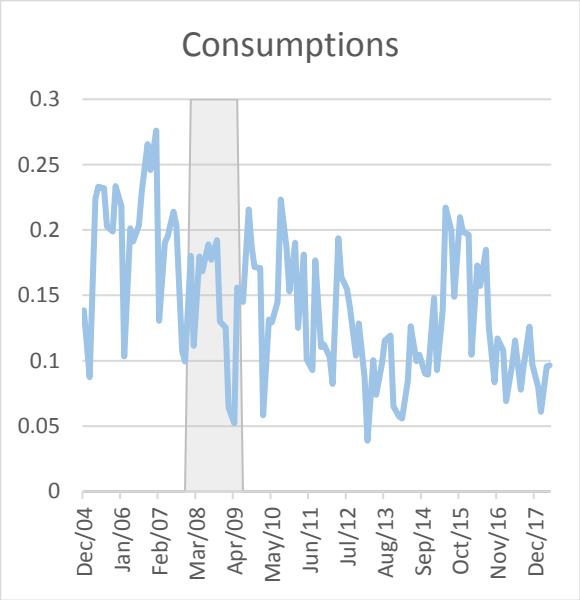
Each graph shows the proportion of each topic in FOMC meeting discussions from December 2004 to May 2018. This chapter uses the coherence score to choose an optimal number of topics from FOMC minutes. Using the Latent Dirichlet Allocation (LDA), we extract ten topics from FOMC meeting minutes. The shaded area represents the recessionary period according to the NBER-designated recession indicator. The graphs indicate that there is a clear change in the FOMC members' discussion after the global financial crisis of 2007-08.

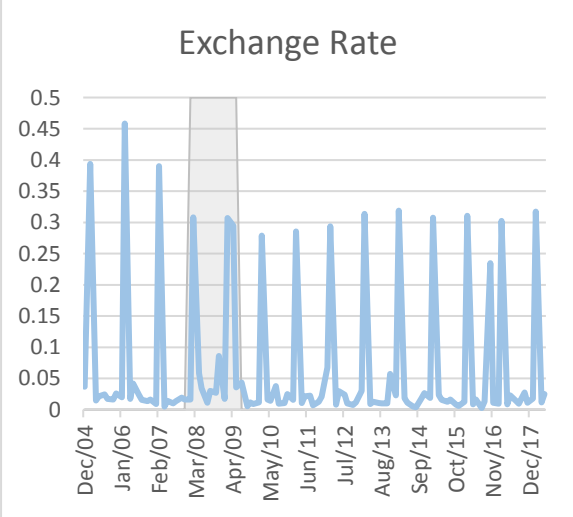



Financial Market
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Dec/04
Jan/06
Feb/07
Mar/08
Apr/09
May/10
Jun/11
Jul/12
Aug/13
Sep/14
Oct/15
Nov/16
Dec/17


Credit Conditions
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Dec/04
Jan/06
Feb/07
Mar/08
Apr/09
May/10
Jun/11
Jul/12
Aug/13
Sep/14
Oct/15
Nov/16
Dec/17


Economy
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Dec/04
Jan/06
Feb/07
Mar/08
Apr/09
May/10
Jun/11
Jul/12
Aug/13
Sep/14
Oct/15
Nov/16
Dec/17


Consumptions
0.3
0.25
0.2
0.15
0.1
0.05
0
Dec/04
Jan/06
Feb/07
Mar/08
Apr/09
May/10
Jun/11
Jul/12
Aug/13
Sep/14
Oct/15
Nov/16
Dec/17


Exchange Rate
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Dec/04
Jan/06
Feb/07
Mar/08
Apr/09
May/10
Jun/11
Jul/12
Aug/13
Sep/14
Oct/15
Nov/16
Dec/17

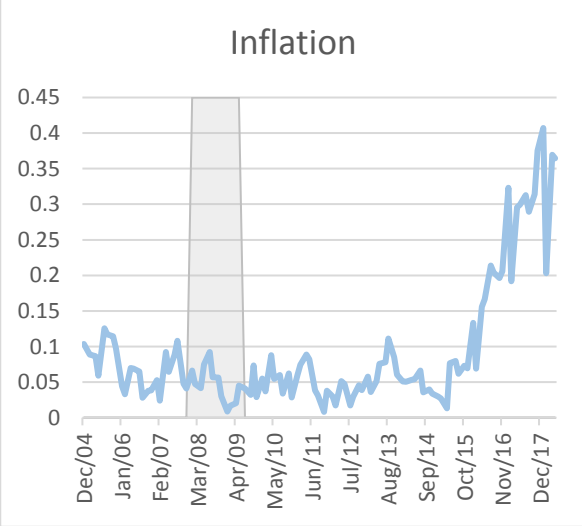

Inflation
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Dec/04
Jan/06
Feb/07
Mar/08
Apr/09
May/10
Jun/11
Jul/12
Aug/13
Sep/14
Oct/15
Nov/16
Dec/17

Figure 3. 7: Topics' Net Optimistic Tone

This graph indicates each topics' net optimistic tone, this chapter uses the Latent Dirichlet Allocation on FOMC meeting minutes for the period from December 2004 to May 2018. This study uses the coherence score to choose the optimal number of topics. Next, we apply Apel and Blix Grimaldi (2012) directional dictionary to classify the phrases in optimistic and pessimistic categories for each topic. Finally, this chapter computes the net optimistic tone of each topic after dividing the difference between optimistic and pessimistic phrases by the total number of phrases in each FOMC meeting minutes. The shaded area shows the recession period using NBER-designated recessionary times.

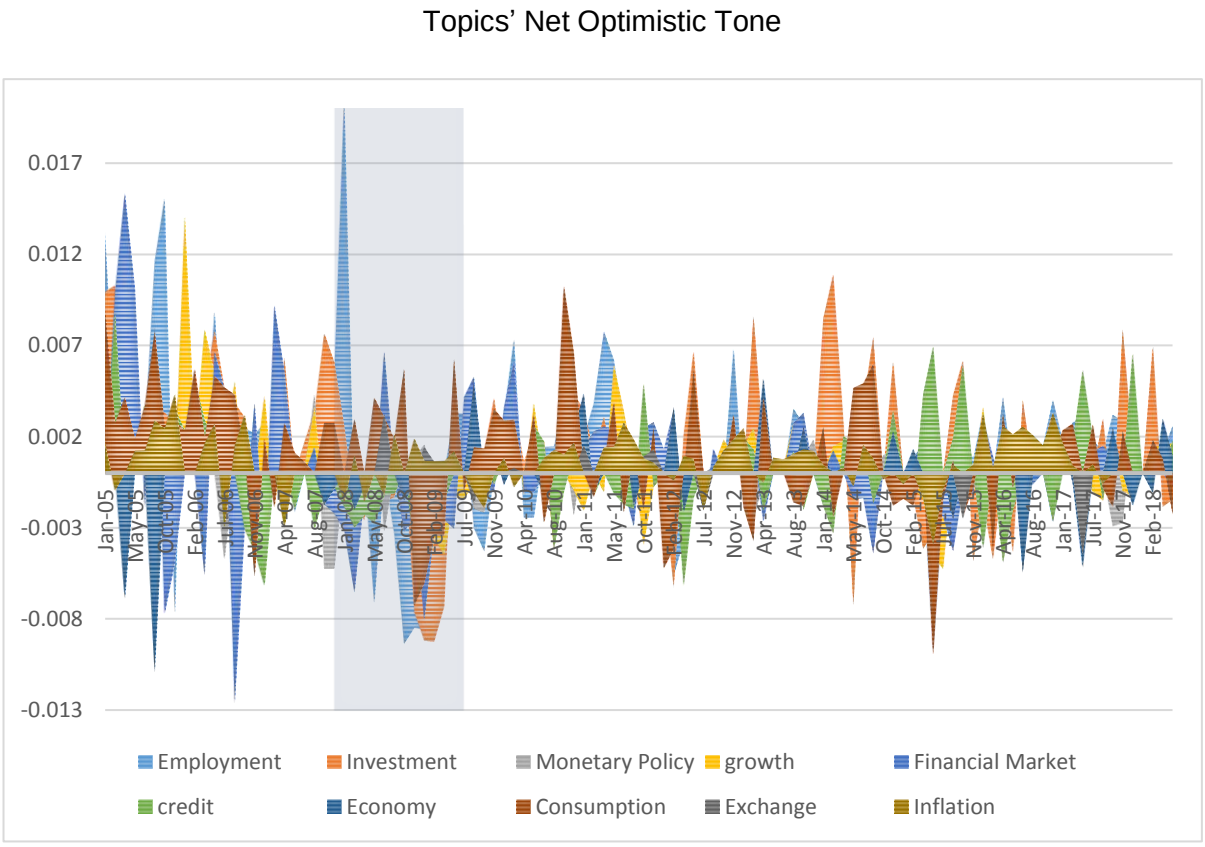
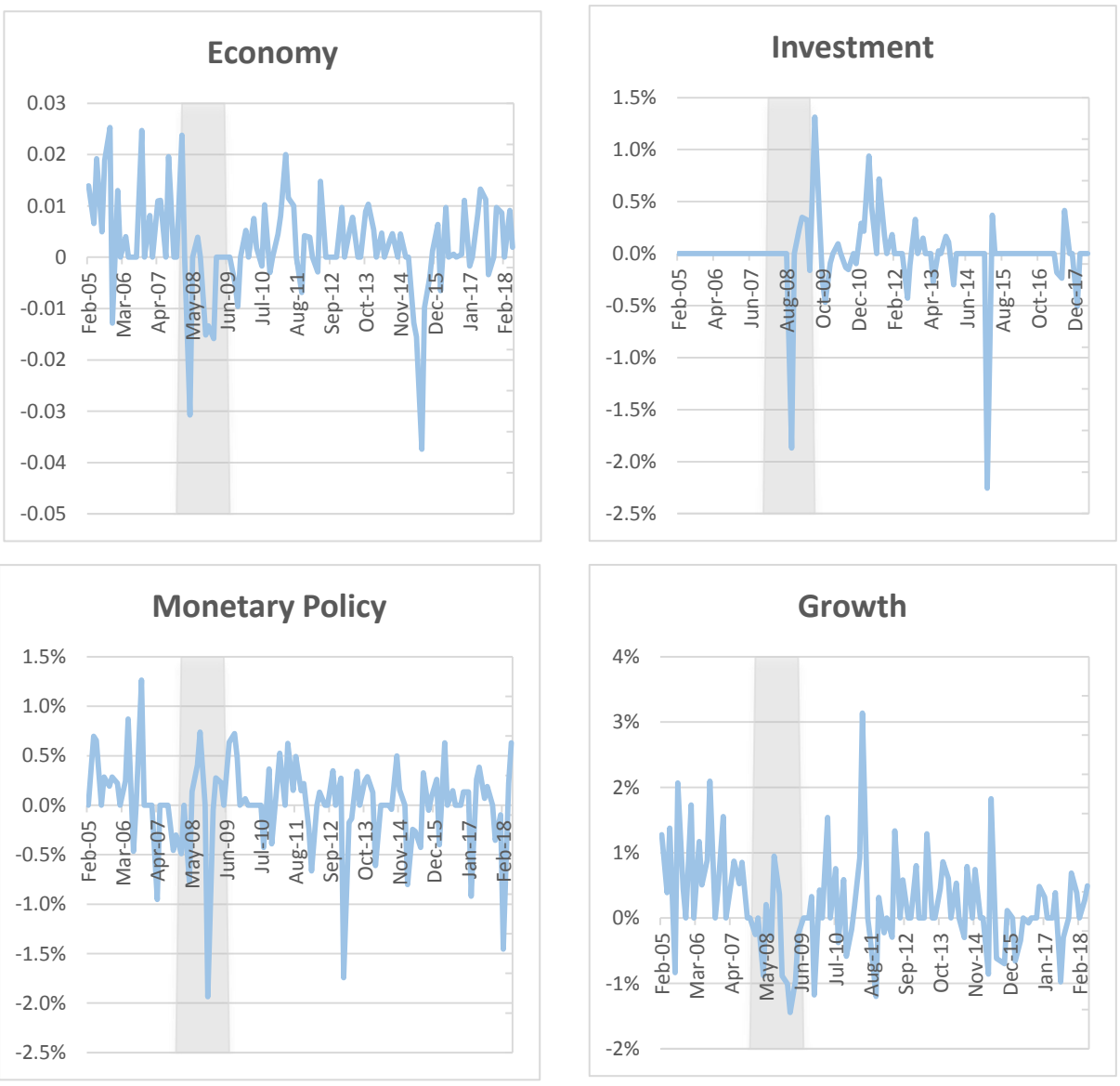
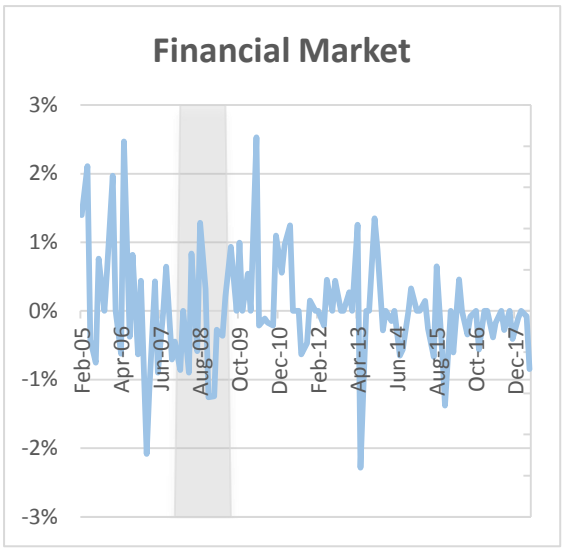
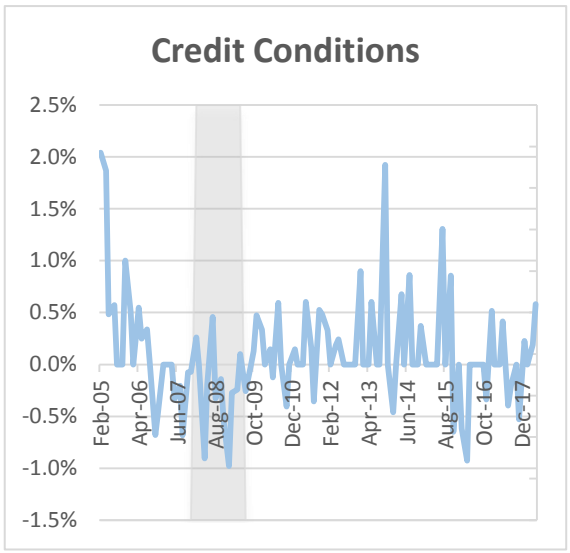


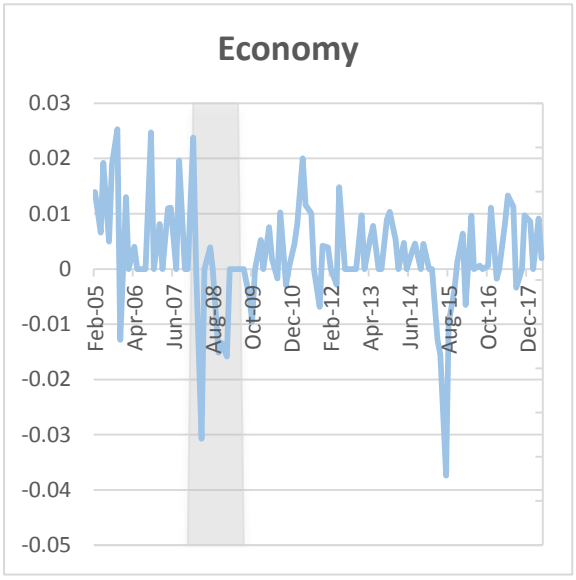
Figure 3. 8: Each Topics' Net Optimistic Tone

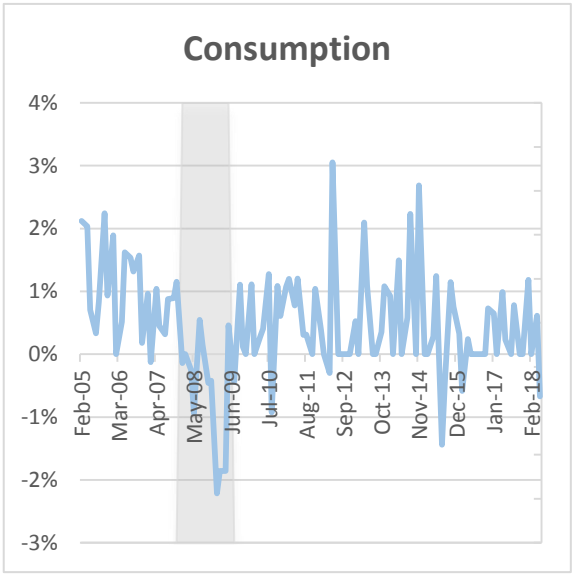
The following graph indicates each topics' net optimistic tone, this chapter uses the Latent Dirichlet Allocation on FOMC meeting minutes for the period from December 2004 to May 2018. This study uses the coherence score to choose the optimal number of topics. Next, we apply Apel and Blix Grimaldi (2012) directional dictionary to classify the phrases in optimistic and pessimistic categories for each topic. Finally, this chapter computes the net optimistic tone of each topic after dividing the difference between optimistic and pessimistic phrases by the total number of phrases in each FOMC meeting minutes. The shaded area shows the recession period using NBER-designated recessionary times.

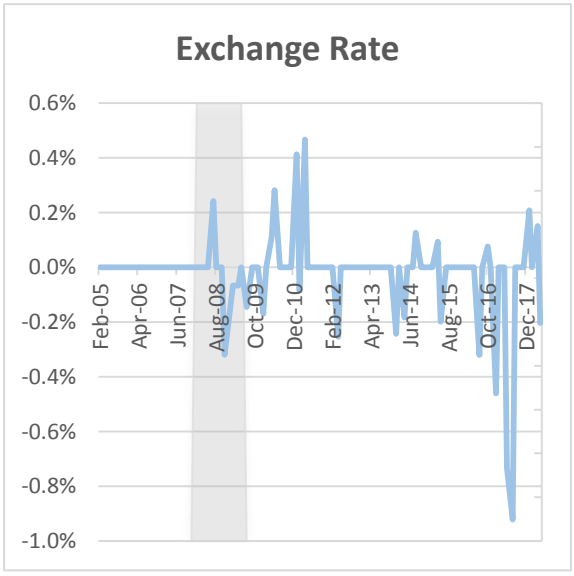



Financial Market
3%
2%
1%
0%
-1%
-2%
-3%
Feb-05
Apr-06
Jun-07
Aug-08
Oct-09
Dec-10
Feb-12
Apr-13
Jun-14
Aug-15
Oct-16
Dec-17


Credit Conditions
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
-0.5%
-1.0%
-1.5%
Feb-05
Apr-06
Jun-07
Aug-08
Oct-09
Dec-10
Feb-12
Apr-13
Jun-14
Aug-15
Oct-16
Dec-17


Economy
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
-0.05
Feb-05
Apr-06
Jun-07
Aug-08
Oct-09
Dec-10
Feb-12
Apr-13
Jun-14
Aug-15
Oct-16
Dec-17


Consumption
4%
3%
2%
1%
0%
-1%
-2%
-3%
Feb-05
Mar-06
Apr-07
May-08
Jun-09
Jul-10
Aug-11
Sep-12
Oct-13
Nov-14
Dec-15
Jan-17
Feb-18


Exchange Rate
0.6%
0.4%
0.2%
0.0%
-0.2%
-0.4%
-0.6%
-0.8%
-1.0%
Feb-05
Apr-06
Jun-07
Aug-08
Oct-09
Dec-10
Feb-12
Apr-13
Jun-14
Aug-15
Oct-16
Dec-17

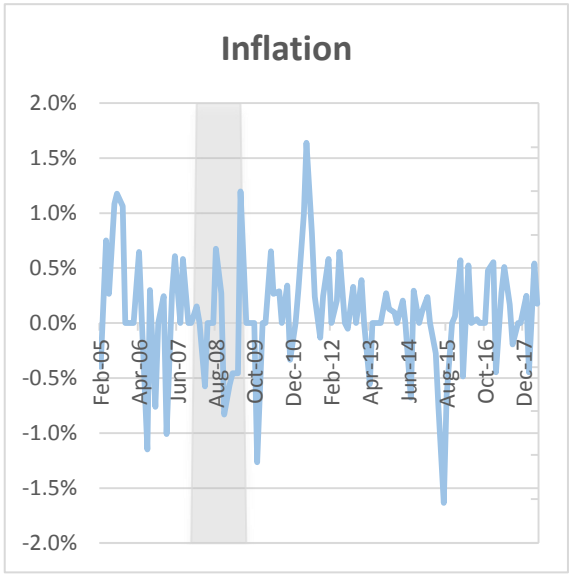

Inflation
2.0%
1.5%
1.0%
0.5%
0.0%
-0.5%
-1.0%
-1.5%
-2.0%
Feb-05
Apr-06
Jun-07
Aug-08
Oct-09
Dec-10
Feb-12
Apr-13
Jun-14
Aug-15
Oct-16
Dec-17

Figure 3. 9: Fed's Positive Tone using an Alternative Dictionary

This graph indicates the Fed's positive tone extracted from Federal Open Market Committee meeting minutes for the period from December 2004 to May 2018. Contrary to our baseline measures for Fed's optimism and pessimism using the Apel and Blix Grimaldi (2012) dictionary. The Fed's positive tone estimated using an alternative directional dictionary. More specifically, first, we use the financial dictionary of Loughran and McDonald (2011) to count the frequency of negative words in each FOMC document. Second, we estimate the Fed's negative words ratio after dividing the frequency of negative words by the total number of words in each FOMC minutes document. Finally, we subtract the ratio of the negative word from 1 to gauge the optimism in the Fed's communications. The shaded area shows the recession period using NBER-designated recessionary times.

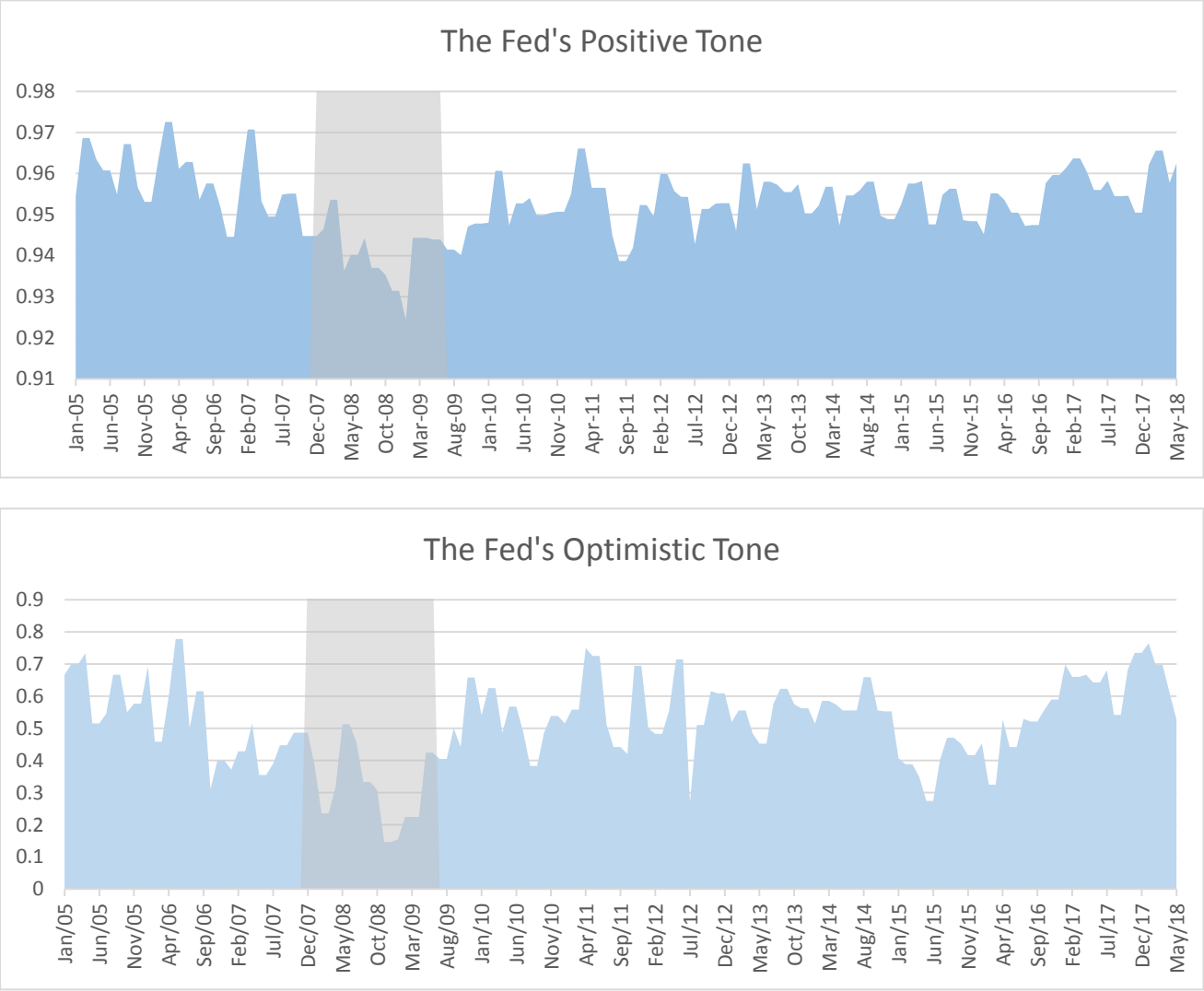


Figure 3. 10: Fed's Net Optimistic Index

This graph shows the Fed's net optimistic index extracted using directional lexicon consists of optimistic and pessimistic bigrams (phrases) on FOMC minutes from December 2004 to May 2018. We count the frequency of optimistic and pessimistic phrases in each document and divide by the sum of optimistic and pessimistic phrases in each document (minutes). The shaded area shows the recession period using NBER-designated recessionary times.

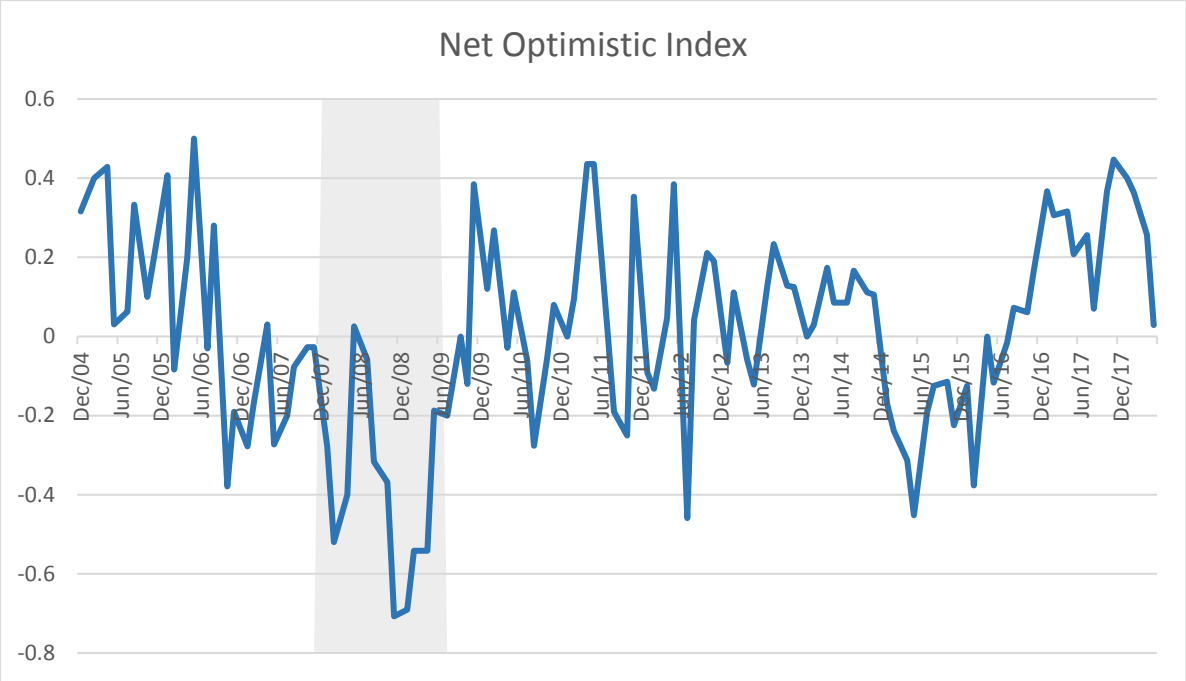


Figure 3. 11: Terms' Probability of Appearing in Each Topic (Eight Topics)

This figure indicates the terms along with their probability of occurrence in each of the 8 topics. Contrary to our baseline topic extraction process which identifies the optimal number of topics using the coherence score. The following figure consists of the eight unique topics identified from the discussions of the FOMC meetings. The probability of occurrence (Beta) shows the probability of each term belongs to a topic. The topics represent discussion related to the following eight topics. Using the Latent Dirichlet Allocation (LDA), we extract ten topics from FOMC minutes.

1. Financial Markets
2. Consumptions
3. Inflation
4. Monetary Policy
5. Employment and Economy
6. Growth
7. Exchange Rate
8. Investment

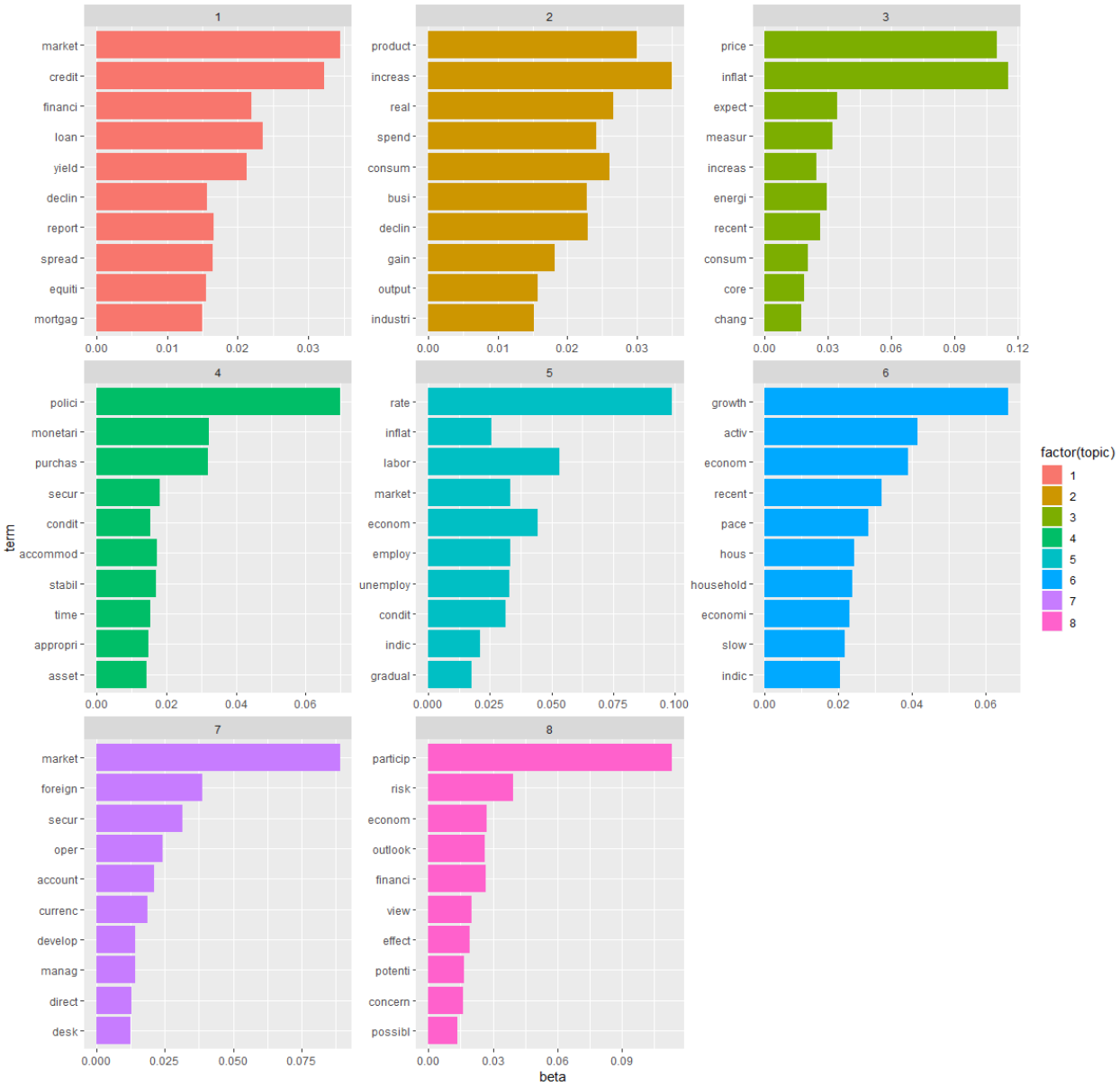
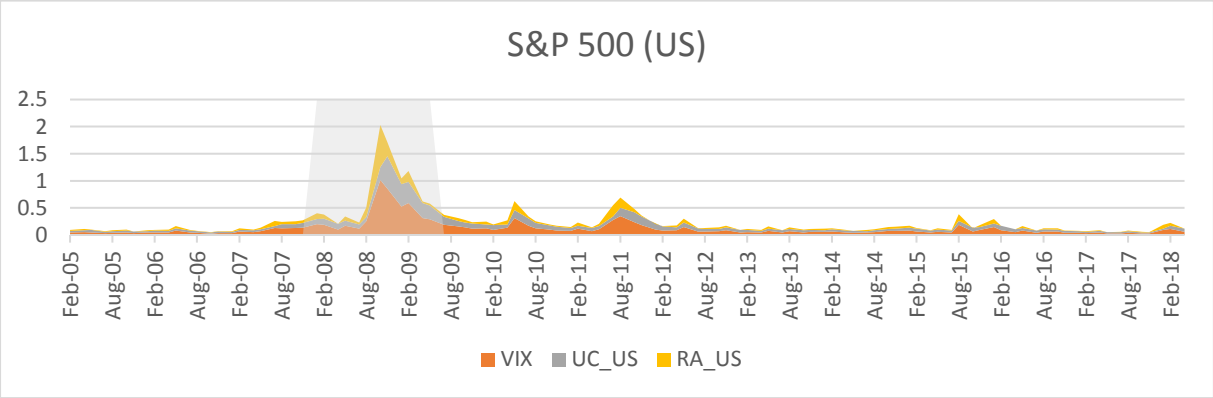
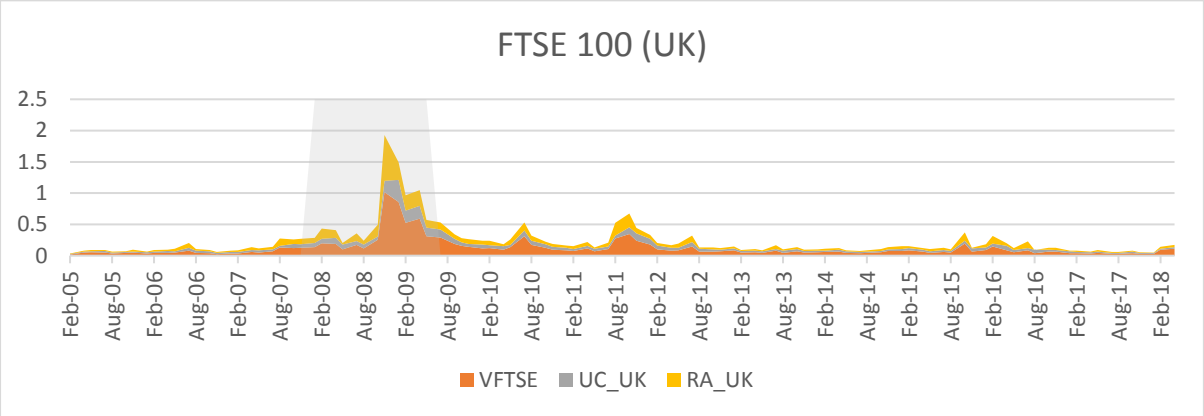
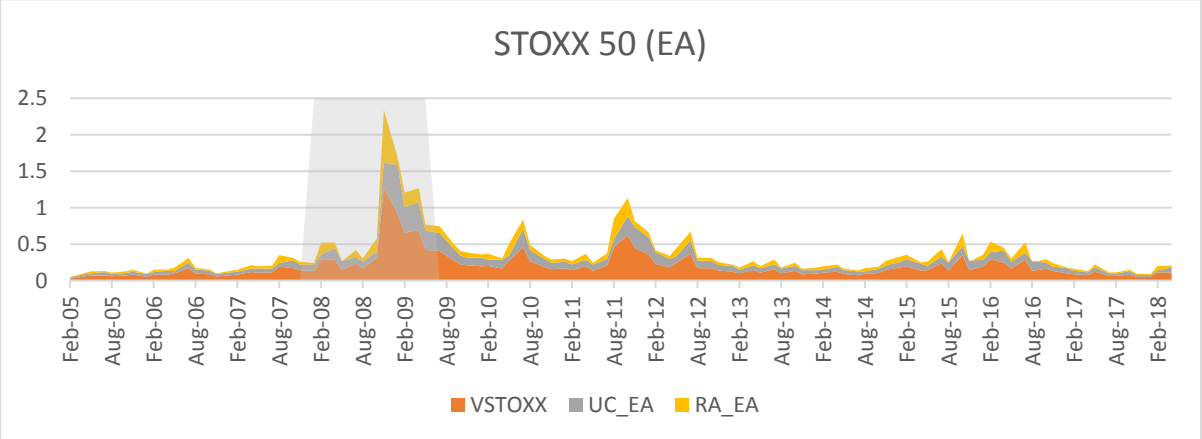


Figure 3. 12: Distribution Plots of IV, UC and RA

The following distribution plots show the variations in implied volatility (IV) index, market uncertainty (UC) and investors' risk aversion (RA) of an equity index. To measure the market uncertainty and investors' aversion to risk in the United States (US), the United Kingdom (UK) and the euro area (EA) equity markets, this study decomposes the implied volatility of S&P 500, FTSE 100 and STOXX 50 index respectively. More specifically, we follow Bekaert, Hoerova and Duca (2013) to decompose the implied variance into uncertainty and risk aversion components using the difference between risk-adjusted and risk-free variance of an equity index.







Chapter3: Tables

Table 3. 1: Descriptive Statistics of Fed's Tone

	Optimistic Tone	Pessimistic Tone	Net Optimistic Tone
Mean	0.786%	0.825%	-0.039%
Standard Deviation	0.398	0.431	0.483
Kurtosis	-0.249	-0.034	0.305
Skewness	-0.272	0.174	-0.211
Minimum	0.014%	0.025%	-1.364%
Maximum	1.634%	1.833%	0.949%
Observations	108	108	108

Note: This table indicates the descriptive statistics of the Fed's optimistic, pessimistic and net optimistic tone respectively. Using directional phrases of Apel and Blix Grimaldi (2012) dictionary, we estimate the Fed's tone from 108 FOMC meeting minutes from December 2004 to May 2018. Specifically, we calculate the net optimistic tone by dividing the difference between optimistic and pessimistic phrases with the total number of phrases in each FOMC meeting minutes.

Table 3. 2: Descriptive Statistics S&P 500 Index

Region	United States (US)			United Kingdom (UK)			Euro area (EA)		
Index	S&P 500			FTSE 100			STOXX 50		
Variable	IV	UC	RA	IV	UC	RA	IV	UC	RA
Mean	0.118	0.074	0.044	0.118	0.048	0.062	0.195	0.100	0.063
Standard Error	0.014	0.008	0.008	0.014	0.005	0.008	0.017	0.009	0.008
St. Deviation	0.147	0.083	0.087	0.147	0.047	0.086	0.180	0.090	0.084
Kurtosis	19.046	17.851	49.721	18.964	19.585	35.220	14.524	15.194	37.246
Skewness	4.009	3.846	6.271	3.997	3.837	5.060	3.307	3.308	5.179
Minimum	0.025	0.020	-0.012	0.018	0.008	-0.003	0.025	0.016	-0.022
Maximum	1.015	0.594	0.781	1.015	0.356	0.733	1.277	0.661	0.724

Note: This table shows the descriptive Statistics of implied volatility (IV), market uncertainty (UC) and investor's risk aversion (RA). We use implied volatility (IV) on equity indexes available in the US, the UK and the euro area. Following Bekaert, Hoerova and Duca (2013), we estimate the difference between risk-adjusted and risk-free variance of equity indexes and decompose the implied volatility into market uncertainty and investor's risk aversion components.

Table 3. 3: Impact of Fed's Net Optimistic Tone

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VIX)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[-0.000]	[-0.000]	[-0.000]	[-0.000]	[-0.000]
Net Optimistic Tone	-0.4597	-0.4607	-0.4132	-0.4391	-0.4474
	[-1.937]*	[-1.930]*	[-2.179]**	[-2.096]**	[-2.091]**
Policy Rate		-0.0561	0.0065	-0.058	-0.1743
		[-0.617]	[0.090]	[-0.528]	[-0.667]
Industrial Production			-0.3771	-0.3887	-0.5589
			[-3.477]***	[-3.102]***	[-1.558]
GDP Forecasts				-0.0382	-0.006
				[-0.449]	[-0.081]
INF Forecasts				0.1252	0.1352
				[0.794]	[0.802]
Unemployment Rate					-0.2361
					[-0.634]
Adj. R2	0.204	0.199	0.332	0.331	0.335
Panel B: Uncertainty (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[-0.000]	[-0.000]	[-0.000]
Net Optimistic Tone	-0.4949	-0.4967	-0.4357	-0.4114	-0.42
	[-1.953]*	[-1.949]*	[-2.392]**	[-2.107]**	[-2.129]**
Policy Rate		-0.0944	-0.0142	0.0543	-0.0676
		[-0.978]	[-0.206]	[0.647]	[-0.373]
Industrial Production			-0.4835	-0.4643	-0.6425
			[-3.562]***	[-3.528]***	[-2.113]**
GDP Forecasts				-0.0661	-0.0324
				[-1.455]	[-0.584]
INF Forecasts				-0.1074	-0.0969
				[-1.350]	[-1.176]
Unemployment Rate					-0.2474
					[-0.829]
Adj. R2	0.238	0.24	0.462	0.462	0.468
Panel C: Risk Aversion (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[-0.000]	[-0.000]	[-0.000]
Net Optimistic Tone	-0.327	-0.3273	-0.3048	-0.3699	-0.3773
	[-1.685]*	[-1.679]*	[-1.736]*	[-1.879]*	[-1.856]*
Policy Rate		-0.0152	0.0144	-0.1548	-0.2579
		[-0.216]	[0.230]	[-1.262]	[-0.880]
Industrial Production			-0.1787	-0.2154	-0.3663
			[-1.946]*	[-1.957]*	[-1.013]
GDP Forecasts				-0.0031	0.0255
				[-0.028]	[0.265]
INF Forecasts				0.3053	0.3142
				[1.483]	[1.429]
Unemployment Rate					-0.2093
					[-0.538]
Adj. R2	0.098	0.09	0.113	0.155	0.154

Note: This table reports the results of equation (3.11). The table shows the impact of the Fed's net optimistic tone on market uncertainty and investor's risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013), we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply directional dictionary of Apel and Blix Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tones. In particular, following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from January 2005 to May 2018. This study estimates the net optimistic tone by dividing the difference between the frequency of optimistic and pessimistic phrases by a total number of phrases in each FOMC minutes. We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the growth of industrial production and the unemployment rate to control business cycle and economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 4: Asymmetric Impact of Fed's Optimistic and Pessimistic Tones

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VIX)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[-0.000]	[-0.000]	[-0.000]	[-0.000]	[-0.000]
Optimistic Tone	-0.3517	-0.3297	-0.2594	-0.2027	-0.2042
	[-2.143]**	[-2.065]**	[-2.540]**	[-2.787]***	[-2.742]***
Pessimistic Tone	0.4314	0.4518	0.3876	0.2807	0.2814
	[1.770]*	[1.801]*	[2.001]**	[2.160]**	[2.155]**
Policy Rate		-0.1074	-0.0387	0.2903	0.2292
		[-1.133]	[-0.529]	[1.903]*	[1.313]
Industrial Production			-0.4461	-0.4132	-0.4929
			[-2.957]***	[-3.648]***	[-2.091]**
GDP Forecasts				0.1029	0.0991
				[0.846]	[0.817]
INF Forecasts				-0.5402	-0.5199
				[-2.439]**	[-2.647]***
Unemployment Rate					-0.1082
					[-0.446]
Adj. R2	0.226	0.229	0.414	0.515	0.512
Panel B: Uncertainty (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[-0.000]	[-0.000]	[-0.000]	[-0.000]	[-0.000]
Optimistic Tone	-0.3167	-0.309	-0.2401	-0.1762	-0.1818
	[-1.472]	[-1.435]	[-1.655]	[-1.832]*	[-1.909]*
Pessimistic Tone	0.3237	0.3308	0.2679	0.1452	0.148
	[1.382]	[1.396]	[1.544]	[1.594]	[1.712]*
Policy Rate		-0.0373	0.0301	0.4077	0.1851
		[-0.566]	[0.520]	[1.992]**	[1.061]
Industrial Production			-0.4371	-0.4012	-0.6917
			[-2.083]**	[-2.582]**	[-2.569]**
GDP Forecasts				0.1301	0.1161
				[1.060]	[0.892]
INF Forecasts				-0.6293	-0.5553
				[-2.067]**	[-2.067]**
Unemployment Rate					-0.3941
					[-1.617]
Adj. R2	0.145	0.138	0.315	0.452	0.472
Panel C: Risk Aversion (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[-0.000]	[-0.000]	[-0.000]	[-0.000]	[-0.000]
Optimistic Tone	-0.2278	-0.2112	-0.1783	-0.1543	-0.1542
	[-2.280]**	[-2.313]**	[-2.628]***	[-2.854]***	[-2.778]***
Pessimistic Tone	0.3923	0.4076	0.3776	0.3061	0.3061
	[1.669]*	[1.662]*	[1.722]*	[1.824]*	[1.806]*
Policy Rate		-0.0806	-0.0484	0.1726	0.1777
		[-0.926]	[-0.649]	[1.298]	[1.089]
Industrial Production			-0.209	-0.21	-0.2034
			[-1.944]*	[-2.571]**	[-1.012]
GDP Forecasts				0.2198	0.2201
				[1.651]	[1.685]*
INF Forecasts				-0.4792	-0.4809
				[-2.503]**	[-2.801]***
Unemployment Rate					0.009
					[0.039]
Adj. R2	0.153	0.15	0.184	0.254	0.247

Note: This table reports the results of equation (3.12). The table shows the asymmetric impact of the Fed's optimistic and pessimistic tones on market uncertainty and investors' risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013), we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply the directional dictionary of Apel and Blix Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tones. In particular, following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from January 2005 to May 2018. We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the growth of industrial production and the unemployment rate to control business cycle and economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 5: State-dependent Impact during Recessions

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VIX)					
Constant	-0.1914	-0.1949	-0.1725	-0.1744	-0.1725
	[-2.465]**	[-2.613]**	[-2.822]***	[-2.862]***	[-2.672]***
Net Optimistic Tone × D^{Rec}	-1.3144	-1.3321	-1.2011	-1.2281	-1.223
	[-4.765]***	[-4.954]***	[-4.523]***	[-4.305]***	[-4.496]***
Net Optimistic Tone × 1-D^{Rec}	-0.0708	-0.0657	-0.0801	-0.0945	-0.1019
	[-1.213]	[-1.172]	[-1.561]	[-1.664]*	[-1.662]*
Policy Rate		-0.1075	-0.0608	-0.1021	-0.1517
		[-1.894]*	[-1.299]	[-1.505]	[-0.990]
Industrial Production			-0.2457	-0.2475	-0.3224
			[-4.526]***	[-3.599]***	[-1.608]
GDP Forecasts				-0.0868	-0.0724
				[-0.566]	[-0.495]
INF Forecasts				0.0939	0.0985
				[1.175]	[1.138]
Unemployment Rate					-0.1017
					[-0.414]
Adj. R2	0.498	0.504	0.556	0.562	0.559
Panel B: Uncertainty (S&P 500)					
Constant	-0.2007	-0.2056	-0.1736	-0.1790	-0.1769
	[-2.389]**	[-2.609]**	[-3.046]***	[-3.249]***	[-3.071]***
Net Optimistic Tone × D^{Rec}	-1.3915	-1.416	-1.2286	-1.2209	-1.2155
	[-5.126]***	[-5.533]***	[-6.140]***	[-5.082]***	[-5.322]***
Net Optimistic Tone × 1 - D^{Rec}	-0.087	-0.0799	-0.1005	-0.0578	-0.0657
	[-1.453]	[-1.458]	[-2.286]**	[-1.200]	[-1.350]
Policy Rate		-0.1486	-0.0819	0.009	-0.0444
		[-2.431]**	[-1.832]*	[0.175]	[-0.465]
Industrial Production			-0.3513	-0.3194	-0.4
			[-5.166]***	[-4.929]***	[-2.437]**
GDP Forecasts				-0.116	-0.1005
				[-1.095]	[-0.947]
INF Forecasts				-0.1395	-0.1345
				[-2.305]**	[-2.326]**
Unemployment Rate					-0.1095
					[-0.573]
Adj. R2	0.562	0.58	0.691	0.707	0.706
Panel C: Risk Aversion (S&P 500)					
Constant	-0.1402	-0.1419	-0.1350	-0.1334	-0.1314
	[-2.164]**	[-2.222]**	[-2.170]**	[-2.110]**	[-1.947]*
Net Optimistic Tone × D^{Rec}	-0.9532	-0.9618	-0.9214	-0.9732	-0.9678
	[-2.685]***	[-2.700]***	[-2.562]**	[-2.797]***	[-2.897]***
Net Optimistic Tone × 1 - D^{Rec}	-0.0421	-0.0396	-0.0441	-0.1065	-0.1142
	[-0.870]	[-0.826]	[-0.920]	[-1.717]*	[-1.577]
Policy Rate		-0.0526	-0.0382	-0.1885	-0.2407
		[-1.087]	[-0.882]	[-1.923]*	[-1.143]
Industrial Production			-0.0758	-0.1075	-0.1862
			[-1.065]	[-1.427]	[-0.811]
GDP Forecasts				-0.0403	-0.0251
				[-0.243]	[-0.164]
INF Forecasts				0.2813	0.2862
				[1.929]*	[1.824]*
Unemployment Rate					-0.107
					[-0.375]
Adj. R2	0.252	0.247	0.245	0.285	0.28

Note: This table reports the results of equation (3.13). The table shows the state-dependent impact of the Fed's net optimistic tone during recessions on market uncertainty and investors' risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013), we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. Following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases using directional dictionary of Apel and Blix Grimaldi (2012) on each FOMC minutes from January 2005 to May 2018. This study estimates an interaction dummy which takes the value of unity for the recessions according to NBER designated recessionary months and zeroes otherwise. We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the growth of industrial production and the unemployment rate to control business cycle and economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 6: State-dependent Impact during High Economic Policy Uncertainty (EPU)

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VIX)					
Constant	-0.0149	-0.0148	-0.0143	-0.0138	-0.0146
	[-0.116]	[-0.114]	[-0.136]	[-0.131]	[-0.141]
Net Optimistic Tone × D^{EPU}	-0.6557	-0.6536	-0.6014	-0.6159	-0.6364
	[-2.179]**	[-2.147]**	[-2.403]**	[-2.383]**	[-2.425]**
Net Optimistic Tone × 1 - D^{EPU}	-0.1455	-0.1501	-0.1116	-0.1446	-0.138
	[-1.137]	[-1.197]	[-1.225]	[-1.331]	[-1.191]
Policy Rate		-0.0282	0.0329	-0.0232	-0.1666
		[-0.339]	[0.487]	[-0.232]	[-0.699]
Industrial Production			-0.3727	-0.3841	-0.5964
			[-4.216]***	[-3.767]***	[-1.762]*
GDP Forecasts				-0.0141	0.0275
				[-0.140]	[0.316]
INF Forecasts				0.1026	0.1138
				[0.649]	[0.685]
Unemployment Rate					-0.295
					[-0.793]
Adj. R2	0.259	0.252	0.383	0.378	0.388
Panel B: Uncertainty (S&P 500)					
Constant	-0.0151	-0.0147	-0.0142	-0.0144	-0.0153
	[-0.112]	[-0.108]	[-0.148]	[-0.150]	[-0.163]
Net Optimistic Tone × D^{EPU}	-0.6934	-0.6886	-0.6215	-0.5964	-0.6179
	[-2.224]**	[-2.180]**	[-2.627]***	[-2.390]**	[-2.497]**
Net Optimistic Tone × 1 - D^{EPU}	-0.1768	-0.1877	-0.1381	-0.1032	-0.0962
	[-1.082]	[-1.169]	[-1.486]	[-1.149]	[-0.933]
Policy Rate		-0.0667	0.0119	0.0907	-0.0595
		[-0.754]	[0.185]	[1.073]	[-0.383]
Industrial Production			-0.4792	-0.4594	-0.6818
			[-3.914]***	[-4.167]***	[-2.382]**
GDP Forecasts				-0.0409	0.0027
				[-0.761]	[0.049]
INF Forecasts				-0.131	-0.1193
				[-1.411]	[-1.299]
Unemployment Rate					-0.309
					[-1.025]
Adj. R2	0.295	0.292	0.514	0.515	0.529
Panel C: Risk Aversion (S&P 500)					
Constant	-0.0121	-0.0122	-0.0120	-0.0108	-0.0115
	[-0.110]	[-0.110]	[-0.113]	[-0.108]	[-0.116]
Net Optimistic Tone × D^{EPU}	-0.4859	-0.4865	-0.462	-0.5088	-0.5265
	[-1.907]*	[-1.892]*	[-1.959]*	[-2.094]**	[-2.082]**
Net Optimistic Tone × 1 - D^{EPU}	-0.0723	-0.071	-0.0529	-0.1387	-0.133
	[-0.765]	[-0.758]	[-0.583]	[-1.204]	[-1.137]
Policy Rate		0.0078	0.0365	-0.1275	-0.2518
		[0.119]	[0.608]	[-1.162]	[-0.912]
Industrial Production			-0.175	-0.2118	-0.3959
			[-2.358]**	[-2.286]**	[-1.140]
GDP Forecasts				0.0158	0.0519
				[0.124]	[0.460]
INF Forecasts				0.2875	0.2973
				[1.428]	[1.391]
Unemployment Rate					-0.2558
					[-0.657]
Adj. R2	0.131	0.122	0.144	0.179	0.183

Note: This table reports the results of equation (3.14). The table shows the state-dependent impact of the Fed's net optimistic tone during episodes of high Economic Policy Uncertainty (EPU) on market uncertainty and investors' risk aversion in the panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013), we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. Following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases using the directional dictionary of Apel and Blix Grimaldi (2012) on each FOMC minutes from January 2005 to May 2018. More specifically, we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from January 2005 to May 2018. This study identifies the months with higher than average EPU using the EPU index of Baker, Bloom and Davis (2016). Next, we develop an interaction dummy by multiplying Fed's tone with a dummy variable which takes the value of unity for the months with higher EPU and zeroes otherwise We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the growth of industrial production and the unemployment rate to control business cycle and economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 7: State-dependent Impact during High Monetary Policy Uncertainty (MPU)

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VIX)					
Constant	-0.0009	-0.0009	-0.0009	-0.0009	-0.0008
	[-0.007]	[-0.007]	[-0.009]	[-0.008]	[-0.008]
Net Optimistic Tone × D^{MPU}	-0.6194	-0.6224	-0.5819	-0.5869	-0.592
	[-2.050]**	[-2.045]**	[-2.274]**	[-2.257]**	[-2.299]**
Net Optimistic Tone × 1 - D^{MPU}	-0.2299	-0.2285	-0.1693	-0.1982	-0.2103
	[-1.299]	[-1.308]	[-1.622]	[-1.714]*	[-1.642]
Policy Rate		-0.0627	0.0004	-0.0343	-0.1433
		[-0.809]	[0.006]	[-0.358]	[-0.639]
Industrial Production			-0.3822	-0.3867	-0.5455
			[-3.735]***	[-3.481]***	[-1.647]
GDP Forecasts				-0.0441	-0.014
				[-0.379]	[-0.148]
INF Forecasts				0.0738	0.084
				[0.535]	[0.571]
Unemployment Rate					-0.2203
					[-0.630]
Adj. R2	0.234	0.23	0.368	0.361	0.364
Panel B: Uncertainty (S&P 500)					
Constant	-0.0007	-0.0007	-0.0008	-0.0009	-0.0009
	[-0.005]	[-0.005]	[-0.008]	[-0.009]	[-0.009]
Net Optimistic Tone × D^{MPU}	-0.6267	-0.6314	-0.5797	-0.5653	-0.5706
	[-2.121]**	[-2.122]**	[-2.554]**	[-2.247]**	[-2.307]**
Net Optimistic Tone × 1 - D^{MPU}	-0.3054	-0.3032	-0.2277	-0.1606	-0.1732
	[-1.318]	[-1.324]	[-1.816]*	[-1.664]*	[-1.638]
Policy Rate		-0.0999	-0.0194	0.0789	-0.0353
		[-1.167]	[-0.323]	[0.950]	[-0.243]
Industrial Production			-0.4879	-0.4622	-0.6287
			[-3.635]***	[-3.921]***	[-2.259]**
GDP Forecasts				-0.0723	-0.0407
				[-1.057]	[-0.727]
INF Forecasts				-0.1609	-0.1501
				[-1.686]*	[-1.628]
Unemployment Rate					-0.231
					[-0.829]
Adj. R2	0.256	0.259	0.488	0.497	0.502
Panel C: Risk Aversion (S&P 500)					
Constant	-0.0009	-0.0009	-0.0009	-0.0007	-0.0007
	[-0.008]	[-0.008]	[-0.009]	[-0.007]	[-0.007]
Net Optimistic Tone × D^{MPU}	-0.4905	-0.4915	-0.472	-0.493	-0.4975
	[-1.780]*	[-1.774]*	[-1.835]*	[-2.008]**	[-2.030]**
Net Optimistic Tone × 1 - D^{MPU}	-0.0919	-0.0915	-0.063	-0.1695	-0.1802
	[-0.996]	[-1.003]	[-0.877]	[-1.478]	[-1.394]
Policy Rate		-0.0219	0.0084	-0.1351	-0.2322
		[-0.380]	[0.164]	[-1.283]	[-0.885]
Industrial Production			-0.1837	-0.2138	-0.3552
			[-2.237]**	[-2.151]**	[-1.050]
GDP Forecasts				-0.008	0.0188
				[-0.058]	[0.159]
INF Forecasts				0.2625	0.2716
				[1.468]	[1.403]
Unemployment Rate					-0.1962
					[-0.532]
Adj. R2	0.129	0.121	0.146	0.172	0.171

Note: This table reports the results of equation (3.15). The table shows the state-dependent impact of the Fed's net optimistic tone during episodes of high Monetary Policy Uncertainty on market uncertainty and investors' risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013), we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. Following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases using the directional dictionary of Apel and Blix and Grimaldi (2012) on each FOMC minutes from January 2005 to May 2018. This study identifies the months with higher than average MPU using the MPU index of Baker, Bloom and Davis (2016). Next, we develop an interaction dummy by multiplying the Fed's tone with a dummy variable which takes the value of unity for the months with higher MPU and zeroes otherwise. We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the growth of industrial production and the unemployment rate to control business cycle and economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 8: Spillover Effect of Fed's Tone to the United Kingdom (UK)

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VFTSE)					
Constant	0.0000	0.0049	0.0049	0.0069	0.0069
	[0.000]	[0.036]	[0.036]	[0.078]	[0.081]
Net Optimistic Tone (Fed)	-0.481	-0.4807	-0.4805	-0.2437	-0.2928
	[-2.146]**	[-2.138]**	[-2.118]**	[-2.244]**	[-2.497]**
Policy Rate (Fed)		-0.0163	-0.0032	-0.6089	-0.4581
		[-0.173]	[-0.012]	[-2.058]**	[-1.741]*
Industrial Production Growth (UK)			-0.0144	0.7378	0.5496
			[-0.056]	[2.234]**	[1.938]*
Gross Domestic Production Growth (UK)				-0.6585	-0.5532
				[-3.276]***	[-3.093]***
Inflation Rate (UK)					0.1746
					[2.243]**
Adj. R2	0.224	0.217	0.209	0.479	0.498
Panel B: Uncertainty (FTSE-100)					
Constant	0.0000	0.0056	0.0050	0.0072	0.0072
	[0.000]	[0.040]	[0.035]	[0.087]	[0.089]
Net Optimistic Tone (Fed)	-0.5205	-0.5209	-0.515	-0.2579	-0.2933
	[-2.187]**	[-2.179]**	[-2.268]**	[-2.388]**	[-2.585]**
Policy Rate (Fed)		-0.0591	0.2469	-0.4105	-0.3021
		[-0.594]	[0.799]	[-2.500]**	[-1.816]*
Industrial Production Growth (UK)			-0.3354	0.4811	0.3458
			[-1.056]	[2.955]***	[2.134]**
Gross Domestic Production Growth (UK)				-0.7148	-0.6391
				[-4.557]***	[-4.300]***
Inflation Rate (UK)					0.1256
					[1.920]*
Adj. R2	0.264	0.261	0.274	0.594	0.603
Panel C: Risk Aversion (FTSE-100)					
Constant	0.0000	0.0047	0.0047	0.0067	0.0067
	[-0.000]	[0.035]	[0.035]	[0.076]	[0.079]
Net Optimistic Tone (Fed)	-0.4653	-0.4649	-0.4654	-0.2364	-0.2862
	[-2.127]**	[-2.119]**	[-2.089]**	[-2.212]**	[-2.470]**
Policy Rate (Fed)		-0.0106	-0.0345	-0.6201	-0.4675
		[-0.115]	[-0.130]	[-1.972]*	[-1.680]*
Industrial Production Growth (UK)			0.0262	0.7535	0.5629
			[0.102]	[2.129]***	[1.854]*
Gross Domestic Production Growth (UK)				-0.6367	-0.5301
				[-3.097]***	[-2.911]***
Inflation Rate (UK)					0.1769
					[2.226]**
Adj. R2	0.209	0.201	0.194	0.445	0.464

Note: This table reports the results of equation (3.16). The table shows the spillover effect of the Fed's net optimistic tone on market uncertainty and investors' risk aversion in the United Kingdom (UK) in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013), we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on FTSE-100 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply a bag of word method of Apel and Blix Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tones. In particular, following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases on each FOMC minutes from January 2005 to May 2018. We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the growth of GDP, the growth of industrial production and the inflation rate in the UK to control domestic economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 9: Spillover Effect of Fed's Tone to the Euro area (EA)

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VFTSE)					
Constant	0.0000	0.0061	0.0040	0.0056	0.0037
	[0.000]	[0.046]	[0.031]	[0.049]	[0.036]
Net Optimistic Tone (Fed)	-0.4735	-0.4757	-0.4642	-0.3567	-0.3961
	[-2.291]**	[-2.296]**	[-2.403]**	[-2.859]***	[-3.090]***
Policy Rate (Fed)		-0.1589	-0.0463	-0.078	-0.1299
		[-1.641]	[-0.372]	[-0.790]	[-1.336]
Industrial Production Growth (EA)			-0.1902	0.1939	0.0504
			[-2.048]**	[0.986]	[0.306]
Gross Domestic Production Growth (EA)				-0.4929	-0.4025
				[-2.161]**	[-2.156]**
Inflation Rate (EA)					0.2557
					[2.040]**
Adj. R2	0.217	0.235	0.251	0.342	0.386
Panel B: Uncertainty (FTSE-100)					
Constant	0.0000	0.0069	0.0033	0.0050	0.0036
	[0.000]	[0.051]	[0.026]	[0.046]	[0.036]
Net Optimistic Tone (Fed)	-0.4824	-0.4852	-0.4652	-0.3518	-0.3809
	[-2.238]**	[-2.250]**	[-2.542]**	[-2.932]***	[-3.180]***
Policy Rate (Fed)		-0.1915	0.0036	-0.0298	-0.068
		[-1.894]*	[0.027]	[-0.312]	[-0.708]
Industrial Production Growth (EA)			-0.3298	0.0754	-0.0303
			[-2.642]***	[0.593]	[-0.239]
Gross Domestic Production Growth (EA)				-0.52	-0.4534
				[-2.785]***	[-2.731]***
Inflation Rate (EA)					0.1884
					[1.622]
Adj. R2	0.225	0.256	0.32	0.423	0.445
Panel C: Risk Aversion (FTSE-100)					
Constant	0.0000	0.0058	0.0040	0.0056	0.0037
	[-0.000]	[0.045]	[0.032]	[0.049]	[0.035]
Net Optimistic Tone (Fed)	-0.4609	-0.463	-0.4531	-0.349	-0.389
	[-2.286]**	[-2.290]**	[-2.373]**	[-2.832]***	[-3.056]***
Policy Rate (Fed)		-0.1502	-0.0527	-0.0833	-0.1361
		[-1.593]	[-0.435]	[-0.850]	[-1.403]
Industrial Production Growth (EA)			-0.1649	0.2069	0.0612
			[-1.863]*	[1.007]	[0.361]
Gross Domestic Production Growth (EA)				-0.4771	-0.3854
				[-2.065]**	[-2.056]**
Inflation Rate (EA)					0.2597
					[2.057]**
Adj. R2	0.205	0.22	0.23	0.315	0.36

Note: This table reports the results of equation (3.17). The table shows the spillover effect of the Fed's net optimistic tone on market uncertainty and investors' risk aversion in the Euro area (EA) in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013), we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on STOXX-50 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply the directional dictionary of Apel and Blix Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tones. In particular, following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from January 2005 to May 2018. We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the growth of GDP, the growth of industrial production and the inflation rate in the EA to control domestic economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 10: Impact of Topic's Tone

Model	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Topic	Panel A: Implied Volatility (VIX)			Panel B: Uncertainty (S&P 500)			Panel C: Risk Aversion (S&P 500)		
Constant	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Economy	0.0591	0.0657	0.0629	-0.1623	-0.1558	-0.167	0.211	0.2155	0.2209
	[0.482]	[0.539]	[0.505]	[-1.096]	[-1.047]	[-1.185]	[1.356]	[1.375]	[1.385]
Financial Market	-0.1189	-0.1288	-0.1266	-0.1326	-0.1424	-0.1336	-0.0887	-0.0954	-0.0997
	[-1.018]	[-1.080]	[-1.055]	[-0.929]	[-1.003]	[-0.964]	[-1.023]	[-1.059]	[-1.056]
Credit Condition	-0.1085	-0.1061	-0.1026	-0.0865	-0.0842	-0.0703	-0.1002	-0.0986	-0.1053
	[-1.674]*	[-1.612]	[-1.473]	[-1.199]	[-1.147]	[-0.948]	[-1.656]	[-1.614]	[-1.601]
Consumptions	-0.2796	-0.2837	-0.2793	-0.3337	-0.3377	-0.3203	-0.1467	-0.1494	-0.1579
	[-2.006]**	[-2.081]**	[-2.065]**	[-1.848]*	[-1.914]*	[-2.064]**	[-1.827]*	[-1.876]*	[-1.770]*
Growth	-0.0386	-0.0371	-0.0195	-0.1477	-0.1461	-0.0754	0.0511	0.0521	0.0177
	[-0.438]	[-0.408]	[-0.255]	[-1.485]	[-1.438]	[-0.842]	[0.570]	[0.570]	[0.253]
Employment	-0.233	-0.2134	-0.222	-0.1668	-0.1474	-0.1819	-0.2386	-0.2254	-0.2086
	[-1.182]	[-1.058]	[-1.143]	[-1.320]	[-1.069]	[-1.260]	[-1.074]	[-1.023]	[-1.034]
Investments	-0.005	-0.0083	-0.0103	0.0656	0.0623	0.0542	-0.0695	-0.0717	-0.0677
	[-0.075]	[-0.127]	[-0.159]	[0.619]	[0.587]	[0.516]	[-1.362]	[-1.415]	[-1.395]
Inflation	0.1328	0.1355	0.1375	0.208	0.2107	0.2186	0.034	0.0358	0.032
	[1.134]	[1.201]	[1.248]	[1.462]	[1.536]	[1.718]*	[0.400]	[0.430]	[0.370]
Monetary Policy	0.1512	0.1549	0.1587	0.1635	0.1672	0.1826	0.1011	0.1035	0.0961
	[2.508]**	[2.563]**	[2.739]***	[1.969]*	[2.034]**	[2.502]**	[2.923]***	[2.943]***	[2.588]**
Exchange Rate	0.0253	0.0274	0.0268	-0.0121	-0.0101	-0.0125	0.0218	0.0232	0.0244
	[0.225]	[0.244]	[0.240]	[-0.115]	[-0.095]	[-0.122]	[0.198]	[0.212]	[0.221]
Control Variables									
GDP Forecast		-0.0721	-0.0714		-0.0714	-0.0683		-0.0485	-0.0500
		[-0.770]	[-0.815]		[-0.768]	[-0.861]		[-0.597]	[-0.513]
INF Forecast			-0.0522			-0.2095			0.1019
			[-0.566]			[-2.916]***			[0.952]
Adj. R2	0.120	0.116	0.109	0.237	0.234	0.267%	0.041	0.034	0.033

Note: This table reports the results of equation (3.18). The table shows the impact of each topic's net optimistic tone on market uncertainty and investors' risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013), we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply the directional dictionary of Apel and Blix Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tone. Following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from January 2005 to May 2018. This study identifies unique topics from the discussion in FOMC meetings using the Latent Dirichlet allocation (LDA) of Blei, Ng and Jordan (2003). More specifically, we use the LDA to estimate terms' weights and topic proportions to identify distinct topics and portion of each topic in FOMC meetings minutes. Moreover, this chapter uses the coherence score to estimate the optimal number of topics. We control the effect of other Fed's announcements using projections for Gross Domestic Production (GDP) and inflation (INF) variables. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicates the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 11: Asymmetric Impact of Topics' Optimistic and Pessimistic Tones

Model		(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Topic	Tone	Panel A: Implied Volatility (VIX)			Panel B: Uncertainty (S&P 500)			Panel C: Risk Aversion (S&P 500)		
Constant		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		[-0.000]	[0.000]	[-0.000]	[-0.000]	[0.000]	[-0.000]	[0.000]	[0.000]	[0.000]
Economy	Optimistic	0.1702	0.1497	0.1832	-0.071	-0.1102	-0.0736	0.3388	0.3408	0.3633
		[1.322]	[1.201]	[1.507]	[-0.720]	[-1.066]	[-0.893]	[1.872]*	[1.917]*	[2.002]**
	Pessimistic	0.151	0.1331	0.1681	0.2345	0.2095	0.2478	0.0809	0.0741	0.0976
		[1.839]*	[1.883]*	[2.350]**	[1.811]*	[1.897]*	[2.185]**	[1.256]	[1.145]	[1.464]
Financial Market	Optimistic	0.1058	0.1339	0.132	-0.0265	0.0389	0.0369	0.1923	0.1788	0.1776
		[1.097]	[1.393]	[1.503]	[-0.252]	[0.404]	[0.502]	[1.281]	[1.259]	[1.236]
	Pessimistic	0.1522	0.1921	0.2776	0.093	0.134	0.2276	0.177	0.2055	0.2628
		[1.349]	[1.667]*	[2.273]**	[0.791]	[1.162]	[1.758]*	[1.624]	[1.797]*	[2.248]**
Credit Conditions	Optimistic	-0.1203	-0.1175	-0.189	-0.0468	-0.0423	-0.1206	-0.1594	-0.159	-0.207
		[-1.768]*	[-1.727]*	[-3.058]***	[-0.626]	[-0.596]	[-1.872]*	[-2.307]**	[-2.237]**	[-2.951]***
	Pessimistic	0.0604	0.0442	0.0715	0.0717	0.0398	0.0697	0.0366	0.039	0.0573
		[1.027]	[0.775]	[1.430]	[1.010]	[0.624]	[1.181]	[0.780]	[0.815]	[1.292]
Consumptions	Optimistic	-0.2212	-0.2398	-0.1914	-0.2784	-0.286	-0.233	-0.1071	-0.1311	-0.0986
		[-1.686]*	[-1.955]*	[-1.819]*	[-1.750]*	[-2.092]**	[-1.950]*	[-1.034]	[-1.308]	[-1.113]
	Pessimistic	0.5163	0.5477	0.4784	0.5225	0.5551	0.4793	0.3702	0.3923	0.3459
		[2.227]**	[2.406]**	[2.369]**	[2.278]**	[2.656]***	[2.710]***	[1.825]*	[1.855]*	[1.738]*
Growth	Optimistic	-0.0162	0.0374	0.0377	-0.0757	0.0256	0.0259	0.0353	0.0313	0.0315
		[-0.166]	[0.357]	[0.424]	[-0.804]	[0.241]	[0.278]	[0.335]	[0.280]	[0.307]
	Pessimistic	-0.2942	-0.337	-0.2865	-0.0818	-0.1581	-0.1029	-0.4143	-0.4152	-0.3814
		[-1.475]	[-1.665]*	[-1.541]	[-0.629]	[-1.232]	[-0.942]	[-1.696]*	[-1.707]*	[-1.620]
Employment	Optimistic	-0.1425	-0.0812	-0.1022	-0.0899	-0.0559	-0.079	-0.1519	-0.0814	-0.0955
		[-1.052]	[-0.614]	[-0.797]	[-0.951]	[-0.564]	[-0.841]	[-0.983]	[-0.563]	[-0.667]
	Pessimistic	0.0899	0.1101	0.0308	0.0699	0.0977	0.0109	0.0897	0.0975	0.0444
		[0.851]	[1.064]	[0.368]	[0.758]	[1.278]	[0.183]	[0.862]	[0.898]	[0.453]
Investments	Optimistic	-0.0366	-0.0524	-0.0516	0.0943	0.0675	0.0684	-0.1499	-0.1516	-0.151
		[-0.469]	[-0.704]	[-0.848]	[0.789]	[0.599]	[0.755]	[-2.112]**	[-2.207]**	[-2.114]**
	Pessimistic	-0.1586	-0.1822	-0.2046	-0.1103	-0.1583	-0.1828	-0.1698	-0.165	-0.18
		[-1.652]	[-1.751]*	[-2.436]**	[-0.941]	[-1.241]	[-1.715]*	[-2.251]**	[-2.031]**	[-2.542]**
Inflation	Optimistic	0.0477	0.0353	-0.0831	0.1636	0.1392	0.0094	-0.0716	-0.0697	-0.1491
		[0.346]	[0.275]	[-0.649]	[1.121]	[1.121]	[0.084]	[-0.575]	[-0.556]	[-1.147]
	Pessimistic	-0.0741	-0.1032	-0.0687	-0.1177	-0.1512	-0.1133	-0.013	-0.0306	-0.0074
		[-0.917]	[-1.362]	[-1.011]	[-1.249]	[-1.809]*	[-1.538]	[-0.186]	[-0.433]	[-0.106]
Policy	Optimistic	0.0123	-0.016	0.0089	0.0221	-0.0298	-0.0025	-0.0049	-0.0043	0.0125
		[0.121]	[-0.144]	[0.095]	[0.291]	[-0.355]	[-0.034]	[-0.039]	[-0.033]	[0.106]
	Pessimistic	-0.0608	-0.0776	-0.0712	-0.0507	-0.0875	-0.0805	-0.052	-0.0461	-0.0419
		[-1.172]	[-1.577]	[-1.295]	[-0.956]	[-1.787]*	[-1.488]	[-1.174]	[-1.053]	[-0.864]
Exchange Rate	Optimistic	0.1624	0.1646	0.1176	0.1999	0.1915	0.1401	0.0884	0.0997	0.0682
		[1.424]	[1.467]	[1.349]	[2.016]**	[1.878]*	[1.794]*	[0.708]	[0.810]	[0.624]
	Pessimistic	0.0458	0.0572	0.1075	0.0773	0.1048	0.1599	0.0522	0.0458	0.0795
		[0.385]	[0.480]	[1.023]	[0.576]	[0.782]	[1.330]	[0.504]	[0.439]	[0.831]
Control Variables										
GDP Forecast			-0.1844	-0.1628		-0.1741	-0.1504		-0.146	-0.1316
			[-2.424]**	[-1.974]*		[-2.862]***	[-2.608]**		[-1.602]	[-1.333]
INF Forecast			-0.1211	0.0427		-0.2551	-0.0758		0.0333	0.143
			[-1.931]*	[0.693]		[-3.535]***	[-1.082]		[0.538]	[2.338]**
Unemployment Rate				0.3467			0.3796			0.2323
				[4.672]***			[3.827]***			[3.456]***
Adj. R2		0.385	0.416	0.498	0.408	0.478	0.58	0.325	0.331	0.363

Note: This table reports the results of equation (3.19). The table shows the impact of the topic's optimistic and pessimistic tones on market uncertainty and investor's risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013), we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply the directional dictionary of Apel and Blix Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tones. In particular, following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from January 2005 to May 2018. This study identifies unique topics from the discussion in FOMC meetings using the Latent Dirichlet allocation (LDA) of Blei, Ng and Jordan (2003). More specifically, we use the LDA to estimate term's weights and topic proportions to identify distinct topics and portion of each topic in FOMC meetings minutes. Moreover, this study uses coherence score to estimate the optimal number of topics We control the effect of other Fed's announcements using projections for Gross Domestic Production (GDP) and inflation (INF) variables. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 12: Impact on Fed's Tone (De-mean)

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VIX)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Net Optimistic Tone	-0.1846	-0.1851	-0.166	-0.1764	-0.1797
	[-1.936]*	[-1.930]*	[-2.179]**	[-2.096]**	[-2.090]**
Policy Rate		-0.3411	0.0398	-0.3498	-1.0569
		[-0.616]	[0.091]	[-0.523]	[-0.665]
Industrial Production			-1.2078	-1.2446	-1.7888
			[-3.477]***	[-3.102]***	[-1.557]
GDP Forecasts				-0.9543	-0.1641
				[-0.455]	[-0.091]
INF Forecasts				2.8547	3.084
				[0.790]	[0.799]
Unemployment Rate					-1.7904
					[-0.633]
Adj. R2	0.203	0.199	0.331	0.331	0.334
Panel B: Uncertainty (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Net Optimistic Tone	-0.1115	-0.1119	-0.0982	-0.0927	-0.0946
	[-1.953]*	[-1.948]*	[-2.392]**	[-2.106]**	[-2.128]**
Policy Rate		-0.3221	-0.0482	0.187	-0.2287
		[-0.978]	[-0.205]	[0.652]	[-0.370]
Industrial Production			-0.8687	-0.8339	-1.1537
			[-3.559]***	[-3.527]***	[-2.111]**
GDP Forecasts				-0.9201	-0.4556
				[-1.465]	[-0.598]
INF Forecasts				-1.3874	-1.2526
				[-1.357]	[-1.184]
Unemployment Rate					-1.0524
					[-0.828]
Adj. R2	0.237	0.239	0.462	0.462	0.468
Panel C: Risk Aversion (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Net Optimistic Tone	-0.0806	-0.0807	-0.0751	-0.0911	-0.0929
	[-1.684]*	[-1.678]*	[-1.735]*	[-1.878]*	[-1.855]*
Policy Rate		-0.0567	0.054	-0.5762	-0.9607
		[-0.216]	[0.230]	[-1.259]	[-0.878]
Industrial Production			-0.3511	-0.4231	-0.7191
			[-1.948]*	[-1.957]*	[-1.012]
GDP Forecasts				-0.0548	0.375
				[-0.032]	[0.259]
INF Forecasts				4.2835	4.4081
				[1.482]	[1.428]
Unemployment Rate					-0.9736
					[-0.537]
Adj. R2	0.098	0.099	0.113	0.154	0.154

Note: This table shows the impact of the Fed's Net Optimistic Tone on implied volatility, uncertainty and risk aversion. First, this study extracts the Fed's optimistic and pessimistic tones using the bi-grams directional dictionary of Apel and Gremaldi (2012). We calculate net optimistic phrases by subtracting the number of pessimistic phrases from a number of optimistic phrases. This study estimates the net optimistic tone by dividing net optimistic phrases with a total number of phrases in each document. Second, we decompose implied volatility into uncertainty and risk aversion using expected realized volatility following Bekaert Hoerova and Duca (2013). This study calculates market uncertainty and investors' risk aversion for the period between two FOMC meeting minutes announcements. We use control variables to control for other Fed's announcement and cyclic effects. The first type of control variables includes the Fed's policy rate and announcements for forecasts of GDP and inflation. The second type of control variables includes the growth of the Industrial Production (IP) and the unemployment rate to control business cycle and economic variations respectively. The Newey-West t-statistics are given in brackets. The superscripts ***, ** and * indicate the significance at the %, 5% and 10% level. This study extracts the Fed's tone using FOMC meeting minutes from December 2014 to May 2018. All series are demeaned to have mean zero.

Table 3. 13: Impact of Fed's Net Optimism Index

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VIX)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[-0.000]	[-0.000]	[-0.000]	[-0.000]	[-0.000]
Net Optimistic Index	-0.486	-0.488	-0.429	-0.4702	-0.4789
	[-2.035]**	[-2.033]**	[-2.243]**	[-2.112]**	[-2.122]**
Policy Rate		-0.062	-0.002	-0.095	-0.2141
		[-0.703]	[-0.028]	[-0.820]	[-0.784]
Industrial Production			-0.358	-0.376	-0.5489
			[-3.494]***	[-3.077]***	[-1.576]
GDP Forecasts				0.0075	0.0411
				[0.109]	[0.525]
INF Forecasts				0.1639	0.1748
				[0.951]	[0.949]
Unemployment Rate					-0.2404
					[-0.661]
Adj. R2	0.229	0.226	0.343	0.346	0.35
Panel B: Uncertainty (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[-0.000]	[-0.000]	[-0.000]
Net Optimistic Index	-0.544	-0.547	-0.471	-0.4521	-0.4614
	[-2.034]**	[-2.036]**	[-2.408]**	[-2.114]**	[-2.154]**
Policy Rate		-0.102	-0.024	0.0162	-0.1093
		[-1.066]	[-0.369]	[0.196]	[-0.569]
Industrial Production			-0.46	-0.4512	-0.6336
			[-3.798]***	[-3.585]***	[-2.191]**
GDP Forecasts				-0.0216	0.0139
				[-0.440]	[0.183]
INF Forecasts				-0.0665	-0.0551
				[-0.763]	[-0.592]
Unemployment Rate					-0.2534
					[-0.883]
Adj. R2	0.289	0.293	0.492	0.485	0.492
Panel C: Risk Aversion (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[-0.000]	[-0.000]	[-0.000]
Net Optimistic Index	-0.33	-0.331	-0.303	-0.3899	-0.3976
	[-1.773]*	[-1.770]*	[-1.806]*	[-1.912]*	[-1.901]*
Policy Rate		-0.019	0.009	-0.1842	-0.2891
		[-0.282]	[0.148]	[-1.383]	[-0.948]
Industrial Production			-0.167	-0.2053	-0.3577
			[-1.799]*	[-1.880]*	[-1.006]
GDP Forecasts				0.0345	0.0641
				[0.363]	[0.686]
INF Forecasts				0.3355	0.345
				[1.514]	[1.463]
Unemployment Rate					-0.2118
					[-0.552]
Adj. R2	0.101	0.092	0.111	0.161	0.161

Note: This table reports the results of our second robustness check exercise by changing the scaling of the Fed's tone measure. The table shows the impact of the Fed's net optimistic index on market uncertainty and investors' risk aversion in panesl A, B and C respectively. Following Bekaert, Hoerova and Duca (2013) we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. To estimate the Fed's tone index, we apply directional dictionary of Apel and Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tones. In particular, following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from January 2005 to May 2018. This study estimates the net optimistic index after dividing the difference between the frequency of optimistic and pessimistic phrases with the sum of optimistic and pessimistic phrases in each FOMC minutes. We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the growth of industrial production and the unemployment rate to control business cycle and economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 14: Impact of Fed's Tone using Term Weighting Scheme

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VIX)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[-0.000]	[-0.000]	[-0.000]	[-0.000]
Net Optimistic Tone	-0.487	-0.491	-0.435	-0.4643	-0.4779
	[-2.022]**	[-2.027]**	[-2.199]**	[-2.140]***	[-2.141]**
Policy Rate		-0.072	-0.01	-0.0839	-0.2209
		[-0.802]	[-0.150]	[-0.748]	[-0.823]
Industrial Production			-0.361	-0.3739	-0.5713
			[-3.559]***	[-3.162]***	[-1.633]
GDP Forecasts				-0.0318	0.0061
				[-0.364]	[0.079]
INF Forecasts				0.1383	0.1515
				[0.881]	[0.901]
Unemployment Rate					-0.2749
Adj. R2	0.23	0.228	0.348	0.349	0.357
Panel B: Uncertainty (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[-0.000]	[-0.000]	[-0.000]
Net Optimistic Tone	-0.518	-0.524	-0.451	-0.4273	-0.4413
	[-2.066]**	[-2.080]**	[-2.466]**	[-2.183]**	[-2.220]**
Policy Rate		-0.111	-0.031	0.0321	-0.1084
		[-1.160]	[-0.482]	[0.396]	[-0.590]
Industrial Production			-0.468	-0.4512	-0.6537
			[-3.596]***	[-3.571]***	[-2.192]**
GDP Forecasts				-0.0607	-0.0218
				[-1.307]	[-0.385]
INF Forecasts				-0.0977	-0.0842
				[-1.247]	[-1.038]
Unemployment Rate					-0.282
Adj. R2	0.262	0.267	0.474	0.472	0.481
Panel C: Risk Aversion (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[-0.000]	[-0.000]	[-0.000]
Net Optimistic Tone	-0.351	-0.353	-0.327	-0.3974	-0.4094
	[-1.711]*	[-1.711]*	[-1.725]*	[-1.897]*	[-1.874]*
Policy Rate		-0.027	0.0017	-0.1783	-0.2997
		[-0.388]	[0.028]	[-1.377]	[-0.985]
Industrial Production			-0.166	-0.2023	-0.3773
			[-1.912]*	[-1.957]*	[-1.065]
GDP Forecasts				0.0027	0.0363
				[0.024]	[0.361]
INF Forecasts				0.3185	0.3301
				[1.538]	[1.489]
Unemployment Rate					-0.2437
Adj. R2	0.115	0.107	0.125	0.172	0.175

Note: This table reports the results of our first robustness check exercise by using the tf.idf weighted scheme. Contrary to our baseline content analysis procedure which assigns equally weighted to each word, tf.idf weighted scheme assigns fewer weights to more frequent words. The table shows the impact of the Fed's net optimistic tone on market uncertainty and investors' risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013) we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply the directional dictionary of Apel and Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tones. In particular, following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from January 2005 to May 2018. We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the growth of industrial production and the unemployment rate to control business cycle and economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 15: Impact of Fed's Positive Tone

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VIX)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Positive Tone	-0.5812	-0.5883	-0.5026	-0.5129	-0.5177
	[-2.682]***	[-2.656]***	[-2.576]**	[-2.455]**	[-2.479]**
Policy Rate		0.0451	0.0761	0.0869	-0.0158
		[0.611]	[1.230]	[1.082]	[-0.088]
Industrial Production			-0.2719	-0.2598	-0.4121
			[-2.815]***	[-2.503]**	[-1.387]
GDP Forecasts				-0.1043	-0.0761
				[-1.238]	[-1.184]
INF Forecasts				0.0075	0.0143
				[0.065]	[0.117]
Unemployment Rate					-0.2128
					[-0.638]
Adj. R2	0.332	0.327	0.387	0.386	0.38.9
Panel B: Uncertainty (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Positive Tone	-0.5987	-0.6001	-0.4775	-0.4789	-0.4839
	[-2.676]***	[-2.613]**	[-2.760]***	[-2.487]**	[-2.539]**
Policy Rate		0.0093	0.0537	0.1899	0.0812
		[0.124]	[0.921]	[2.188]**	[0.736]
Industrial Production			-0.3892	-0.344	-0.5053
			[-3.054]***	[-3.281]***	[-2.060]**
GDP Forecasts				-0.1279	-0.098
				[-2.817]***	[-2.210]**
INF Forecasts				-0.2177	-0.2105
				[-2.730]***	[-2.749]***
Unemployment Rate					-0.2252
					[-0.861]
Adj. R2	0.352	0.346	0.476	0.509	0.514
Panel C: Risk Aversion (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Positive Tone	-0.4364	-0.446	-0.419	-0.4348	-0.4391
	[-2.200]**	[-2.205]**	[-2.119]**	[-2.179]**	[-2.184]**
Policy Rate		0.0611	0.0709	-0.0325	-0.1241
		[0.950]	[1.173]	[-0.428]	[-0.577]
Industrial Production			-0.0859	-0.1059	-0.2419
			[-1.031]	[-1.113]	[-0.792]
GDP Forecasts				-0.059	-0.0338
				[-0.533]	[-0.385]
INF Forecasts				0.2063	0.2124
				[1.341]	[1.280]
Unemployment Rate					-0.1899
					[-0.533]
Adj. R2	0.183	0.179	0.177	0.196	0.195

Note: This table reports the results of our third robustness check exercise by changing the directional dictionary to capture the Fed's tone. In our baseline results, we use optimistic and pessimistic phrases combining the directional nouns and adjectives of Apel and Grimaldi (2012). Whereas, the results in the table are obtained using directional words of Loughran and McDonald (2011). Specifically, we follow Jegadesh and Wu (2017) and use a list of negative words from a financial dictionary of Loughran and McDonald (2011) to capture pessimism in FOMC discussions. Next, we subtract the percentage of negative words in each document from one to capture the Fed's positive tone. The table shows the impact of the Fed's net optimistic tone on market uncertainty and investors' risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013) we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the growth of industrial production and the unemployment rate to control business cycle and economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 16: Impact of Fed's Tone on the Day Minutes Published

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VIX) Day					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[-0.000]	[-0.000]	[-0.000]
Net Optimistic Tone	-0.4015	-0.3994	-0.3508	-0.3525	-0.3548
	[-1.844]*	[-1.818]*	[-2.011]**	[-1.782]*	[-1.805]*
Policy Rate		-0.0368	0.0169	0.0301	-0.0934
		[-0.505]	[0.288]	[0.367]	[-0.405]
Industrial Production			-0.3454	-0.3355	-0.5189
			[-2.959]***	[-2.698]***	[-1.425]
GDP Forecasts				-0.1008	-0.0666
				[-1.390]	[-1.243]
INF Forecasts				0.0006	0.0093
				[0.005]	[0.071]
Unemployment Rate					-0.2539
					[-0.672]
Adj. R2	0.153	0.146	0.255	0.251	0.256
Panel B: Uncertainty (S&P 500) Day					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[-0.000]	[0.000]	[-0.000]	[-0.000]	[-0.000]
Net Optimistic Tone	-0.456	-0.4526	-0.3775	-0.3242	-0.325
	[-1.919]*	[-1.886]*	[-2.391]**	[-2.018]**	[-2.016]**
Policy Rate		-0.0609	0.0221	0.1461	0.102
		[-0.684]	[0.288]	[1.384]	[0.707]
Industrial Production			-0.5333	-0.5043	-0.5698
			[-2.868]***	[-2.930]***	[-1.997]**
GDP Forecasts				-0.0414	-0.0292
				[-0.454]	[-0.257]
INF Forecasts				-0.2198	-0.2167
				[-2.016]**	[-2.031]**
Unemployment Rate					-0.0907
					[-0.384]
Adj. R2	0.20	0.197	0.468	0.487	0.484
Panel C: Risk Aversion (S&P 500) Day					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[-0.000]	[-0.000]	[-0.000]	[-0.000]	[-0.000]
Net Optimistic Tone	-0.4323	-0.4289	-0.3541	-0.2935	-0.2939
	[-1.895]*	[-1.861]*	[-2.403]**	[-2.009]**	[-2.001]**
Policy Rate		-0.0612	0.0215	0.1589	0.1345
		[-0.711]	[0.283]	[1.505]	[1.032]
Industrial Production			-0.5312	-0.5004	-0.5366
			[-2.776]***	[-2.863]***	[-1.998]**
GDP Forecasts				-0.026	-0.0192
				[-0.233]	[-0.149]
INF Forecasts				-0.2484	-0.2467
				[-2.271]**	[-2.311]**
Unemployment Rate					-0.0501
					[-0.231]
Adj. R2	0.179	0.175	0.444	0.471	0.466

Note: This table reports the results of our fourth robustness check exercise by changing the response time for market uncertainty and investors' risk aversion to the Fed's tone. Specifically, in our baseline results, we estimate the impact of net optimistic tone on uncertainty and risk aversion for the "Minutes Publication Cycle" (covers the period between two FOMC minutes publication days). While this table shows the impact of the Fed's tone on the day FOMC minutes published. The table shows the impact of the Fed's net optimistic tone on market uncertainty and investors' risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013) we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply the directional dictionary of Apel and Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tone. In particular, following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from January 2005 to May 2018. This chapter estimates the net optimistic tone by dividing the difference between the frequency of optimistic and pessimistic phrases by the total number of phrases in each FOMC minutes. We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the growth of industrial production and the unemployment rate to control business cycle and economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicates the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 17: Impact of Fed's Eight Topics' Net Optimistic Tone

	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Net Opt: Tone	Panel A: Implied Volatility (VIX)			Panel B: Uncertainty (S&P 500)			Panel C: Risk Aversion (S&P 500)		
Constant	0.022	0.0217	0.018	0.0828	0.082	0.075	-0.0353	-0.0347	-0.0344
	[0.190]	[0.187]	[0.154]	[0.581]	[0.572]	[0.526]	[-0.438]	[-0.426]	[-0.418]
Market	-0.1037	-0.0849	-0.1637	-0.0408	-0.0235	-0.0733	-0.187	-0.1731	-0.2248
	[-1.174]	[-1.043]	[-2.104]**	[-0.626]	[-0.364]	[-0.939]	[-1.777]*	[-1.861]*	[-2.560]**
Consumption	-0.275	-0.2674	-0.264	-0.2669	-0.2674	-0.2653	-0.1819	-0.1923	-0.1901
	[-2.041]**	[-2.261]**	[-2.366]**	[-1.526]	[-1.701]*	[-1.728]*	[-2.10]**	[-2.51]**	[-2.639]***
Inflation	0.1113	0.1872	0.0662	0.0342	0.1015	0.025	0.0701	0.1208	0.0413
	[1.273]	[1.784]*	[0.678]	[0.402]	[1.227]	[0.327]	[0.902]	[1.155]	[0.385]
Policy	0.1073	0.1225	0.1362	0.1657	0.1782	0.1868	0.0801	0.088	0.097
	[1.073]	[1.357]	[1.643]	[1.209]	[1.371]	[1.427]	[1.095]	[1.256]	[1.484]
Employment	-0.2355	-0.2364	-0.2501	-0.1677	-0.1637	-0.1723	-0.2606	-0.2509	-0.2599
	[-1.478]	[-1.666]*	[-1.800]*	[-1.449]	[-1.618]	[-1.677]*	[-1.423]	[-1.497]	[-1.574]
Growth	-0.1921	-0.1861	-0.1544	-0.1696	-0.1681	-0.148	-0.0489	-0.0528	-0.0319
	[-1.867]*	[-2.170]*	[-1.837]*	[-1.524]	[-1.723]*	[-1.614]	[-0.614]	[-0.708]	[-0.437]
Exchange Rate	-0.0025	0.042	0.0367	0.0279	0.069	0.0657	0.018	0.0512	0.0478
	[-0.039]	[0.580]	[0.637]	[0.435]	[0.884]	[0.901]	[0.377]	[0.942]	[1.058]
Investment	-0.1709	-0.1202	-0.1043	-0.1843	-0.1376	-0.1275	-0.1124	-0.0748	-0.0644
	[-1.318]	[-1.359]	[-1.247]	[-1.346]	[-1.504]	[-1.423]	[-1.050]	[-0.999]	[-0.885]
Control Variables									
GDP Forecasts		0.0134	0.1448		0.0837	0.1668		0.1614	0.2477
		[0.093]	[1.121]		[0.580]	[1.016]		[1.336]	[2.237]**
INF Forecasts		-0.3911	-0.3254		-0.4055	-0.3639		-0.3856	-0.3424
		[-1.826]*	[-1.605]		[-1.680]*	[-1.617]		[-2.00]**	[-1.808]*
Unemployment Rate			0.2979			0.1885			0.1956
			[3.414]***			[1.434]			[2.794]***
Adj. R2	0.26	0.38	0.43	0.22	0.33	0.34	0.13	0.20	0.22

Note: This table reports the results of our robustness check exercise by changing the number of topics identified using the Latent Dirichlet Allocation. More specifically, in our baseline analysis, we use the coherence score to estimate the optimal ten number of topics in FOMC meeting discussions. Compared to our baseline results for the topic to tone, this table contains the results for eight unique topics from FOMC minutes. The table shows the impact of the topics' net optimistic tone on market uncertainty and investors' risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013) we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply directional dictionary of Apel and Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tones. In particular, following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from January 2005 to May 2018. This study identifies unique topics from the discussion in FOMC meetings using the Latent Dirichlet allocation (LDA) of Blei, Ng and Jordan (2003). More specifically, we use the LDA to estimate term's weights and topic proportions to identify distinct topics and portion of each topic in FOMC meetings minutes. We control the effect of other Fed's announcements using projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the unemployment rate to control economic variations. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 18: Impact of Fed unique Topics' Optimistic and Pessimistic Tones

Model		(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Topic	Tone	Panel A: Implied Volatility (VIX)			Panel B: Uncertainty (S&P 500)			Panel C: Risk Aversion (S&P 500)		
Market	Optimistic	-0.2766	-0.2652	-0.3984	-0.1181	-0.0908	-0.1217	-0.4985	-0.4625	-0.5889
		[-1.295]	[-1.496]	[-2.038]**	[-1.241]	[-1.212]	[-1.475]	[-1.709]*	[-1.817]*	[-2.058]**
	Pessimistic	0.4022	0.3244	0.3831	0.3069	0.2467	0.2604	0.5034	0.4318	0.4875
		[1.601]	[1.648]	[1.912]*	[2.213]**	[2.597]**	[2.732]***	[1.549]	[1.593]	[1.734]*
Consumption	Optimistic	-0.1228	-0.037	-0.0244	-0.3355	-0.2875	-0.2845	0.0567	0.1104	0.1224
		[-1.280]	[-0.484]	[-0.343]	[-3.059]***	[-3.52]***	[-3.52]***	[0.545]	[1.014]	[1.095]
	Pessimistic	0.4213	0.3989	0.3529	0.6975	0.6829	0.6722	0.115	0.0982	0.0545
		[3.582]***	[3.286]***	[2.848]***	[5.090]***	[5.561]***	[5.507]***	[0.684]	[0.526]	[0.272]
Inflation	Optimistic	-0.0429	0.0946	0.0447	0.0089	0.0877	0.0761	-0.0316	0.0571	0.0098
		[-0.409]	[0.960]	[0.535]	[0.112]	[1.028]	[0.900]	[-0.346]	[0.576]	[0.120]
	Pessimistic	-0.0208	0.0083	0.2071	-0.1123	-0.0862	-0.0401	0.1131	0.1448	0.3333
		[-0.107]	[0.056]	[1.753]*	[-0.684]	[-0.641]	[-0.299]	[0.686]	[1.059]	[2.864]***
Policy	Optimistic	0.0455	-0.0108	-0.0248	0.1014	0.0566	0.0533	0.0069	-0.0469	-0.0601
		[0.658]	[-0.174]	[-0.432]	[1.184]	[0.910]	[0.862]	[0.109]	[-0.571]	[-0.736]
	Pessimistic	-0.0587	-0.1988	-0.2605	-0.1149	-0.2122	-0.2301	-0.068	-0.1778	-0.2361
		[-0.436]	[-1.401]	[-2.096]**	[-1.271]	[-2.096]**	[-2.249]**	[-0.512]	[-1.288]	[-1.898]*
Employment	Optimistic	-0.2815	-0.3399	-0.2577	-0.1643	-0.207	-0.1879	-0.2988	-0.3491	-0.2711
		[-2.183]**	[-2.362]**	[-2.037]**	[-2.214]**	[-2.75]***	[-2.378]**	[-1.720]*	[-1.799]*	[-1.595]
	Pessimistic	-0.067	-0.061	-0.1592	-0.0958	-0.1048	-0.1276	-0.0281	-0.0414	-0.1345
		[-0.393]	[-0.476]	[-1.492]	[-0.783]	[-1.013]	[-1.233]	[-0.158]	[-0.260]	[-1.014]
Growth	Optimistic	0.0093	-0.0665	-0.0688	0.0141	-0.0287	-0.0293	0.0822	0.0341	0.0319
		[0.092]	[-0.703]	[-0.758]	[0.128]	[-0.271]	[-0.272]	[0.679]	[0.307]	[0.304]
	Pessimistic	0.0653	-0.017	-0.07	0.1293	0.0803	0.068	-0.0959	-0.1515	-0.2017
		[0.526]	[-0.178]	[-0.724]	[0.862]	[0.656]	[0.556]	[-0.585]	[-0.838]	[-1.050]
Exchange Rate	Optimistic	0.1805	0.1704	0.1734	0.1123	0.1137	0.1144	0.2023	0.2058	0.2085
		[2.014]**	[1.928]*	[2.039]**	[2.507]**	[2.455]**	[2.538]**	[1.725]*	[1.702]*	[1.753]*
	Pessimistic	0.1115	0.0621	0.1278	0.0015	-0.0296	-0.0144	0.1898	0.1541	0.2164
		[0.711]	[0.470]	[1.079]	[0.022]	[-0.517]	[-0.252]	[0.935]	[0.874]	[1.223]
Investment	Optimistic	-0.0469	-0.0229	-0.0432	-0.1491	-0.1321	-0.1368	0.004	0.024	0.0047
		[-0.359]	[-0.223]	[-0.466]	[-1.500]	[-1.534]	[-1.595]	[0.028]	[0.210]	[0.045]
	Pessimistic	0.0471	0.0355	0.0753	-0.0389	-0.0604	-0.0511	0.146	0.1181	0.1558
		[0.489]	[0.499]	[1.037]	[-0.599]	[-0.922]	[-0.805]	[1.096]	[1.095]	[1.363]
Control Variables										
GDP Forecasts			-0.037	0.0828		0.0737	0.1015		0.1072	0.2208
			[-0.344]	[0.898]		[0.879]	[1.225]		[1.026]	[1.865]*
INF Forecasts			-0.3914	-0.3108		-0.3352	-0.3165		-0.4057	-0.3292
			[-2.407]**	[-2.224]**		[-2.898]***	[-2.730]***		[-2.17]**	[-2.090]**
Unemployment Rate				0.3176			0.0737			0.3012
				[3.305]***			[0.908]			[2.525]**
Adj. R2		0.43	0.55	0.60	0.65	0.70	0.71	0.24	0.31	0.35

Note: This table reports the results of our robustness check exercise by changing the number of topics identified using the Latent Dirichlet Allocation. More specifically, in our baseline analysis, we use the coherence score to estimate the optimal ten number of topics in FOMC meeting discussions. Compared to our baseline results for the topic to tone, this table contains the results for eight unique topics from FOMC minutes. The table shows the impact of the topic's optimistic and pessimistic tones on market uncertainty and investors' risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013) we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply the directional dictionary of Apel and Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tones. In particular, following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from January 2005 to May 2018. This study identifies unique topics from the discussion in FOMC meetings using the Latent Dirichlet allocation (LDA) of Blei, Ng and Jordan (2003). More specifically, we use the LDA to estimate terms' weights and topic proportions to identify distinct topics and portion of each topic in FOMC meetings minutes. We control the effect of other Fed's announcements using projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the unemployment rate to control economic variations. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 19: Impact of Fed's Net Optimistic Tone (Policy Statements)

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VIX)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$Net\ Optimistic\ Tone^{PS}$	-0.4453	-0.5063	-0.3836	-0.3723	-0.5282
	[-1.968]*	[-2.189]**	[-1.778]*	[-1.592]	[-1.754]*
Policy Rate		-0.2057	-0.128	-0.0241	-0.4808
		[-2.104]**	[-1.544]	[-0.206]	[-1.213]
Industrial Production			-0.3006	-0.2787	-0.7875
			[-2.096]**	[-2.266]**	[-1.752]*
GDP Forecasts				-0.0988	-0.0633
				[-1.345]	[-0.904]
INF Forecasts				-0.1555	-0.0872
				[-1.320]	[-0.722]
Unemployment Rate					-0.7644
					[-1.304]
Adj. R2	0.191	0.222	0.292	0.301	0.368
Panel B: Uncertainty (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[-0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$Net\ Optimistic\ Tone^{PS}$	-0.3505	-0.4174	-0.224	-0.2281	-0.3124
	[-2.544]**	[-3.198]***	[-2.273]**	[-1.936]*	[-2.279]**
Policy Rate		-0.2253	-0.1029	0.0697	-0.1773
		[-2.679]***	[-1.424]	[0.643]	[-0.951]
Industrial Production			-0.4736	-0.4162	-0.6914
			[-2.110]**	[-2.467]**	[-2.260]**
GDP Forecasts				-0.0802	-0.061
				[-0.877]	[-0.600]
INF Forecasts				-0.2924	-0.2555
				[-2.345]**	[-2.206]**
Unemployment Rate					-0.4135
					[-1.418]
Adj. R2	0.115	0.153	0.336	0.382	0.397
Panel C: Risk Aversion (S&P 500)					
Constant	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$Net\ Optimistic\ Tone^{PS}$	-0.3234	-0.3891	-0.1901	-0.1966	-0.2665
	[-2.612]**	[-3.391]***	[-2.192]**	[-1.996]**	[-2.383]**
Policy Rate		-0.2213	-0.0954	0.0831	-0.1215
		[-2.751]***	[-1.337]	[0.781]	[-0.754]
Industrial Production			-0.4872	-0.4258	-0.6537
			[-2.097]**	[-2.456]**	[-2.285]**
GDP Forecasts				-0.0745	-0.0586
				[-0.748]	[-0.541]
INF Forecasts				-0.3058	-0.2752
				[-2.471]**	[-2.377]**
Unemployment Rate					-0.3425
					[-1.338]
Adj. R2	0.096	0.133	0.327	0.376	0.385

Note: This table reports the results of our additional analysis by extracting the Fed's tone from monetary policy statements. This table shows the results for the impact of Policy Statements' (PSs') tone on market uncertainty and risk aversion. The table shows the impact of the Fed's net optimistic tone on market uncertainty and investors' risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013) we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply the directional dictionary of Apel and Girmaldi (2012) to categorise the contents in policy statements into an optimistic and pessimistic tones. This study estimates the net optimistic tone by dividing the difference between the frequency of optimistic and pessimistic phrases by the total number of phrases in each policy statement. We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the unemployment rate to control business cycle and economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 20: Impact of Fed's Tone of FOMC Minutes Before and After April 2011

Model	(1)	(2)	(3)	(4)	(5)
Panel A: Implied Volatility Index (VIX)					
Constant	0.1684	0.4033	0.1294	0.1008	0.1924
	[0.887]	[1.799]*	[0.536]	[0.473]	[0.659]
Net Optimistic Tone × $D^{Conference}$	-0.4269	-0.8555	-0.3496	-0.2998	-0.47
	[-2.026]**	[-2.910]***	[-1.004]	[-0.981]	[-0.981]
Net Optimistic Tone × (1 - $D^{Conference}$)	-0.6592	-0.6327	-0.6283	-0.6461	-0.6523
	[-2.340]**	[-2.439]**	[-2.558]**	[-2.460]**	[-2.612]**
Policy Rate		-0.3315	-0.127	-0.1502	-0.3687
		[-2.410]**	[-0.875]	[-0.942]	[-0.969]
Industrial Production			-0.27	-0.2912	-0.4804
			[-3.108]***	[-3.105]***	[-1.896]*
GDP Forecasts				-0.0396	0.0053
				[-0.438]	[0.071]
INF Forecasts				0.0838	0.0864
				[0.713]	[0.742]
Unemployment Rate					-0.3312
					[-0.830]
Adj. R2	0.313	0.374	0.402	0.396	0.409
Panel B: Uncertainty [S&P 500]					
Constant	0.1666	0.4494	0.0027	0.0435	0.1332
	[0.821]	[1.972]*	[0.016]	[0.237]	[0.598]
Net Optimistic Tone×$D^{Conference}$	-0.4317	-0.9479	-0.1225	-0.192	-0.3586
	[-1.926]*	[-3.151]***	[-0.512]	[-0.725]	[-0.964]
Net Optimistic Tone × (1 - $D^{Conference}$)	-0.7055	-0.6736	-0.6665	-0.6344	-0.6405
	[-2.309]**	[-2.440]**	[-2.763]***	[-2.472]**	[-2.636]***
Policy Rate		-0.3993	-0.0656	-0.0064	-0.2203
		[-2.720]***	[-0.553]	[-0.050]	[-0.845]
Industrial Production			-0.4405	-0.397	-0.5822
			[-4.514]***	[-4.562]***	[-2.784]***
GDP Forecasts				-0.0665	-0.0226
				[-1.421]	[-0.471]
INF Forecasts				-0.1361	-0.1336
				[-2.284]**	[-2.408]**
Unemployment Rate					-0.3242
					[-1.070]
Adj. R2	0.354	0.445	0.53	0.536	0.549
Panel C: Risk Aversion [S&P 500]					
Constant	0.1115	0.2438	0.1958	0.111	0.193
	[0.649]	[1.100]	[0.680]	[0.502]	[0.601]
Net Optimistic Tone×$D^{Conference}$	-0.2895	-0.531	-0.4423	-0.2962	-0.4485
	[-1.537]	[-1.870]*	[-1.022]	[-0.911]	[-0.853]
Net Optimistic Tone × (1 - $D^{Conference}$)	-0.4756	-0.4607	-0.4599	-0.5186	-0.5242
	[-1.939]*	[-1.964]*	[-1.955]*	[-2.088]**	[-2.182]**
Policy Rate		-0.1868	-0.1509	-0.2434	-0.4389
		[-1.608]	[-0.931]	[-1.347]	[-0.990]
Industrial Production			-0.0473	-0.1221	-0.2915
			[-0.356]	[-1.049]	[-1.065]
GDP Forecasts				-0.0052	0.035
				[-0.045]	[0.355]
INF Forecasts				0.2634	0.2657
				[1.559]	[1.559]
Unemployment Rate					-0.2964
					[-0.674]
Adj. R2	0.15	0.163	0.156	0.184	0.191

Note: This table reports the results for the impact of the Fed's tone extracted from FOMC minutes before and after April 2011. In April 2011 Fed started doing a press conference after each FOMC meeting. A press conference also contains details of FOMC members view about the financial market and economic conditions and provide vital information before minutes of the meeting published. To investigate the change in impact, we create an interaction dummy by multiplying the Fed's tone with a dummy which takes a value of unity for the FOMC minutes published after April 2011 and zeroes otherwise. The table shows the impact of the Fed's net optimistic tone on market uncertainty and investors' risk aversion in panels A, B and C respectively. Following Bekaert, Hoerova and Duca (2013) we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply a bag of word method of Apel and Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tones. In particular, following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from December 2004 to May 2018. This chapter estimates the net optimistic tone by dividing the difference between the frequency of optimistic and pessimistic phrases by the total number of phrases in each FOMC minutes. We control the effect of other Fed's announcements using policy rate decisions and projections for Gross Domestic Production (GDP) and inflation (INF) variables. We also include the unemployment rate to control business cycle and economic variations respectively. All the series are standardized to have mean zero and unit standard deviation. The Newey-West t-statistics are reported in brackets and superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Table 3. 21: Summary of the Key Results

Table	**Asymmetric Impact**	Implied Volatility(IV)	Uncertainty (UC)	Risk Aversion (RA)
3.3	Net Optimistic Tone	-**	-**	-*
3.4	Optimistic Tone	-***	-*	-***
	Pessimistic Tone	+**	+*	+*
3.5	**State-Dependent Impact During Recessions (Rec)**			
	Net Opt Tone × D^{Rec}	-***	-***	-***
	Net Opt Tone × (1 - D^{Rec})	-*		
3.6	**State-Dependent Impact During Economic Policy Uncertainty (EPU)**			
	Net Opt Tone × D^{EPU}	-**	-**	-**
	Net Opt Tone × 1 - D^{EPU}			
3.7	**State-Dependent Impact During Monetary Policy Uncertainty (MPU)**			
	Net Opt Tone × D^{MPU}	-**	-**	-**
	Net Opt Tone × 1 - D^{MPU}			
3.8	**Spillover Impact in the United Kingdom (UK)**			
	Net Optimistic Tone (Fed)	-**	-**	-**
3.9	**Spillover Impact in Euro area (EA)**			
	Net Optimistic Tone (Fed)	-***	-***	-***
3.10	**Each Topics' Net Optimistic Tone**			
	Economy			
	Financial Market			
	Credit Conditions			
	Consumptions	-**	-**	-*
	Growth			
	Employment			
	Investments			
	Inflation		+*	
	Policy	+**	+**	+**
	Exchange Rate			
	Robustness Checks			
3.12	Volatility Persistence (De-mean)	-**	-**	-*
3.13	Weighting Scheme (tf.idf)	-**	-**	-*
3.14	Net Optimistic Index (Scale)	-**	-**	-*
3.15	Positive Tone (Dictionary)	-**	-**	-*
3.16	Response Window (Day)	-*	-**	-**
	Additional Results			
3.19	Policy Statements	-*	-**	-***
3.20	Net Opt Tone × $D^{Press\ Conf}$			
	Net Opt Tone × 1 - $D^{Press\ Conf}$	-**	-***	-**

Note: This table summarises the results of this chapter. Following Bekaert, Hoerova and Duca (2013), we use the difference between risk-adjusted and risk-free volatility to decompose the implied volatility on S&P 500 into uncertainty and risk aversion components. To estimate the Fed's tone, we apply the directional dictionary of Apel and Blix Girmaldi (2012) to categorise the discussion in FOMC meetings into an optimistic and pessimistic tone. In particular, following Apergis and Paragidis (2019), we measure the frequency of optimistic and pessimistic phrases in each FOMC minutes from January 2005 to May 2018. This study identifies unique topics from the discussion in FOMC meetings using the Latent Dirichlet allocation (LDA) of Blei, Ng and Jordan (2003). We control the effect of other Fed's announcements using projections for Gross Domestic Production (GDP) and inflation (INF) variables. The superscripts ***, **, * indicate the statistical significance at the 1%, 5% and 10% level respectively.

Appendix B:

Appendix B 1: FOMC Meeting and Minutes Dates

S. No:	Meetings Dates	Minutes Publication Dates
1	14-Dec-04	04-Jan-05
2	02-Feb-05	23-Feb-05
3	22-Mar-05	12-Apr-05
4	03-May-05	24-May-05
5	30-Jun-05	21-Jul-05
6	09-Aug-05	30-Aug-05
7	20-Sep-05	11-Oct-05
8	01-Nov-05	22-Nov-05
9	13-Dec-05	03-Jan-06
10	31-Jan-06	21-Feb-06
11	28-Mar-06	18-Apr-06
12	10-May-06	31-May-06
13	29-Jun-06	20-Jul-06
14	08-Aug-06	29-Aug-06
15	20-Sep-06	11-Oct-06
16	25-Oct-06	15-Nov-06
17	12-Dec-06	03-Jan-07
18	31-Jan-07	21-Feb-07
19	21-Mar-07	11-Apr-07
20	09-May-07	30-May-07
21	28-Jun-07	19-Jul-07
22	07-Aug-07	28-Aug-07
23	18-Sep-07	09-Oct-07
24	31-Oct-07	20-Nov-07
25	11-Dec-07	02-Jan-08
26	30-Jan-08	20-Feb-08
27	18-Mar-08	08-Apr-08
28	30-Apr-08	21-May-08
29	25-Jun-08	16-Jul-08
30	05-Aug-08	26-Aug-08
31	16-Sep-08	07-Oct-08
32	29-Oct-08	19-Nov-08
33	16-Dec-08	06-Jan-09
34	28-Jan-09	18-Feb-09
35	18-Mar-09	08-Apr-09
36	29-Apr-09	20-May-09
37	24-Jun-09	15-Jul-09
38	12-Aug-09	02-Sep-09
39	23-Sep-09	14-Oct-09
40	04-Nov-09	24-Nov-09
41	16-Dec-09	06-Jan-10
42	27-Jan-10	17-Feb-10
43	16-Mar-10	06-Apr-10
44	28-Apr-10	19-May-10
45	23-Jun-10	14-Jul-10
46	10-Aug-10	31-Aug-10
47	21-Sep-10	12-Oct-10
48	03-Nov-10	23-Nov-10
49	14-Dec-10	04-Jan-11
50	26-Jan-11	16-Feb-11
51	15-Mar-11	05-Apr-11
52	27-Apr-11	18-May-11
53	22-Jun-11	12-Jul-11
54	09-Aug-11	30-Aug-11
55	21-Sep-11	12-Oct-11
56	02-Nov-11	22-Nov-11
57	13-Dec-11	03-Jan-12
58	25-Jan-12	15-Feb-12
59	13-Mar-12	03-Apr-12
60	25-Apr-12	16-May-12
61	20-Jun-12	11-Jul-12
62	01-Aug-12	22-Aug-12
63	13-Sep-12	04-Oct-12

64	24-Oct-12	14-Nov-12
65	12-Dec-12	03-Jan-13
66	30-Jan-13	20-Feb-13
67	20-Mar-13	10-Apr-13
68	01-May-13	22-May-13
69	19-Jun-13	10-Jul-13
70	31-Jul-13	21-Aug-13
71	18-Sep-13	09-Oct-13
72	30-Oct-13	20-Nov-13
73	18-Dec-13	08-Jan-14
74	29-Jan-14	19-Feb-14
75	19-Mar-14	09-Apr-14
76	30-Apr-14	21-May-14
77	18-Jun-14	09-Jul-14
78	30-Jul-14	20-Aug-14
79	17-Sep-14	08-Oct-14
80	29-Oct-14	19-Nov-14
81	17-Dec-14	07-Jan-15
82	28-Jan-15	18-Feb-15
83	18-Mar-15	08-Apr-15
84	29-Apr-15	20-May-15
85	17-Jun-15	08-Jul-15
86	29-Jul-15	19-Aug-15
87	17-Sep-15	08-Oct-15
88	28-Oct-15	18-Nov-15
89	16-Dec-15	06-Jan-16
90	27-Jan-16	17-Feb-16
91	16-Mar-16	06-Apr-16
92	27-Apr-16	18-May-16
93	15-Jun-16	06-Jul-16
94	27-Jul-16	17-Aug-16
95	21-Sep-16	12-Oct-16
96	02-Nov-16	23-Nov-16
97	14-Dec-16	04-Jan-17
98	01-Feb-17	22-Feb-17
99	15-Mar-17	05-Apr-17
100	03-May-17	24-May-17
101	14-Jun-17	05-Jul-17
102	26-Jul-17	16-Aug-17
103	20-Sep-17	11-Oct-17
104	01-Nov-17	22-Nov-17
105	13-Dec-17	03-Jan-18
106	31-Jan-18	21-Feb-18
107	21-Mar-18	11-Apr-18
108	02-May-18	23-May-18

Source: Minutes of FOMC meeting published on Fed's website.
https://www.federalreserve.gov/monetarypolicy/fomccalendars.htm

Appendix B 2 : List of Directional Words

S. No:	Nouns		Adjectives	
	Optimistic	**Pessimistic**	**Optimistic**	**Pessimistic**
1	Develop	Import	Rose	Low
2	Market	Credit	Strengthen	Declin
3	Consum	Risk	Increase	Lower
4	Product	Debt	Gain	Modest
5	Recoveri	Accommod	Expand	Reduc
6	Energi	Loan	Higher	Depress
7	Confid	Uncertainty	Rise	Concern
8	Retail	Deficit	Larg	Slow
9	Inflat	Unemploy	Expans	Fell
10	Econom	Cost	Faster	Decreas
11	Growth			
12	Finance			
13	Price			
14	Employ			
15	Purchas			
16	Income			
17	Outlook			
18	Domest			
19	Spend			
20	Output			
21	Equity			
22	Export			
23	Sale			
24	Progress			
25	Invest			
26	Condit			
27	Secur			
28	Labor			
29	Busi			
30	Demand			
31	Economi			

Note: This table contains the list of positive (negative) nouns and optimistic (pessimistic) adjectives to extract the Federal Reserve's optimistic and optimistic tone. The directional dictionary is based on directional lexicon of Apel and Grimaldi (2012) primarily developed to estimate tone from central bank communications. This study uses a combination of noun and adjective (bigram) to construct a list of optimistic and pessimistic phrases. We perform Porter's stemming allocation to stem all words to their common linguistic root.

Appendix B 3: Preparing Paragraph for Content Analysis

Raw Paragraph from FOMC minutes:
The Manager of the System Open Market Account reported on recent developments in foreign exchange markets. There were no open market operations in foreign currencies for the System's account in the period since the previous meeting. The Manager also reported on recent developments in domestic financial markets and on System open market transactions in government securities and securities issued or fully guaranteed by federal agencies during the period November 10, 2004, through December 13, 2004. By unanimous vote, the Committee ratified these transactions.
After Removing Punctuations and Numbers:
The Manager of the System Open Market Account reported on recent developments in foreign exchange markets There were no open market operations in foreign currencies for the System's account in the period since the previous meeting The Manager also reported on recent developments in domestic financial markets and on System open market transactions in government securities and securities issued or fully guaranteed by federal agencies during the period November through December By unanimous vote the Committee ratified these transactions
After Removing Stop Words:
Manager System Open Market Account reported recent developments foreign exchange markets there open market operations foreign currencies System's account period since previous meeting The Manager also reported recent developments domestic financial markets System open market transactions government securities issued fully guaranteed federal agencies period November December By unanimous vote Committee ratified transactions
After converting all Words to Lower Capitalization:
the manager system open market account reported recent developments foreign exchange markets there open market operations foreign currencies system' account period since previous meeting the manager also reported recent developments domestic financial markets system open market transactions government securities issued fully guaranteed agencies period by unanimous vote ratified transactions
After Applying Porter's stemming to Stem Words:
the manag system open market account report recent develop foreign exchang market there open market oper foreign currenc system' account period sinc previous meet the manag also report recent develop domest financi market system open market transact govern secur secur issu fulli guarante agenc period by unanim vote ratifi transact

Manag	System	Open	market	Account	Report	recent	develop	foreign	exchang	Oper
currenc	Period	Sinc	previous	Meet	Also	domest	financi	transact	govern	Secur
Issu	Fulli	Guarantee	feder	Agenc	Novemb	decemb	unanim	vote	committe	Ratifi
Inform	Receiv	Suggest	economi	Expand	Moder	pace	third	quarter	current	Consum
Spend	Solid	Invest	remain	Strong	Manufactur	product	increas	modest	employ	Gain

Source: Minutes of FOMC meeting published on Fed's website.
https://www.federalreserve.gov/monetarypolicy/fomccalendars.htm

Appendix B 4: Most Frequent Words in FOMC Minutes

S. No:	Term	Frequency	S. No:	Term	Frequency
1	Market	6173	26	outlook	1568
2	Inflat	5636	27	purchas	1466
3	Particip	4471	28	Balance	1417
4	Econom	4460	29	measur	1400
5	Price	4350	30	employ	1388
6	Increase	3690	31	Credit	1354
7	Growth	2722	32	treasuri	1319
8	Condit	2604	33	Report	1312
9	Finance	2476	34	unemploy	1276
10	Recent	2465	35	Low	1259
11	Declin	2419	36	improv	1241
12	Secur	2400	37	currenc	1172
13	Period	2301	38	Oper	1166
14	Labor	2174	39	product	1162
15	Indic	1991	40	economi	1153
16	Foreign	1966	41	develop	1143
17	Pace	1957	42	Energi	1122
18	Consum	1821	43	Effect	1066
19	Expect	1765	44	Inform	1060
20	Real	1697	45	Object	1047
21	Active	1671	46	Rise	1044
22	Busi	1630	47	Loan	1034
23	Spend	1611	48	Sector	1034
24	Risk	1599	49	anticip	1032
25	Time	1571	50	account	1024

This table contains the top 50 most frequent stemmed terms appearing in FOMC Minutes with their relative frequencies. We use Porter's Stemming Algorithm to stem all words to their common linguistic root.

Appendix B 5: Most Frequent Words in Each Topic of FOMC (Ten Topics)

Topic	1. Employment		2.Investments		3. Policy		4.Growth		5. Finan. Market		6. Credit Cond.		7.Economy		8.Consumption		9.Exchange Rate		10.Inflation	
S.No	Term	Beta	Term	Beta	Term	Beta	Term	Beta	Term	Beta	Term	Beta	Term	Beta	Term	Beta	Term	Beta	Term	Beta
1	rate	0.069	Spend	0.042	polici	0.058	econom	0.076	intermeet	0.037	Credit	0.041	market	0.183	price	0.119	secur	0.069	inflat	0.046
2	labor	0.061	Busi	0.039	purchas	0.026	growth	0.068	Yield	0.026	Remain	0.040	financi	0.082	inflat	0.104	foreign	0.045	econom	0.037
3	unemploy	0.037	Product	0.030	discuss	0.024	risk	0.039	Net	0.021	Continu	0.036	rate	0.046	expect	0.047	currenc	0.035	condit	0.034
4	continu	0.037	Increase	0.027	note	0.023	activ	0.036	Declin	0.020	Loan	0.032	term	0.030	measur	0.032	account	0.030	polici	0.031
5	employ	0.029	Consum	0.027	monetari	0.022	project	0.024	Spread	0.019	Hous	0.029	develop	0.027	energi	0.031	agenc	0.030	rate	0.030
6	pace	0.029	Real	0.026	addit	0.019	economi	0.022	equity	0.018	Home	0.021	balanc	0.027	increas	0.029	direct	0.024	expect	0.027
7	indic	0.028	Invest	0.018	rate	0.018	outlook	0.019	increase	0.018	Mortgag	0.020	condit	0.018	consum	0.022	author	0.023	member	0.027
8	improv	0.025	Declin	0.017	asset	0.017	gdp	0.018	Treasuri	0.018	Sale	0.020	report	0.017	core	0.019	transact	0.023	rang	0.025
9	level	0.024	Industry	0.016	normal	0.013	continu	0.016	Bond	0.018	Demand	0.019	oper	0.017	chang	0.016	treasuri	0.022	object	0.023
10	increas	0.023	Good	0.015	time	0.012	real	0.015	Dollar	0.016	Bank	0.018	liquid	0.016	declin	0.015	oper	0.020	target	0.021
11	remain	0.023	Import	0.015	provid	0.011	forecast	0.015	Little	0.015	Commerci	0.017	effect	0.015	moder	0.014	hold	0.019	consist	0.021
12	market	0.019	Export	0.015	regard	0.011	like	0.014	Rose	0.014	Sector	0.016	limit	0.014	rise	0.013	mortgageback	0.016	outlook	0.020
13	averag	0.019	Appear	0.014	communic	0.011	anticip	0.014	Chang	0.014	Condit	0.016	facil	0.013	remain	0.013	desk	0.014	monetari	0.018
14	expand	0.015	Household	0.013	program	0.011	expect	0.013	Index	0.014	Firm	0.016	interest	0.012	pce	0.012	manag	0.014	time	0.018
15	suggest	0.014	Capit	0.013	express	0.011	note	0.012	Investor	0.013	Level	0.015	includ	0.012	cost	0.012	arrang	0.013	stabil	0.017
16	job	0.011	Sector	0.013	forward	0.011	fiscal	0.012	Foreign	0.013	Issuanc	0.014	institut	0.010	higher	0.012	purchas	0.013	accommod	0.017
17	gain	0.011	Gain	0.013	need	0.010	pace	0.012	Broad	0.011	Report	0.013	dealer	0.010	pressur	0.012	swap	0.013	assess	0.015
18	part	0.011	Manufactur	0.013	chang	0.010	sever	0.011	Corpor	0.011	Low	0.013	revers	0.009	survey	0.012	matur	0.013	inform	0.015
19	receiv	0.010	Vehicle	0.012	decis	0.010	downsid	0.011	Govern	0.011	High	0.011	fund	0.009	low	0.011	domest	0.013	judg	0.015
20	payrol	0.010	Output	0.012	reduc	0.009	come	0.010	General	0.010	Pace	0.011	stabil	0.008	stabl	0.011	maintain	0.013	appropri	0.015

This table contains the top twenty most frequent stemmed terms appearing in each topic of FOMC meeting minutes. The topic and weights are extracted through the Latent Dirichlet Allocation (LDA). The terms' weight (Beta) indicates the probability of each word appearing in each topic. We use the coherence score to choose an optimal number of topics from FOMC minutes.

Chapter 4: Federal Reserve Communications and Returns and Traders' Positions in the Commodity Markets

Abstract

The catastrophic effects of commodity markets boom on economic activity encourage scholars to explore the determinants of commodity returns. The policy rate has been an important factor in explaining the variations in the commodity markets. However, the introduction of unconventional policy tools and reducing the policy rate to near zero motivated researchers to investigate the impact of central bank qualitative communication on the financial markets. This chapter investigates the impact of the Federal Reserve communications on the returns and traders' positions in the commodity markets. Using computational linguistic analysis, we extract the policymakers' assessments about the forthcoming economic scenario and inclination regarding the future path of the policy rate. We find that the central bank's hawkish tone decreases the one month ahead returns on metals, energy and overall commodity indexes. Also, commodity traders' speculating (hedging) positions increase (decrease) in response to a hawkish communication from the Monetary Policy Committee (MPC). This implies that the central bank communication tone contains information about the economic conditions and forward guidance which affects the returns and the positions of traders in commodity markets. In addition, the impact of communication is more significant during recessionary periods and for uncertain times. Further analysis on the topic of the central bank communications reveals that a hawkish discussion about consumption, financial market, and inflation is particularly important in determining the returns on metals, energy and overall commodity indexes.

Keywords: Federal Reserve's Communications, Portfolio Allocation, Commodity Returns, Positions of Traders, Textual Analysis, Topic Modelling

JEL Classification: D83, D84, G13, E52, E58, Q02

4.1 Introduction

The mid-2000s commodity prices surge with the consequences of the economic meltdown motivated academicians and policymakers to reinvestigate the determinants of commodity prices. The monetary policy plays a vital role in driving prices and trading activities in the commodity markets (Frankel and Rose, 2010; Glick and Leduc, 2012; Frankel, 2014 and Triantafyllou and Dotsis, 2017). To stabilize the financial markets after the global financial crisis of 2007-2008, central banks introduced the unconventional monetary policy and decreased the policy rate to the near-zero lower bound in major economies. As a result, the central bank's communications emerged as the most important source to manage investor expectations and to influence the asset prices in the financial markets (Blinder et al. 2008; Apergis 2015; Leombroni et al. 2018). Several studies document the negative relationship between the policy rate and commodity prices (Frankel, 2008; Anzuini, Lombardi and Pagano, 2013; Gubler and Hertweck, 2013). For instance, using the uncertainty related to surprise policy rate changes, Gospodinov and Jamali (2018) document that the monetary policy uncertainty drives excessive speculative activity and affects the commodity prices.[71] Yet, relatively little is known about the impact of qualitative communications on investors' positions and commodity returns.

Recent evidence suggests that apart from policy rate decisions (actions), the qualitative communications (word) of the Federal Open Market Committee (FOMC) also contains new information for investors that drive the volatility in financial markets (Gurkaynak, Sack, Swanson, 2005; Hansen and McMahon, 2016; Jubinski and Tomljanovich, 2017). Several studies document a significant impact of central bank qualitative communications on economic activity (Hansen and McMahon, 2016; Tobback, Nardelli and Martens, 2017), Treasury yields (Hansen, McMahon and Tong, 2019; Hubert and Labondance, 2019; Leombroni et al. 2018), equity returns (Schmeling and Wagner, 2019; Apergis and Pragidis, 2019), market volatilities (Jegadeesh and Wu, 2017; Picault and Renault, 2017), currency risk premium (Dossani, 2019), and inflation pressure (Neuenkirch, 2013; Hubert and Labondance, 2019). Despite the growing number of studies on central bank communications, our understanding of the effect of central bank communications on the returns and positions of traders in the commodity markets is still limited.[72]

[71] Gospodinov and Jamali (2018) measure the investors' excessive speculative activity from positions of commercial and non-commercial traders in commodity futures market using T-index of Working (1960).

[72] Two noticeable exemptions are the recent studies of Thorarinsson and Eshraghi (2013) and Hayo, Kutan and Neuenkrich (2012) who analyse the effect of the Fed's Chair speeches on the commodity markets.

Therefore, in this chapter, we seek to fill this gap in the literature by examining the impact of hawkish and dovish discussions in the Financial Open Market Committee (FOMC) meetings (which represent the Fed's assessment about future economic conditions and potential policy intervention) on the returns and traders' behaviour in commodity markets.[73] Overall, this study adds to the growing literature studying the impact of central bank communications in a number of ways. First, while an increasing number of studies show that central bank communications drive investor expectation about future economic growth, inflation and interest rates (Boukus and Rosenberg, 2006; Hansen and McMahon, 2016 and Jegadeesh and Wu, 2017), little research has been conducted on the potential influence of central bank communications on commodity markets. The current chapter represents the latest attempt of such efforts.

Second, to the best of our knowledge, this study is also the first attempt in investigating the impact of the Fed's hawkish (dovish) tone on the activities of various traders in the commodity futures market. Considering the response of hedging and speculating activities to central bank communications is essential to understand the role of information on the formation of investor expectations and their portfolio rebalancing activities. According to Keynes's (1930) theory of normal backwardation, the market participants holding the long positions in a futures contract earns the risk premium to compensate for the fluctuations in the spot prices for the period of the contract. In addition, Barsky and Killian (2004) argue that the signals inbound in the monetary policy drive the agents' expectations about future inflation and economic growth which in turn lead to shifts in commodity returns. Gorton and Rouwenhorst (2006) suggest that investors participate in the commodity markets mainly to hedge against future inflation pressure.

Third, this study also explores the state-dependent impact of the central bank's tone on returns and traders' positions in the commodity markets. Kurov (2012) finds that the market participants' response to the signals about the future path of monetary policy depends on the business cycle and credit market conditions.[74] In addition, Gospodinov and Jamali (2018) also find that the impact of monetary policy uncertainty on commodity returns is higher during recessionary periods. Moreover, Kurov and Stan (2018) find that the market participants are more responsive to macroeconomic announcements during episodes of high monetary policy uncertainty. Focusing on central bank communication, Apergis and Pragisis (2019) also document the profound impact of the ECB's tone on equity returns and volatility during the

[73] Central bank communications carry additional information in the shape of policymakers' assessment about the current and future economic scenario (Kohn and Sack, 2003).

[74] Kurov (2012) divides the Fed's decisions into change in the current target rate and the future path of interest rate (path factor) using changes in prices of the Fed funds futures, and volatility of Eurodollar futures contracts respectively.

global financial crisis period. Motivated by these empirical studies and findings, we seek to determine in this chapter the extent to which the impact of the Fed's tone on commodity markets is indeed state-dependent. To facilitate such an investigation, we interact our measure of central bank communication tone with a dummy variable taking a value of one for recession episodes and the periods of high economic uncertainty.

Finally, for a deeper understanding of the relationship between the information in the central bank communications and investing behaviour, this study examines the heterogonous impact of central bank communications on different topics on commodity markets. Picault and Renault (2017) find that investors respond differently to information about future economic conditions and the future path of the policy rate. In this chapter, we investigate the heterogeneous response of returns and positions of traders in the commodity markets to different topics' tone. Specifically, we follow the topics and tone approach of Hansen and McMahon (2016) and estimate the topics' tone using a combination of the Latent Dirichlet Allocation (LDA) and a bag of words approach.[75] Overall, we seek to address the following questions:

1. Whether, and to what extent, the Fed's communication affect the prices and positions of traders in commodity markets?
2. Do the Fed's hawkish and dovish tones have an asymmetric impact on commodity markets?
3. Is the impact of the Fed's communication on commodity markets state-dependent?
4. Does the Fed's tone associated with different topics have a heterogeneous impact on the commodity markets?

To measure the variations in commodity returns, this chapter uses changes in the prices of front-month commodity futures for seventeen different commodities across the five commodity groups. Moreover, using the Commitment of Traders (COT) data we estimate hedging (speculating) pressures by subtracting the number of short positions from long positions of commercial (non-commercial traders), respectively. The Commodity Futures Trading Commission (CFTC) reports positions of commercial and non-commercial traders in their weekly Commitment of Traders reports. The commercial traders participate in the commodity markets for hedging purposes, whereas the non-commercial traders participate in the commodity futures market for speculations (Schwarz, 2012; Dewally, Edrington and Fernando, 2013). Furthermore, to estimate the Fed's overall tone and topics' tone, we use computational linguistic analysis on the Federal Open Market Committee (FOMC) meeting

[75] The LDA is a popular logarithm-based topic modelling procedure to identify distinguished topics under the discussion in a document. Luangaram and Wongwachara (2017) also use the LDA to extract topics' tone from communications of the Federal Reserve, the European Central Bank and Bank of Japan.

minutes.[76] Specifically, we use the directional dictionary of Apel, Blix Grimaldi and Hull (2019) and a bag of word approach to categorise the Fed's communications to hawkish and dovish tones.[77]

The results of this chapter confirm that the central bank's hawkish (dovish) tone decreases (increases) the commodity returns and shifts speculating (hedging) pressure upwards (downwards). In addition, the impact of the Fed's tone is heterogeneous on different commodity groups and highly significant during economic meltdowns. Specifically, the Fed's tone is an important determinant of the returns for metals and energy but does not significantly affect returns of agricultural commodities. Moreover, the commodity markets participants react strongly to the central bank communication tone related to the consumption, financial markets and policy. The findings of this study remain statistically significant even after controlling for macroeconomic fluctuations and commodity-specific factors. These findings provide a novel explanation for the link between central bank communication and commodity markets: the Delphic forward guidance inbounds in the central bank communication drive investors' expectations about future macroeconomic outlook which in turn shift the portfolio allocation decisions of investors and affect commodity returns.

The rest of this chapter is organized as follows. Section 4.2 reviews previous relevant studies; section 4.3 explains the measurement of key variables and methodology; section 4.4 describes the data and presents empirical results: finally, section 4.5 concludes the chapter by discussing the policy implications and future scopes for research.

[76] Boukus and Rosenberg (2006) find that the minutes of FOMC meetings provide the most detailed information about each committee members' views about current and future economic conditions

[77] The appendix (B2) contains the complete list of directional lexicons of Apel, Blix Grimaldi and Hull (2019) developed in the context of central bank communication. It contains the list of directional phrases which combines the economic terms (nouns) and tone modifiers (adjectives).

4.2 Literature Review

In this section, we first discuss the theoretical link between monetary policy and commodity returns and review the results of some related empirical studies. After that, we explain the potential monetary policy transmission channels through which central bank communication affects returns and traders' positions in the commodity markets.

4.2.1 Monetary Policy and Commodity Markets

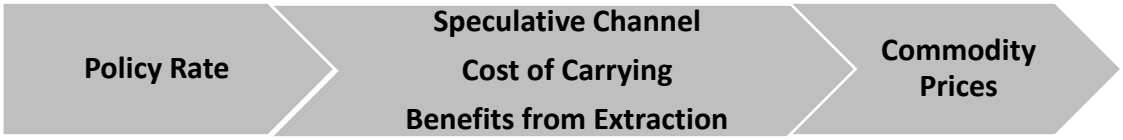
The link between monetary policy stance and commodity price fluctuations always remained in academic discussions (Chambers and Just, 1982; Frankel 1986; Dorfman and Lastrapes, 1996; Barsky and Killian, 2002; and Scrimgeour, 2015). In a noteworthy work, Frankel (1986) documents that changes in the policy rate play an important role in setting prices of commodities. The commodity markets surge in 2006-2008 has further motivated researchers and policymakers to reinvestigate the response of commodity returns to the policy rate. For example, Frankel (2008) extends the overshooting theory of Dornbusch[78] (1976) and explains the rationale behind the negative relationship between the interest rate and commodity prices. According to Frankel (2008), an increase in the real interest rate decreases the prices of the commodity through (i) speculative activities, (ii) inventory and (iii) benefits from extraction channels.

4.2.1.1 Monetary Policy Transmission Channels

The speculative channel works through portfolio reallocation after the change in the target rate. More specifically, a reduction in the target rate makes investing in a commodity more attractive compared to fixed income securities. For example, in response to an expansionary monetary policy, investors reallocate their funds from Treasury securities to commodities in the search for a higher return. The cost of carrying inventory channel affects commodity prices through variation in the cost of capital. For instance, an expansionary monetary policy reduces the cost of carrying inventory through a decrease in the cost of borrowing. Finally, a change in the short-term interest rate may affect commodity prices by increasing the benefits from extracting the commodity sooner than later (i.e., benefits of extraction channel). For example, a monetary policy easing decision decreases the opportunity cost for delaying the exploration of commodities. Overall, the direct effect of the interest rate on the demand and supply of commodities defines the impact of the policy rate on commodity prices (Frankel, 2008).

[78] In his theory of overshooting, Dornbusch (1976) argues that the exchange rate is highly sensitive to monetary policy, which leads to changes in prices of financial assets in the short-term and subsequently shifting the commodity prices in the long-term.

Monetary Policy Transmission Channels:



Source: Frankel (2008)

4.2.1.2 Indirect Effect of Policy Rate

Apart from the direct effect through the interest rate, the monetary policy also provides information about future economic conditions and the future path of the policy which consequently affect the commodity returns (Barskly and Killian, 2004). Furthermore, for the unconventional monetary policy period, Gagnon et al. (2010) argue that the Large Scale Asset Purchase (LSAP) announcements drive the commodity returns via "Signalling Effect" and "Portfolio Rebalancing". The signalling effect works through carrying signals of the deteriorating (expanding) future economic outlook which subsequently reduce (increase) the commodity returns.

Anzuini, Lombardi and Pagano (2013) also confirm that signals about future economic growth and anticipation of future policy rate plays a vital role in the impact of monetary policy on commodity returns. Moreover, using the convenience yield Gospodinov and Ng (2013) find that the variations in commodity spot and futures prices depend upon the investors' perception of future economic conditions.[79] This indirect effect of monetary policy shifts the market expectations about the future economic activities and the interest rate in the short- and long-term which subsequently shifts commodity returns.

While analysing the effect of economic uncertainty on commodity prices, Bakas and Triantafyllou (2018) find that the latent uncertainty shocks related to macroeconomic conditions affect the time-varying commodity price volatility.[80] Triantafyllou and Dotsis (2017) analyse the impact of monetary policy on investors' expatiations about commodity prices[81] and find that an expansionary monetary policy drives the investors' expectation about commodity prices upward and increases the volatility in the commodity markets. Gosodinov and Jamali (2018) document that a positive monetary policy uncertainty shock (uncertainty related to a surprise decrease in the policy rate decreases the prices in the commodity futures

[79] The convenience yield refers to the gains of holding a commodity physically compared to holding futures contract on a similar commodity.
[80] Bakas and Triantafyllou (2018) identify the uncertainty about future demand and supply conditions, using the measure of latent economic uncertainty of Jurado, Ludvigson and Ng (2015).
[81] Traintafyllou and Dotsis (2017) use option-implied skewness to measure investors' expectations about the commodity prices.

market.[82] The uncertainty associated with contractionary or expansionary monetary policy shock contains vital information about future economic and financial conditions which shifts the positions of traders[83] and leads to commodity price fluctuations (Gospodinov and Jamali, 2018).

4.2.2 Information Content in Central Bank Communications

In addition to decisions about the current policy rate, previous studies also document that the central bank communications contain detailed assessment about the future economic situation and the future path of the policy rate which may, in turn, move the asset prices in the financial markets (Blinder, 2018; Nakamura and Steinssin. 2018; Hansen, McMahon and Tong, 2019 and Neuhierl and Weber, 2019). For instance, Gurkaynak, Sack and Swanson (2005) compare the market response to FOMC decision and policy statements using intraday high-frequency data and find that the policy statements containing information about path factor have a more profound impact on asset returns compared to FOMC decisions (Gurkaynak, Sack and Swanson, 2005). Neuenkirch (2013) find the central bank's indication of the future path of the policy rate in central bank communication drive inflation expectations and future output growth. The "artificial neural network" model of Salle (2015) suggests that an agents' inflation expectations are based on the information about macroeconomic development, inflation and output gap projections provided in the central bank communications. Leombroni et al. (2018) advocate that a policy rate shock, as well as a communication shock, drives the investors' risk-bearing capacity through the "risk premium channel". For instance, a negative communication shock[84] providing information about future bad credit conditions increases the probability of default and expected risk premium on an investment. In this chapter, we seek to empirically examine the response of commodity returns and trading activities to central bank communications on the future economic outlook and the course of the short-term rate.

4.2.2.1 Transmission Channels of Central Bank Communications

Before discussing the channels through which information in central bank communications affect commodity returns, we first elaborate on the relationship between macroeconomic announcements and variations in commodity markets. The literature suggests that macroeconomic news influence the prices of energy (Ghura, 1990; Cai, Cheung and Wong,

[82] To measure the uncertainty associated with expansionary and contractionary policy shocks Gospodinov and Jamali (2018) use a combination of Eurodollar futures volatility along with the sign of change in prices of the Fed funds futures.

[83] The weekly COT reports contain the positions of commercial (hedgers) and non-commercial (speculators) traders for each commodity.

[84] Leombroni et al. (2018) identify communication shock using high frequency changes in credit spread before and after the European Central Bank's press conference.

2001 and Roache and Rossi, 2010). Specifically, for energies Killian and Vega (2011), for precious metals (Elder, Miao and Ramchander, 2012), and for crude oil (Bahloul and Gupta, 2018) document the impact of macroeconomic announcements on commodity price changes. This chapter aims to explore the response of commodity returns towards future macroeconomic conditions reflected in central bank communications.

Romer and Romer (2000) put forward the "Information Effect" of central bank announcements to explain the impact of monetary policy on the market participants' long-term expectations. According to the "information effect" transformation channel, central bank announcements comprise upcoming prosperous or deteriorating economic conditions which could alter the investors' expectation about risk and return. In addition, Woodford (2001) argues that signals inbound monetary policy about the future path of the short-term rate play an important role in determining the asset prices in the market. Moreover, investigating the rationale for the effect of monetary policy on term premium, Hanson and Stein (2015) show that economic agents relocate their investment in response to easing or tightening decisions. For example, after a monetary easing announcement investors shift their funds from short-term to longer-term bond in "Reaching for Yield" which in turn decreases the term premium.

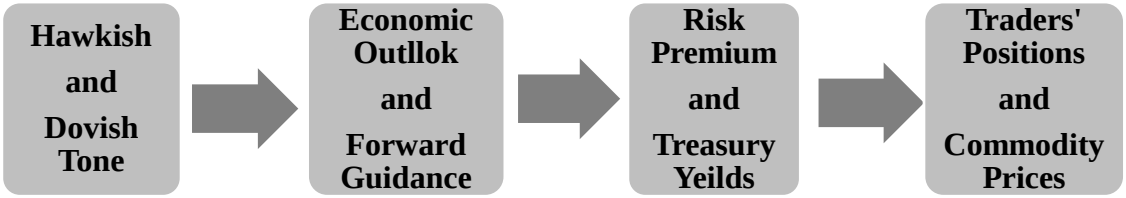
Several studies also consider channels in which central bank communications may affect investor expectation of the interest rate at various maturities. For example, consistent with the finding of Nakamura and Steinsson (2018) about the information effect of monetary policy announcements, Hansen, McMahon and Tong (2019) suggest two information-based channels i.e. expectation and uncertainty for the impact of central bank communication on the long-term interest rate. The expectation channel argues that central bank communications influence investor expectations about the future macroeconomic outlook and future path of the policy that consequently move the short and long-term Treasury yields. The Delphic forward guidance in central bank communications is an example of the signals related to future economic conditions.[85] The uncertainty channel suggests that the long-run interest rate expectations in the market are based on the assessment of policymakers about the variation in economic projections.

On the contrary, Hubert and Lebondance (2019) propose a new measure for central bank sentiment and suggest that the personal opinions of policymakers spread in the market and lead to herding behaviour. More specifically, the sentiment in central bank communications serves as the spreading of beliefs from committee members to investors in

[85] Contrary to the commitment to a persistent policy rate (Odyssean forward guidance), the Delphic forward guidance promises an easing monetary policy intervention based on future deteriorating economic conditions (Campbell et al. 2012).

the market (Hubert and Lebondance, 2019). The central bank sentiment proposition supports the notion of "narrative economics" which advocates the role of narratives of policymakers in shaping the market expectations, motivating trading activities and altering asset prices (Shiller, 2017).

Central Bank Communication Transmission Channel:



4.2.2.2 Central Bank Communications and Asset Prices

Several papers find that central bank communications in the forms of policy statements, minutes of committee meetings, speeches and press conferences carry important additional information that moves prices in financial markets (Apergis, 2015 and Hubert and Labondance, 2019). For instance, Hansen, McMahon and Tong (2019) and Hubert and Lebondance (2019) find that tone in central bank communications predicts changes in the term premium in the UK and the U.S, respectively. Focusing on the Fed Chairman's speeches and testimonies to US Congress, Kohan and Sack (2003) divide the information inbound in Fed's communications into an indication of the future short-term interest rate (future path of the policy rate) and assessment of future economic scenario (future economic conditions). Their results show that not only the signals about the economic conditions but also the indications about the future path of the policy rate drive return and volatility in the financial market. Using the narrative coding content analysis process, Ehrmann and Fratzscher (2007) also categorise monetary policy statements into two sections, indicating the future economic outlook and path of the policy rate and draw similar conclusions.[86] However, it is argued that studies using narrative exercises to capture the forward guidance from central bank communications may suffer from an element of the subjectivity of the researcher.

Using computational content analysis techniques, several studies confirm the importance of central bank tone on trading activity, asset prices and market volatility in financial markets (Hansen and McMahon, 2016; Jegadeesh and Wu, 2017; Dossani, 2019 and Schmeling and Wagner, 2019). Schmeling and Wagner (2019) for instance, find that the

[86] For economic outlook Ehrmann and Fratzscher (2007) divide policy statements demonstrating strong, neutral and weakening economic conditions. Similarly, monetary statements the categorised according to signals inbound about future contractionary, neutral and expansionary policy.

Fed's positive tone increases stock returns and decreases the term premium in the bond market. Picault and Renault (2017) investigate the impact of the European Central Bank (ECB)'s positive, neutral and negative tone on stock market volatility and find that positive tone in ECB's press conferences reduces the volatility in the equity markets. Using combination topic modelling and bag of the word content analysis approach, Hansen and McMahon (2016) show that both real economic activities and financial markets respond to the Fed's tone about the future economic outlook.

4.2.2.3 Central Bank Communications and Commodity Markets

While many studies document the effects of central bank tone on macroeconomic indicators, Treasury yields, credit spread, equity market return and volatility, exchange rate fluctuations and inflation expectations, less attention has been given to the potential effects of central bank tone on price fluctuations and trading activities in the commodity markets. Two exceptional efforts along this line are Hayo, Kutan and Neuenkrich (2012) and Thorarinsson and Eshraghi (2013). In an event study framework, Hayo, Kutan and Neuenkrich (2012) find that the Fed's communications carry important information about future policy indication and economic scenario[87] that reduce the price volatility of commodities. The decrease in the volatility after the FOMC statements, speeches and testimonies of Fed's governors indicates that the central bank communications have a "calming effect" on the price fluctuations in the commodity markets. Though the findings of Hayo, Kutan and Neuenkrich (2012) confirm that investors respond not only to the Fed's action but also the qualitative communications, they do not provide direct evidence on the extent to which information in the central bank communications affects commodity returns.[88]

Using a computational content analysis technique to estimate the Fed's sentiment Thorarinsson and Eshraghi (2013) also document that the level of activity, reality and certainty in the Fed's tone significantly affect the prices and volatility in gold and silver markets.[89] Thorarinsson and Eshraghi (2013) argue that gold and silver work as "Safe Haven" investments and market participants invest in gold and silver to decrease the aggregate risk of the portfolio. The degree of certainty, reality and activity extracted from speeches of Fed's Chairman provide additional information about the future deteriorating economic activity and financial conditions which push demand for safer investment up subsequently shifting prices

[87] Hayo, Kutan and Neuenkrich (2012) include only the communication events, which contain either an indication for future policy decisions or describing future economic outlook.

[88] Leombroni et al. (2018) argue that an interesting area for future research is analysing the impact of information content in central bank communication on asset prices.

[89] To estimate the Fed's sentiment from qualitative communication Thorarinsson and Eshraghi (2013) use Diction 6.0 a comprised content analysis tool that identifies semantic feature from the text.

of gold and silver. The findings of Thorarinsson and Eshraghi (2013) suggest that the information about the future economy inbound in central bank communications influences the prices of gold and silver. Yet, the directional impact of policy makers' indication regarding future contractionary (expansionary) monetary policy and fluctuations in commodity prices are not clear. Therefore, in this chapter, we investigate empirically the impact of the Fed's hawkish (dovish) tone about the future contractionary (expansionary) policy on returns and traders' short and long positions in the commodity markets. Investors these days reallocate their funds between equities, fixed income securities and commodities more frequently due to higher financialization in the commodity markets (Chau and Deesomsak, 2018; Cheng and Xiong, 2014). Furthermore, we examine the heterogeneity in the response of various commodity groups and investigate the response of commodity markets participants to the policy makers' tone related to different macroeconomic indicators.

To shed further insights on the channels through which the Fed's tone affect commodity returns, we also analyse the effects of the Fed's tone on the positions of commercial (hedgers) and non-commercial (speculators) traders. In general, the investor participates in the commodity markets to hedge against the risk associated with future deteriorating economic conditions and inflation pressure. However, speculators may reallocate their portfolio towards commodities in response to a signal of future expansionary policy to earn a higher yield. This chapter aims to empirically examine this "portfolio rebalancing" effect of central bank communications.

4.3 Measurement of Key Variables and Methodology

This study investigates the response of returns, hedging, and speculating activities in the U.S commodity futures markets to the Fed's hawkish (dovish) tone. In this section, we first outline the construction of key variables in measuring commodity returns, trading activities and central bank communication tone. Then, we present our regression model that used to examine the impact of central bank tone on returns and trading in the commodity markets.

4.3.1 Identification of Variables

First, we define the process to construct the key variables for our empirical investigation. We start with an explanation of the procedure to capture the hedging and speculating pressure in the commodity markets. In the later part, we explain our computational content analysis techniques to gauge the tone from central bank qualitative discussions and describe the construction of the control variables.

4.3.1.1 Returns and Traders' Positions in the Commodity Markets

According to Fama and French (1987), the nearest futures prices can be used to represent the spot prices in the absence of accurate commodity markets data. Thus, we estimate the change in commodity prices using the difference between the nearest and next to the nearest futures monthly prices as in Gospodinov and Ng (2013):

$$\Delta F_{jt} = \frac{F_{jt}^{E} - F_{jt}^{B}}{F_{jt}^{B}} \times 100 \tag{4.1}$$

where F_{jt}^{B} is the futures price at the beginning of the month and F_{jt}^{E} is the commodity futures price at the end of the month for each commodity.

Following Dewally Ederington and Fernando (2013), we estimate the Hedging Pressure (HP) by calculating the difference between the numbers of long and short positions of commercial traders (hedgers) in commodity futures contracts:

$$HP_{Jt} = \frac{(CL_{jt} - CS_{jt})}{(CL_{jt} + CS_{jt})} \tag{4.2}$$

where CL and CS denote the number of long and short positions of commercial traders (hedgers) respectively. Similarly, the Speculating Pressure (SP) is calculated as follow:

$$SP_{Jt} = \frac{(NL_{jt} - NS_{jt})}{(NL_{jt} + NS_{jt})} \tag{4.3}$$

Where NL denotes the number of long positions of non-commercial traders (speculators) and NS denotes the number of short positions held by non-commercial traders (speculators). Following, Working (1960), we also estimate the T-index[90] to gauge the excessive speculative activity in the commodity futures market:

$$T_{jt} = \begin{cases} 1 + NS_{jt}/(CL_{jt} + CS_{jt}) & if\ CS_{jt} \geq CL_{jt} \\ 1 + NL_{jt}/(CL_{jt} + CS_{jt}) & if\ CS_{jt} < CL_{jt} \end{cases} \quad (4.4)$$

The excessive speculative activity measures the speculators' long (short) positions higher than required to satisfy the demand of hedgers for each commodity.

4.3.1.2 Fed Communications

Like many other central banks, the Fed also communicates to the public through several communication tools i.e. policy statements, FOMC meeting minutes, press conferences, and testimonies to US Congress and public speeches. The public speeches include the addresses, media talks, and academic lectures of Fed's Chair, Vice-Chair, Board of Directors and Regional Reserve Banks' Presidents.[91] Rosa (2013) documents that new information in FOMC minutes has a significant effect on prices and volatility in the equity markets. In another recent study, Rosa (2016) also analyse the impact of Fed Chairman speeches and testimonies to US Congress along with policy statements and FOMC minutes on asset prices in financial markets. The results of Rosa (2016) suggest that policy statements, FOMC minutes and Chairman Speeches are important determinants of the asset prices in fixed income and equity markets. Moreover, comparing the impact of two different Chairman's tone on financial markets, Rosa (2016) documents that Greenspan's speeches have a larger effect on the volatility of fixed income compared to equity markets. On the contrary, the speeches of Bernanke bring a higher shift in prices of stocks than bonds. Similarly, for the commodity markets, Thorarinsson and Eshraghi (2013) find that the level of certainty, activity and reality in the tone of Greenspan's speeches has a significant positive impact on the returns of gold and silver. Whereas, the prices of gold and silver do not respond to the level of certainty, realism or optimism in the tone of Bernanke's speeches. This implies that the subjective selection of words depending upon the personal characteristics and preferences of the speaker plays a vital role in influencing investor expectations. Therefore, to mitigate the speaker's subjectivity bias in our analysis, we use a well-structured central bank communication tool (i.e., FOMC meeting minutes) to extracts the Fed's tone.

[90] Gogolin and Kearney (2016) and Sanders, Irwin and Merrin (2010) also use the T-index of Working (1960) to gauge the speculating activity using traders' positions in commodity markets.

[91] Suda, Ito and Lzumi (2018) enlist the number of speeches of the Fed's Chair, Vice-Chair, Governors and Regional Reserve Bank's presidents in each year for the period from 2000 to 2017.

The minutes of the FOMC meetings are a useful tool to gauge the Fed's views about the future policy rate. As Boukus and Rosenberg (2006) point out, the minutes of the FOMC meeting describe the view of each committee member providing a richer source of information about the central bank's assessment for the future economic outlook. Indeed, Apergis (2015) finds that FOMC minutes significantly affect the volatility in the fixed income, foreign exchange, and housing markets. In addition, unlike the speeches of the Chair, the Fed publishes the minutes of the FOMC meeting at regular intervals. The policy statements, on the other hand, lack the assessment of committee members about the future economic outlook and signals about the future path of the policy rate. The policy statements are announced simultaneously with monetary decisions making it very difficult to separate the impact of the Fed's actions (decisions) from words (communications). Finally, the semi-annual testimonies of the Fed's Chair and the Fed's press conference (started in April 2011) are also not suitable for analysis due to the relatively small numbers of observations.

4.3.1.3 Fed's Tone

There are many different content analysis techniques available to quantify the tone from central bank communications. The survey of Bholat et al. (2015) summarises in detail the textual analysis techniques that have been used in the context of central bank communications. To extract the Federal Reserve's tone from Federal Open Market Committee (FOMC) meeting minutes, we apply the directional dictionary of Apel and Blix Grimaldi and Hull (2019) and estimate the Fed's hawkish and dovish tones. Specifically, this study uses a list of directional phrases, a combination of economic concept and tone modifier to estimate the frequency of hawkish and dovish phrases in each paragraph. Next, we aggregate the total number of hawkish and dovish phrases (i) in each FOMC minutes document (D):

$$Hawkish_{(D)} = \sum_{i=1}^{n} Hawkish_{i,(D)} \tag{4.5}$$

$$Dovish_{(D)} = \sum_{i=1}^{n} Dovish_{i,(D)} \tag{4.6}$$

After the extraction of the phrases, we estimate the hawkishness (dovishness) using the percentage of hawkish (dovish) phrases out of the total phrases in a document. Next, we estimate the Fed's Net Hawkish Index[92] (NHI) by subtracting the number of dovish phrases from the number of hawkish phrases and dividing the difference by the total number of hawkish and dovish phrases in each document. This chapter estimates the NHI by dividing the number of net phrases by the sum of hawkish and dovish phrases. In this way, the measure differs

[92] Note in the section 3.4.3.2 of chapter 3 we perform a robustness check using sum of optimistic and pessimistic phrases in the denominator and repeat the analysis using net optimistic index.

from our tone measure in chapter 3, equation (3.5), which estimates the net optimistic tone by dividing the difference by the number of total phrases in a document. Hubert and Labondance (2019) point out that dividing by the total number of phrases penalizes the tone measure for the length of the document. For example, a lengthy FOMC meeting produces an extremely low tone value despite having comparatively more directional phrases in the discussion. Therefore, in this chapter, we divide the difference by the sum of hawkish and dovish phrases:

$$Hawkisness_{(D)} = \frac{Hawkish_{(D)}}{Total\ Number\ of\ Phrases_{(D)}} \tag{4.7}$$

$$Dovishness_{(D)} = \frac{Dovish_{(D)}}{Total\ Number\ of\ Phrases_{(D)}} \tag{4.8}$$

$$Net\ Hawkish\ Index\ (NHI)_{(D)} = 1 + \frac{Hawkish_{(D)} - Dovish_{(D)}}{Hawkish_{(D)} + Dovish_{(D)}} \tag{4.9}$$

For a deeper understating of the link between information inbound in the Fed's communications and commodity markets fluctuations, we extract unique topics from the discussion in the FOMC meetings using the Latent Dirichlet Allocation (LDA) technique.[93] The LDA has two main outputs, first, it provides the relative weight of each word (β) which measures the probability of each word appearing in a topic. The β is the vector of probabilities for observing each term in a particular topic:

$$\widehat{\beta_{it}} \equiv P_{topic_1}(infl t), P_{topic_2}(price), \dots\dots\dots, P_{Topic_n}(growth) \tag{4.10}$$

For instance, if the discussion in the paragraph is about inflation topic (t) then terms (i) (inflt) and (price) have higher β compared to the (growth). The second output of the LDA is known as theta (θ) which estimates the probability of each topic appearing in each paragraph:

$$\widehat{\theta_{ip}} \equiv P_{paragraph_1}(topic_1), P_{pragraph_2}(topic_2), \dots\dots\dots, P_{paragraph_n}(topic_n) \tag{4.11}$$

Specifically, similar to Jegadeesh and Wu (2017), we apply the LDA on FOMC meeting minutes to extract topics under the discussion in FOMC meetings. Moreover, using Hansen and McMahon (2016) topic to tone approach, we estimate the topics' tone from FOMC meeting minutes. Our two-step approach is similar to that of Hansen and McMahon (2016) which combines topic modelling and dictionary-based textual analysis. In the first step, we identify the unique topics and each topics' relative portion in each paragraph of the FOMC meeting

[93] Section 3.3.1.2 of this thesis explains our topic modelling procedure (LDA) to identify topics under the discussion in FOMC meetings.

minutes. In the second step, we extract each topics' tone using a directional dictionary on the identified paragraphs in the first step.

4.3.1.4 Control Variables

While investigating the impact of the Fed's tone on price changes and positions of traders in the commodity markets, we need to control for other macroeconomic and commodity-specific factors. This study first controls for monetary policy actions while evaluating the impact of the Fed's qualitative language (words). Specifically, this chapter includes the change in the Federal Funds Rate (FFR) for the conventional policy period and the change in the shadow rate of Wu and Xia (2016) for the unconventional policy period. After the global financial crisis of 2007-2008, the Fed introduced unconventional monetary policymaking and decreased policy rate to near zero lower bound. Consequently, the FFR no longer accurately represent the monetary policy decision after the introduction of the unconventional framework (Wright, 2012). Thus, to measure the changes in the policy rate during unconventional policy times we follow Wu and Xia (2016) and use the shadow interest rate.[94]

In addition to the policy rate, many studies document that inflationary pressure drives the positions of traders on commodity futures contracts and shifts commodity prices (Barsky and Kilian, 2004; Gospodinov and Ng, 2013). To control for the effects of inflation fluctuations we include the inflation rate in the analysis. Apart from macroeconomic variables, this chapter also uses commodity-specific factors to control for other potential factors that may affect commodity price changes. Following Gospodinov and Jamali (2018) we include commodity-specific convenience yield, and liquidity and momentum factors. More specifically, in line with Goyenko, Holden, and Trzcinka (2009) we measure the liquidity of each commodity using a modified version[95] of Roll (1984). Furthermore, this study also includes the commodity-specific momentum factor of Moskowitz, Ooi and Pedersen (2012). Using the commodity-specific convenience yield, we control for the fluctuations in prices while investigating the response of hedging and speculating activities to the Fed's tone. Similarly, in the course of the analysing the impact of the Fed's tone on the changes in the commodity prices, we control for the positions of traders by including the hedging pressure in the following model:

[94] Wu and Xia (2016) develop the shadow the Fed funds rate using the multifactor shadow rate term structure to study the impact of monetary policy during unconventional policy periods.

[95] The serial covariance of changes in commodity prices represents the monthly Roll spread in commodity prices (Marshall, Nguyen and Visaltanachoti, 2013).

4.3.2 Investigating the Impact of the Fed's Tone

We investigate the impact of the Fed's communication tone on commodity returns and traders' positions using the following OLS regression model:

$$Y_{j,t+1} = \alpha_j + \beta_j \, Fed's \; Net \; Hawkish \; Index_t + \delta_j \, X_t + \varepsilon_{j,t+1} \tag{4.12}$$

For each commodity (j) we run a separate model to investigate the impact for each dependent variable (Y) such as a change in prices (ΔF), net hedging pressure (HP), net speculating pressure (SP), and excessive speculative activity index (T). We estimate the net hawkish index (NHI) by subtracting the frequency of dovish phrases from the frequency of hawkish phrases and divide the difference by the sum of hawkish and dovish phrases. The X represents the vector of control variables including the macroeconomic and commodity-related factors such as the policy rate, inflation and commodity-specific momentum and liquidity factors.[96] Following Gospodinov and Jamali (2018), we also include hedging pressure and convenience yield while investigating the impact of tone on returns and traders' positions respectively. In addition, following Schmeling and Wagner (2019), we control for changes in the policy rate to control the effects of the monetary policy actions.

Gospodinov and Jamali (2018) show that uncertainty related to the positive and negative changes in policy rate have asymmetric effects on returns and traders' positions in the commodity markets. Specifically, the uncertainty associated with positive (negative) monetary policy shock increases (decreases) the prices of metals and energy. Therefore, to investigate the asymmetric effect of the central bank communications on commodity markets variations, we analyse the effects of the Fed's hawkishness and dovishness on commodity prices and trading positions using the following regressions:

$$Y_{j,t+1} = \alpha_j + \beta_j \, Hawkishness_t + \gamma_j \, \text{Dovishness}_t + \delta_j X_t + \varepsilon_{j,t+1} \tag{4.13}$$

4.3.2.1 State-dependent Impact

We also examine the state-dependent impact of the Fed's communication during the recession periods. Gospodinov and Jamali (2018) find that returns and positions of traders in commodity markets respond to unexpected changes in the policy rate more significantly during recessions. Eijffinger, Mahieu and Raes (2017) also document that the conditional impact of central bank communications about the forward guidance varies across business cycles. To investigate the state-depend response of commodity markets to central bank communications, we multiply our tone index with a dummy variable, which takes the value of one for economic

[96] The section 4.3.1.4 describes the measurement of momentum and liquidity factors.

downturns and zero otherwise. To identify the recessionary periods, we follow Basistha and Kurov (2008) and use a combination of the National Bureau of Economic Research (NBER) business cycle dates and the Chicago Fed National Activity Index (CFNAI).

The literature also provides evidence that economic policy uncertainty shocks significantly affect commodity price fluctuations (Bakas and Triantafyllou, 2018). This study explores the potential state-dependent impact of the Fed's tone on the commodity returns and traders' positions during the episodes of high policy uncertainty. We identify the periods of higher economic and monetary policy uncertainty using Baker, Bloom and Davis' (2016) measures of Economic Policy Uncertainty (EPU) and Monetary Policy Uncertainty (MPU). Specifically, following Chau, Deesomsak and Lau (2011), we compare the current months EPU (MPU) with its lagged three months moving average and identify the months when uncertainty is higher than the average. Next, we create dummy variables taking the value of unity for the months having higher than average EPU (MPU) and zero otherwise. Then, we multiply our dummy variables D^{EPU} (D^{MPU}) with our tone index (NHI):

$$Y_{j,t+1} = \alpha_j + \beta_j NHI_t * D_t^R + \gamma_j NHI_t(1 - D_t^R) + \delta_j \mathrm{X}_t + \varepsilon_{j,t+1} \quad (4.14)$$

$$Y_{j,t+1} = \alpha_j + \beta_j NHI_t * D_t^{EPU} + \gamma_j NHI_t (1 - D_t^{EPU}) + \delta_j \mathrm{X}_t + \varepsilon_{j,t+1} \quad (4.15)$$

$$Y_{j,t+1} = \alpha_j + \beta_j NHI_t * D_t^{MPU} + \gamma_j NHI_t(1 - D_t^{MPU}) + \delta_j \mathrm{X}_t + \varepsilon_{j,t+1} \quad (4.16)$$

4.3.2.2 Topics' Tone Impact

We also perform a deeper analysis to understand the information content that drives the investors' expectations and determine variations in the commodity markets. In particular, using the topics' tone, we study the impact of each topics' net hawkish index on returns, hedging pressure and excessive speculative activity in the commodity futures market.[97]

$$Y_{j,z,t+1} = \alpha_{j,z} + \beta_{j,z} Topic's\ NHI_t + \gamma_{j,z} \mathrm{X}_t + \varepsilon_{j,z,t+1} \quad (4.17)$$

This study estimates the above equation separately for each commodity (j) and each unique topic (z). In the next section, we present the data description, contents of FOMC minutes and discuss the key results of this chapter.

[97] We follow Hansen and McMahon (2016) approach to first identify paragraphs containing discussion related to a specific topic using the LDA on the FOMC meeting minutes and then apply directional dictionary to capture tone from the selected paragraphs.

4.4 Data Description and Main Results

In this section, we first explain the data description and highlight the information inside the central bank communications. In the later part of this section, we discuss the main findings of this chapter with reference to previous related empirical results and perform several robustness checks to validate the findings.

4.4.1 Data Description

This part of the chapter explains the descriptive statistics of the returns on commodity futures and positions of commercial and non-commercial traders in commodity markets followed by demonstrating the characteristics of FOMC meeting minutes and the Fed's tone.

4.4.1.1 Commodity Returns

To measure the impact of the Fed's tone on commodity returns this chapter uses changes in the front-month futures prices of the commodities following Gospodinov and Ng (2013). The commodity markets data for this study comprises of prices of front-month futures contracts on 17 commodities such as metals, energy, agriculture and industrial commodity groups. More explicitly, following Gospodinov and Jamali (2018), we choose commodities that contemporaneously respond to macroeconomic announcements i.e. copper, gold, platinum, silver, crude and heating oil, cocoa, coffee, corn, oats, orange juice, soybean oil, soybean, sugar, wheat, cotton and lumber. The commodity futures prices data is available at the Commodity Research Bureau (CRB), we calculate the difference between the beginning and end prices for each month. Using daily futures prices, we calculate the monthly change in futures contract prices from December 2004 to May 2018. In line, with Jubinski and Tomljanovich (2013, 2017) this study only focuses on the discussion in FOMC meetings after December 2004. As before December 2004, the Fed publishes FOMC meeting minutes with irregular intervals.[98]

Table (4.1) shows the details for commodities in the sample along with descriptive statistics for returns and traders' positions in the commodity markets. Panel A indicates that among the metals, copper has the highest monthly average return of 0.75%, whereas silver and gold have 0.6% and 0.56% average monthly returns respectively. Amongst the agricultural commodities, soybean, cocoa and oats show high monthly returns. While wheat and coffee have on average negative monthly returns.

[98] The Fed publishes meeting minutes after 6 weeks of the FOMC meeting, which provide additional information in the shape of policy statements before the meeting minutes announced.

We also use the returns on the two most popular commodity price indexes i.e. Goldman and Sachs Commodity Index (S&P GSCI) and Reuters/Commodity Research Bureau (CRB) index. The S&P GSCI is a tradable benchmark index for commodity price fluctuations as it contains most liquid commodities (Whaley, 2000). The S&P GSCI one of the most widely used indexes has a monthly return of -0.24% on average during the sampling period. Likewise, Reuters/CRB is another well-known index that represents aggregate movement in commodity prices, where it has a monthly average return of 0.097% during the period under the study.[99] Compared to Reuters/CRB index which assigns 39% weight to energy commodities, the S&P GSCI index is dominated by energy commodities (Glick and Leduc, 2012).

4.4.1.2 Positions of Traders

The Commodity Futures Trading Commission (CFTC) publishes weekly Commitment of Traders (COT) reports. The COT reports describe the open interests of traders for each commodity futures exceeding the pre-specified limit. The weekly COT reports contain the long and short positions of commercial and non-commercial traders on futures contracts. Specifically, we use the open interest of commercial and non-commercial traders from COT weekly reports for each commodity. Academicians have a consensus that commercial traders participate in the commodity futures market for hedging purposes whereas the positions of non-commercial traders represent speculating activities (Bessembinder and Seguin, 1992; and Schwarz, 2012). Specifically, using long and short positions of traders on commodity futures this study estimates the proxy for hedging pressure, speculating pressure and excessive speculative activity monthly.

Panel B of Table (4.1) shows that the commercial traders take a higher number of short positions compared to long positions as indicating a negative hedging pressure of all the commodities with exemption to copper and wheat. Specifically, Table (4.1) indicates the negative hedging pressure for almost all the commodities showing a comparatively higher number of short positions than long positions for commercial traders. Whereas, panel C in Table (4.1) specifies that the non-commercial traders (speculators) take more long positions than short positions on futures contracts on commodities. The positive speculating pressure for almost all the commodities implies that on average non-commercial traders take more long

[99] The S&P-GSC index is based on the weighted average return on 24 commodities divided into five groups i.e. energy (62.3%), agriculture (15.41%), industrial metals (11.16%), precious metals (4.14%) and livestock (6.66%). On the other hand, Reuters/CRB index is composed of weighted average return on 19 commodities distributed in four different groups i.e. energy (39%), agriculture (41%), industrial metals (13%) and precious metals (7%). In addition, contrary to Reuters/CRB index which assigns equal weight to each commodity in the group, the S&P-GSC index assigns different weights to each commodity in each category.

positions compared to short positions during the sample period. While comparing the positions of both commercial and non-commercial traders in panel D of Table (4.1), we can observe that all the commodities show excessive speculation from a minimum of 11.11% for soybean to a maximum of 26.2% for copper.

4.4.1.3 FOMC Meetings Minutes

Historically the Fed only publishes the policy actions and the record of policy actions on a periodical basis. For example, the summaries of FOMC meetings generally referred to as "Policy Records" published only on a yearly basis. Further, initially, the policy records provide only a rationale for policy actions very precisely (only two paragraphs) which later extended to five pages long text after 1965 (Danker and Luecke, 2005). Though the committee formulates the exclusive minutes after each meeting comprising the detailed discussion of members, still these minutes remained confidential before 1993 to avoid negative consequences of the information inbound in the discussion. Such as the information available in the FOMC meeting minutes may lead to speculative decisions, imperfect market or damage the objectives of the central bank. In 1993 the Fed first time started to publish FOMC meeting minutes.

The Federal Open Market Committee meets eight times on average in a year to discuss the monetary policy decisions. But before December 2004 the Fed released minutes with irregular delays and sometimes minutes of the previous meeting were published after the new policy decision in a succeeding meeting. To avoid this distortion due to irregular delays in the publication of meeting minutes, following Jubinski and Tomljanovich (2013, 2017), this chapter focuses on the FOMC meeting minutes from December 2004 to May 2018. Figure (4.1) shows the most frequent (phrase) bigrams and trigrams in the FOMC meeting minutes. The frequency of the phrases in the graph shows that the most common economic concepts discussed are employment, financial conditions, interest rate, inflation rate, economic outlook and GDP growth. Before applying the dictionary to extract the Fed's tone using FOMC meeting minutes, we process the text by removing the stop words, punctuations, administrative details and numbers. We also stem the words to their common linguistic root using Porter's stemming. Section 3.4.1.1 explains the text cleaning process and appendix (B3) in chapter 3 demonstrates the processing with examples.

4.4.1.4 Fed's Tone

To extract the Fed's hawkish and dovish tones, this study uses the directional dictionary[100] of Apel, Blix Grimaldi and Hull (2019). More specifically, using the combinations of terms (nouns)

[100] The dictionary of Apel, Blix Girmaldi and Hull (2019) contains improved list of directional words to estimate the central bank's hawkish (dovish) tone representing future contractionary (expansionary) policy decision. We

and tone modifiers (adjective) the directional dictionary categorises the Fed's tone to hawkish and dovish tones.[101] The hawkish tone in the Fed's communications depicts that members of FOMC are optimistic about the future economic outlook and forecast higher output and inflation, hence it is subsequently an indication of potential future contractionary monetary policy. On the other hand, the dovishness in the FOMC discussion hints the forthcoming deteriorating economic scenario consequently signals an expansionary policy decision. Several scholars estimate hawkishness (dovishness) using the directional dictionary of Apel and Blix Grimaldi (2012) in a computational linguistic analysis on central bank communications[102] (Adesina, 2017; Dossani, 2019; White, 2018 and Neuhierl and Weber, 2019). In this study, using the advanced directional dictionary of Apel, Blix Grimaldi and Hull (2019), we count the number of hawkish and dovish phrases in each FOMC meeting minutes to capture the Fed's tone related to economic activity, employment and inflation. Panel (A) of Figure (4.2) shows that the Fed's hawkishness (ratio of hawkish phrases out of total phrases) during the sample period. The graph indicates that the hawkishness fluctuates throughout the period and remained lowest during the global financial crisis of 2007-2008. We spot similar patterns from panel (B) of Figure (4.2) representing the dovishness which shows the highest dovish tone during the 2007-2008 global financial crisis and the European sovereign debt crisis. Further, Table (4.2) shows that the FOMC members use more hawkish phrases compared to dovish phrases during the period under the analysis. Moreover, Figure (4.3) depicts similar patterns of the Fed's net hawkish index and variations in the commodity indexes. As evident from Figure (4.3) that the Fed's tone and commodity price index moves together during the period under the investigation. As there is co-movement of the net hawkish index and most widely known commodity indexes during the global financial crisis and sovereign debt crisis.

After analysing the FOMC meeting minutes using the topic-modelling technique (LDA), we recognise five unique topics in the FOMC meeting discussions. The most frequent terms identify that FOMC meeting minutes contain discussion about consumption, financial markets, exchange rate, policy and inflation. Figure (4.4) depicts each topic's tone during the period under the study, the shaded area represents the NBER designated recessionary period. The graphs specify that the Fed's net hawkish index for financial market and consumption indicate similar patterns demonstrating the assessment of policymakers regarding future economic

use a different version of directional Apel and Blix Girmaldi' (2012) dictionary to extract central bank optimism (pessimism) related to future economic outlook in the third chapter.

[101] The appendix (B2) comprises of the list of the directional phrases of Apel, Blix Grimaldi and Hull (2019) combining the terms (economic concepts) and tone modifiers (adjectives).

[102] In particular, Neuhierl and Weber (2019) advocate that hawkish (dovish) tone represents future contractionary (expansionary) monetary policy.

outlook. Likewise, the Fed's hawkish tone for inflation rate and policy rate show co-movement indicating policy inclination of the committee members. Moreover, Figure (4.5) compares the NHI of all five topics' proportional tone according to the relative discussion in each FOMC meeting over the sample period.

4.4.2 Results and Discussion

This part of the chapter discusses the main findings for analysing the impact of the Fed's tone on changes in commodity prices as well as positions of traders in the US commodity markets. Further, for both returns and positions of traders, we compare the impact during the normal economic times with the impact during recessionary periods and episodes of high policy uncertainty. Moreover, we also assess the impact of the topics' tone on returns and traders' positions in the commodity markets.

4.4.2.1 Impact on Commodity Returns

This study confirms that the hawkishness in the Fed's tone drives the one month ahead price changes across the commodity groups and overall commodity indexes. More specifically, after subtracting the frequency of hawkish from dovish phrases and dividing the difference by a total number of hawkish and dovish phrases in each document, this chapter estimates the Net Hawkish Index (NHI). A higher NHI reduces the monthly return on copper, silver, crude oil, heating oil and overall commodity index in the following month. A closer look in panel A of Table (4.3) reveals that an increase of one percent in the NHI decreases the S&P GSCI index by 0.2374%. We control for the effects of monetary policy actions, inflation, traders' positions, and commodity-specific momentum and liquidity factors.[103] The relationship between the NHI and commodity indexes is economically meaningful and statistically significant even after controlling for the policy rate, macroeconomic and commodity-specific determinants. The results in Table (4.3) also confirm that the returns of precious metals and energy commodities decrease in response to the Fed's signals about forthcoming contractionary policy and prospering future economic outlook. For example, gold and silver returns drop by 0.1635% and 0.1709% respectively in response to a one percent increase in the net hawkish tone.

In addition to the precious metals, hawkishness also has a similar effect on copper. Along with metals, the returns of energy commodities also decrease after an increase in the net hawkish index. The results for metals illustrate that the coefficients are statistically

[103] We follow Gospodinov and Jamali (2018) and include the macroeconomic and the commodity specific variables to control the effect of other drivers of commodity prices. Section 3.1.4 provides the details about measurement of commodity specific and macroeconomic control variables.

significant only at the 10% level of significance with an exception to platinum. But, the impact of the Fed's tone on the return of heating oil is also statistically significant at the 5% confidence level. However, the returns of agricultural and industrial commodities do not respond to the Fed's tone with exceptions to coffee and sugar. This implies that the impact of the Fed's tone is heterogeneous across the commodity groups. This heterogeneity in the impact of the Fed's tone on various commodity group is due to the dissimilar nature and use of various commodities. For example, hedgers use precious metals such as gold and silver for hedging purposes, on the other hand, agricultural and industrial commodities move with the business cycle. Overall, the Reuters/CRB and the S&P GSCI both commodity indexes also decline in response to a relatively more hawkish tone in FOMC meetings.

Panels B and C of Table (4.3) indicate that the Fed's hawkish and dovish tones have an asymmetric impact in commodity markets as returns only respond to the Fed's hawkish tone. Specifically, a one percent increases in the hawkishness (ratio of hawkish phrases out of total phrases) in the FOMC meeting minutes reduces the monthly returns on copper, heating oil and crude oil futures contracts by 0.2038, 0.1505 and 0.2402 percent respectively. Panel B of Table (4.3) specifies that the returns on the crude and heating oil futures contracts also decrease in response to an increase in hawkishness of FOMC members' discussion. However, panel C of Table (4.3) depicts that the dovishness does not determine the return on commodity futures contracts. This implies that the impact of the Fed's hawkish and dovish tones is asymmetric and commodity markets participants only react to FOMC members' optimistic assessment about the future economic scenario and an inclination of future increase in the policy rate. These findings are consistent with Bahloul and Gupta (2018) who find the asymmetric impact of the positive and negative macroeconomic surprises on oil futures volatility.[104] A potential rationale for the statistically insignificant impact of the Fed's dovishness is that investors only respond to the net effect of the tone. For instance, Table (4.2) describes that on average there are more hawkish compared to dovish phrases in the FOMC meeting minutes during the sample period.

A potential interpretation of our findings is the speculative channel of monetary policy transmission in the model of Frankel (2008), which suggests that investors reallocate their funds in response to policy rate changes. In our case, after an indication of future contractionary policy inbound in the Fed's hawkish tone, the investor prefers higher-yielding Treasury securities and shift their investments from commodities to fixed income securities subsequently decreasing the commodity returns. While Frankel's (2008) model primarily

[104] A positive macroeconomic surprise significantly determines the oil futures volatility, whereas the impact fades away in the case of a negative macroeconomic surprise.

focuses on the conventional monetary policy decisions and reallocating investments after policy actions (policy rate decisions). However, the "portfolio rebalance" channel of Gagnon et al. (2010) explains the effect of the Fed's Large-Scale Asset Purchase (LSAP) and other unconventional monetary policy announcements on commodity returns. For instance, after a monetary easing announcement such as the LSAP the demand and returns of long-term Treasuries appreciate due to preferred habitat. Consequently, the returns of long-term Treasury bills decline, and investors participate in the commodity markets in a search for higher yields. This implies that during both conventional and unconventional policy periods, the role of these yield-oriented investors drives the commodity returns through the "reaching for yield" channel of Hanson and Stein (2015).

The key findings of our study discovered a novel relationship between the information in the Fed's communication (words) and commodity returns. As already discussed, the Fed's tone contains signals about the future path of the policy rate as well as a future economic scenario which subsequently effect heterogeneously across the commodity groups.[105] The previous studies of Hayo, Kutan and Neuenkrich (2012) and Thorarinsson and Eshraghi (2013) also document the connection between central bank communications and commodity markets variations. Consistent with our findings, the results of Hayo, Kutan and Neuenkirch (2012) also document that the Fed's communications decrease the price volatility in five commodity sub-indices. Specifically, in an event study, Hayo, Kutan and Neuenkrich (2012) find that commodity markets volatility declines on the day the Fed Chair and Governor deliver speeches. In an effort to analyse the information content Thorarinsson and Eshraghi (2013) use the computational content analysis and document that the level of certainty, realism and activism in the central bank communications define precious metal returns. While the previous empirical studies describe the link between central bank communications and commodity returns, our chapter describes a unique relationship between the future policy indication (future path of the policy) in the central bank communication and commodity price fluctuations. For fixed-income securities and stocks, Neuhierl and Weber (2019) find that apart from the monetary policy decision, the tone in the policymakers' communications also determines the changes in the short and long-term interest rate which move asset returns.[106] In this investigation, we extend the impact of the forward guidance inbounds in the central bank communications on commodity returns.

[105] While analysing the impact of economic news on commodity prices Roache and Rossi (2010) also find a heterogeneous response of different commodity groups to the macroeconomic announcements.

[106] Similar to our computational content analysis approach Neuhierl and Weber (2019) also extract hawkish tone indicating a faster future contractionary policy which determines the market participants' expectations about the future interest rate.

Gospodinov and Jamali (2018) analyse the impact of policy rate (actions) on commodity prices. The conclusion of Gospodinov and Jamali (2018) is different from our findings and document an increase in the prices of metals and energy futures contracts in response to the uncertainty associated with a surprise increase in the policy rate. According to Gospodinov and Jamali (2018), the unexpected increase in the policy rate (positive shock) contains a negative signal for investors and reduce their expected equity returns consequently increasing commodity prices. More specifically, a surprise increase in the policy rate leads to an increase in the discount rate subsequently decreasing the stock prices. Next, in response to declining equity returns after a contractionary policy shock the investors look for safer investment options and reallocate their funds from equity to the commodity markets. A potential rationale for the discrepancy in the findings is the dissimilar measures for future guidance in FOMC meetings. While our study estimates forward guidance from the policy makers' tone in the central bank communications. On the contrary, Gospodinov and Jamali (2018) rely on the changes in Eurodollar futures (path factor surprises). Another potential reason for the discrepancy in the results is the difference in the sampling periods and the introduction of unconventional monetary policy decisions. Contrary to the study of Gospodinov and Jamali (2018) which only focuses on the conventional monetary policy period, our investigation focuses on both conventional and recent era of unconventional policy practises. After the introduction of unconventional monetary policy tools such as LSAP which leads to changes in the Treasury yields subsequently altering the demand and returns of commodities. Our results are consistent with the findings of Amatov and Dorfman (2017) for unconventional policy decisions reporting a positive relationship between the Fed's balance sheet and commodity returns.

To validate our interpretation of portfolio reallocation in response to central bank communications, we investigate the impact of the tone on the number of long and short positions of commercial and non-commercial traders in the commodity markets. As discussed in earlier sections, commercial traders participate in the commodity markets to hedge against the expected inflation. On the contrary, non-commercial traders take long positions in the commodity markets for speculation purposes. If investors rearrange their portfolio in response to the Fed's communications, then we can observe the effects of tone on the hedging and speculating activities in the commodity markets.

4.4.2.2 Impact on Positions of Traders

The response of traders' positions in the commodity markets to central bank communication confirms our interpretations regarding the impact of tone on commodity returns. Specifically, Table (4.4) shows that a more hawkish tone increases the hedging pressure (net long

positions of commercial traders) and decreases the speculating pressure (net long positions of non-commercial traders) in the commodity markets.[107]

Table (4.4) panel A demonstrates that commercial traders increase their net long positions for gold after a sign of future inflationary pressure and forthcoming contractionary policy in the central bank's tone. For instance, the hedgers either short more or long less the futures contracts on gold after an increase in the hawkishness representing future higher output and inflation. The results are significant at the 5% level of significance even after controlling for commodity price changes, inflation and commodity-specific risk factors. On the contrary, the hedgers' net long positions on crude oil decrease in response to an increase in the net hawkish index. In addition, similar to our commodity returns results there is no significant impact of tone on the hedgers' positions for agricultural commodities except the cases of coffee and sugar.

Similarly, for the speculating pressure, panel B of Table (4.4) indicates that an increase in the net hawkish index leads to a decrease in the speculators' net long positions. A closer examination of Table (4.4) also reveals that the speculators reduce their net long positions on the futures contracts of metals, energy and some agricultural commodities. Further, panel C of Table (4.4) displays that an increase in the Fed's hawkish tone rises the excessive speculative activity in the commodity markets. Specifically, the change in speculators' long (short) positions in response to the Fed's tone is independent of the requirements of hedgers. Looking closely in panel C of Table (4.4), we can observe a rise in the excessive speculative activity for metals, energy and some of the agricultural commodities after a more hawkish discussion in the FOMC meeting.[108]

Apart from making Treasuries more attractive compared to commodities as argued by Gagnon et al. (2010), an indication of tight monetary policy also increases the cost of the leverage for speculators in commodity markets later reducing the speculating pressure. The model of Acharya, Lochstoer and Ramadorai (2013) argues that the speculators face capital constraints during taking necessary positions to satisfy hedgers' demands consequently changing the spot and future commodity prices. Our findings provide empirical evidence that speculators' positions in commodity markets vary with the information about the future path of the interest rate driving cost of leverage. Overall, the findings for the response of the long and short positions to the Fed's tone supports the notion that central bank communications affect

[107] For monetary policy actions Gospodinov and Jamali (2013) find that an expansionary policy shock decreases (increases) the speculating (hedging) pressure.

[108] These findings are consistent with Dewally, Ederington and Fernando (2013) suggesting that the speculators are more sensitive to new information compared to hedgers.

commodity returns through portfolio rebalancing channel.[109] More specifically, an indication of a contractionary policy motivates speculators to shift their investments from commodities to Treasuries, decreasing the speculating activities subsequently decreasing the commodity returns. This implies that not only the policy decisions (actions) but also the tone (words) determine commodity returns through the speculative channel.[110] The higher financialization of commodities during the sample under the study also empower investors to shuffle their funds more easily between commodities to other asset classes to earn higher returns (Chau and Deesomsak, 2018). Next, we also investigate the state-depend impact of the Fed's tone on returns and traders' positions during recessionary and uncertain times. Precisely, if the signals inbound in the central bank communications are responsible for the relationship between the committee members' tone and commodity returns, the impact must be much higher during the economic meltdowns and uncertain times.

4.4.2.3 State-Dependent Impact

We inspect the state-dependent impact of the Fed's tone on returns and positions of traders using interaction dummy variables for recessions and uncertain times. Specifically, by comparing the coefficients in each panel of Tables (4.5) to (4.8) this study measures the change in the intensity of the impact during recessions, economic and monetary policy uncertainty times.

While analysing the impact during recessions and uncertain times, this chapter points out a few interesting facts in Table (4.5) regarding commodity returns response. First, panel A of Table (4.5) portrays that the Fed's hawkishness significantly determines the changes in commodity indexes during the recessionary period for copper and orange juice. Whereas, the effect is not statistically significant through normal economic times. Second, the intensity of the effect is about four times higher in recessions compared to expansions and thrice compared to the overall sample results in Table (4.3). Previous studies also document the overwhelming impact of monetary policy decisions on commodity returns in recessions (Kurov and Stan, 2018 and Gospodinov and Jamali, 2018). On the other hand, using bonds yields and stock returns, prior studies also find the impact of the central bank's tone on asset prices hinge on the state of the economy (Hubert and Labondance, 2019 and Eijffinger, Mahieu and Raes, 2017). Moreover, using a narrative approach Hayo, Kutan and Neuenkrich (2015) find

[109] For instance, after an indication of future increase in the interest rate in the central bank communications investors prefer Treasury bill to commodities to earn higher yield.

[110] The speculative channel in the Frankel's model suggests that Treasuries and other fixed income securities become more attractive for investors after an increase in the policy rate.

that the participants in bond and stock markets react incredibly higher to the hawkish central bank's tone during the global financial crisis.

Panel B shows that the impact of the Fed's tone is higher during the episodes of higher economic and monetary policy uncertainty. As per Table (4.5), the Fed's hawkishness has a significant impact on commodity index movements during higher than average economic policy uncertainty (EPU) phases. However, the intensity of impact is equivalent to the full sample results in Table (4.3). For the phases of higher monetary policy uncertainty (MPU), panel C also demonstrates a similar pattern. For example, panel C in Table (4.5) expresses that the Fed's tone significantly determines the changes in Reuters/CRB index only during the episodes of MPU. This implies that during uncertain times the traders respond to the signals about forthcoming monetary policy provided in the central bank communications. Our chapter extends the previous discoveries of Bakas and Triantafyllou (2018, 2020) concluding that uncertainty related to macroeconomic activity and global pandemic determines the volatility in the commodity markets. Furthermore, Hubert and Lemenado (2019) also record the state-depend impact of the Fed's tone on the future short-term interest rate during high financial stress times. This chapter verifies that uncertainty related to policy plays a vital role in driving commodity returns in response to central bank communications.

Parallel to the state depends impact on commodity returns, Tables (4.6), (4.7) and (4.8) demonstrate that the Fed's tone has a state-dependent impact on hedging, speculating and excessive speculative activities respectively. Particularly, panels A, B and C of Table (4.6) show that during recessions there is an amplified impact of the Fed's NHI on hedging, speculating and excessive speculative activities compared to normal economic times. Specifically, the Fed's tone has a higher impact on the hedging pressure associated with precious metals during the recessionary period compared to normal economic times. On the other hand, the Fed's NHI leads to a greater decline in speculating pressure during the recessions compared to recoveries. The comparative analysis of the left and right side of panel C explains that the Fed's NHI has a profound impact on excessive positions of speculators during hard economic times. A potential reason for this state-dependency in the market response is the element of unexpected assessment of policymaker in the central bank communication about the future course of action. Our findings are consistent with the results of Farka (2011) and Tsai (2014) for equity and bond markets documenting that investors only react to "informed" central bank communication.[111] For example, during the economic

[111] Using newswire reports Farka (2011) categorises the FOMC statements into the "informative" and "uninformative" groups. Only the informative FOMC statements containing important and unexpected additional information determine the changes in the stock and bond prices (Farka, 2011 and Tsai, 2014).

downturn market participants expecting an easing intervention from the central bank. Contrary to their expectations the Fed's hawkishness communication indicating a contractionary monetary policy is a surprise for the market participants which receives an overwhelming response.

Similar to the state-dependent effect of recessions, this chapter also confirms that the impact of the Fed's tone is higher on positions of traders during the episodes of policy uncertainty. Specifically, responding to the Fed's tone the speculating positions on precious metals experience higher changes during the economic and monetary policy uncertain times. Further, Table (4.7) for economic and Table (4.8) for monetary policy uncertainty show that traders respond to the Fed's tone overwhelmingly during uncertain times. On the contrary, the traders' net long positions on crude oil and wheat are higher during less uncertain times. This heterogeneity in the state-dependent impact of the Fed's tone on different commodity groups is due to divergent usage of various commodities. Contrary to precious metals, the positions of traders on crude oil and industrial commodities respond more to the Fed's tone during normal economic times.

4.4.2.4 Topics' Tone

After documenting the impact of the central bank's tone on returns and traders' positions in the commodity markets, we explore an interesting question. What information inside the central bank communications drives the investors' decisions in the commodity markets? To answer this question, this chapters extracts unique topics using the Latent Dirichlet Allocation. After identifying paragraphs related to a particular economic concept in the FOMC meeting minutes, we use a directional dictionary to estimate each topic's NHI. Table (4.9) reveals that the discussion in the FOMC meeting during the sample period revolves around five unique topics i.e. consumption, financial markets, exchange rate, policy and inflation. A closer observation of Table (4.9) depicts that FOMC members' hawkish tone related to consumption, financial markets conditions and inflation define the changes in the prices of metals, energy and overall commodity indexes. This implies the concept that investors in commodity markets react to the Delphic forward guidance rather than Odyssean forward guidance.

The impact of the topics' tone on positions of traders also verifies the role of Delphic information content in deriving the hedging and speculating activities in the commodity markets. For example, both commercial and non-commercial traders participate in the commodity markets in response to a more hawkish discussion about consumption, financial market conditions and inflation. The speculators also consider the Fed's discussion related to the exchange rate while participating in the commodity markets. Similar to the above results

for overall Fe's tone, the hawkish discussion about consumption, financial market and inflation also increase (decrease) hedging and speculating activities. Specifically, Table (4.10) for hedgers and 4.11 for speculators confirms that positions of traders change after a hawkish discussion about consumption, financial market situations and inflation. Moreover, Table (4.12) indicates that policymakers' conversation related to exchange rate is also important for excessive speculative activity.

Our results are similar to the previous studies findings for bond and equity markets. For instance, Jeegadesh and Wu (2017) find that a positive tone related to employment, policy and inflation defines the unexpected volatility in fixed income and equity markets. Further, Picault and Renault (2017) document that both hawkishness about monetary policy stance and positivism about economic conditions in the ECB's tone decreases the volatility in the European equity markets. Moreover, Hansen and McMahon (2016) also find that forward guidance inbound in central bank communication drives the financial market volatilities and macroeconomic activities. Similar to price changes, the topics' tone impact on positions of traders indicates that the Fed's tone about consumption, financial market, and inflation primarily drive hedging and speculating pressure in the commodity markets.

4.4.3 Robustness Checks

We perform three robustness checks to confirm the above findings of this study. In our first exercise, we investigate the impact of tone on returns and traders' positions using six variable Vector Autoregressive (VAR) models. To verify our topics' tone findings, this chapter uses the coherence score to obtain the optimal number of topics in the Latent Dirichlet Allocation methodology. Finally, this study extracts the Fed's tone from alternative communication tools i.e. FOMC statements to endorse the relationship between the central bank's tone and commodity markets fluctuations.

4.4.3.1 VAR Model

The baseline results of this chapter explain the impact of the Fed's tone on returns and trading activates in the commodity markets using the OLS regression model. For robustness checks, we estimate VAR models using Net Hawkish Index (NHI) in a Cholesky decomposition to estimate the dynamic impact of communication shock. We include inflation rate, unemployment rate, the policy rate, NHI, commodity price changes, and T-index in our VAR model for each commodity. We ordered the unemployment rate before the monetary policy because contrary to macroeconomic news, the interest rate announcements affect assets with a time lag. In this study, we control for inflation, business cycle and policy rate while investigating the impact of the Fed's tone on return and trading positions in commodity

markets. This study uses the Akaike Information Criteria (AIC) to identify optimal lags for each commodity VAR model. For simplicity, we only estimate the VAR model for commodities in metals and energy groups as baseline results are statistically significant for both commodity groups. Further, we also investigate the dynamic impact of the Fed's tone on commodity indexes returns in a VAR framework i.e. inflation rate, unemployment rate, the policy rate, NHI, Reuters CRB Index and S&P Sachs Index.

Figures (4.6) and (4.7) show the Impulse Response Functions (IRF) graphs and Table (4.13) describes the variance decomposition results of VAR models for each commodity. Figure (4.6) confirms the baseline findings of this study, as in response to the one standard deviation hawkish shock (a signal for forthcoming contractionary policy) the returns on metals, energy, and commodity indexes decrease in the following months except for silver. The response of commodity returns fades away in the short-term (3 to 6 months). The response of excessive speculative activity to communication shock in Figure (4.7) demonstrates that a one standard deviation hawkish shock indicating a future contractionary policy reduces the excessive speculative activity in the commodity future market. Further, the IFRs show higher impact of the communication shock on the precious metals compared to other commodities. Moreover, Table (4.13) enlists that communication shock explains 3% to 5% of the variance in commodity price changes in the three to six months horizon. Whereas, variance decompositions in panel B of Table (4.13) reports that communication shock determines about 2% of the variance in T-index (excessive speculative activity) in six months horizon. Overall, the robustness exercise using the VAR model validates the baseline results of the OLS regression equation documenting a decrease (increase) in commodity returns (speculating activities) after an increase in the hawkish Fed's tone. The above relationships do not change after using the alternative ordering of the variables in Cholesky decomposition and four variable VAR models.[112]

4.4.3.2 Number of Topics

The Logarithm-based Latent Dirichlet Allocation is an automated content analysis process with little human involvement and limited subjectivity from the researcher. One of the important subjective judgments of the researcher in choosing the optimal number of topics. Selecting a correct number of topics is a vital decision as too few and a too large number of topics lead to vague topics and distort the findings. In the baseline analysis, we extract five topics from FOMC meeting minutes, in this robustness analysis, we use the coherence score to choose the optimal number of topics rather than making a subjective decision. Table (4.14) reports

[112] The four variable VAR model only includes one control variable i.e. the policy rate along with our main variables such as Fed's tone, commodity returns and T-index (excessive speculative activity).

that tone related consumption, credit conditions, policy, employment, and international trade have a significant impact on commodity price changes out of ten topics. The outcome of this robustness exercise suggests that the information related to economic concepts like consumption, financial market, and economic growth drive investors' expectations subsequently define changes in asset prices.

4.4.3.3 FOMC Statements' Tone

Our third and final robustness check analysis uses an alternative communication tool to extract the Fed's tone and investigate its impact on commodity markets fluctuations. The minutes of the FOMC covers the detailed views of members. This implies that the most effective Fed's communication tool to extract FOMC members' assessment related to the future path of the policy rate is the meetings minutes. Yet, the three weeks lag in the publication of minutes may provide redundant information. To resolve this problem the ideal choice is the Fed's press conferences providing detailed discussions in a timely manner. But unfortunately, the Fed started press conferences after the FOMC meeting in April 2011 and the number of observations is very limited up to now. A reasonable alternative communication tool is short FOMC statements released after each meeting covering the rationale for a policy decision. This chapter also estimates the Fed's NHI from FOMC policy statements to confirm the response of the commodity markets to central bank communications. To measure the hawkish and dovish in the policy statement, we use only the directional tone modifiers of Apel, Blix Grimaldi, and Hull (2019) as there is less frequency of directional phrases (the combination of concepts and tone modifiers) in a short text. Table (4.15) shows that the impact of NHI using FOMC statements is similar in direction and magnitude to our baseline results for returns and trading activities in the commodity markets.

4.5 Conclusion

To stabilize financial markets after the global financial crisis central banks reduced the policy rate near zero lower bound. Resulting investors increasingly rely on central bank qualitative communications to look for professional forecasts about the forthcoming economic scenario and the future path of the policy rate. Further, the introduction of unconventional monetary policy measures such as the LSAP motivated market participants to reallocate their portfolio from Treasuries in a search for yield. In addition, the improved financialization of the commodity markets facilitates shifting investments from fixed income securities and stocks to commodities that subsequently move asset prices. In this chapter, we investigate the impact of forward guidance inbound in the central bank communications on returns and traders' long and short positions in the commodity futures market. To gauge the trading activities in the commodity futures market, this study utilizes the COT reports dataset and measures hedging and speculating pressure. Moreover, this chapter estimates the Fed's Net Hawkish Index (NHI) representing Delphic forward guidance of a contractionary policy using computational linguistic analysis.

The findings of this chapter document that the degree of hawkishness in the Fed's communications representing a future contractionary policy drive returns on metals, energy, and commodity indexes downwards. Further, the impact of the Fed's tone is heterogamous on different commodity groups. Moreover, the impact of hawkish and dovish tones is asymmetric on commodity returns. The portfolio rebalancing channel potentially explains the impact of forward guidance in the central bank communication on variations in commodity returns. More specifically, we argue that investors swing their funds between fixed income securities and commodities after an optimistic projection of future economic outlook consequently forthcoming contractionary policy.

To validate this portfolio rebalancing channel, this chapter analyses the impact of the Fed's tone on hedging and speculating pressure in the commodity markets. The results of this study confirm our notion and report an increase in the hedging pressure in the commodity markets in response to the Fed's hawkish tone. Similarly, a more hawkish Fed's tone reduces the speculating pressure in the commodity markets. Overall, a hawkishness in the policymakers' tone leads to an increase in excessive speculating positions of the commodity traders. Moreover, the state-dependent and topics' tone impact analyses on traders' positions also support our interpretation of findings regarding commodity price movements. For instance, the impact of the Fed's net hawkish tone carrying signals of future contractionary policy is highly significant during uncertain times and four times higher during the recessionary period. This implies that commodity traders are highly sensitive to Fed's communication during

the economic meltdowns subsequently shifting their funds between commodities and Treasury securities.

The results of this chapter are statistically significant and economically expressive after controlling for the business cycle and commodity-specific factors. Moreover, the robustness analysis validates the relationship between central bank communications and the commodity markets after changing communication tool and investigating method. The findings of this chapter highlight the critical role of language in developing investor expectations subsequently shifting asset prices in financial markets. Further, this chapter reports that communication from the central bank comprising the future course of the policy actions leads to portfolio rebalancing decisions in the financial markets. Furthermore, policymakers must rely on effective, frequent, and timely communication during economic meltdowns and uncertain times to stabilize asset prices in the financial markets. Moreover, this study suggests that market participants consider qualitative communication along with policy decisions while formulating their investments and trading strategies.

The potential future extensions to this study may divide the central bank communication into expected and unexpected categories to assess the impact of surprising policymakers' tone on asset prices. Another interesting scope of future research is comparing the impact of various communication tools i.e. speeches of the Fed Chairman, FOMC members speeches, testimonies, and summary of economic projections. Further, a fascinating topic of future research is investigating the asymmetric effect of information about the future scope of the economy, forward guidance, and pure sentiment (orthogonal to macroeconomic variables) of policymakers on asset prices in financial markets. Furthermore, in the future, one must measure the efficiency of the policy makers' communications around the world in reducing the economic devastating effects of the current uncertain and unprecedented era of COVID-19.

Chapter 4: Figures and Tables

Chapter 4: Figures

Figure 4. 1: Most Frequent Bigrams and Trigrams

These graphs show the most frequent Bigrams and Trigrams in the Federal Open Market Committee (FOMC) meeting minutes from December 2004 to May 2018. Before applying the textual analysis, we first eliminate all the punctuations, auxiliary verbs, numbers, symbols and common words (stop words). To avoid the repetition of words with similar concepts, we stem all the unique words to their epitomical root.

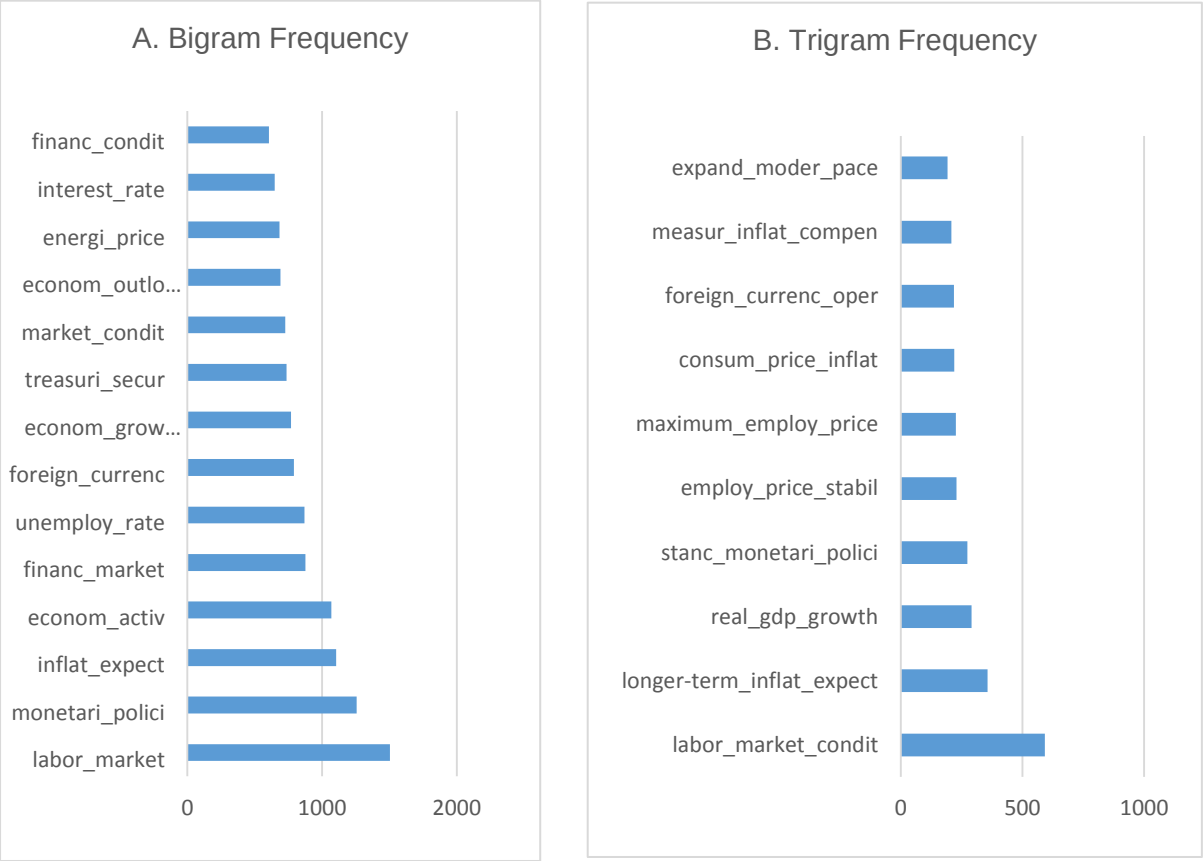
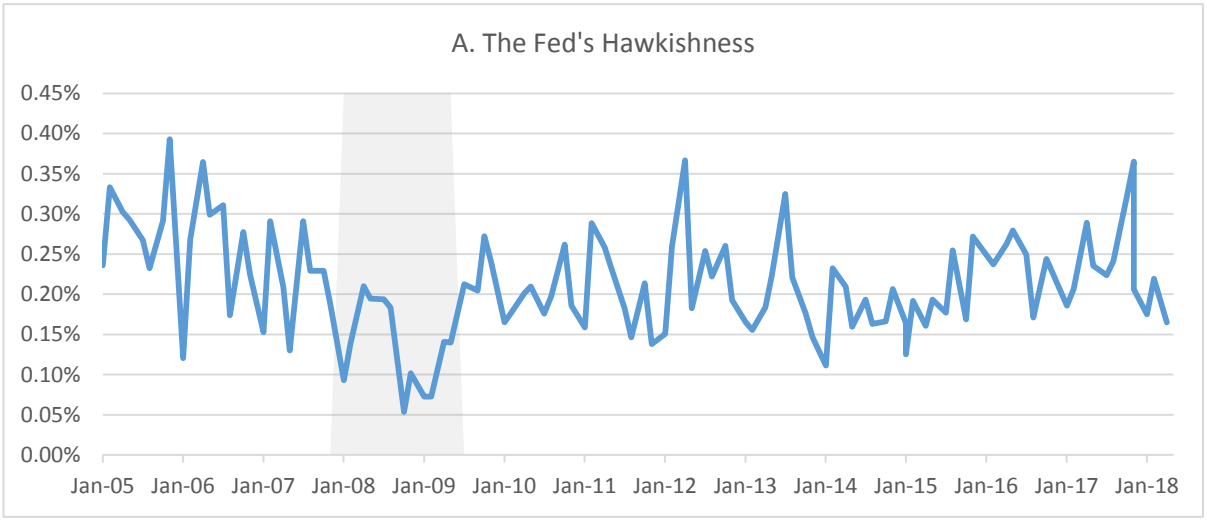


Figure 4. 2: Fed's Degree of Hawkishness and Dovishness

Plots A and B show the Fed's degree of hawkishness and dovishness respectively. Using the content analysis technique, we extracted the Fed's tone from the Federal Open Market Committee meeting minutes. Specifically, we use Apel, Blix Grimaldi and Hull (2019) directional lexicon to classify the phrases to hawkish and dovish categorise. Next, we estimate the degree of hawkishness (dovishness) by dividing the number of hawkish (dovish) phrases by the total number of the phrases in each meeting minutes from December 2004 to May 2018. The shaded area represents the recession period using NBER-designated recessionary times.



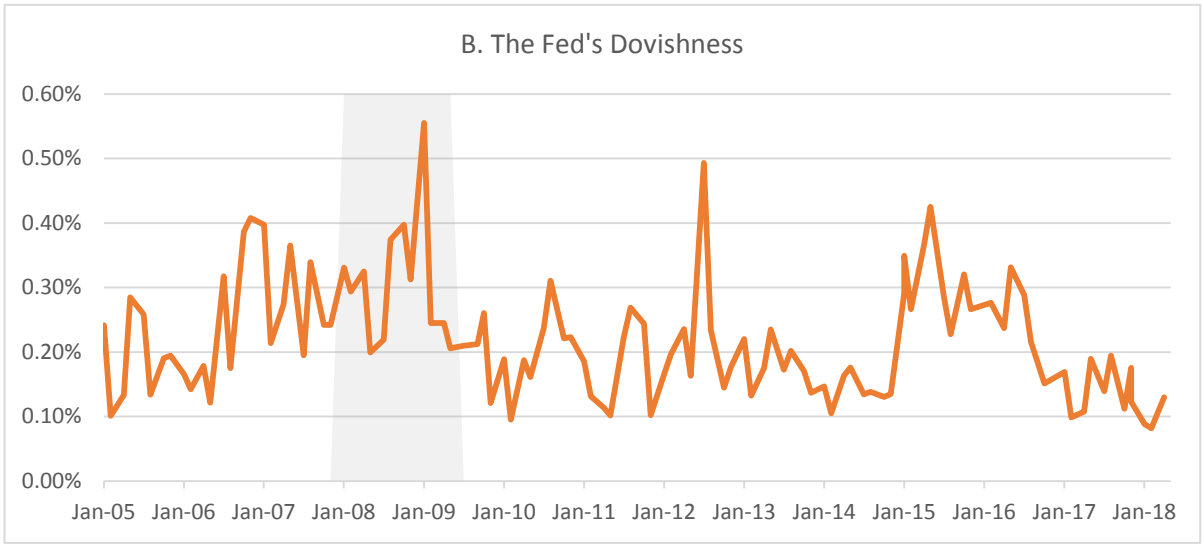


Figure 4. 3: Net Hawkish Index and Commodity Indexes

The first Graph shows the Fed's Net Hawkish Index extracted using computational linguistic analysis on the Federal Open Market Committee meeting minutes. We use Apel, Blix Grimaldi and Hull (2019) directional lexicon to classify the phrases in hawkish and dovish categories. Next, we estimate the net hawkish index by dividing the difference between the number of hawkish and dovish phrases with the sum of the hawkish and dovish phrases in each meeting minutes. Plot B and C indicates the return on the Reuters/Jefferies Commodity Research Bureau (CRB) Index and S&P-Goldman Sachs Commodity Index (S&P GSCI) for the period from December 2004 to May 2018. The shaded area shows the recession period using NBER-designated recessionary times.

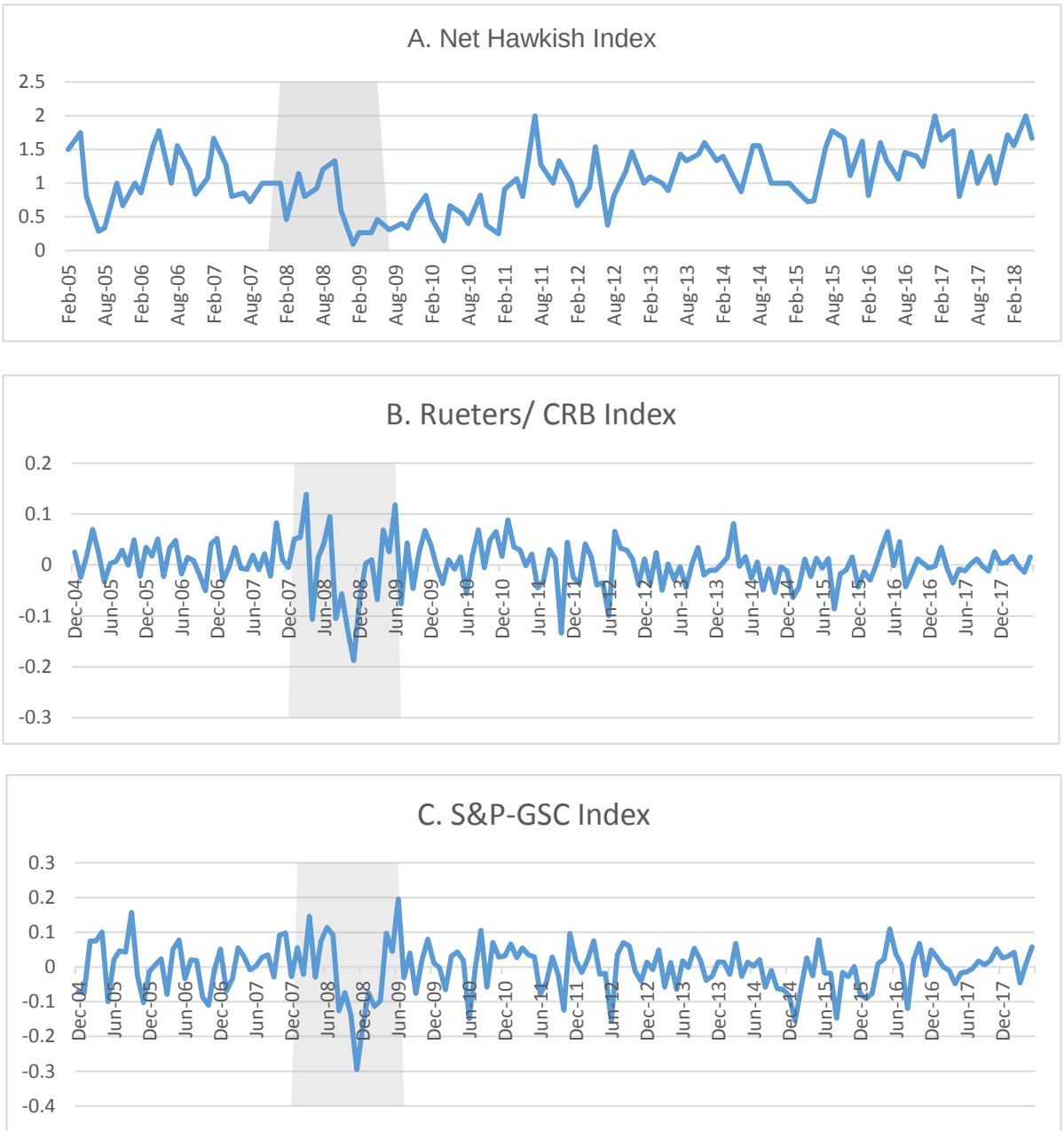
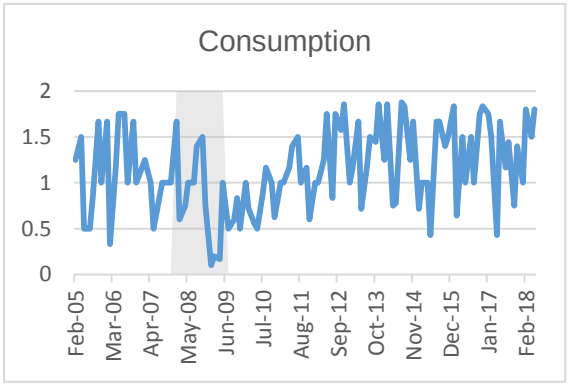
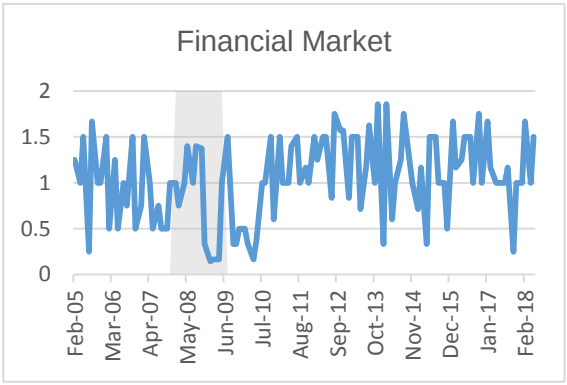
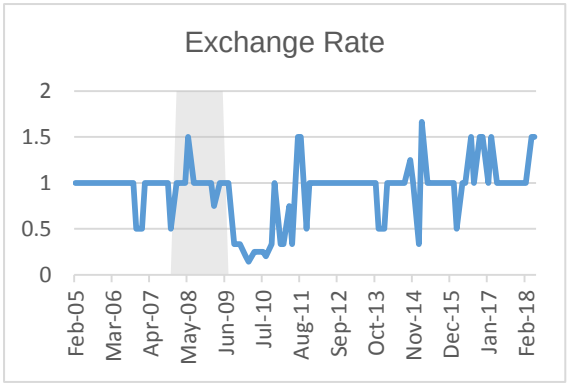


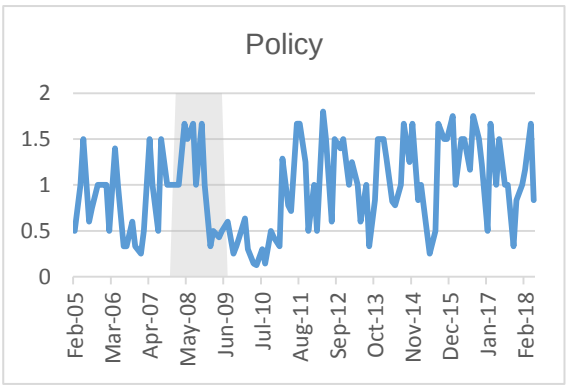
Figure 4. 4: Each Topics' Tone

Each graph shows the Fed's Net Hawkish Index (NHI) of about a particular topic (economic concept) extracted applying the Latent Dirichlet Allocation (LDA) on the Federal Open Market Committee meeting minutes. Afterwards, we use Apel, Blix Grimaldi and Hull (2019) directional lexicon to classify the tone related to each topic to hawkish and dovish categorise. Next, we estimate the net hawkish index by dividing the difference between the number of hawkish and dovish phrases by the sum of the hawkish and dovish phrases in each meeting minutes. The shaded area shows the recession period using NBER-designated recessionary times.









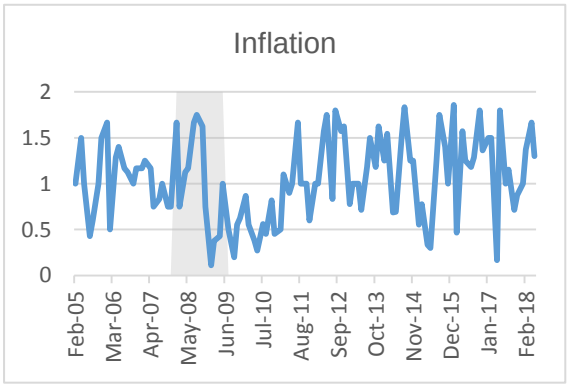


Figure 4. 5: Topics' Proportional Tone

This plot indicates each topics' proportional Net Hawkish Index (NHI) extracted applying the Latent Dirichlet Allocation (LDA) on the Federal Open Market Committee (FOMC) meeting minutes for the period from December 2004 to May 2018. First, we use the LDA to measure the proportion of each topic in the discussion of each FOMC meeting. Second, we apply Apel, Blix Grimaldi and Hull (2019) directional dictionary to classify the phrases hawkish and dovish categorise for each topic. Third, this paper computes the NHI after dividing the difference of dovish phrases from hawkish phrases with a total number of hawkish and dovish phrases. The shaded area shows the recession period using NBER-designated recessionary times.

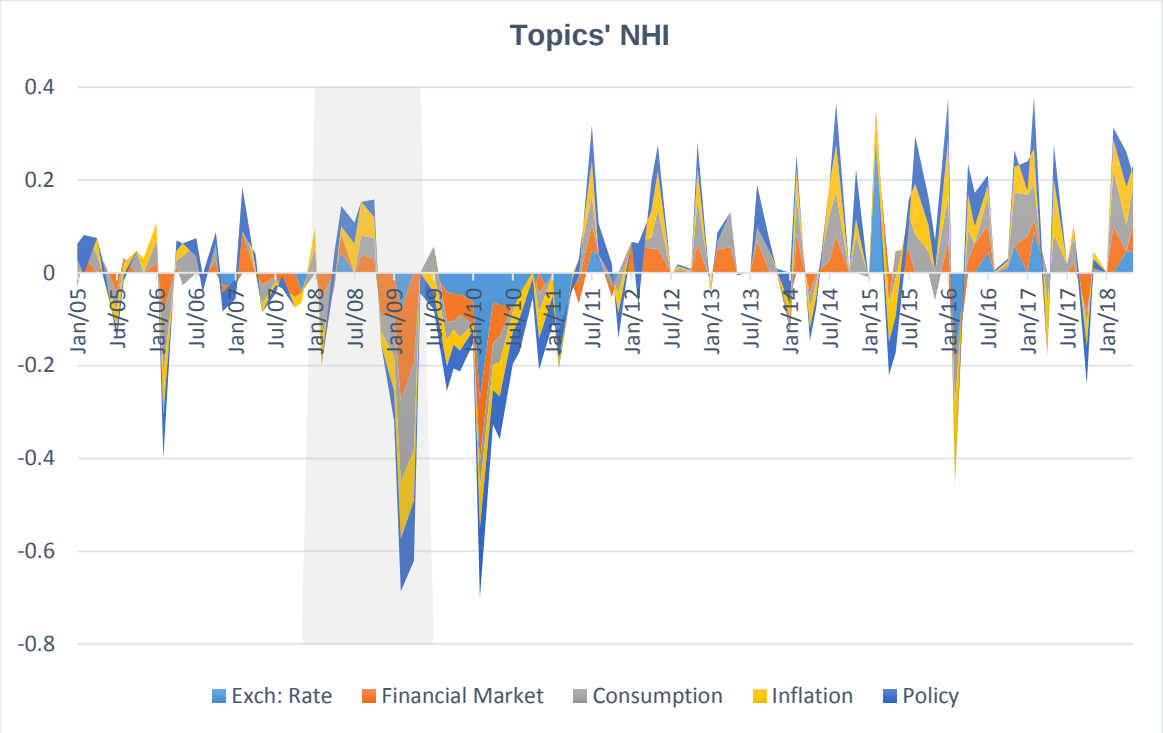
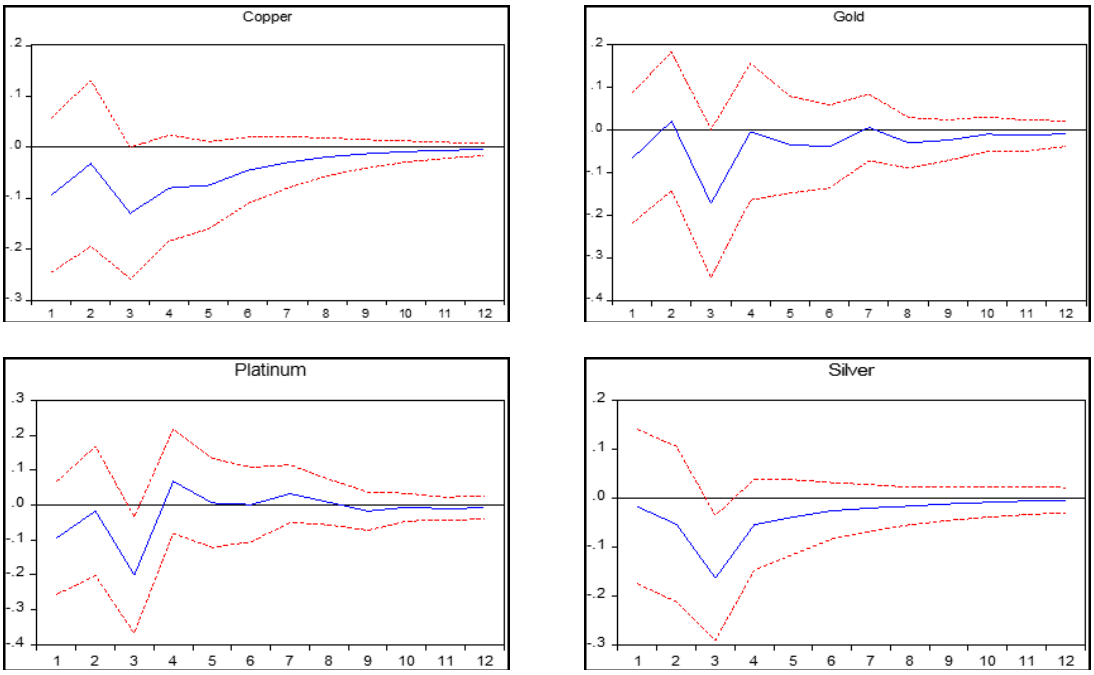
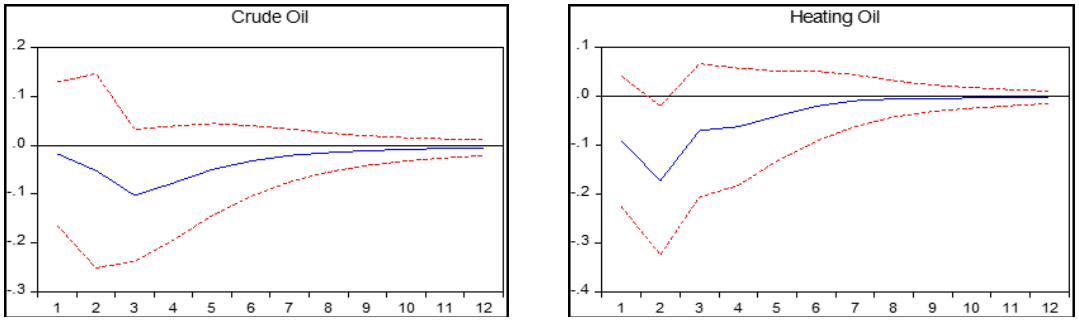


Figure 4. 6: Impulse Response Functions (Commodity Returns)

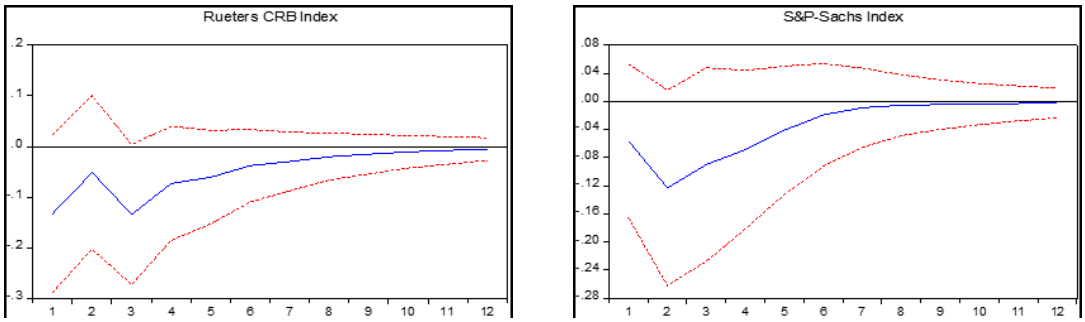
A. Metals



B. Energy



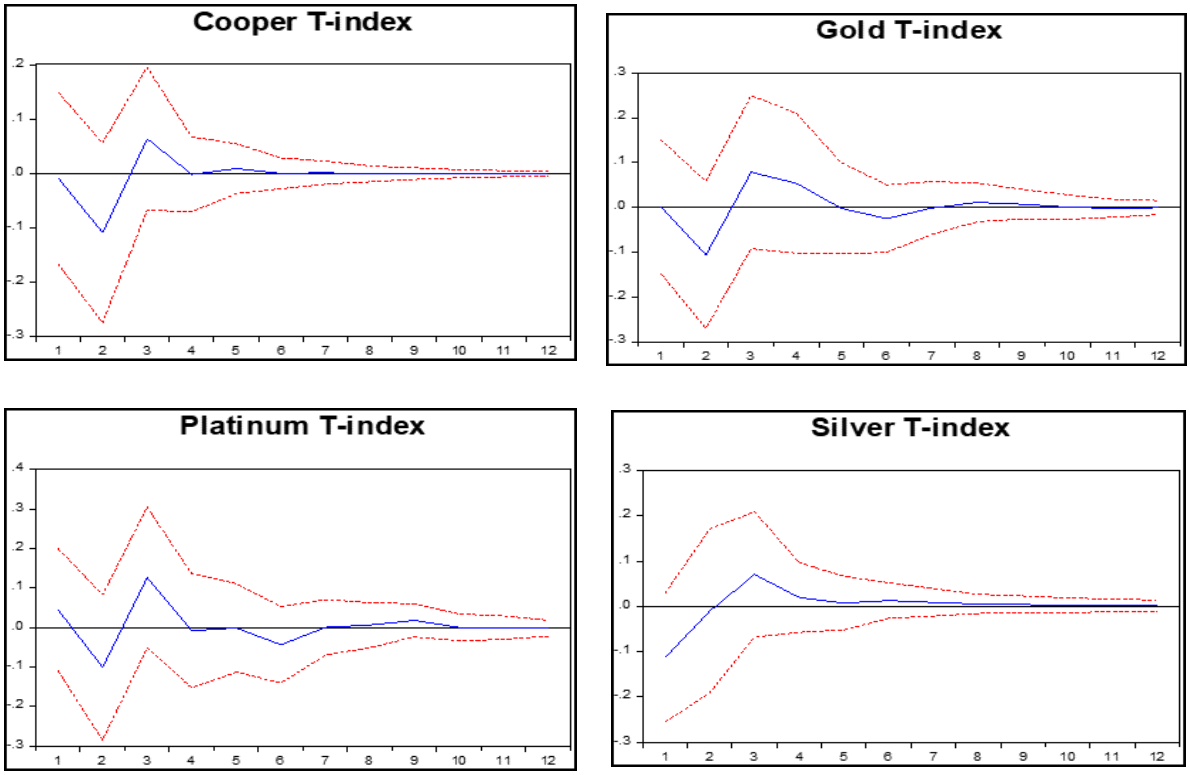
C. Indexes



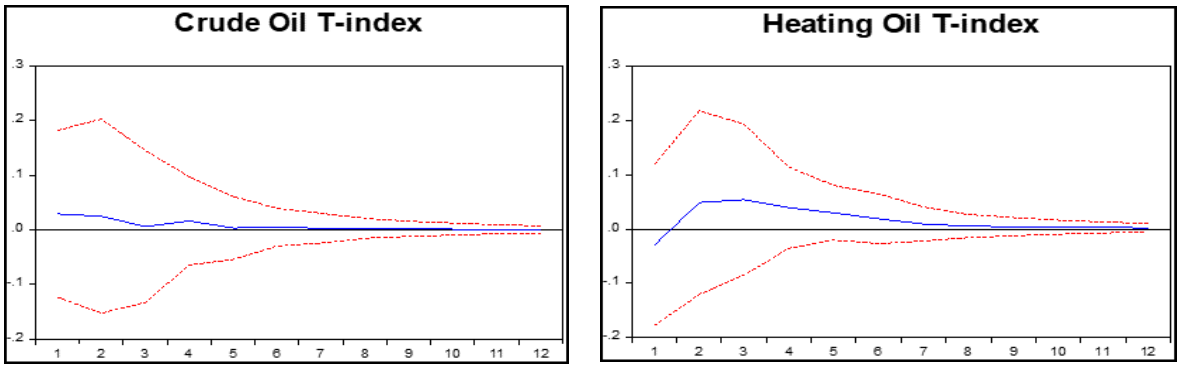
Note: This figure shows the impulse responses of commodity price changes to the Net Hawkish Index for 12 months. This study extracts the Fed's tone from the Federal Open Market Committee (FOMC) meeting minutes using the directional dictionary of Apel, Blix Grimaldi and Hull (2019). Further, we estimate the percentage change in prices using beginning and month-end prices of futures contracts on commodities. Finally, using Working's (1960) T-index, we estimate excessive speculative activity as the number of positions of non-commercial traders (speculators) over and above the positions of commercial traders (hedgers). This study estimates the communication shock using Cholesky decomposition in a six variable Vector Autoregressive (VAR) framework. We identify the lag length for each VAR model using Akaike Information Criteria (AIC). All the series are standardized to have zero mean and unit standard deviation.

Figure 4. 7: Impulse Response Functions (Positions of Traders)

A. Metals



B. Energy



Note: This figure shows impulse responses of excessive speculative activity T-index of each commodity to Net Hawkish Index for 12 months. This study extracts the Fed's tone from the Federal Open Market Committee (FOMC) meeting minutes using the directional dictionary of Apel, Blix Grimaldi and Hull (2019). Further, we estimate the percentage change in prices using beginning and ending monthly prices of futures contracts on commodities. Finally, using Working's (1960) T-index, we estimate excessive speculative activity as the number of positions of non-commercial traders (speculators) over and above the positions of commercial traders (hedgers). This study estimates the communication shock using Cholesky decomposition in six variable Vector Autoregressive (VAR) framework. We identify the lag length for each VAR model using Akaike Information Criteria (AIC). All the series are standardized to have zero mean and unit standard deviation.

Chapter 4: Tables

Table 4. 1: Descriptive Statistics of Returns and Positions of Traders

Group	Commodity	Panel A			Panel B			Panel C			Panel D		
		(%) Change in Prices			Hedging Pressure			Speculating Pressure			Excessive Speculative Activity		
		Mean	St: Dev	Kurtosis	Mean	St: Dev	Kurtosis	Mean	St: Dev	Kurtosis	Mean	St: Dev	Kurtosis
Metals	Copper	0.757	7.602	3.739	0.031	0.169	-0.825	-0.029	0.257	-0.008	1.262	0.122	-0.492
	Gold	0.564	5.162	0.966	-0.398	0.136	0.000	0.547	0.186	-0.006	1.152	0.102	13.430
	Platinum	0.103	6.853	3.154	-0.600	0.137	-0.346	0.611	0.207	-0.627	1.193	0.155	1.716
	Silver	0.601	9.399	0.372	-0.371	0.154	-0.840	0.496	0.228	-0.609	1.134	0.081	2.432
Agriculture	Cocoa	0.604	8.504	-0.038	-0.152	0.126	-0.698	0.313	0.260	-0.907	1.112	0.051	-0.114
	Coffee	-0.248	8.262	1.291	-0.077	0.133	-1.012	0.203	0.310	-1.367	1.138	0.053	-0.584
	Corn	0.128	8.313	0.693	-0.041	0.108	-0.473	0.296	0.274	-0.996	1.117	0.078	-0.624
	Oats	0.665	9.119	1.275	-0.255	0.206	-0.346	0.434	0.369	-1.024	1.167	0.096	-0.100
	Orange Juice	0.435	9.322	-0.114	-0.247	0.199	0.150	0.391	0.353	0.243	1.164	0.082	-1.067
	Soybean Oil	0.063	7.093	2.189	-0.091	0.126	-0.621	0.226	0.299	-0.991	1.138	0.073	0.219
	Soybean	0.958	7.547	0.743	-0.062	0.145	-0.601	0.330	0.303	-0.605	1.111	0.121	6.758
	Sugar	0.304	9.352	0.575	-0.119	0.109	-0.615	0.355	0.301	-1.191	1.136	0.077	0.761
	Wheat	-0.347	9.198	0.727	0.051	0.102	0.891	-0.010	0.177	0.646	1.112	0.051	-0.114
Energy	Crude Oil	0.769	8.968	0.769	-0.123	0.102	-0.979	0.304	0.219	-0.858	1.116	0.035	1.039
	Heating Oil	0.235	8.518	1.308	-0.061	0.065	-0.546	0.152	0.206	-0.553	1.112	0.051	-0.114
Industry	Lumber	-0.847	8.290	0.374	-0.071	0.349	-0.763	0.096	0.277	-0.342	1.159	0.088	1.118
	Cotton	0.661	8.552	2.088	-0.137	0.156	-0.602	0.271	0.300	-0.716	1.249	0.091	-0.311
Index	Reuters CRB	0.097	4.518	2.354									
	S&P GSCI	-0.243	6.903	1.652									

Note: Panel A of this table indicates the descriptive statistics of change in monthly futures prices. Similarly, panel B and C show the descriptive statistics of hedging and speculating pressure. Using long and short positions of commercial (hedgers) and non-commercial (speculators) traders we estimate hedging and speculating pressure in the commodity markets. More specifically, using Dewally Ederington and Fernando (2013), this study calculates the difference between the numbers of long and short positions on commodity futures contracts. Further, to estimate the excessive speculative activity in the commodity markets, we divide long (short) positions of non-commercial traders by the sum of long and short positions of commercial trader. More specifically, following Working's (1960) T-index, we estimate excessive speculative activity index which calculates the speculating positions higher and above than the hedging positions on each commodity. Our dataset includes 17 commodities from five different commodity groups and two commodity indexes for the period from December 2004 to May 2018. We include two widely used commodity indexes i.e. Goldman and Sachs (S&P GSCI) and Reutters (CRB) commodity indexes.

Table 4. 2: Descriptive Statistics of the Fed's Tone

	Net Hawkish index	Degree of Hawkishness	Degree of Dovishness
Mean	1.0606	0.2061%	0.1913%
Standard Deviation	0.4575	0.1091%	0.1177%
Kurtosis	-0.7000	-0.1806	-0.2523
Skewness	-0.0487	0.5182	0.5619

Note: This table indicates the descriptive statistics of the Fed's tone. Using Apel, Blix Grimaldi and Hull (2019) directional lexicon this study extracts the Fed's hawkish and dovish tones from FOMC minutes. We estimate the degree of hawkishness (dovishness) by dividing the number of hawkish (dovish) phrases by the total number of phrases in the discussion in FOMC meetings. Further, we calculate the net hawkish index by subtracting the number of dovish phrases from the number of hawkish phrases and dividing the difference by the sum of hawkish and dovish phrase. This study covers the FOMC meetings from December 2004 to May 2018, as before December 2004, the Fed published minutes of FOMC meeting with irregular lags.

Table 4. 3: Impact of Tone on Price Changes

		(A)	(B)	(C)
Commodity		NHI	Hawk	Dove
Metals	Copper	-0.1888 [-1.971]*	-0.2094 [-1.8904]*	-0.0384 [-0.4453]
	Gold	-0.1635 [-1.669]*	-0.1651 [-1.2498]	-0.1111 [-1.2298]
	Platinum	-0.1099 [-1.578]	-0.1173 [-1.1704]	-0.0981 [-1.0077]
	Silver	-0.1709 [-1.827]*	-0.1674 [-1.5342]	-0.0887 [-0.9252]
Energy	Crude Oil	-0.2082 [-2.398]**	-0.0991 [-1.3713]	-0.1883 [-1.9003]
	Heating Oil	-0.2645 [-2.548]**	-0.2435 [-2.6354]**	-0.0077 [-0.0752]
Agriculture	Cocoa	-0.0673 [-0.493]	-0.0411 [-0.3526]	-0.1524 [-1.5474]
	Coffee	-0.1718 [-1.979]*	-0.1981 [-1.7139]	-0.242 [-1.7718]
	Corn	-0.0181 [-0.156]	-0.0443 [-0.3690]	-0.1523 [-1.4551]
	Oats	-0.1191 [-1.173]	-0.1339 [-1.2376]	-0.1886 [-2.2010]*
	Orange	-0.0685 [-0.833]	-0.0342 [-0.4312]	-0.0054 [-0.0556]
	Soya Oil	-0.0659 [-0.724]	-0.0882 [-0.7460]	-0.0474 [-0.6296]
	Soybean	-0.0059 [-0.064]	-0.0489 [-0.5225]	-0.1219 [-1.4512]
	Sugar	-0.1717 [-1.668]*	-0.2477 [-2.0666]*	-0.0785 [-0.6700]
	Wheat	0.055 [0.730]	0.0379 [0.4134]	-0.0903 [-0.9086]
Industrial	Cotton	-0.078 [-0.840]	-0.0469 [-0.4999]	-0.0857 [-0.6881]
	Lumber	0.1241 [1.277]	0.1288 [1.5202]	-0.0257 [-0.2016]
Index	Reuters/CRB	-0.2492 [-1.758]*	-0.2292 [-1.8775]	0.0822 [0.7339]
	S&P GSCI	-0.2374 [-1.864]*	-0.2401 [-1.7690]	0.0221 [0.1757]

Note: This table indicates the impact of the Fed's tone on commodity futures returns. We estimate the percentage change in monthly prices of futures contracts on commodities. Moreover, this study extracts the Fed's hawkish and dovish tones applying the directional dictionary of Apel, Blix Grimaldi and Hull (2019) on the Federal Open Market Committee (FOMC) meeting minutes. Afterwards, we calculate the net hawkish index (NHI) by subtracting the number of dovish phrases from the number of hawkish phrases and dividing the difference by the sum of hawkish and dovish phrases. Panels A, B and C demonstrate the impact of the Fed's Net Hawkish Index (NHI), hawkishness and dovishness on commodity futures return respectively. The Newey-West t-statistics are given in brackets and the superscripts ***, ** and * indicate the statistical significance of coefficients at the 1%, 5% and 10% level. This table shows the impact of the Fed's tone on the changes in the prices of futures contracts. We choose 17 different commodities and two commodity indexes for the period from December 2004 to May 2018. We use widely used Goldman and Sachs (S&P GSCI) and Reutters (CRB) commodity indexes. All the series are standardized to have mean zero and unit standard deviation. We control for the monetary policy actions and inflation by including the Federal Funds Rate (FFR) and inflation rate in the equation. In addition, this study also controls for commodity-specific momentum and liquidity factors. Moreover, this chapter uses hedging pressure to control the trading activities in the commodity markets.

Table 4. 4: Impact of Tone on Positions of Traders

		(A)			(B)			(C)		
		Hedging Pressure			Speculating Pressure			Excessive Speculative Activity		
	Commodity	NHI	Hawk	Dove	NHI	Hawk	Dove	NHI	Hawk	Dove
Metals	Copper	-0.0015	0.0221	-0.0158	0.0238	-0.1006	-0.0526	0.3562	0.0066	-0.3813
		[-0.012]	[0.1681]	[-0.1276]	[0.172]	[-0.6648]	[-0.3570]	[3.068]***	[0.0497]	[-4.5163]**
	Gold	0.3186	0.1974	-0.2152	-0.3591	-0.1944	0.2908	0.3567	0.1433	-0.3011
		[2.575]**	[1.9732]	[-1.9432]	[-3.689]***	[-1.9468]	[3.5059]**	[3.099]***	[1.4929]	[-3.6389]**
	Platinum	0.1149	0.1481	-0.0298	-0.2957	-0.0888	0.2937	0.2801	0.0501	-0.2835
		[0.863]	[1.2588]	[-0.3134]	[-2.705]***	[-0.8405]	[3.3312]**	[3.395]***	[0.5336]	[-3.5916]**
	Silver	0.1787	-0.026	-0.2339	-0.2644	-0.0621	0.2835	0.2465	0.0794	-0.2436
		[1.506]	[-0.2313]	[-2.2010]*	[-1.943]*	[-0.5671]	[2.5527]*	[2.077]**	[0.7905]	[-2.7342]**
Energy	Crude Oil	-0.519	-0.1025	0.4828	0.5066	0.1209	-0.4563	-0.1108	-0.1053	0.0829
		[-4.690]***	[-0.8444]	[6.9629]**	[4.149]***	[0.9985]	[-6.0381]**	[-0.808]	[-1.0421]	[0.6818]
	Heating Oil	0.0696	0.1237	0.0063	-0.2697	-0.19	0.1702	0.4519	0.1076	-0.4571
		[0.641]	[0.9853]	[0.0589]	[-2.229]**	[-1.9579]	[1.6344]	[3.680]***	[1.1845]	[-5.1893]**
Agriculture	Cocoa	-0.1025	-0.0867	0.0434	0.0252	0.0661	0.0289	0.2315	0.103	-0.161
		[-0.824]	[-0.8544]	[0.3404]	[0.209]	[0.7313]	[0.2168]	[1.823]*	[1.1425]	[-1.0966]
	Coffee	0.2226	0.2219	-0.1063	-0.232	-0.2374	0.1138	0.2501	0.2393	-0.1342
		[2.072]**	[2.3450]*	[-1.1227]	[-2.168]**	[-2.9076]**	[1.1501]	[2.326]**	[2.4471]*	[-1.4778]
	Corn	0.02	-0.0072	-0.0865	-0.1503	0.0157	0.2147	0.262	0.051	-0.2734
		[0.148]	[-0.0569]	[-0.7648]	[-1.236]	[0.1211]	[2.1825]*	[2.513]**	[0.4264]	[-3.0755]**
	Oats	0.0307	-0.0344	-0.0265	-0.109	-0.0522	0.1115	0.3207	0.0293	-0.3544
		[0.237]	[-0.2967]	[-0.2749]	[-1.294]	[-0.4394]	[1.0814]	[3.051]***	[0.3399]	[-3.6870]**
	Orange	0.095	0.0856	-0.0867	-0.1842	0.0099	0.2079	-0.022	0.0573	0.0904
		[1.147]	[0.7366]	[-0.8316]	[-1.387]	[0.0753]	[1.6472]	[-0.207]	[0.4332]	[0.7088]
	Soya Oil	0.0221	-0.1118	-0.0906	-0.0487	0.1457	0.1512	0.296	-0.0532	-0.3464
		[0.232]	[-0.9848]	[-0.7879]	[-0.526]	[1.0490]	[1.2673]	[3.296]***	[-0.4734]	[-3.5914]**
	Soybean	-0.0003	-0.0188	-0.0745	-0.0863	-0.0066	0.1483	0.1665	0.007	-0.2122
		[-0.003]	[-0.1762]	[-0.7903]	[-0.877]	[-0.0600]	[1.7140]	[1.846]*	[0.0860]	[-2.2235]*
	Sugar	0.2142	0.2352	-0.0922	-0.2789	-0.2298	0.1738	0.2691	0.0787	-0.2662
		[1.574]	[2.3924]*	[-0.8935]	[-2.336]**	[-2.4703]*	[1.7144]	[2.319]**	[0.8585]	[-2.7406]**
	Wheat	-0.2392	-0.1387	0.1103	0.2825	0.2105	-0.1136	0.3962	0.0971	-0.3856
		[-1.646]	[-1.2878]	[0.9315]	[1.974]*	[1.7889]	[-1.0055]	[3.427]***	[0.9547]	[-3.7662]**
Industrial	Cotton	-0.2559	0.0896	0.2742	0.2271	-0.124	-0.2643	0.1035	0.1777	-0.0275
		[-2.243]**	[0.7804]	[2.6012]*	[1.929]*	[-0.9752]	[-2.5171]*	[0.927]	[2.1436]*	[-0.2631]
	Lumber	0.0131	0.0502	0.0144	-0.1382	-0.0475	0.1076	0.1436	0.2822	0.068
		[0.109]	[0.5285]	[0.1244]	[-1.042]	[-0.4705]	[0.8845]	[1.136]	[1.8183]	[0.5427]

Note: Each panel of this table indicates the impact of the Fed's net hawkish index (NHI), hawkishness and dovishness on positions of traders in the commodity markets respectively. Following, Dewally, Edrington and Fernando (2013) this study calculates the hedgers' pressure applying the difference between the numbers of long and short positions of non-commercial traders for commodity futures contracts. Similarly, for speculating pressure, we use the difference between the numbers of long and short positions of commercial traders for commodity futures contracts. Further, using Working's (1960) T-index, we estimate excessive speculative activity as the number of positions of non-commercial traders (speculators) over and above the positions of commercial traders (hedgers). Moreover, this study also extracts the Fed's hawkish and dovish tones using the directional dictionary of Apel Blix Grimaldi and Hull (2019) on the Federal Open Market Committee (FOMC) meeting minutes. Afterwards, we calculate the net hawkish index (NHI) by subtracting the number of dovish phrases from the number of hawkish phrases and dividing the difference by the sum of hawkish and dovish phrases The Newey-West t-statistics are given in brackets and the superscripts ***, ** and * indicate the statistical significance of coefficients at the 1%, 5% and 10% level. This table shows the impact of the Fed's tone on the 17 different commodities from 5 different commodity groups for the period from December 2004 to May 2018. All the series are standardized to have mean zero and unit standard deviation. The right side of each panel demonstrates the impact of the Fed's tone on the positions of traders including control variables. This study controls for the monetary policy actions and inflation by including the Federal Funds Rate (FFR) and inflation rate in the equations. In addition, this study also controls for commodity-specific momentum and liquidity factors. Moreover, this chapter uses convenience yield on each commodity to control for price variations in the commodity markets.

Table 4. 5: State-dependent Impact of Tone on Price Changes

		(A) Recessions (Rec)		(B) Economic Policy Uncertainty (EPU)		(C) Monetary Policy Uncertainty (MPU)	
Commodity		$NHI^{(Rec)}$	$NHI^{(1-Rec)}$	$NHI^{(EPU)}$	$NHI^{(1-EPU)}$	$NHI^{(MPU)}$	$NHI^{(1-MPU)}$
Metals	Copper	-0.4748	-0.0334	-0.161	-0.1247	-0.1298	-0.16
		[-2.032]**	[-0.419]	[-1.358]	[-1.357]	[-1.342]	[-1.443]
	Gold	-0.2006	0.021	0.0712	-0.1406	-0.0466	-0.0014
		[-0.728]	[0.203]	[0.541]	[-1.091]	[-0.369]	[-0.011]
	Platinum	-0.053	0.0169	-0.0605	0.0724	-0.175	0.1891
		[-0.231]	[0.178]	[-0.623]	[0.498]	[-1.635]	[1.334]
	Silver	0.0113	-0.1078	-0.0284	-0.1437	-0.0846	-0.076
		[0.059]	[-1.137]	[-0.299]	[-1.112]	[-1.068]	[-0.601]
Energy	Crude Oil	0.2262	-0.0293	-0.0359	0.0972	-0.0736	0.1328
		[1.105]	[-0.333]	[-0.379]	[0.655]	[-0.701]	[0.906]
	Heating Oil	-0.1155	-0.1842	-0.2802	-0.0343	-0.2257	-0.1045
		[-0.855]	[-1.819]*	[-2.898]***	[-0.283]	[-1.798]*	[-0.729]
Agriculture	Cocoa	0.1999	-0.0222	0.1086	-0.0563	0.0442	0.0185
		[0.925]	[-0.196]	[0.653]	[-0.433]	[0.293]	[0.128]
	Coffee	0.0808	0.0947	0.208	-0.0435	0.2174	-0.0385
		[0.561]	[0.626]	[1.685]*	[-0.296]	[1.484]	[-0.268]
	Corn	-0.0046	0.1429	0.0876	0.1234	0.0993	0.1095
		[-0.036]	[0.891]	[0.583]	[0.778]	[0.580]	[1.008]
	Oats	-0.096	0.1223	0.1486	-0.0282	0.1891	-0.064
		[-0.510]	[1.638]	[1.500]	[-0.253]	[1.826]*	[-0.598]
	Orange	-0.2246	0.0521	-0.0251	-0.012	-0.0068	-0.0324
		[-2.099]**	[0.397]	[-0.180]	[-0.109]	[-0.042]	[-0.266]
	Soya Oil	-0.1194	0.0131	-0.0659	0.0279	-0.0354	-0.0068
		[-0.934]	[0.136]	[-0.535]	[0.302]	[-0.277]	[-0.069]
	Soybean	0.1022	0.0562	-0.0469	0.1991	0.0867	0.0483
		[0.548]	[0.513]	[-0.407]	[1.500]	[0.770]	[0.425]
	Sugar	-0.1201	-0.0909	-0.1042	-0.0903	-0.1471	-0.0403
		[-0.642]	[-0.622]	[-0.712]	[-0.658]	[-1.079]	[-0.285]
	Wheat	-0.1887	0.2173	0.1513	0.0767	0.1412	0.0913
		[-1.192]	[1.926]*	[1.345]	[0.506]	[1.143]	[0.698]
Industrial	Cotton	0.0582	0.0191	-0.0423	0.1134	0.0873	-0.0353
		[0.350]	[0.113]	[-0.288]	[0.827]	[0.535]	[-0.249]
	Lumber	0.1235	0.1287	0.135	0.1185	0.0694	0.1886
		[0.385]	[1.105]	[0.878]	[0.636]	[0.381]	[1.053]
Index	Reuters/CRB	-0.1607	-0.1861	-0.2722	-0.0722	-0.1971	-0.1608
		[-0.734]	[-1.474]	[-2.434]**	[-0.518]	[-1.905]*	[-1.098]
	S&P GSCI	-0.146	-0.1691	-0.2683	-0.0412	-0.1565	-0.1705
		[-0.833]	[-1.600]	[-2.348]**	[-0.406]	[-1.389]	[-1.305]

Note: This table indicates the impact of the Fed's Net hawkish Index (NHI) on price variations in the US commodity markets during recessionary and uncertain times. We estimate the percentage change in prices using beginning and ending monthly prices of futures contracts on commodities. Moreover, this study also extracts the Fed's tone form the Federal Open Market Committee (FOMC) meeting minutes using the directional dictionary of Apel, Blix Grimaldi and Hull (2019). We estimate interactive variables representing the recessions and policy uncertainty period by multiplying our tone variables with dummies. The recession (Rec) dummy variable takes the value of unity for the recessionary period and zeros otherwise. Following Basistha and Kurov (2008) we identify recessionary period using a combination of business cycle dates of NBER and a three-month moving average of Chicago Fed National Activity Index. In addition, Economic Policy Uncertainty (EPU) and Monetary Policy Uncertainty (MPU) dummies take value of unity for the months when uncertainty is higher than previous three months rolling over average and zero otherwise. Using EPU and MPU indexes of Baker, Bloom and Davis (2016), this study identifies months with higher economic and monetary policy uncertainty respectively. The Newey-West t-statistics are given in brackets and the superscripts ***, ** and * indicate the significance of coefficient at the 1%, 5% and 10% level. We choose 17 different commodities across the five commodity groups for the period from December 2004 to May 2018. We also include two widely used and tradable commodity indexes i.e. Goldman and Sachs Commodity Index (S&P GSCI) and Thomson Reuters/Commodity Research Bureau Index (CRB). All the series are standardized to have mean zero and unit standard deviation. To controls the for monetary policy actions through including policy rate for the conventional policy period and Wu and Xia's (2016) shadow interest rate for the unconventional policy period. We also control for the inflation rate and commodity-specific risk factors i.e. momentum and factor. Furthermore, we control for traders' positions while investigating the impact on commodity prices.

Table 4. 6: State-dependent Impact of Tone on Positions of Traders (Recessions)

		(A)		(B)		(C)	
		Hedging Pressure		Speculating Pressure		Excessive Speculative Activity	
Commodity		$NHI^{(Rec)}$	$NHI^{(1\text{-}Rec)}$	$NHI^{(Rec)}$	$NHI^{(1\text{-}Rec)}$	$NHI^{(Rec)}$	$NHI^{(1\text{-}Rec)}$
Metals	Copper	0.0575 [0.202]	-0.0207 [-0.137]	0.0977 [0.255]	-0.0002 [-0.002]	0.784 [3.678]***	0.2168 [1.674]*
	Gold	0.8278 [2.946]***	0.1442 [1.191]	-0.9185 [-4.591]***	-0.1675 [-1.953]*	0.5989 [4.622]***	0.2737 [1.661]
	Platinum	-0.2134 [-1.006]	0.2265 [1.547]	-0.2984 [-1.425]	-0.2947 [-1.986]**	0.5373 [2.864]***	0.1926 [1.624]
	Silver	0.5867 [2.471]**	0.0349 [0.270]	-0.8425 [-3.944]***	-0.0607 [-0.445]	0.8728 [5.288]***	0.0257 [0.244]
Energy	Crude Oil	-1.0123 [-4.492]***	-0.3544 [-3.184]***	1.0256 [4.442]***	0.3334 [2.644]***	-0.4783 [-2.374]**	0.0118 [0.084]
	Heating Oil	0.3402 [2.420]**	-0.0239 [-0.198]	-0.8499 [-4.323]***	-0.0691 [-0.638]	1.068 [4.911]***	0.2388 [2.240]**
Agriculture	Cocoa	0.0312 [0.137]	-0.1433 [-0.970]	-0.1514 [-0.655]	0.079 [0.529]	0.3164 [1.625]	0.2056 [1.261]
	Coffee	0.32 [1.558]	0.1885 [1.385]	-0.3798 [-1.777]*	-0.1803 [-1.283]	0.4374 [1.836]*	0.1845 [1.483]
	Corn	-0.3346 [-1.966]*	0.1456 [0.851]	0.0246 [0.152]	-0.2122 [-1.400]	0.0169 [0.101]	0.3489 [2.866]***
	Oats	-0.2552 [-1.155]	0.1285 [1.013]	-0.2608 [-1.035]	-0.057 [-0.505]	0.3575 [1.354]	0.3082 [3.269]***
	Orange	0.2358 [0.996]	0.0457 [0.421]	0.3052 [1.047]	-0.3553 [-3.313]***	-0.1096 [-0.415]	0.0086 [0.082]
	Soya Oil	-0.2148 [-1.045]	0.1019 [1.086]	0.1854 [0.963]	-0.1275 [-1.270]	0.4448 [2.134]**	0.2458 [2.454]**
	Soybean	-0.2356 [-1.075]	0.0817 [0.658]	0.0505 [0.271]	-0.134 [-1.019]	0.0616 [0.294]	0.203 [1.791]*
	Sugar	0.4224 [2.598]**	0.1421 [0.866]	-0.6524 [-3.706]***	-0.1496 [-1.024]	0.7924 [3.859]***	0.088 [0.705]
	Wheat	-0.3202 [-1.820]*	-0.2115 [-1.169]	0.4221 [1.998]**	0.2347 [1.329]	0.7007 [3.603]***	0.292 [1.973]*
Industrial	Cotton	-0.174 [-0.897]	-0.2842 [-2.186]**	0.0942 [0.526]	0.273 [1.995]**	0.4183 [2.491]**	-0.0053 [-0.038]
	Lumber	0.1741 [0.602]	-0.0416 [-0.309]	-0.3589 [-1.107]	-0.0632 [-0.434]	0.1411 [0.489]	0.1444 [0.974]

Note: This table indicates the state-depend impact of the Fed's net hawkish index on positions of traders in commodity markets during recessions and expansions. This study extracts the Fed's tone from the Federal Open Market Committee (FOMC) meeting minutes using the directional dictionary of Apel, Blix Grimaldi and Hull (2019). Next, we estimate an interactive variable representing the Fed's tone during the recessions and expansions by multiplying our tone variables with a dummy taking the value of unity for the recessionary periods and zero otherwise. Following Basistha and Kurov (2008) we identify recessionary periods using a combination of business cycle dates of NBER and a three-month moving average of Chicago Fed National Activity Index. Moreover, following Dewally, Edrington and Fernando (2013) this study calculates the hedgers' pressure using the difference between the numbers of long and short hedging positions for commodity futures contracts. Similarly, for speculating pressure, we use the difference between the numbers of long and short speculators' positions for commodity futures contracts. Finally, using the Working's (1960) T-index, we estimate excessive speculative activity as the number of positions of non-commercial traders (speculators) over and above the positions of commercial traders (hedgers). The Newey-West t-statistics are given in brackets and the superscripts ***, ** and * indicate the significance of coefficient at the 1%, 5% and 10% level. We choose 17 different commodities across the five commodity groups for the period from December 2004 to May 2018. All the series are standardized to have zero mean and unit standard deviation. We control the for monetary policy actions through including the policy rate for the conventional policy period and Wu and Xia's (2016) shadow interest rate for the unconventional policy period. We also control for the inflation rate and commodity-specific risk factors i.e. momentum and liquidity factors. Furthermore, we control for price variations through convenience yield while investigating the impact on positions of traders.

Table 4. 7: State-dependent Impact of Tone on Positions of Traders (EPU)

		(A)		(B)		(C)	
		Hedging Pressure		Speculative Pressure		Excessive Speculative Activity	
Commodity		$NHI^{(EPU)}$	$NHI^{(1\text{-}EPU)}$	$NHI^{(EPU)}$	$NHI^{(1\text{-}EPU)}$	$NHI^{(EPU)}$	$NHI^{(1\text{-}EPU)}$
Metals	Copper	-0.1097 [-0.753]	0.1191 [0.776]	0.1507 [0.822]	-0.1176 [-0.870]	0.4083 [3.034]***	0.2981 [1.901]*
	Gold	0.3697 [3.369]***	0.2583 [1.294]	-0.485 [-5.072]***	-0.2105 [-1.513]	0.3428 [4.043]***	0.3731 [1.445]
	Platinum	-0.0631 [-0.569]	0.3122 [1.585]	-0.0903 [-0.735]	-0.5233 [-3.880]***	0.1667 [1.373]	0.4057 [4.058]***
	Silver	0.0932 [0.781]	0.277 [1.743]*	-0.2221 [-1.568]	-0.313 [-1.859]*	0.3168 [2.287]**	0.1657 [1.020]
Energy	Crude Oil	-0.3884 [-2.662]***	-0.668 [-5.557]***	0.3577 [2.275]**	0.6762 [4.972]***	-0.1836 [-0.971]	-0.0279 [-0.148]
	Heating Oil	0.2002 [1.922]*	-0.081 [-0.515]	-0.2948 [-2.462]**	-0.2407 [-1.334]	0.3551 [2.324]**	0.5636 [3.569]***
Agriculture	Cocoa	-0.1239 [-0.849]	-0.0782 [-0.447]	0.049 [0.324]	-0.0019 [-0.010]	0.1035 [0.657]	0.377 [2.346]**
	Coffee	0.1422 [0.946]	0.3134 [2.773]***	-0.1342 [-0.906]	-0.3425 [-3.040]***	0.1784 [1.201]	0.3311 [2.496]**
	Corn	-0.0094 [-0.055]	0.0539 [0.287]	-0.0899 [-0.689]	-0.22 [-1.074]	0.087 [0.823]	0.4641 [2.485]**
	Oats	-0.062 [-0.441]	0.1388 [0.760]	-0.039 [-0.387]	-0.1906 [-1.356]	0.2668 [2.582]**	0.3836 [1.923]*
	Orange	0.0227 [0.224]	0.1764 [1.388]	-0.0804 [-0.431]	-0.3011 [-1.776]*	-0.284 [-2.020]**	0.2731 [1.899]*
	Soya Oil	0.0117 [0.095]	0.0332 [0.260]	-0.0198 [-0.175]	-0.0794 [-0.607]	0.2298 [2.072]**	0.3664 [2.532]**
	Soybean	-0.0157 [-0.114]	0.0173 [0.120]	-0.0699 [-0.506]	-0.105 [-0.742]	0.0687 [0.528]	0.2778 [2.272]**
	Sugar	0.1845 [1.205]	0.2492 [1.554]	-0.2559 [-1.624]	-0.306 [-2.502]**	0.2573 [1.656]	0.283 [2.240]**
	Wheat	-0.1243 [-0.693]	-0.366 [-2.345]**	0.1562 [0.976]	0.4219 [2.321]**	0.2865 [2.390]**	0.5173 [2.651]***
Industrial	Cotton	-0.229 [-1.638]	-0.2868 [-2.164]**	0.2186 [1.516]	0.2367 [1.769]*	-0.035 [-0.216]	0.2624 [1.734]*
	Lumber	0.1072 [0.768]	-0.0951 [-0.588]	-0.175 [-1.135]	-0.0959 [-0.580]	0.2142 [1.219]	0.0624 [0.436]

Note: This table indicates the state-depend impact of the Fed's net hawkish index on positions of traders in commodity markets during episodes of high and low economic policy uncertainty (EPU). This study extracts the Fed's tone from the Federal Open Market Committee (FOMC) meeting minutes using the directional dictionary of Apel, Blix Grimaldi and Hull (2019). We multiply our tone variables with EPU dummy taking a value of unity for the high monetary policy uncertain times and zeros otherwise. Using EPU indexes of Baker, Bloom and Davis (2016), this study identifies months with higher uncertainty. Moreover, following Dewally, Edrington and Fernando (2013) this study calculates the hedgers' pressure using the difference between the numbers of long and short hedging positions for commodity futures contracts. Similarly, for speculating pressure, we use the difference between the numbers of long and short speculators' positions for commodity futures contracts. Finally, using Working's (1960) T-index, we estimate excessive speculative activity as the number of positions of non-commercial traders (speculators) over and above the positions of commercial traders (hedgers). The Newey-West t-statistics are given in brackets and the superscripts ***, ** and * indicate the significance of coefficient at the 1%, 5% and 10% level. We choose 17 different commodities across the five commodity groups for the period from December 2004 to May 2018. All the series are standardized to have zero mean and unit standard deviation. We control for for monetary policy actions by including policy rate for the conventional policy period and Wu and Xia's (2016) shadow interest rate for the unconventional policy period. We also control for the inflation rate and commodity-specific risk factors i.e. momentum and liquidity factors. Furthermore, we control for price variations through convenience yield while investigating the impact on positions of traders.

Table 4. 8: State-dependent Impact of Tone on Positions of Traders (MPU)

		(A)		(B)		(C)	
		Hedging Pressure		Speculative Pressure		Excessive Speculative Activity	
Commodity		$NHI^{(MPU)}$	$NHI^{(1-MPU)}$	$NHI^{(MPU)}$	$NHI^{(1-MPU)}$	$NHI^{(MPU)}$	$NHI^{(1-MPU)}$
Metals	Copper	0.0233 [0.164]	-0.0281 [-0.164]	-0.0157 [-0.093]	0.0661 [0.405]	0.4024 [3.180]***	0.3067 [1.975]*
	Gold	0.3704 [2.699]***	0.2623 [1.512]	-0.4362 [-3.657]***	-0.2753 [-2.075]**	0.2814 [3.226]***	0.4384 [2.007]**
	Platinum	0.1164 [0.964]	0.1134 [0.539]	-0.2147 [-1.773]*	-0.3777 [-2.526]**	0.2391 [2.157]**	0.3216 [3.051]***
	Silver	0.1193 [0.934]	0.2428 [1.552]	-0.2253 [-1.357]	-0.3066 [-1.980]*	0.2538 [1.634]	0.2386 [1.838]*
Energy	Crude Oil	-0.4327 [-3.656]***	-0.61 [-3.771]***	0.4287 [3.529]***	0.5887 [3.201]***	-0.2206 [-1.537]	0.005 [0.024]
	Heating Oil	0.2034 [1.947]*	-0.0758 [-0.436]	-0.3064 [-2.264]**	-0.2298 [-1.410]	0.3343 [2.407]**	0.5799 [3.887]***
Agriculture	Cocoa	-0.0373 [-0.213]	-0.1715 [-1.353]	-0.025 [-0.139]	0.0784 [0.644]	0.233 [1.320]	0.2298 [1.576]
	Coffee	0.1962 [1.354]	0.2503 [1.868]*	-0.1976 [-1.350]	-0.2681 [-2.109]**	0.2664 [1.759]*	0.2329 [1.783]*
	Corn	0.0261 [0.146]	0.0134 [0.087]	-0.1331 [-0.882]	-0.1688 [-1.238]	0.2175 [1.891]*	0.31 [1.951]*
	Oats	-0.0203 [-0.158]	0.0858 [0.532]	-0.0669 [-0.603]	-0.1544 [-1.299]	0.2382 [2.306]**	0.4098 [1.862]*
	Orange	0.0598 [0.587]	0.1324 [1.212]	-0.0853 [-0.584]	-0.2895 [-1.616]	-0.2001 [-1.178]	0.1675 [1.397]
	Soya Oil	0.0701 [0.532]	-0.0231 [-0.202]	-0.0352 [-0.296]	-0.0614 [-0.503]	0.2537 [2.172]**	0.3358 [2.617]**
	Soybean	0.0096 [0.087]	-0.0108 [-0.075]	-0.1191 [-1.175]	-0.0515 [-0.341]	0.1271 [1.171]	0.2084 [1.668]*
	Sugar	0.1139 [0.719]	0.3191 [2.086]**	-0.1438 [-0.963]	-0.4202 [-3.300]***	0.1707 [1.161]	0.372 [2.965]***
	Wheat	-0.1997 [-1.060]	-0.2813 [-1.675]*	0.2663 [1.571]	0.2997 [1.611]	0.4584 [3.690]***	0.3301 [1.983]*
Industrial	Cotton	-0.2373 [-1.572]	-0.2761 [-2.247]**	0.2079 [1.394]	0.2479 [1.867]*	-0.0183 [-0.139]	0.2354 [1.638]
	Lumber	0.0424 [0.309]	-0.0176 [-0.112]	-0.1775 [-1.224]	-0.0971 [-0.564]	0.2964 [1.732]*	-0.0165 [-0.106]

Note: This table indicates the state-depend impact of the Fed's net hawkish index on positions of traders in commodity markets during episodes of high and low monetary policy uncertainty (MPU). This study extracts the Fed's tone form the Federal Open Market Committee (FOMC) meeting minutes using the directional dictionary of Apel, Blix Grimaldi and Hull (2019). We multiply our tone variables with MPU dummy taking a value of unity for the high monetary policy uncertain times and zeros otherwise. Using EPU indexes of Baker, Bloom and Davis (2016), this study identifies months with higher uncertainty. Moreover, following Dewally, Edrington and Fernando (2013) this study calculates the hedgers' pressure using the difference between the numbers of long and short hedging positions for commodity futures contracts. Similarly, for speculating pressure, we use the difference between the numbers of long and short speculator's' positions for commodity futures contracts. Finally, using the Working's (1960) T-index, we estimate excessive speculative activity as the number of positions of non-commercial traders (speculators) over and above the positions of commercial traders (hedgers). The Newey-West t-statistics are given in brackets and the superscripts ***, ** and * indicate the significance of coefficient at the 1%, 5% and 10% level. We choose 17 different commodities across the five commodity groups for the period from December 2004 to May 2018. All the series are standardized to have zero mean and unit standard deviation. We control for the for the monetary policy actions through including the policy rate for the conventional policy period and Wu and Xia's (2016) shadow interest rate for the unconventional policy period. We also control for the inflation rate and commodity-specific risk factors i.e. momentum and liquidity factors. Furthermore, we control for price variations through convenience yield while investigating the impact on positions of traders.

Table 4. 9: Impact of Topics' Tone on Prices

		(A)	(B)	(C)	(D)	(E)
	Commodity	Consumption	Fin: Market	Exch: Rate	Policy	Inflation
Metals	Copper	-0.2132	-0.1743	-0.0644	-0.1951	-0.2679
		[-1.9695]*	[-1.7868]*	[-1.0548]	[-2.2269]**	[-2.3139]**
	Gold	-0.0004	-0.1512	-0.1448	-0.0812	-0.0874
		[-0.0046]	[-1.8822]*	[-1.9230]*	[-0.9634]	[-1.1055]
	Platinum	-0.0392	-0.1456	-0.0726	-0.0898	-0.0897
		[-0.3903]	[-1.9893]**	[-0.7813]	[-1.0850]	[-0.9373]
	Silver	-0.0375	-0.0979	-0.2031	-0.1596	-0.1543
		[-0.4167]	[-1.1112]	[-1.8310]*	[-1.8529]*	[-1.8667]*
Energy	Crude Oil	-0.0942	-0.154	0.0686	-0.0181	-0.133
		[-0.9077]	[-1.7399]*	[0.7877]	[-0.1776]	[-1.1666]
	Heating Oil	-0.2576	-0.2723	-0.1926	-0.1249	-0.2512
		[-3.9754]***	[-3.0626]***	[-2.6541]***	[-1.4416]	[-3.0932]***
Agriculture	Cocoa	-0.0834	0.0141	0.0058	-0.0461	-0.1001
		[-0.7479]	[0.1590]	[0.0516]	[-0.4818]	[-0.9297]
	Coffee	0.1086	-0.0363	-0.0078	0.0654	0.0908
		[1.2742]	[-0.4922]	[-0.0701]	[0.5549]	[0.9406]
	Corn	0.1231	0.0381	-0.2415	-0.0878	0.0324
		[1.4510]	[0.4450]	[-2.2398]**	[-0.7966]	[0.2650]
	Oats	-0.0066	-0.1143	-0.0841	-0.0356	-0.0577
		[-0.0646]	[-1.4781]	[-0.8186]	[-0.4076]	[-0.6366]
	Orange	0.0119	-0.1517	-0.0576	-0.0566	-0.0167
		[0.1482]	[-1.7400]*	[-0.6645]	[-0.5735]	[-0.1478]
	Soya Oil	-0.0064	-0.1955	-0.1159	-0.0452	-0.0209
		[-0.0873]	[-2.8462]***	[-1.6376]	[-0.5693]	[-0.2332]
	Soybean	0.0732	-0.0929	-0.1341	-0.0647	0.0383
		[0.9014]	[-1.1022]	[-1.4553]	[-0.8048]	[0.4133]
	Sugar	-0.0276	-0.072	0.0429	0.0538	0.0006
		[-0.2738]	[-0.8521]	[0.4581]	[0.5475]	[0.0055]
	Wheat	0.0569	-0.0731	-0.1678	-0.1313	0.0042
		[0.5970]	[-0.8105]	[-1.9718]*	[-1.4513]	[0.0371]
Industrial	Cotton	0.0147	-0.0976	0.0046	0.0128	-0.0157
		[0.1723]	[-1.3058]	[0.0307]	[0.1184]	[-0.1486]
	Lumber	0.1951	0.0312	0.1023	0.0363	0.1702
		[1.8717]*	[0.2678]	[0.7527]	[0.3290]	[1.6484]
Index	Reuters CRB	-0.1827	-0.1167	-0.165	-0.1597	-0.2261
		[-2.0872]**	[-1.4675]	[-1.8177]*	[-1.6206]	[-2.1168]**
	S&P Sachs	-0.2586	-0.1602	-0.1671	-0.1453	-0.2664
		[-3.5230]***	[-2.2200]**	[-2.1176]**	[-1.4529]	[-2.8870]***

Note: This table indicates the impact of the Fed's net hawk tone related to unique topics on commodity price returns. We estimate the change in monthly prices of futures contracts on commodities. This chapter extracts five unique topics from the Federal Open Market Committee (FOMC) meeting minutes using the Latent Dirichlet Allocation (LDA). Moreover, this study also extracts the Fed's hawkish and dovish tones using the directional dictionary of Apel and Blix Grimaldi (2019) on the Federal Open Market Committee (FOMC) meeting minutes. Afterwards, we calculate the net hawkish index (NHI) by subtracting the number of dovish phrases from the number of hawkish phrases and dividing the difference by the sum of hawkish and dovish phrases. The Newey-West t-statistics are given in brackets and the superscripts ***, ** and * indicate the statistical significance of coefficients at the 1%, 5% and 10% level. This table shows the impact of the Fed's Tone on 17 different commodities from five groups and two widely used commodity indexes for the period from December 2004 to May 2018. All the series are standardized to have zero mean and unit standard deviation. This study controls for the monetary policy actions and inflation by including the Federal Funds Rate (FFR) and inflation rate in the model. In addition, this study also controls for commodity-specific and momentum and liquidity factors. Moreover, this chapter uses hedging pressure to control for the positions of traders in the commodity markets.

Table 4. 10: Impact of Topics' Tone on Hedging Pressure

		(A)	(B)	(C)	(D)	(E)
	Commodity	Consumption	Fin: Market	Exch: Rate	Policy	Inflation
Metals	Copper	0.035	-0.0007	0.0994	0.1002	0.1263
		[0.3297]	[-0.0079]	[0.8307]	[0.8645]	[1.3770]
	Gold	0.2401	0.2302	0.1249	0.1726	0.231
		[2.5823]**	[2.6921]***	[1.2345]	[1.5055]	[2.1387]**
	Platinum	-0.0006	-0.096	0.1522	0.0288	0.0987
		[-0.0060]	[-0.9465]	[1.4735]	[0.2401]	[0.8430]
	Silver	0.1415	0.1643	0.1201	0.1845	0.1131
		[1.5956]	[2.0021]**	[1.2355]	[1.5715]	[1.1233]
Energy	Crude Oil	-0.3858	-0.2567	-0.2438	-0.3376	-0.3071
		[-4.0295]***	[-3.0033]***	[-2.5028]**	[-3.7014]***	[-3.1424]***
	Heating Oil	0.1708	0.207	-0.0348	0.0603	0.1577
		[1.7969]*	[2.1738]**	[-0.3448]	[0.5565]	[1.5540]
Agriculture	Cocoa	-0.1061	0.0579	0.0846	-0.0392	-0.0937
		[-1.0179]	[0.6056]	[0.7205]	[-0.4144]	[-0.8896]
	Coffee	0.1706	0.1332	0.1997	0.1232	0.2022
		[1.8730]*	[1.5229]	[2.3005]**	[1.2646]	[2.1640]**
	Corn	-0.0412	-0.129	0.144	-0.0023	-0.0357
		[-0.4434]	[-1.4949]	[1.0748]	[-0.0210]	[-0.3208]
	Oats	-0.0898	-0.0589	-0.0416	0.0533	-0.0351
		[-0.9676]	[-0.7061]	[-0.4728]	[0.5641]	[-0.3351]
	Orange	0.0966	-0.0086	0.2178	0.1405	0.1321
		[1.1282]	[-0.1162]	[2.6306]***	[1.3550]	[1.2516]
	Soya Oil	0.0351	0.0805	0.0164	0.0582	0.0513
		[0.3426]	[0.7759]	[0.1586]	[0.5068]	[0.4962]
	Soybean	-0.0399	-0.1796	0.0508	-0.0127	-0.1125
		[-0.4494]	[-2.2179]**	[0.5460]	[-0.1239]	[-1.1574]
	Sugar	0.1974	0.1061	0.0955	0.0572	0.156
		[2.2451]**	[1.2471]	[0.8445]	[0.4848]	[1.5813]
	Wheat	-0.2632	-0.1453	-0.0716	-0.1232	-0.2238
		[-2.7631]***	[-1.9098]*	[-0.6346]	[-1.2036]	[-1.9327]*
Industrial	Cotton	-0.0719	-0.0872	-0.1038	-0.0898	-0.0179
		[-0.6252]	[-0.9425]	[-0.9367]	[-0.8121]	[-0.1620]
	Lumber	-0.0552	-0.1492	0.0387	0.0169	-0.0661
		[-0.5570]	[-1.2953]	[0.3249]	[0.1341]	[-0.6039]

Note: This table indicates the impact of the Fed's net hawk index (NHI) related to unique topics on speculating pressure. The commitment of traders' report contains the number of commercial (hedging) and non-commercial (speculating) positions in commodity futures contracts. Following Dewally, Edrington and Fernando (2013), this study calculates the hedging pressure using the difference between the numbers of long and short hedger's positions for commodity futures contracts. This chapter extracts five unique topics from the Federal Open Market Committee (FOMC) meeting minutes using the Latent Dirichlet Allocation (LDA). Moreover, this study also extracts the Fed's hawkish and dovish tones using the directional dictionary of Apel, Blix Grimaldi and Hull (2019) on the Federal Open Market Committee (FOMC) meeting minutes. Afterwards, we calculate the net hawkish index (NHI) by subtracting the number of dovish phrases from the number of hawkish phrases and dividing the difference with the sum of hawkish and dovish phrases. The Newey-West t-statistics are given in brackets and the superscripts ***, ** and * indicate the statistical significance of coefficients at the 1%, 5% and 10% level. This table shows the impact of the topics' tone on 17 different commodities from five groups for the period from December 2004 to May 2018. All the series are standardized to have zero mean and unit standard deviation. This study controls for the monetary policy actions and inflation by including policy rate and inflation rate in the model. In addition, this study also controls for commodity-specific liquidity and momentum factors. Moreover, this chapter uses convenience yield to control for the price variations in the commodity markets.

Table 4. 11: Impact of Topics' Tone on Speculating Pressure

		(A)	(B)	(C)	(D)	(E)
	Commodity	Consumption	Fin: Market	Exch: Rate	Policy	Inflation
Metals	Copper	0.0073	0.0684	-0.1569	-0.017	-0.1068
		[0.0585]	[0.5419]	[-1.1380]	[-0.1204]	-0.1073
	Gold	-0.2516	-0.2351	-0.2693	-0.2092	-0.2599
		[-2.6676]***	[-2.8380]***	[-3.4855]***	[-2.0468]**	(0.1015)**
	Platinum	-0.1177	-0.057	-0.3519	-0.3012	-0.2434
		[-1.2931]	[-0.7027]	[-3.9637]***	[-2.7374]***	(0.1058)**
	Silver	-0.1819	-0.2416	-0.2166	-0.2252	-0.1825
		[-1.7040]*	[-2.5728]**	[-2.0580]**	[-1.8995]*	(0.1090)*
Energy	Crude Oil	0.3827	0.254	0.241	0.3015	0.2928
		[3.9581]***	[2.9598]***	[2.3566]**	[3.0836]***	(0.1037)***
	Heating Oil	-0.2835	-0.3094	-0.1026	-0.1528	-0.2335
		[-2.9989]***	[-3.5397]***	[-1.0989]	[-1.5466]	(0.1001)**
Agriculture	Cocoa	0.0516	-0.1543	-0.1434	0.028	0.0681
		[0.4916]	[-1.5010]	[-1.1134]	[0.2767]	-0.1059
	Coffee	-0.1776	-0.1225	-0.2128	-0.1314	-0.2177
		[-1.8270]*	[-1.4212]	[-2.2808]**	[-1.2566]	(0.1015)**
	Corn	-0.0566	0.0237	-0.2368	-0.1203	-0.0454
		[-0.6915]	[0.2842]	[-2.2090]**	[-1.1420]	-0.1068
	Oats	-0.036	-0.0131	-0.1196	-0.1687	-0.0752
		[-0.3240]	[-0.1026]	[-0.9053]	[-1.3691]	-0.1157
	Orange	-0.0812	-0.0092	-0.2061	-0.1223	-0.101
		[-0.9824]	[-0.1305]	[-2.5119]**	[-1.1709]	-0.0967
	Soya Oil	-0.0653	-0.0992	-0.0463	-0.1427	-0.0904
		[-0.6558]	[-0.9197]	[-0.4650]	[-1.2105]	-0.0984
	Soybean	-0.0442	0.0891	-0.1146	-0.0753	0.0193
		[-0.5542]	[1.1585]	[-1.2562]	[-0.7464]	-0.0958
	Sugar	-0.2371	-0.1506	-0.1904	-0.1529	-0.2183
		[-2.6883]***	[-1.6308]	[-1.5195]	[-1.2765]	(0.0955)**
	Wheat	0.2828	0.1336	0.1086	0.1364	0.2673
		[3.0002]***	[1.5624]	[0.9166]	[1.2212]	(0.1156)**
Industrial	Cotton	0.0638	0.0745	0.0912	0.0829	0.0048
		[0.6097]	[0.8072]	[0.8316]	[0.7599]	-0.1064
	lumber	0.0008	0.0346	-0.1362	-0.1272	-0.0104
		[0.0073]	[0.2841]	[-1.0215]	[-0.9850]	-0.1206

Note: This table indicates the impact of the Fed's net hawk tone related to unique topics on pressure. The commitment of traders' report contains the number of commercial (hedging) and non-commercial (speculating) positions in commodity futures contracts. Following Dewally, Edrington and Fernando (2013), this study calculates the speculating pressure using the difference between the numbers of long and short speculators' positions for commodity futures contracts. This chapter extracts five unique topics from the Federal Open Market Committee (FOMC) meeting minutes using the Latent Dirichlet Allocation (LDA). Moreover, this study also extracts the Fed's hawkish and dovish tones using the directional dictionary of Apel, Blix Grimaldi and Hull (2019) on the Federal Open Market Committee (FOMC) meeting minutes. Afterwards, we calculate the net hawkish index (NHI) by subtracting the number of dovish phrases from the number of hawkish phrases and dividing the difference with the sum of hawkish and dovish phrases. The Newey-West t-statistics are given in brackets and the superscripts ***, ** and * indicate the statistical significance of coefficients at the 1%, 5% and 10% level. This table shows the impact of the topic's tone on 17 different commodities from five groups for the period from December 2004 to May 2018. All the series are standardized to have zero mean and unit standard deviation. This study controls for the monetary policy actions and inflation by including policy rate and inflation rate in the model. In addition, this study also controls for commodity-specific liquidity and momentum factors. Moreover, this chapter uses convenience yield to control for the price variations in the commodity markets.

Table 4. 12: Impact of Topics' Tone on Excessive Speculating Activity

		(A)	(B)	(C)	(D)	(E)
	Commodity	Consumption	Fin: Market	Ech: Rate	Policy	Inflation
Metals	Copper	0.2612	0.2826	0.3144	0.4147	0.2948
		[2.7738]***	[3.3385]***	[4.1476]***	[4.1040]***	[3.2341]***
	Gold	0.1903	0.1509	0.333	0.2346	0.242
		[2.2366]**	[2.0397]**	[3.1664]***	[2.0474]**	[2.1296]**
	Platinum	0.1357	0.1292	0.301	0.3122	0.2143
		[1.4874]	[1.6746]*	[4.5687]***	[2.9867]***	[2.1289]**
	Silver	0.1914	0.2352	0.2127	0.2135	0.1955
		[1.8750]*	[2.3859]**	[2.7104]***	[2.0126]**	[1.8379]*
Energy	Crude Oil	-0.1455	-0.0608	-0.021	0.1286	-0.0121
		[-1.4413]	[-0.6583]	[-0.1740]	[0.9349]	[-0.0861]
	Heating Oil	0.3451	0.2885	0.2692	0.3118	0.2704
		[3.0194]***	[3.0696]***	[3.4826]***	[3.2241]***	[2.4327]**
Agriculture	Cocoa	0.0994	0.2131	0.2581	0.0646	0.0572
		[0.8884]	[2.0514]**	[1.8548]*	[0.6106]	[0.5136]
	Coffee	0.1773	0.1422	0.1883	0.0698	0.1664
		[1.7170]*	[1.5281]	[2.2080]**	[0.6465]	[1.6360]
	Corn	0.1215	0.0236	0.2809	0.1674	0.1327
		[1.5359]	[0.2993]	[2.5189]**	[1.7605]*	[1.3919]
	Oats	0.2169	0.1894	0.1311	0.3409	0.2482
		[2.6362]***	[1.6106]	[1.5528]	[2.4967]**	[2.4589]**
	Orange	-0.0092	-0.0372	0.1549	0.1307	0.1361
		[-0.0898]	[-0.3712]	[1.8508]*	[1.1617]	[1.1045]
	Soya Oil	0.2035	0.2027	0.1173	0.1999	0.127
		[2.2333]**	[2.5050]**	[1.7082]*	[2.1647]**	[1.4308]
	Soybean	0.1005	-0.0334	0.1491	0.1488	0.0576
		[1.2311]	[-0.4139]	[1.4952]	[1.4925]	[0.5902]
	Sugar	0.2586	0.2335	0.2207	0.2205	0.1966
		[2.5683]**	[2.3855]**	[2.0007]**	[1.7344]*	[1.7136]*
	Wheat	0.2006	0.221	0.3562	0.3088	0.2455
		[2.2807]**	[2.7110]***	[3.6170]***	[2.5936]**	[2.1488]**
Industrial	Cotton	0.2246	0.1701	0.1434	0.3066	0.3202
		[2.2387]**	[1.7533]*	[1.5124]	[2.9728]***	[2.9031]***
	Lumber	0.0359	-0.1639	0.1037	-0.0237	-0.0239
		[0.2892]	[-1.3729]	[1.1138]	[-0.1904]	[-0.2753]

Note: This table indicates the impact of the Fed's net hawk tone related to different topics on excessive speculating activity index. The commitment of traders' report contains the number of commercial (hedging) and non-commercial (speculating) positions in commodity futures contracts. Using the Working's (1960) T-index, we estimate excessive speculative activity as the number of positions of non-commercial traders (speculators) over and above the positions of commercial traders (hedgers). This chapter extracts five unique topics from the Federal Open Market Committee (FOMC) meeting minutes using the Latent Dirichlet Allocation (LDA). Moreover, this study also extracts the Fed's hawkish and dovish tones using the directional dictionary of Apel, Blix Grimaldi and Hull (2019) on the Federal Open Market Committee (FOMC) meeting minutes. The list of directional lexicons in the dictionary of Apel and Blix Grimaldi (2019) contains directional phrases measuring hawkishness (dovishness) related to three main economic concepts. Afterwards, we calculate the net hawkish index (NHI) by subtracting the number of dovish phrases from the number of hawkish phrases and dividing the difference with the sum of hawkish and dovish phrases. The Newey-West t-statistics are given in brackets and the superscripts ***, ** and * indicate the statistical significance of coefficients at the 1%, 5% and 10% level. This table shows the impact of the Fed's Tone on the speculating activities on 17 different commodities from five groups for the period from December 2004 to May 2018. All the series are standardized to have zero mean and unit standard deviation. This study controls for the monetary policy actions and inflation by including policy rate and inflation rate in the model. In addition, this study also controls for commodity-specific momentum and liquidity factors. Moreover, this chapter uses hedging pressure to control for the positions of traders in the commodity markets.

Table 4. 13 Variance Decomposition

Horizon in Months		3	6	12
Panel A: Commodity Price Changes				
Metals	Copper	2.4520	3.6657	3.7907
	Gold	3.1759	3.2314	3.3549
	Platinum	4.5907	4.7272	4.7985
	Silver	2.8211	3.2539	3.3313
Energy	Crude Oil	1.2910	2.1493	2.2304
	Heating Oil	4.0293	4.5221	4.5312
Index	Reuters CRB	3.6224	4.5335	4.6794
	S&P Sachs	2.4814	3.0793	3.0921
Panel B: Excessive Speculative Activity (T-index)				
Metals	Copper	0.0064	1.4874	1.4876
	Gold	0.0004	2.0188	2.0292
	Platinum	0.2201	2.6201	2.6192
	Silver	1.3468	1.6932	1.7055
Energy	Crude Oil	0.0901	0.1668	0.1688
	Heating Oil	0.0942	0.8350	0.8487

Note: This table indicates the variance decomposition of price changes and excessive speculative activity (T-index) attributed to the Net Hawkish Index (NHI) at 3, 6, and 12 months horizon. This study extracts the Fed's tone form the Federal Open Market Committee (FOMC) meeting minutes using the directional dictionary of Apel, Blix Grimaldi and Hull (2019). Further, we estimate the percentage change in prices using beginning and end monthly prices of futures contracts on commodities. Finally, using the Working's (1960) T-index, we estimate excessive speculative activity as the number of positions of non-commercial traders (speculators) over and above the positions of commercial traders (hedgers). The values in the table show a portion of forecast variance due to communication shock. All the values are in percentages. This study estimates the variance decomposition using Cholesky decomposition in a Vector Autoregressive (VAR) framework. We identify the correct number of lags using Akaike Information Criteria (AIC). All the series are standardized to have zero mean and unit standard deviation.

Table 4. 14: Impact of Topics' Tone on Returns (Ten Topics using Coherence Score)

Panel		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
TOPIC		CONS	ECON	EMPL	GRWT	INV	CRDT	MRKT	Trade	INFL	POL
Metals	COPPER	-0.0423	-0.0627	0.1817	0.0668	-0.141	0.2486	-0.0411	0.1177	0.0103	-0.0892
		[-0.409]	[-0.960]	[1.902]*	[0.422]	[-1.264]	[2.049]**	[-0.379]	[1.163]	[0.058]	[-0.738]
	GOLD	-0.2087	-0.0779	0.0399	0.0784	0.1004	-0.1159	-0.0709	-0.0682	-0.0466	0.1015
		[-1.528]	[-0.807]	[0.326]	[0.512]	[1.021]	[-1.226]	[-0.758]	[-0.706]	[-0.269]	[1.117]
	PLATINUM	-0.193	-0.0193	0.1739	-0.0355	0.02	-0.0332	-0.0846	-0.1307	0.0706	0.0653
		[-1.638]	[-0.194]	[1.910]*	[-0.209]	[0.160]	[-0.313]	[-0.756]	[-0.927]	[0.438]	[0.600]
	SILVER	-0.1479	0.0728	0.1354	-0.1203	0.1114	0.039	-0.07	0.0115	0.1657	0.0597
		[-0.937]	[0.680]	[1.211]	[-0.686]	[0.907]	[0.387]	[-0.632]	[0.107]	[0.926]	[0.644]
Energy	CRUDE OIL	0.0252	-0.01	0.0428	-0.058	-0.1124	0.0607	0.0524	-0.0361	-0.0048	-0.1696
		[0.191]	[-0.084]	[0.310]	[-0.330]	[-0.801]	[0.387]	[0.526]	[-0.269]	[-0.031]	[-1.211]
	HEATING OIL	0.1774	-0.0775	0.0839	0.0896	0.0132	-0.0234	0.002	0.1293	-0.3443	-0.0491
		[1.511]	[-0.494]	[0.591]	[1.024]	[0.111]	[-0.209]	[0.016]	[2.050]**	[-2.060]**	[-0.409]
Agriculture	COCOA	-0.1264	0.1841	0.0689	-0.298	0.0788	-0.0784	-0.0571	-0.1032	-0.2339	0.1327
		[-1.250]	[2.154]**	[0.702]	[-2.221]**	[0.591]	[-0.673]	[-0.621]	[-0.586]	[-1.182]	[1.688]*
	COFEE	-0.0734	-0.0258	-0.0974	-0.1964	0.4585	-0.1275	-0.1562	0.0284	0.0263	0.1678
		[-0.456]	[-0.264]	[-1.225]	[-1.200]	[2.052]**	[-0.911]	[-1.794]*	[0.326]	[0.179]	[1.864]*
	CORN	-0.0573	0.2916	0.1108	-0.0759	0.1702	-0.1341	0.0172	-0.1995	0.0855	-0.0087
		[-0.395]	[3.816]***	[0.965]	[-0.719]	[1.835]*	[-1.067]	[0.184]	[-1.583]	[0.452]	[-0.081]
	OATS	0.0206	0.1342	-0.0346	-0.0126	0.1525	-0.1528	-0.1785	-0.1975	0.029	-0.1941
		[0.150]	[1.836]*	[-0.396]	[-0.114]	[0.911]	[-1.399]	[-1.849]*	[-2.730]***	[0.206]	[-1.608]
	ORANGE	-0.1946	0.1264	0.1682	-0.2046	0.1637	0.2834	-0.0705	-0.0851	0.3692	0.0058
		[-1.797]*	[1.728]*	[1.714]*	[-2.264]**	[1.751]*	[2.117]**	[-1.010]	[-0.696]	[1.845]*	[0.070]
	SOYA_OIL	-0.046	0.0163	-0.0105	-0.0614	0.1054	0.0496	-0.0352	-0.0762	-0.1862	-0.0849
		[-0.309]	[0.161]	[-0.094]	[-0.372]	[0.705]	[0.290]	[-0.238]	[-0.562]	[-1.032]	[-0.683]
	SOYABEAN	-0.0626	0.2352	-0.0409	-0.1657	0.2052	-0.1378	0.0069	-0.1653	0.0627	-0.0347
		[-0.545]	[2.143]**	[-0.466]	[-1.241]	[1.632]	[-0.896]	[0.046]	[-1.307]	[0.347]	[-0.345]
	SUGAR	-0.2372	0.0881	0.3427	0.0191	-0.2988	-0.0289	0.0715	-0.0284	0.1798	-0.1603
		[-1.737]*	[1.141]	[3.560]***	[0.081]	[-2.877]***	[-0.315]	[0.674]	[-0.415]	[1.007]	[-1.731]*
	WHEAT	-0.1111	0.0963	-0.0076	0.0426	0.3406	0.0161	-0.047	0.01	-0.0397	0.0458
		[-0.873]	[1.335]	[-0.082]	[0.391]	[3.138]***	[0.140]	[-0.520]	[0.143]	[-0.176]	[0.263]
Industrial	COTTON	0.1619	-0.0639	-0.0815	-0.1454	0.0183	0.0712	0.0358	-0.0185	-0.0979	-0.0741
		[1.082]	[-0.569]	[-0.979]	[-1.133]	[0.163]	[0.695]	[0.457]	[-0.227]	[-0.409]	[-0.616]
	LUMBER	-0.0153	0.0356	-0.1304	0.0058	0.1431	-0.0235	-0.054	-0.1396	0.0486	0.0071
		[-0.117]	[0.355]	[-0.988]	[0.047]	[1.601]	[-0.218]	[-0.470]	[-1.376]	[0.316]	[0.058]
Index	Reuters (CRB)	0.1932	-0.0241	0.175	0.0101	0.0434	0.013	-0.1059	0.2663	-0.1812	-0.1578
		[2.034]**	[-0.268]	[1.542]	[0.098]	[0.381]	[0.089]	[-1.266]	[2.364]**	[-0.854]	[-2.003]**
	S&P-Sachs	0.2344	-0.0812	0.0695	0.0351	0.129	0.0408	-0.0237	0.218	-0.3575	-0.0565
		[2.415]**	[-0.956]	[0.609]	[0.385]	[1.062]	[0.378]	[-0.294]	[2.942]***	[-1.962]*	[-0.553]

Note: This table indicates the impact of the Fed's net hawk index (NHI) related to unique topics on commodity price returns. We estimate the change in monthly prices of futures contracts on commodities. This chapter extracts ten unique topics from the Federal Open Market Committee (FOMC) meeting minutes using the Latent Dirichlet Allocation (LDA). This paper uses the coherence score to choose an optimal number of topics from FOMC minutes. The FOMC members mainly discuss the consumption (CONS), economy (ECON), employment (EMPL), Growth (GRWT), Investment (INV), credit conditions (CRDT), financial markets (MRKT), international trade (Trade), inflation (INFL) and monetary policy (POL). Moreover, this study extracts the Fed's hawkish and dovish tones applying the directional dictionary of Apel and Blix Grimaldi (2019) on the FOMC meeting minutes. Afterwards, we calculate the net hawkish index (NHI) by subtracting the number of dovish phrases from the number of hawkish phrases and dividing the difference by the sum of hawkish and dovish phrases. The Newey-West t-statistics are given in brackets and the superscripts ***, ** and * indicate the statistical significance of coefficients at the 1%, 5% and 10% level. This table shows the impact of the Fed's tone on 17 different commodities from five groups and two widely used commodity indexes for the period from December 2004 to May 2018. All the series are standardized to have zero mean and unit standard deviation. This study controls for the monetary policy actions and inflation by including the Federal Funds Rate (FFR) and inflation rate in the model. In addition, this study also controls for commodity-specific and momentum and liquidity factors. Moreover, this chapter uses hedging pressure to control for the positions of traders in the commodity markets.

Table 4. 15: Impact of Policy Statements

		(A)	(B)	(C)	(D)
Commodity		Δ Price	Hedging Pressure	Speculating Pressure	Excessive Speculative Activity
Metals	Copper	-0.3072 [-2.8296]***	0.3236 [3.2688]***	-0.3562 [-2.7597]***	-0.2577 [-1.9004]*
	Gold	-0.188 [-1.8423]*	0.2236 [1.6155]	-0.1555 [-1.4246]	0.0479 [0.4689]
	Platinum	-0.1371 [-1.4388]	0.1497 [1.3769]	0.0668 [0.5765]	-0.1771 [-1.5030]
	Silver	-0.0893 [-0.8554]	0.0913 [0.5070]	-0.1061 [-0.7103]	-0.0555 [-0.4020]
Energy	Crude Oil	-0.144 [-1.5309]	0.0843 [0.5352]	-0.0383 [-0.2503]	-0.1343 [-1.2645]
	Heating Oil	-0.0682 [-0.7365]	0.2481 [2.1642]**	-0.245 [-2.2000]**	-0.0158 [-0.1167]
Agriculture	Cocoa	-0.1051 [-1.0564]	-0.1844 [-1.4331]	0.2097 [1.5114]	-0.1819 [-1.2257]
	Coffee	-0.0164 [-0.1838]	0.0216 [0.1786]	-0.0649 [-0.5551]	0.1817 [1.6681]*
	Corn	0.0351 [0.2922]	-0.1538 [-1.5986]	0.2199 [1.8205]*	-0.1906 [-1.6663]*
	Oats	-0.0469 [-0.5266]	0.1036 [0.6808]	0.1427 [1.0635]	-0.0996 [-0.9440]
	Orange	-0.1522 [-1.7904]*	-0.1989 [-1.4778]	0.297 [2.2455]**	-0.1595 [-1.4865]
	Soya Oil	-0.2064 [-1.6177]	-0.0646 [-0.4236]	0.1651 [0.8668]	-0.0858 [-0.4985]
	Soybean	0.0329 [0.4291]	-0.1705 [-1.7833]*	0.1804 [1.9128]*	-0.0082 [-0.0782]
	Sugar	-0.1173 [-1.1717]	0.1905 [1.4024]	-0.2403 [-1.6165]	0.1088 [0.8153]
	Wheat	0.0953 [0.9189]	0.0016 [0.0122]	0.1511 [1.1814]	-0.053 [-0.4432]
Industrial	Cotton	-0.0004 [-0.0047]	0.1935 [1.6084]	-0.2579 [-1.9857]**	0.2876 [2.9577]***
	Lumber	-0.0684 [-0.8681]	0.3182 [3.4326]***	-0.327 [-3.3610]***	0.3478 [2.4262]**
Index	Reuters CRB	-0.0524 [-0.4870]			
	S&P-Sachs	-0.116 [-1.0924]			

Note: This table indicates the impact of the Fed's net hawkish index (NHI) on prices and positions of traders in the commodity markets. We estimate the change in monthly prices of futures contracts on commodities. Following Dewally, Edrington and Fernando (2013) this study calculates the hedgers' pressure using the difference between the numbers of long and short hedging positions for commodity futures contracts. Similarly, for speculating pressure, we use the difference between the numbers of long and short speculators' positions for commodity futures contracts. Further, using Working's (1960) T-index, we estimate excessive speculative activity as the number of positions of non-commercial traders (speculators) over and above the positions of commercial traders (hedgers). Moreover, this study also extracts the Fed's hawkish and dovish tones applying the directional dictionary of Apel and Blix Grimaldi (2012) on the monetary policy statements. Afterwards, we calculate the net hawkish index (NHI) by subtracting the number of dovish phrases from the number of hawkish phrases and dividing the difference by the sum of hawkish and dovish phrases. The Newey-West t-statistics are given in brackets and the superscripts ***, ** and * indicate the statistical significance of coefficients at the 1%, 5% and 10% level. This table shows the impact of the Fed's tone on the 17 different commodities from 5 different commodity groups and two commodity indexes for the period from December 2004 to May 2018. All the series are standardized to have zero mean and unit standard deviation. This study controls for the monetary policy actions and inflation by including policy rate and inflation rate in the model. In addition, this study also controls for commodity-specific momentum and liquidity factors. Moreover, this chapter uses convenience yield on each commodity to control for price variations in the commodity markets.

Table 4. 16: Summary of Results

Commodity		(A) Commodity Price Change	(B) Hedging Pressure	(C) Speculative Pressure	(D) Excessive Speculative Activity
Metals	Copper	Δ ⌂			Δ □
	Gold	Δ	Δ	Δ □	Δ □
	Platinum			Δ □	Δ □
	Silver	Δ	□	Δ □	Δ □
Energy	Crude Oil	Δ	Δ □	Δ □	
	Heating Oil	Δ ⌂		Δ	Δ □
Agriculture	Cocoa				Δ
	Coffee	Δ	Δ ⌂	Δ ⌂	Δ ⌂
	Corn			□	Δ □
	Oats	Δ □			
	Orange				Δ □
	Soya Oil				Δ □
	Soybean				Δ □
	Sugar	Δ ⌂	⌂	Δ ⌂	Δ □
	Wheat			Δ	
Industrial	Cotton		Δ □	Δ □	⌂
	Lumber				
Index	Reuters CRB	Δ			
	S&P GSCI	Δ			

Note: The shape of Δ, ⌂ and □ represents a significant impact of the Fed's Net Hawkish Index (NHI), degree of hawkishness and degree of dovishness respectively. This table indicates the impact of the Fed's net hawkish tone on price changes and positions of traders in the US commodity markets. We estimate the percentage change in prices using beginning and end monthly prices of futures contracts on commodities. Following Dewally, Edrington and Fernando (2013) we also measure the hedging and speculating pressure using net long positions of commercial (hedgers) and non-commercial (speculators) traders respectively. In addition, using Working's (1960) T-index, we estimate excessive speculative activity using the number of positions of non-commercial traders (speculators) over and above the positions of commercial traders (hedgers). Moreover, this study also extracts the Fed's net hawkish index (NHI) from the Federal Open Market Committee (FOMC) meeting minutes using the directional dictionary of Apel, Blix Grimaldi and Hull (2019). This table shows the impact of the Fed's tone on commodity price changes and positions of traders on 17 different commodities across the five commodity groups for the period from December 2004 to May 2018. We also use two widely used and tradable commodity indexes i.e. Goldman and Sachs Commodity Index (S&P GSCI) and Thomson Reuters/Commodity Research Buerue Index (CRB). All the series are standardized to have zero mean and unit standard deviation. We control for the monetary policy actions by including the policy rate for the conventional policy period and Wu and Xia's (2016) shadow interest rate for the unconventional policy period. We also control for the inflation rate and commodity-specific risk factors i.e. momentum and liquidity factors. Furthermore, we control for price variation and traders' positions while investigating the impact on positions of traders and commodity price changes respectively.

Appendix C:

Appendix C 1: Inflation Directional Phrases

Concepts (Nouns)	Tone Modifiers (Adjectives/Adverbs)	
	Hawkish	Dovish
Consumer Prices Inflation	Accelerat* Boost* Elevated* Escalat* High* Increase* Jump* Pickup* Rise* Rose* Rising* run_up* Runup* Strong* Surg* Up*	Decelerat* Declin* Decreas* Down* Drop* Fall* Fell* Low* Muted* Reduc* Slow* Stable* Subdued* Weak* Contained*
Inflation Pressure	Accelerat* Boost* Build* Elevat* Emerg* Great* Height* High* Increase* Intensif* Mount* Pickup* Rise* Rose* Rising* Stock* Strong* Sustain*	Abat* Contain* Dampen* Decelerat* Declin* Decreas* Dimin* Eas* Fall* Fell* Low* Moderat* Reduc* Subdued* Temper*

Note: This table enlists terms and tone modifiers related to topic inflation. The asterisk after the words indicates that words can take any suffix as the words are stemmed. The directional phrases are a combination of terms (noun) and tone modifiers (adjectives).

Source: Apel, Blix Grimaldi and Hull (2019)

Appendix C 2: Employment Directional Phrases

Concepts (Nouns)	Tone Modifiers (Adjectives)	
	Hawkish	Dovish
Employment	Expand*	Slow*
	Gain*	Declin*
	Improv*	Reduc*
	Increase*	Weak*
	Pick* up	Deteriorate*
	Pickup*	Shrink*
	Rais*	Shrank*
	Rise*	Fall*
	Rising*	Fell*
	Rose*	Drop*
	Strength*	Contract*
	Turn* up	Sluggish*
Labor Market	Strain*	Eased*
	Tight*	Easing*
		Loos*
		Soft*
		Weak*
Unemployment	Declin*	Elevat*
	Fall*	High*
	Fell*	Increase*
	Low*	Ris*
	Reduc*	Rose*

Note: This table enlists terms and tone modifiers related to topic Employment. The asterisk after the words indicates that words can take any suffix as the words are stemmed. The directional phrases are a combination of terms (noun) and tone modifiers (adjectives).

Source: Apel, Blix Grimaldi and Hull (2019)

Appendix C 3: Economic Activity Directional Phrases

Concepts (Nouns)	Tone Modifiers (Adjectives)	
	Hawkish	Dovish
Consumer Spending	Accelerat* Edg* Up Expan* Increas* Pick* Up Pickup* Soft* Strength* Strong* Weak*	Contract* Decelerat* Decreas* Drop* Retrench* Slow* Slugg* Soft* Subdued*
Economic Activity Economic Growth	Accelerat* Buoyant* Edg* Up Expan* Increas* High* Pick* Up Pickup* Rise* Rose* Rising* Step* Up Strength* Strong* Upside*	Contract* Curtail* Decelerat* Declin* Decreas* Downside* Drop* Fall* Fell* Low* Moderat* Slow* Slugg* Weak*
Resource Utilization	High* Increas* Rise* Rising* Rose* Tight*	Declin* Fall* Fell* Loose* Low*

Note: This table enlists terms and tone modifiers related to topic Economic Activity. The asterisk after the words indicates that words can take any suffix as the words are stemmed. The directional phrases are a combination of terms (noun) and tone modifiers (adjectives).

Source: Apel, Blix Grimaldi and Hull (2019)

Chapter 5: Conclusion

5.1 Research Objectives

This thesis investigates the effects of the central bank's actions and words on confidence, assessment of risk, trading behaviour and asset prices in the financial markets. The central bank manages investor expectations about future earnings and shifts investment behaviour in the financial markets to achieve macroeconomic objectives. The monetary policy decisions and communications provide additional information about policymakers' assessments of future economic and financial conditions that may affect investor expectations, trading behaviour and asset prices. In addition, after the catastrophic effects of the global financial crisis, policymakers became more concerned about financial asset prices and stability. Central banks in the developed countries started reducing the policy rate to lower bound and adopted the unconventional monetary policy measure in the aftermath of the global financial crisis. The announcements of unconventional policy decisions such as the large-scale asset purchase programs strengthened the importance of investor expectation and behaviour in the financial market to achieve the ultimate goals of stable prices and maximum employment.

There is a large number of studies analysing the effects of conventional and unconventional monetary policy on asset prices in financial markets. In addition, researchers also examine the response of investor sentiment to the monetary decisions during conventional and unconventional periods. In this thesis, we add to this strand of literature by investigating the effectiveness of conventional and unconventional policy actions in boosting consumer and manager confidence. It is imperative to analyse the impact of central bank decisions separately on the consumer and manager confidence as, unlike consumers, managers form their expectations based on detailed information and professional evaluations. We contribute to the literature by examining the impact of surprise of conventional and unconventional policy decisions on the expectations of both individual households and sophisticated investors (managers).

After the introduction of inflation targeting monetary policy in the 1990s, the central bank started making the policy-making process more transparent and communicating more frequently. Indeed, the vital role of the monetary policy in financial market development requires transparency from the central bank. For example, both the information about economic outlook and signals related to the future of the policy rate drive expected risk and return on a portfolio. Moreover, after the introduction of unconventional monetary decisions, policymakers become increasingly relying on communication about the future economic scenario and the future path of the policy rate (forward guidance) to achieve the monetary

policy objectives. For instance, the tone of the central bank depicts Odyssean and Delphic forward guidance. Odyssean forward guidance refers to central bank commitment to the future consistent policy. However, the Delphic forward guidance promises a contractionary (expansionary) policy in response to prosper (worsen) economic conditions. In general, a positive (negative) tone in the central bank communication not only represents a signal about future tight (loose) policy but also contains non-monetary news related to the future improving (deteriorating) economy.

Several studies investigate the impact of central bank communication on asset prices and volatility in the financial market using an event study framework. Recently, studies also estimate quantitative tone from qualitative communication and examine its effects on financial markets. Moreover, the response of the investors' expected risk premium to policy rate decisions has also been the focus of some papers. The literature shows that a surprise change in the policy rate changes the investors' perception and attitude towards risk. In this research, we extend these results and investigate the impact of the central bank's optimistic (pessimistic) tone on market uncertainty and investors' risk-bearing capacity. It is argued that policymakers' optimism (pessimism) illustrates professional assessment about future prosperous (worsen) economic and financial conditions, which could, in turn, affect investors' expected risk premium. In addition, an optimistic tone also represents the inclination of a future contractionary policy that change expectations related to the short-term and long-term interest rates. The shift in risk perception and risk tolerance of investors leads to a change in the expected excess return on investment. Thus, investors may adjust their trading behaviour and the level of hedging and speculating activities to mitigate the risk or in the search for a higher return.

Therefore, this thesis further explores the effect of the central bank's hawkish and dovish tones on the commitment of commodity traders in hedging and speculating activities. The policymakers' hawkish and dovish tones represent the inclination of future tight and loose monetary policy respectively. This forward guidance inbound in central bank communications leads to a significant shift in the expected return on a portfolio. Hence, investors rebalance their portfolio and participate in the commodity markets in the search for higher yield after a decline in the expected return on their investments. As a result, the returns of commodities tend to increase in response to an anticipated expansionary monetary policy.

5.2 Summary of Findings

This thesis finds that both domestic and US conventional monetary policy shocks have a significant impact on consumer and manager confidence. However, the impact dramatically

changed after the adoption of unconventional policy tools and many investors consider central bank communication as a primary source of information.

Chapter 2 confirms that an expansionary conventional monetary policy shock has a favourable effect in boosting consumer and manager confidence. Specifically, the consumer and business confidence increase in response to a surprise decrease in the policy rate in the UK and the euro area. Furthermore, the unexpected change in the Fed's policy rate has a significant spillover impact on the consumer and manager confidence in the UK and euro area during the conventional policy period. In general, a favourable change in the domestic policy rate is useful in boosting consumer confidence but manager confidence responds primarily to the news on the Federal Fund Rate (FFR) movement. In addition, we find that investors in the euro area countries respond differently to the ECB policy. During the unconventional policy period, the US and domestic monetary easing announcements do not significantly affect the confidence indicators. The response of consumer and manager confidence to monetary policy shifts dramatically after the global financial crisis.

Chapter 3 documents that the optimism in the Fed's communication decreases market uncertainty and investors' risk aversion in the global equity markets. The optimistic Fed's tone containing professional assessments of the future prosperous economic outlook that decreases the uncertainty and investors' risk aversion in the US, UK and euro area. Furthermore, investor risk-bearing capacity in global equity markets significantly increases in response to the optimistic discussion in FOMC meetings. Moreover, investors' responses to the Fed's optimism are also more pronounced during recessions and uncertain times. Finally, we find that market uncertainty and risk aversion increases (decreases) in response to the optimistic discussion of FOMC member about monetary (non-monetary) topics.

Chapter 4 finds that the Fed's hawkish tone shifts traders' positions in the commodity markets and decreases the commodity returns. Specifically, commodity traders' speculating (hedging) positions increase (decrease) in response to the Fed's hawkish communication tone. The increase in speculating positions is over and above that need to compensate for the change of hedging positions in the market. Further analysis reveals that the central bank's hawkish discussion about consumption, financial market, and inflation is particularly important in determining returns on metals, energy, and the overall commodity markets. Finally, we also find a heterogeneous response to the Fed's communication tone in different commodity groups.

5.3 Policy Implications

Overall, the results of this thesis confirm the important role of the central bank's decisions and communications in investors' sentiment, risk perception, risk tolerance and trading behaviour.

Our findings suggest that investors consider the central bank's communication tone along with policy actions while making investment decisions. Therefore, we make the following policy recommendations to improve the effectiveness of central bank actions and communications.

Central bank communication is a useful tool to influence investors' expectation and to achieve desired macroeconomic goals and, thus, policymakers may increase the frequency and clarity in the communication to accomplish the ultimate goals of monetary policy. The policymakers should provide comprehensive, consistent and transparent communications to ensure market stabilization and effective implementation of monetary policy. In addition, policymaker must be more careful while communicating during recessionary periods and economic meltdowns. Likewise, officials need to be cautious while using pessimistic language related to economic conditions as market participants overreact to bad news. Furthermore, policymakers can focus more on the Delphic forward guidance and provide the assessment related to future economic outlook along with an indication of the future path of the policy. Market participants require transparency from the central bank and react more significantly to the Delphic forward guidance compared to Odyssean forward guidance. Finally, policymakers could also put more emphasis on sharing information about the non-monetary topics i.e. employment, consumption and growth along with the discussion for monetary topics such as the policy rate and inflation.

5.4 Future Scope of Research

This thesis finds that the central bank's actions and communications drive investors' sentiment, risk perception, risk-bearing capacity and trading behaviour in the financial markets. However, there are a number of areas that require further research.

For instance, an interesting avenue is to explore the impact of the monetary policy shock on both direct and indirect measures of investor sentiment. Different sentiment indexes capture different aspects of investor expectation and estimating the response of different sentiment proxies helps to understand channels through which monetary policy transmit in financial markets. Another possible research topic is a comparative analysis of the role of central bank actions and words in changing investor expectations in the market. Likewise, a potential topic for further research is a comparative study to analyse the impact of discussion (topic) with the language (tone) on investor expectation. In addition, it is also interesting to analyse the effects of central bank tone about economic outlook and policy stance on portfolio rebalancing and arbitrage strategies in the equity market. Moreover, researchers may decompose the information content of central bank communication into expected and unexpected components before investigating the impact on asset prices. Similarly, decomposing the central bank communication into monetary and non-monetary components

for further investigation is also an interesting research area. Finally, future research may examine the efficiency of central banks' communications in boosting consumer confidence and in reducing uncertainty during this unprecedented era of COVID-19.

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