Disaster-Driven Uncertainty and Information Effects: Market Responses to Federal Reserve Announcements

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PRELIMINARY AND INCOMPLETE‡

Abstract

This study investigates the impact of disaster shocks on the Federal Reserve's (Fed) communication and the subsequent market response, focusing on the transmission of monetary policy surprises (MPS) into the economy and examining the Fed's role in reducing economic uncertainty in natural disaster periods. The analysis is conducted in two stages. Initially, an event study on daily data is used to capture the immediate reaction of the market to Federal Open Market Committee (FOMC) announcements. This approach reveals that markets exhibit pronounced reactions to FOMC announcements following disaster events, indicating that natural disaster shocks amplify the market's sensitivity to policy signals.

In the second stage, the study focuses on the dynamic effects of monetary policy shocks on industrial production, the Consumer Price Index (CPI), and a set of uncertainty indicators. The structural vector autoregression (SVAR) model demonstrates a pronounced "Fed Information Effect" (FIE) in disaster periods, characterized by a simultaneous increase in industrial production and CPI along with a reduction in macroeconomic uncertainty and oil price uncertainty. These results underscore the critical role of the Fed's communication in shaping market expectations and mitigating uncertainty, particularly during disaster periods.

Keywords: Macroeconomic Uncertainty, Disaster Shocks, Fed information effect, Event Study, Proxy SVAR
JEL Classification: E52, E58, E70, E12, E43

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‡This paper presents preliminary analysis and does not yet reflect a complete version of the study.

1 Introduction

Disasters or uncertainty shocks have always been part of our lives and a concern of policymakers. For instance, after the 9/11 attacks, the Fed emphasized the real-options effects of uncertainty. In the wake of the COVID-19 pandemic, the focus shifted to increased inflation uncertainty. Recent studies indicate that geopolitical concerns have overtaken inflation as the main risk factor for central banks and financial market participants. Following geopolitical risk, climate change is identified as the second significant concern for the next decade (Invesco, 2024).

The macroeconomic consequences of uncertainty shocks have been widely studied. However, their implications for central banks' communication remain insufficiently explored. This study aims to address this gap by focusing on natural disasters as a growing and policy-relevant source of exogenous uncertainty. The discrete nature of natural disasters provides a clear setting for examining how disaster-driven uncertainty shapes the market's response to monetary policy signals. The focus on natural disasters is motivated not only by their policy-relevant nature but also by their significant economic impact. Natural disasters disrupt supply chains by damaging infrastructure and disrupting production, leading to spikes in oil prices and heightened inflationary pressures. Unlike demand shocks, which are generally more predictable and better understood, natural disasters resemble supply shocks with complex spillover effects on demand.

In addition to the literature on uncertainty shocks, this study is also motivated by Weber et al. (2023), which examines how the economic environment influences the way households and firms process and respond to new information. It also builds on the "Fed Information Effect" (FIE) literature (Romer and Romer, 2000; Nakamura and Steinsson, 2018; Jacobson et al., 1993; Jarociński and Karadi, 2020; Jarociński and Karadi, n.d.), which emphasizes the forward-looking nature and informational content of FOMC announcements.

The remainder of this paper is structured as follows. Section 2 describes the data employed in the analysis. Section 3 outlines the event study methodology and presents the main findings. Section 4 introduces the Structural Vector Autoregression (SVAR) model and discusses ongoing work.

2 Data

Information about disasters has been collected from EM-DAT (The International Disaster Database).[1] The total number of natural disasters is 35. The selection criteria for disasters include all categories of natural disasters (Hydrological, Geophysical, Meteorological, etc.) that caused more than 100 deaths or affected more than 20,000 people in the United States.

Further, two additional subsets of disasters were selected: the six and the four largest disasters, which exclude disasters that occurred in 2008. Disaster periods are defined as

The findings and methods discussed here are part of ongoing research that will be further developed and enhanced in subsequent stages.

[1] Source: https://www.emdat.be The Center for Research on the Epidemiology of Disasters

three calendar months after the day the disaster happened. The start day of the disaster is defined as stated in the Centre for Research on the Epidemiology of Disasters database. For example, for the hurricanes, the start day is defined as its landfall day. To be more precise, if the start day of the disaster is on 1 January 2022, the defined period would end on 1 April 2022. In the case of overlapping disasters, the time extends to three months after the last disaster.

Table 1: 6 Natural Disasters

Date	Natural Disasters	Affected	Total Deaths
13-Sep-99	Hurricane Floyd	3000000	70
29-Aug-05	Hurricane Katrina	500000	1833
9-Jun-08	Hurricane Gustav	2100000	43
1-Sep-08	Hurricane Ike	200000	82
25-Aug-17	Hurricane Harvey	555000	88
12-Sep-18	Hurricane Florence	1500000	50

Of the 35 selected disasters, 19 occurred along the Gulf Coast—a region of critical importance due to its concentration of energy production, refining, petrochemical industries, shipping, and trade. However, the Gulf Coast is also highly vulnerable to natural disasters, particularly hurricanes. A closer examination of FOMC transcripts following major disasters reveals several recurring themes in their discussions: (i) energy and commodity prices, (ii) government spending, (iii) supply chain and trade disruptions, (iv) housing prices, (v) labor market effects, and (vi) impacts on tourism and agriculture, all of which are linked to broader concerns about inflation and economic growth.

2.1 Uncertainty

The key uncertainty indices used in preliminary analysis are presented in Table 2.

2.1.1 FOMC announcements and Uncertainty

On December 18, 2024, Wall Street's "fear gauge" - VIX, spiked by 74%, reaching 27.62. This spike marked the second-largest single-day increase, surpassed only by a 115% surge in February 2018. This surge followed an unexpected announcement from the Federal Reserve, which revealed plans to scale back its rate-cutting campaign. The Federal Reserve reduced its benchmark federal funds rate by 0.25% points to a range of 4.25%-4.50%. However, it projected a decline to 3.9% in 2025, signaling fewer rate cuts than anticipated in its September projections. The Fed raised PCE inflation expectation for 2025 to 2.5%. The FOMC (2024) "Projection Materials" highlights a sharp increase in uncertainty and risks surrounding projections for PCE inflation, alongside a moderate rise in uncertainty and risks related to GDP growth compared to the September projections. During the conference, Fed Chair Jerome Powell explained that the slower pace of projected rate cuts reflects persistently high inflation in recent months and elevated inflation expectations.

This is one episode when markets react to expected higher inflation uncertainty by increasing uncertainty in financial markets. Meanwhile, some studies, for example Chaudhry,

Table 2: Summary of Uncertainty Indicators Used in the Analysis

Indicator	Description
CBOE Volatility Index (VIX)	Measures market-implied volatility based on S&P 500 options; reflects financial uncertainty and investor sentiment.
Macroeconomic Uncertainty Index (JLM)	Constructed by Jurado et al. (2015). Macroeconomic uncertainty is captured by estimating a common latent factor from a large dataset of U.S. macroeconomic indicators using a dynamic factor model.
Economic Policy Uncertainty Index (EPU)	Developed by Baker et al. (2016); based on newspaper coverage frequency of policy-related uncertainty.
Oil Price Uncertainty (OPU) Index	Proposed by Abiad and Qureshi (2023). Oil-related uncertainty is measured based on the frequency of newspaper articles containing terms related to uncertainty and oil markets, following the methodology of Baker et al. (2016).
Core PCE Inflation Forecast Dispersion	Measures the dispersion of professional forecasts for future U.S. core PCE inflation. Used as a proxy for inflation uncertainty, reflecting disagreement and unpredictability in inflation expectations.

2020, analyzing the impact of economic news on uncertainty, documented a drop in uncertainty on the days of economic news announcements. To obtain a better understanding of the economic news' impact on uncertainty, this study takes a more detailed approach by breaking down the state-dependent impact of different types of news, with a particular focus on scheduled FOMC announcements.

2.2 Economic News

This study includes a broad range of scheduled announcements from the FOMC, the Bureau of Economic Analysis (BEA), and the Bureau of Labor Statistics (BLS).

The FOMC holds eight regularly scheduled meetings each year. The exception was 2020, with only seven announcements. Over the sample, there were 223 meetings, 144 of which were two-day meetings. Prior to 2007, two two-day meetings were held each year, except in 2003 and 2006, when there were three. After 2007, two-day meetings became the norm, and as of 2024, all FOMC meetings span two days.

From the BEA, three types of news are collected: (i) advance, preliminary, and final announcements about quarterly real GDP growth; (ii) announcements about Corporate Profits; and (iii) announcements about Personal Income. Announcements about Corporate Profits, coincide with preliminary and final GDP announcements. However, while the announcements about GDP are consistent, announcements about Corporate Profits do not arrive consistently in every period. Data from the BLS includes monthly unemployment reports, CPI and PPI announcements, along with many other reports.

The event study is carried out using daily data and a five-day event window from 1996 to 2024 to capture the market's immediate reaction to FOMC announcements.The complete list can be found in Table 6 in Appendix 3

3 Event Study

The event study approach allows us to delve deeper into the effect of macroeconomic news and FOMC announcements on uncertainty measures and specifically analyze the impacts of the disasters. This methodology is motivated by the event study literature, such as Chaudhry, 2020, who documents a reduction in uncertainty on the days of macroeconomic news releases.

3.1 Methodology

In preliminary analysis, the event study model is employed for estimating the impact of FOMC announcements on financial uncertainty, in particular the VIX index. The central idea is to compare the actual changes in the VIX index during the event window to what would have been expected in the absence of the event, focusing on the combined effects of FOMC announcements, other macroeconomic news, and natural disasters.

The analysis consists of three parts: (i) disclosing the average effect of the economic news announcements for the entire period, (ii) disclosing the patterns for the periods after experiencing disasters, and (iii) disclosing the patterns for periods that are not associated with disasters. To examine the immediate impact of economic news and disaster shocks on the variables of interest, the regression equation (1) is initially employed. For robustness and specification checks, equations (2) and (3) are subsequently estimated. The event window is set to 5 days. The analysis covers the period from 1996 to 1st January 2024, and the data is at a daily frequency.

$$Y_t = \alpha + \beta \cdot X_t + \underbrace{\sum_{j \in \{-m,\ldots,0,\ldots,m\}} \gamma_j \cdot E_{t-j}}_{\text{News}} + \underbrace{\sum_{j \in \{-m,\ldots,0,\ldots,m\}} \delta_j \cdot \left(E_{t-j} \cdot D_{t,\tau+n}\right)}_{\text{News \& Disaster}} + \varepsilon_t \quad (1)$$

$$Y_t = \alpha + \beta \cdot X_t + \underbrace{\sum_{j \in \{-m,\ldots,0,\ldots,m\}} \gamma_j \cdot E_{t-j}}_{\text{News}} + \varepsilon_t \quad (2)$$

$$Y_t = \alpha + \beta \cdot X_t + \underbrace{\sum_{j \in \{-m,\ldots,0,\ldots,m\}} \delta_j \cdot \left(E_{t-j} \cdot D_{t+n}\right)}_{\text{Interaction with disaster}} + \varepsilon_t \quad (3)$$

Where Y_t represents the variable of interest, the log difference of the VIX index is standardized to have a mean of zero and a standard deviation of one. This standardization ensures consistent interpretation across the regression results.

X_t represents control variables in the main specification. To address potential autocorrelation issues and manage pre-event trends (Miller, 2023; Huntington-Klein, 2021), lags of the VIX are selected based on AIC and BIC criteria, and the HAC standard errors are

used. In the second specification, X_t contains all macroeconomic news as dummy variables on the news days.

E_{t-j} is an indicator variable for the day of the economic news announcement, meaning that the announcement took place j periods before. Hence, $j = 0$ is the day of the announcement and for the 5-day event window $j \in (-5, 5)$. The coefficients γ_j capture the dynamic effects of the economic news announcement.

D_{t+n} is an indicator variable for the duration of the disaster shocks. The duration of the disaster shock n is 3 months.

The interaction term δ_j shows the impact of the news announcement and disaster in the overlap.

3.2 Results

The VIX exhibits a significant average decline on days of FOMC announcements, with this decline being notably larger during disaster periods. Figure 1 illustrates the results, demonstrating that the VIX response becomes more pronounced as the severity of the disaster increases. In contrast, during non-disaster periods, the VIX does not show a significant reaction to FOMC announcements on the first day of the meeting. As shown in Table 4, in Appendix 3, the average level of the VIX index remains relatively stable across FOMC and non-FOMC days, as well as on disaster days. Furthermore, the results of the placebo test indicate no statistically significant difference in VIX fluctuations between actual event periods and placebo dates. The corresponding figures are provided in Appendix 3. These findings suggest that the observed differences in the VIX index are not due to level effects.

On average, the standardized log-differenced VIX decreases by 0.18 standard deviations on the day of an FOMC announcement. Given that the historical standard deviation of the log-differenced VIX is approximately 0.072, this corresponds to an average decline of about 1.3%, which is not significantly different from its historical average movement of 1.28%. On the second day, the VIX decreases further, by approximately 2.16% on average. For the natural disaster periods (3 months after the disaster), the VIX decreases by approximately 0.5 standard deviations — equivalent to a 3% decline or a reduction of roughly 1.03 index points. This effect nearly doubles in magnitude for the six most severe natural disasters. These findings demonstrate that market responses to FOMC announcements vary depending on underlying states, revealing distinct behavioral patterns.

Bauer and Swanson (2023a) argue that both the Fed and market participants update their forecasts based on publicly available economic news, rather than the Fed having access to private or insider information. More importantly, Bauer and Swanson (2023a) and Bauer and Swanson (2023b) find that, after controlling for economic news released prior to FOMC announcements, the FIE disappears. To address this concern and ensure that the observed differences in market responses are not driven by pre-announcement economic news, the second specification of the event study includes economic news as a control variable.

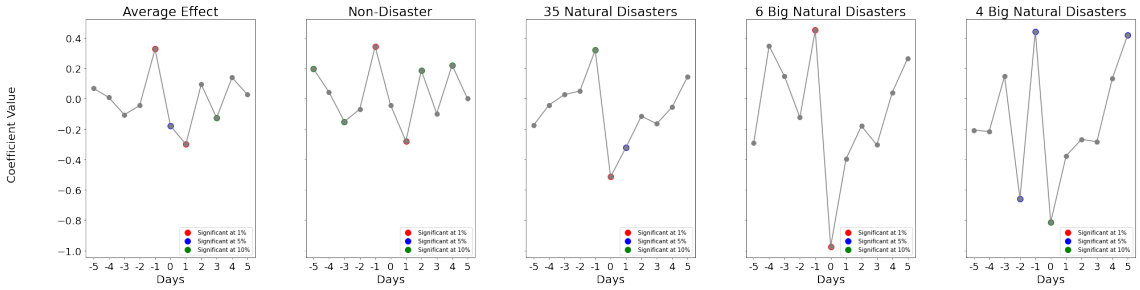


Figure 1: Response of VIX (percent change of the log normalized index) 5 days before and 5 days after the FOMC meeting for all specified periods. Dot colors indicate the significance of the coefficients at the 1%, 5%, and 10% significance levels.

Table 3 presents the regression results for the response of the VIX to FOMC announcements in both disaster and non-disaster states, as well as the results after accounting for the impact of economic news from the BEA and BLS. As discussed by Bauer and Swanson (2023a), the "Employment Situation" report particularly contains important piece of information, and in line with their study Table 3 shows that the VIX drops significantly on the "Employment Situation" report days. However, economic news does not affect the overall results, and in disaster states, the VIX response to FOMC announcements is notably larger compared to the average. Additionally, an interesting pattern emerges in the coefficient on imports and exports, which becomes statistically insignificant. This likely reflects concerns about trade disruptions, as echoed in the FOMC meeting transcripts.

The results underscore the Fed's role in providing information, particularly during disaster periods. However, event studies are limited to capturing short-run effects. Consequently, whether these announcements have more persistent impacts— and, more importantly, whether they ultimately lead to a sustained reduction in uncertainty — cannot be determined within this framework. Therefore, in the next section, the dynamic effects of FOMC announcements are examined using the Structural Vector Autoregression (SVAR) model.

4 The Dynamic Effects of FOMC announcements

4.1 VAR Specification

To capture the dynamic effects of FOMC announcements, I utilize the Monetary Policy Surprises identified by Bauer and Swanson (2023b), ensuring consistency with established literature. These monetary policy surprises data reflect exogenous changes in interest rates within tight time windows surrounding FOMC announcements. Specifically, the MPS dataset published on Federal Reserve Bank of San Francisco webpage includes two types of surprises: raw surprises, denoted as z_t, which are based on changes in money market futures rates and orthogonalized surprises, denoted as z_t^{orth}, which control for information publicly available prior to the FOMC announcements.

Using the orthogonalized surprises, Bauer and Swanson (2023b) provide evidence

Table 3: Event study regression results. Disaster periods are defined as the three-month window following the day of a natural disaster, while Non-Disaster periods include all other times. The "Average" column reflects estimates based on the full sample. For each specification, the second row labeled "Control: Yes" reports regression results that control for the effects of other economic news.

	On average		Non-Disaster		Natural Disaster		6 Big
1 day before the meeting	0.33***	0.29***	0.34***	0.31***	0.32*	0.33*	0.45***
	(0.08)	(0.08)	(0.09)	(0.09)	(0.18)	(0.17)	(0.16)
1st day of the meeting	−0.18**	−0.21***	−0.04	−0.07	−0.51***	−0.50***	−0.97***
	(0.08)	(0.08)	(0.09)	(0.09)	(0.17)	(0.17)	(0.37)
2nd day of the meeting	−0.30***	−0.30***	−0.28***	−0.29***	−0.32**	−0.30**	−0.40
	(0.07)	(0.07)	(0.09)	(0.09)	(0.13)	(0.13)	(0.25)
Control	no	yes	no	yes	no	yes	no
Preliminary GDP		-0.20*		-0.15		-0.23*	
		(0.12)		(0.14)		(0.15)	
Final GDP		-0.25***		-0.31***		-0.02	
		(0.08)		(0.09)		(0.16)	
State Employment and Unemployment		-0.13*		-0.14		-0.09	
		(0.07)		(0.11)		(0.09)	
Weekly Earnings of Wage and Salary Workers		-0.24*		-0.22		-0.20	
		(0.14)		(0.34)		(0.14)	
CPI		-0.23*		-0.18		-0.23	
		(0.14)		(0.17)		(0.20)	
PPI		0.04		0.009		0.25	
		(0.09)		(0.10)		(0.17)	
IM/EX		-0.14**		-0.16**		0.04	
		(0.07)		(0.08)		(0.16)	
Employment Situation		-0.35***		-0.29***		-0.37***	
		(0.07)		(0.08)		(0.13)	
County Employment and Wages		-0.25*		-0.16		-0.46*	
		(0.14)		(0.16)		(0.28)	

that the FIE disappears. Specifically, they demonstrate that the previously documented positive response of stock prices and economic activity to contractionary monetary policy surprises, such as that reported by Gertler and Karadi (2015)—is no longer present. Jarociński and Karadi (n.d.) conduct a follow-up study using structural a SVAR with sign and magnitude restrictions from January 1988 to September 2024 and confirm that information shocks have a significant and positive dynamic impact on macroeconomic variables, even after controlling for the Fed's response to news effects.

Using orthogonalized MPS identified by Bauer and Swanson (2023b), this study analyses the aftermath of 35 natural disasters, focusing on the three months following each disaster. The results show an increase in interest rates accompanied by rising economic activity and inflation, alongside a decrease in oil price uncertainty and macroeconomic uncertainty.

As in Bauer and Swanson (2023b), $\mathbf{Y}_t$ includes log (Industrial Production), log (Consumer Price Index), Excess Bond Premium (EBP), and 2-year Treasury Yield. EBP captures fluctuations in credit spreads, reflecting changes in investor risk appetite and financial market conditions. Including EBP in SVAR analysis is essential because it helps isolate the transmission of monetary policy through financial intermediaries, particularly under stress or uncertainty. In the context of natural disasters, I assume that the EBP captures the heightened risk perceived by the market.

To specify a two-regime SVAR model, building on Bauer and Swanson (2023b), let

$s_t = \text{Disaster}_t \in \{0,1\}$ be a binary variable equal to one during 3-month disaster periods and zero otherwise. The reduced-form model allows for regime-specific autoregressive dynamics and shock variances:

$$Y_t = A^{(s_t)}(L)Y_{t-1} + u_t^{(s_t)}, \quad u_t^{(s_t)} \sim \mathcal{N}(0, \Sigma^{(s_t)}) \tag{4}$$

α is a vector of intercept terms. $B(L)$ is a matrix polynomial in the lag operator L (captures past values of Y) u_t is a vector of reduced-form residuals. Residuals u_t are assumed to be serially uncorrelated (no autocorrelation). The variance-covariance matrix $\text{Var}(u_t) = \Omega$ can have off-diagonal elements-meaning the errors in different equations may be correlated.

The key assumption in structural VARs is that the observed errors u_t in each equation of the reduced-form VAR are assumed to arise from underlying economic shocks ε_t, transformed by the matrix S. Assuming that the economy is driven by a set of serially uncorrelated structural shocks and u_t is a linear combination of these shocks:

$$u_t^{(s_t)} = S^{(s_t)}\varepsilon_t, \quad \varepsilon_t \sim \mathcal{N}(0, I) \tag{5}$$

Where u_t is a vector of reduced-form residuals. S is a matrix of contemporaneous impact coefficients. ε_t is a vector of structural shocks. A standard assumption in the SVAR literature that simplifies identification and ensures shocks are statistically independent is that each structural shock ε_t has unit variance and shocks are orthogonal, hence uncorrelated with each other.

$$\Omega = S^{(s_t)}S'^{(s_t)} \tag{6}$$

This is the fundamental link between the observable variance-covariance matrix Ω of the reduced-form residuals and the unobservable impact matrix S of structural shocks. Ω can be estimated from the residuals of the reduced-form VAR. As the interest is in the monetary policy shock, $\varepsilon_t^{mp(s_t)}$, and it is assumed to be the first shock in $\varepsilon_t^{(s_t)}$, partial identification can be used. As noted in Bauer and Swanson (2023b), there is a concern regarding weak instruments—a limitation that I aim to address in subsequent stages of the analysis.

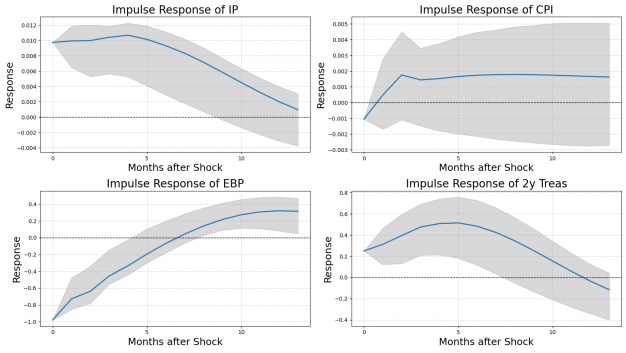
To identify the monetary policy shock empirically, Bauer and Swanson (2023b) use an external instrument: z_t and z_t^{orth}, which are high-frequency monetary policy surprises computed as the first principal component of the changes in Eurodollar futures contracts. While z_t^{orth} addresses the predictability issues of conventional monetary policy surprises from publicly available news. 2SLS is applied to estimate the effect of a monetary policy shock. To estimate the impact of shocks for disaster periods, an important modification is the selected number of lags. Because the sample size is notably small, the number of lags is set to 3 according to AIC criteria and similar to Ramey (2016).

Appendix 5 displays replication results of the SAVR model as in Bauer and Swanson (2023b), while the next section shows state-dependent responses.

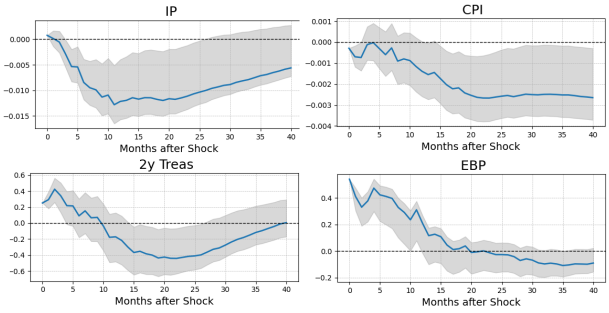
4.2 Results

The CPI exhibits a pronounced price puzzle, increasing over 10 months following the shock. Industrial production also rises on impact, while the excess bond premium declines immediately and remains low for approximately four months. These puzzling responses suggest the presence of a FIE even when monetary policy surprises are orthogonalized. These findings align with macroeconomic models such as Christiano et al. (2005), which imply that positive news about output leads the Federal Reserve to raise interest rates, while also causing output and/or inflation to rise. Results are presented in Figure 2

During disaster periods, it is likely that FOMC announcements reveal additional information about underlying economic and financial conditions. Notably, FOMC communications in these periods often provide critical insights into the Fed's assessment of economic growth, inflationary pressures, and the broader outlook. In such contexts, an increase in interest rates suggests that the Fed places greater emphasis on addressing inflationary concerns. This pattern is observed following events such as Hurricane Floyd (1999), Hurricane Katrina (2005), Hurricane Harvey (2017), and Hurricane Florence (2018). For instance, the FOMC's interpretation of Hurricane Katrina emphasized its transitory impact on growth, while highlighting rising inflation as a more significant concern. As a result, the Fed opted to continue tightening monetary policy and raised policy rates. Consequently, when the Fed conveys a more optimistic view of growth, economic activity tends to increase in response.



(a) Disaster

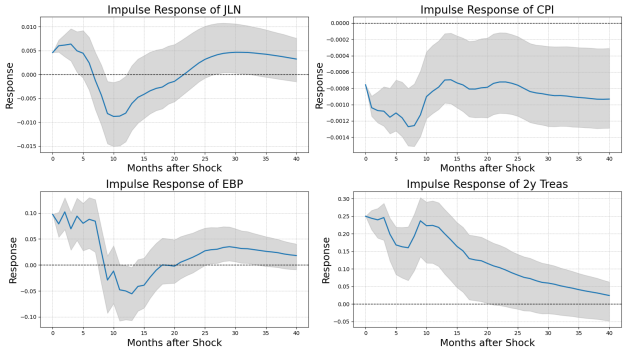


(b) Non-Diaster

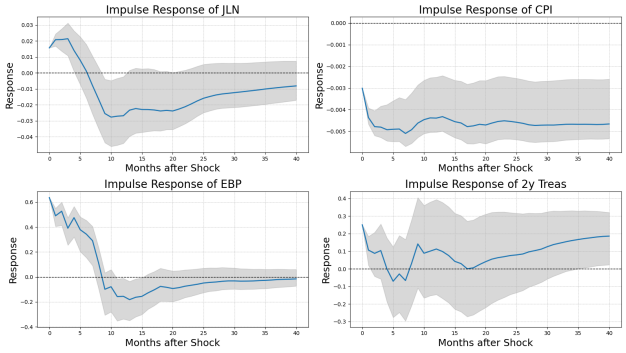
Figure 2: State dependent SVAR IRF to a 25bp monetary policy shock, identified using orthogonalized MPS for 1988:1–2019:12. Shaded regions report bootstrapped 90% standard-error bands.

Further, using both orthogonalized and conventional MPS over the full sample period

from 1988:1 to 2020:2, the SVAR regression employs the log of the JLN index to assess the impact of monetary policy shocks on macroeconomic uncertainty. Figure 3 presents the results. An unanticipated 25 basis point rate increase leads to a rise in macroeconomic uncertainty of up to 1% within the first four months. A plausible explanation is that unexpected deviations from anticipated policy prompt market participants, firms, and households to reassess their expectations about the economic outlook.



(a) Conventional MPS

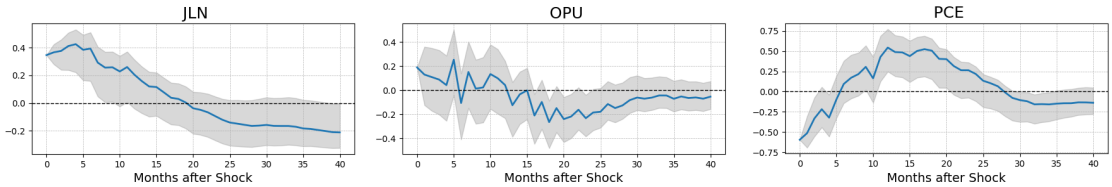


(b) Orthogonalized MPS

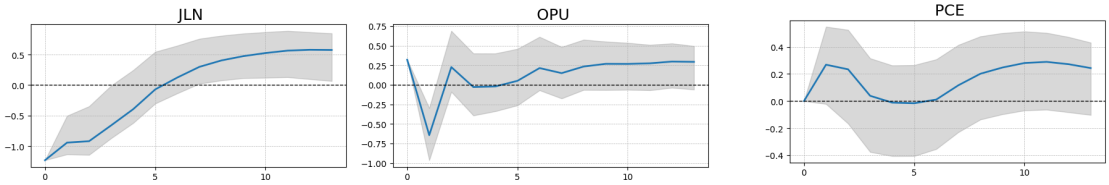
Figure 3: State dependent SVAR IRF to a 25bp monetary policy shock, identified using orthogonalized and conventional MPS for 1988:1–2020:2. The solid blue lines report the estimated impulse response functions, while the shaded gray regions report 90% standard-error bands around those point estimates, computed using 10,000 bootstrap replications.

To analyze the response of uncertainty measures to monetary policy shocks, an SVAR is estimated using the JLN, OPI, and PCE uncertainty indices. All series are standardized relative to their historical means to facilitate comparison. Summary statistics for these variables are provided in the Appendix 3. Figure 4 presents the impulse response functions, showing that disaster periods are characterized by a short-lived decline in macroeconomic and oil price uncertainty, accompanied by an increase in inflation uncertainty. In contrast, during non-disaster periods, positive monetary policy surprises lead to an increase in macroeconomic and oil price uncertainty, while inflation uncertainty tends to decline.

In summary, the preliminary analysis suggests that the effects of FOMC announcements and monetary policy shocks are regime-dependent, with disaster periods exhibiting qualitatively different dynamics. During such periods, the presence of a Fed information effect (FIE) is accompanied by a decline in macroeconomic and oil price uncertainty. However, the simultaneous increase in inflation uncertainty may indicate that markets in-



(a) Non-Disaster



(b) Diaster

Figure 4: SVAR IRF to a 25bp monetary policy shock, identified using orthogonalized MPS for 1988:1–2019:12. Shaded regions report bootstrapped 90% standard-error bands.

terpret policy tightening as a response to rising price pressures, rather than solely as a signal of strong economic fundamentals.

4.3 Methodological Enhancements and Future Directions

To further enhance the credibility, robustness, and policy relevance of the results, I am currently focusing on several methodological improvements. First, I am implementing the local projection (LP) approach introduced by Jordà (2005) as an alternative to the SVAR framework. Unlike the traditional SVAR, the LP method estimates impulse responses period-by-period without imposing a full multivariate structure, making it more robust to model misspecification. Second, I am refining the existing SVAR specification through extensive sensitivity analyses. This involves assessing how the results vary across different sample windows and under alternative identification assumptions to ensure that the findings are not driven by specific modeling choices.

Third, I plan to incorporate time-series models with explicit regime-switching features, such as Markov-switching VARs, to formally capture differences between disaster and non-disaster periods. This regime-sensitive modeling allows impulse responses to vary across states, reflecting evidence that shock impacts can be significantly amplified during disasters. Fourth, to address the issue of weak instruments in monetary policy identification, I will employ inference techniques that are robust to weak instrument problems.

Finally, I aim to broaden the set of uncertainty indicators used in the analysis. In particular, I will include additional proxies such as the financial market uncertainty measure developed by Ludvigson et al. (2021) and the Economic Policy Uncertainty (EPU) Index by Baker et al. (2016). Collectively, these enhancements are intended to provide more flexible and reliable estimates of the relationship between monetary policy shocks and uncertainty, thereby improving the overall robustness of the findings and their relevance for monetary policy evaluation.

5 Conclusion

This study investigates how disaster shocks influence Federal Reserve communication and how the economy responds to unexpected changes in monetary policy. By combining high-frequency event study analysis with structural time-series models, it provides novel evidence on the Fed's role in shaping expectations and managing uncertainty. The findings indicate that responses to FOMC announcements and MPS are state-dependent. In particular, market reactions to policy signals are significantly amplified during disaster periods, suggesting that in times of heightened uncertainty, investors place greater weight on the Fed's guidance. Furthermore, the SVAR analysis reveals a pronounced "Fed Information Effect" in disaster contexts. Specifically, unexpected changes in monetary policy are associated with simultaneous increases in both output and inflation—consistent with the interpretation that policy tightening conveys positive news about the economic outlook.

Appendixes

Appendix 1

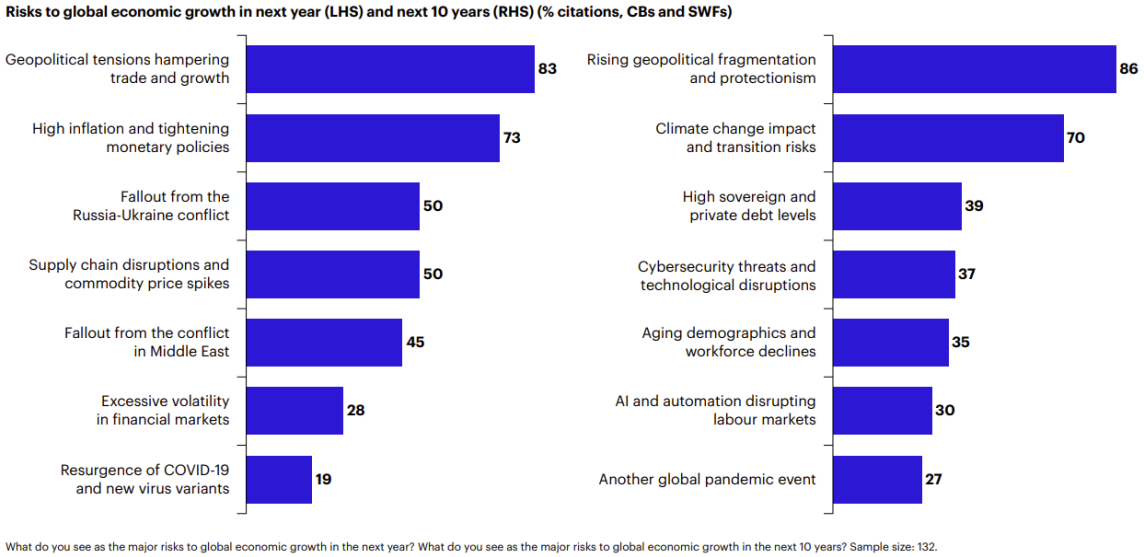


Figure 5: Annual report on sovereign investors conducted by () gathering insights and perspectives from 140 senior investment professionals, including chief investment officers, heads of asset classes, and lead portfolio strategists, representing 83 sovereign wealth funds and 57 central banks. Together, these organizations oversee approximately US $22 trillion in assets under management.

Appendix 2

The original VIX (1993 version) used Black-Scholes implied volatilities from at-the-money S&P 100 options. It was a model-based measure of expected 30-day volatility.

The Black-Scholes model:

$$\text{Call Option Price} = S_0 \cdot N(d_1) - K \cdot e^{-RT} \cdot N(d_2) \tag{7}$$

$$\text{Put Option Price} = K \cdot e^{-RT} \cdot N(-d_2) - S_0 \cdot N(-d_1) \tag{8}$$

- S_0 is the current price of the underlying asset
- K_i is the i option strike price
- N(d) is the CDF of the standard normal distribution
- T is time to expiration (in years).
- R is the risk-free rate

$$d_1 = \frac{\ln(S_0/K) + \left(R + \sigma^2/2\right) T}{\sigma\sqrt{T}} \tag{9}$$

$$d_2 = d_1 - \sigma\sqrt{T} \tag{10}$$

- σ is implied volatility (standard deviation of the underlying asset's returns). When implied volatility rises, the time value component of option prices increases, making both call and put options more expensive.

Since 2003, the CBOE VIX uses a model-free approach based on a wide range of out-of-the-money (OTM) S&P 500 options. This approach does not assume Black-Scholes dynamics. It uses option prices directly to infer the market's expectation of variance. Hence, the modern VIX uses a model-free, market-based method that better reflects real-world risks and expectations, especially non-normal return distributions. The formula of VIX obtained from Cboe (2022) Volatility Index Methodology is:

$$VIX = \sigma \times 100 \tag{11}$$

$$\sigma^2 = \frac{2}{T}\sum_i \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i) - \frac{1}{T}\left[\frac{F}{K_0} - 1\right]^2 \tag{12}$$

- T is the time to expiration
- K_i is the i option strike price
- $Q(K_i)$ is the midpoint of the bid and ask price for each K_i
- R is the risk-free rate
- F is the forward index level
- K_0 is the first strike below the forward index level This formula reflects the expected variance of the S&P 500 index

$$F = \text{ Strike Price } + e^{RT} \times (\text{ Call Price } - \text{ Put Price }) \tag{13}$$

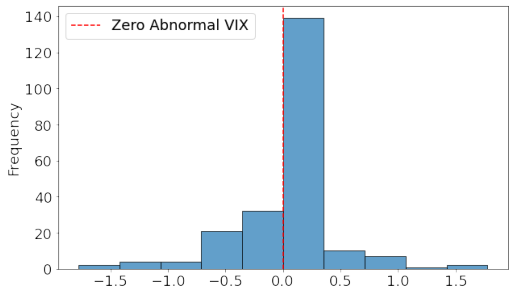
The strike prices of SPX options reflect different levels at which the S&P 500 might settle in the future. These strike prices determine the option's payoff based on the index's value at expiration. SPX option prices with a constant maturity term of 30 days provide the raw data (premiums) that feed into the VIX formula. The risk-free interest rates are based on U.S. Treasury yield curve rates (commonly referred to as "Constant Maturity Treasury" rates, or CMTs), to which a cubic spline is applied to derive yields on the expiration dates of relevant SPX options. As such, the VIX Index calculation may use different risk-free interest rates for different options.

Appendix 3

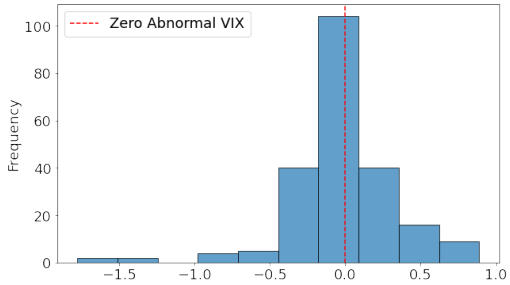
Table 4: Descriptive statistics of daily VIX index from January 1, 1996, January 1, 2024 across all days, FOMC days, non-FOMC days, and disaster periods.

	All Data			FOMC Days			Non-FOMC Days			Disasters		
	VIX	ΔVIX	% ΔVIX	VIX	ΔVIX	% ΔVIX	VIX	ΔVIX	% ΔVIX	VIX	ΔVIX	% ΔVIX
count	7077	7076	7076	223	223	223	6854	6854	6854	35	35	35
mean	20.34	0.00	0.24	20.34	-0.40	-1.24	20.34	0.01	0.29	20.26	-0.47	-1.81
std	8.23	1.74	7.17	7.87	1.87	6.62	8.25	1.73	7.18	10.18	1.64	6.12
min	9.14	-17.64	-29.57	9.43	-13.10	-26.96	9.14	-17.64	-29.57	11.28	-6.63	-12.77
25%	14.46	-0.72	-3.84	14.52	-0.86	-4.40	14.46	-0.72	-3.81	14.17	-1.25	-7.60
median	18.76	-0.08	-0.45	19.03	-0.23	-1.16	18.76	-0.07	-0.42	17.57	-0.20	-1.46
75%	23.91	0.61	3.40	24.30	0.28	1.74	23.90	0.62	3.44	22.44	0.44	1.56
max	82.69	24.86	115.60	66.96	5.34	30.57	82.69	24.86	115.60	59.83	1.97	12.31

Placebo Tests for the VIX Index

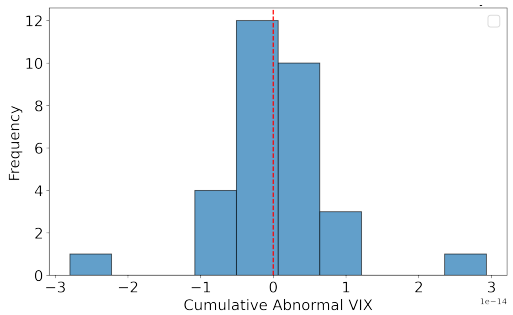


(a) Cumulative Abnormal VIX around **Actual FOMC Event Days**

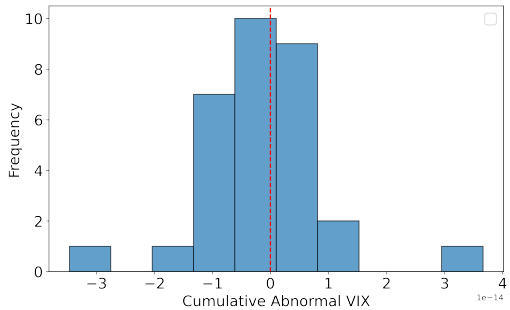


(b) Cumulative Abnormal VIX around **Placebo Events**

Figure 6: Placebo Test: The difference between the daily average VIX change and the mean VIX change over actual events do not significantly deviate from what might be expected by random chance.



(a) Cumulative Abnormal VIX around **Actual Disaster Days**



(b) Cumulative Abnormal VIX around **Placebo Events**

Figure 7: Placebo Test: The difference between the daily average VIX change and the mean VIX change over actual events do not significantly deviate from what might be expected by random chance.

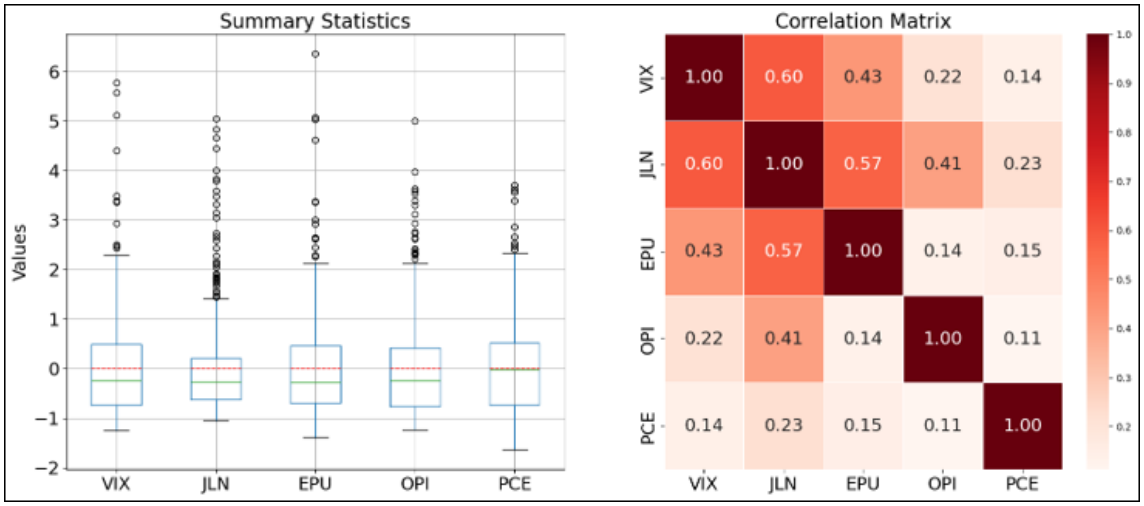


Figure 8: Monthly series are standardized over their historical means. The left figure is a correlation matrix that illustrates the relationships between the uncertainty measures-the VIX, macroeconomic uncertainty, Economic Policy Uncertainty, oil price uncertainty, and the PCE Dispersion. The color intensity represents the strength and direction of correlations, with darker shades indicating stronger relationships. The right figure displays box plots summarizing the distribution of the variables. The box plot illustrates the mean in a red dashed line.

Uncertainty Measures

Table 5: Summary statistics of monthly standardized uncertainty measures. The table reports descriptive statistics—including count, mean, standard deviation, and percentiles—for five widely used uncertainty indicators: VIX, JLN (1 month), EPU, OPI, and PCE-based uncertainty. All series are standardized to have a mean of zero and a standard deviation of one, except where otherwise noted.

	VIX	JLN_1M	EPU	OPI	PCE
Count	348	348	348	348	349
Mean	0.10	0.12	0.08	0.12	0.00
Std	1.04	1.05	1.06	0.94	1.00
Min	-1.25	-1.05	-1.39	-1.21	-1.64
25%	-0.67	-0.53	-0.66	-0.55	-0.84
median	-0.07	-0.21	-0.18	-0.06	-0.06
75%	0.58	0.33	0.57	0.55	0.52
Max	5.77	5.04	6.35	3.63	3.70

Table 6: Major Economic Indicators Released by BEA and BLS. The BLS releases are split across two columns.

BEA	**BLS**	
(1)	**(1)**	**(2)**
GDP - Advance	Employment Cost Index	Productivity and Costs
GDP - Preliminary	Employment Situation Report	Total Factor Productivity

BEA	**BLS**	
(1)	**(1)**	**(2)**
GDP - Final	State Employment and Unemployment Report	Employer Costs for Employee Compensation
GDP - Revised	Job Openings and Labor Turnover Survey	Productivity and Costs by Industry: Manufacturing and Mining
Core PCE - Preliminary	Usual Weekly Earnings of Wage and Salary Workers	Total Factor Productivity in Major Industries
Core PCE - Final	Producer Price Index	County Employment and Wages
Core PCE - Revised	U.S. Import and Export Price Indexes	Metropolitan Area Employment and Unemployment
Personal Income	Consumer Price Index	Real Earnings

Appendix 4

29-Aug-2005 Hurricane Katrina

The FOMC meetings held on September 20, November 1, and December 13, 2005, included extensive discussions about the impact of Hurricane Katrina. The transcript from the September 20 meeting reveals that the hurricane was a central focus of the FOMC's deliberations. This section provides a summary of the FOMC's analysis of these events, drawing from the reports and transcripts of the meetings.

The immediate economic impact involved billions in losses. The reports intensively examine oil prices influenced by the hurricane. The FOMC (2005) transcript contains a comprehensive discussion about growth and inflation effects, based on which the decision about policy rates has been made. Overall economic growth, is considered robust and the decision to continue tightening policy was made because of inflationary forces. The situation was considered extraordinary as both the demand and the supply side of the economy was affected.

Katrina's immediate effect was a significant disruption to economic activity, especially in the Gulf region. However, this disruption was expected to be temporary. The Greenbook forecast suggested that while growth would slow in the near term, rebuilding efforts and federal spending would ultimately provide a boost to growth in the following quarters. The FOMC anticipated a recovery as federal aid and insurance payments began flowing, which would stimulate demand and drive rebuilding efforts.

The hurricane severely affected oil production, with U.S. crude oil production in the Gulf falling to about 50% of pre-Katrina levels. This drop was partially offset by releases from the Strategic Petroleum Reserve. Prices for West Texas Intermediate (WTI) crude oil were revised upwards due to the supply disruptions. The FOMC projected a $1.40 per barrel increase in spot WTI oil prices for the fourth quarter of 2005 and $1.80 for 2006. Additionally, the U.S. oil import price was expected to rise by $2.60 per barrel due to the need to import refined products. This contributed to higher import bills and inflation concerns. Non-oil commodities, especially natural gas, also saw price hikes. There were concerns about prolonged natural gas supply disruptions, which added to uncertainty regarding future commodity prices.

Because of rising energy prices, inflation concerns were heightened. The breakeven inflation curve showed an increase after the storm, committee members were concerned about market expectations of rising inflation in the near term. Real yields dropped, reflecting the growing demand for inflation protection.

Financial markets showed mixed reactions. Equity markets remained resilient, with energy stocks outperforming others. Municipal bonds from the Gulf region performed well due to expectations of federal aid and spreads narrowed versus Treasuries. However, implied volatility in certain markets, such as gasoline contracts, spiked dramatically. In FOMC (2005), it is mentioned that credit spreads showed no uniform response to the hurricane. Investment-grade and high-yield spreads increased slightly, but spreads on emerging markets bonds (EMBI+) continued to narrow, indicating that investors were not broadly panicking. Hedge funds and other investors seemed to be reassessing risk, but

there was no widespread fear of systemic financial disruption. In summary, the FOMC viewed the effects of Hurricane Katrina as transitory on growth, while increasing inflation was more concerning. Thus, the decision was made to continue tightening policy and increase policy rates.

12-Jan-96, 15-Jan-96, 7-Feb-96 winter storm and floods

- ”Disappointing sales and attendant inventory imbalances in a few sectors, and the disruptions of activity associated with the government shutdown and severe winter weather, seem to be cutting into the growth of employment and output.” FOMC, 1996a

- ”Signals from the housing market have been mixed in recent weeks and the harsh winter weather in mid-January clearly disrupted activity. Housing starts moved up further in November, reflecting a rise in the construction of multifamily units, but sales of new and existing homes posted declines in November and December, respectively. In contrast, builders’ ratings of sales remained in the favorable range in early January, and the MBA’s index of mortgage applications for home purchase rose to a record level before the January storms, suggesting a strengthening of activity.” FOMC, 1996a

- "In the near term, we expect the blizzard of 1996 to produce considerable volatility in the monthly consumption data. Many purchases delayed by bad weather are likely to be made up soon" FOMC, 1996a

- "Oil prices rose more than $2 per barrel in December and early January, with the spot WTI price peaking at nearly $20.50 per barrel on January 8. Political uncertainties in Saudi Arabia and colder-than-normal weather in the northern hemisphere contributed to the rise. However, the spot price has fallen below $18 per barrel recently as temperatures returned to normal and as Iraq suggested a greater willingness to negotiate a reentry into the world oil market on a restricted basis." FOMC, 1996a

- "With respect to the external sector, the trade-weighted dollar in terms of other G-10 currencies has changed little on net since January, and we have retained the assumption that the dollar will remain near recent levels. The outlook for foreign economic activity is also little changed, with foreign real GDP (on a U.S. export-weighted basis) projected to increase about 3-1/2 percent in each of the next two years, compared with 2 percent in 1995. The price of crude oil has firmed recently as a result of the unseasonably cold winter; it has been buffeted as well by shifting views on the likelihood that Iraq will resume exporting oil. Last Greenbook, we had expected that the spot price of WTI would hold steady in the first half of this year at its fourth-quarter average of about $18 per barrel. In the interim, the spot price has moved above $19 per barrel on average this quarter, and we now expect it to rise slightly above $20 per barrel early next quarter. The longer-term outlook for oil prices has not been revised, however: We still expect that the spot price will settle at $18.50 by midyear–with a downside risk associated with the possible resumption of oil exports by Iraq". FOMC, 1996b

13-Sep-99 Hurricane Floyd

- "The jump in CPI energy prices in August was the second in a row and reflected the pass-through of higher crude petroleum costs into motor fuel and home heating oil. Since the end of last year, gasoline prices have climbed about 23 percent (not at an annual rate) after having fallen more than 15 percent in 1998. The latest survey data suggest that retail prices for gasoline rose further in September. In August, natural gas prices posted a large increase for the third consecutive month. Food prices, on the other hand, have remained more or less in check, rising 0.2 percent in each of the past two months. Since August of last year, food prices have increased 2.0 percent, about in line with the core CPI. Prices of some farm commodities moved up a little following the damage wrought by hurricane Floyd; overall, however, agricultural futures prices are lower than they were at the time the August Greenbook was published." FOMC, 1999

9-Jun-08 Riverine flood

- "Flooding in the U.S. Midwest has contributed to sharp increases in corn and soybean prices. Based on prices in spot and futures markets, we project that a trade-weighted average of nonfuel commodity prices will increase at an annual rate of 14 percent in the second quarter and thereafter remain roughly stable." FOMC, 2008

- "PCE food prices are estimated to have risen 0.3 percent in May after having increased 0.9 percent in April, putting the estimated annualized three-month change through May at nearly 6 percent. Most spot prices for farm crops have increased further since the April Greenbook. Although wheat prices have edged down 1 percent in response to early reports of plentiful yields for U.S. winter wheat, corn and soybean prices have climbed further in response to wet weather and flooding in some Midwest growing areas. Livestock prices have also moved up in recent weeks, partly reflecting stronger demand from abroad. Even so, futures prices for farm products remain consistent with a significant deceleration in crude food costs later this year." FOMC, 2008

25-Aug-2017 Hurricane Harvey

- "This report was prepared at the Federal Reserve Bank of Chicago based on information collected on or before August 28, 2017. The information included in the District reports was primarily collected before Hurricane Harvey made landfall on the Gulf Coast. However, some Districts received preliminary information from business contacts regarding the impact of the storm, which is compiled in a special paragraph in the national summary" (FOMC, 2017a).

- "A Special Note on the Impact of Hurricane Harvey: Hurricane Harvey created broad disruptions to economic activity along the Gulf Coast in the Dallas and Atlanta Districts, although it was too soon to gauge the full extent of the impact. Many firms and organizations in the affected areas closed due to flooding. A fifth of the oil and natural gas production in the Gulf of Mexico was offline, and many onshore producers in the Eagle Ford region temporarily stopped production. Harvey

also affected fuel and petrochemical production, forcing fifteen refineries in the region to shut down temporarily and several others to operate at reduced capacity. Some areas experienced gasoline shortages, and supply was expected to remain tight in the Southeastern United States because of pipeline disruptions. Contacts in the Richmond District indicated that spot freight prices jumped after the storm, as freight was being redirected around the country. The Port of Charleston expected increased volumes in coming weeks as freight traffic is routed away from the Port of Houston." FOMC, 2017a

- "Manufacturing and Related Services: Based on an unusually low number of respondents this round, 60 percent of manufacturing firms reported higher sales in line with expectations. One contact reported a decline driven mostly by disruptions in its chemical business due to the hurricanes; specifically, a plant delivering a key input was destroyed by Hurricane Harvey and the firm temporarily shifted its sourcing to costlier South American sources. A toy manufacturer also reported some hurricane-related problems related to plastic supply. Neither firm expected any long-term effects from the Hurricane. A company that produces packaging used by Internet retailers reported strong sales growth, although lower than in comparable periods in recent years. None of our contacts reported any revisions to their capital expenditure plans. All responding firms reported a positive outlook with only small revisions from previous rounds. A toy manufacturing contact said they were less optimistic than when they last spoke to us, but still optimistic." FOMC, 2017b

- "Energy prices increased moderately since the previous report. In Illinois and Kentucky, coal prices rose modestly. In Arkansas, Mississippi, and Tennessee, Hurricane Harvey caused relatively strong increases in gasoline prices compared with national prices. Cotton, rice, soybean, and wheat prices increased moderately, while sorghum prices were flat and corn prices decreased modestly." FOMC, 2017b

- "Growth in Tenth District energy activity eased since the last survey period, while expectations for future activity remained solid. The number of active oil and gas drilling rigs was little changed across the District, and contacts expected them to stay near current levels in the coming months. Respondents projected a modest increase in future oil prices and hence higher profits over the next six months. The abundant supply of natural gas was expected to keep weighing on prices and profitability in that sector. Firms surveyed expected Hurricane Harvey to have low to medium impacts on the oil and gas industry. Contacts, on average, estimated the effects on offshore production, trade, and refineries to last five, six and nine weeks, respectively, from the start of Harvey." FOMC, 2017b

- 'Overall employment rose, and upward wage pressure persisted. Hiring picked up in manufacturing, continued at about the same modest pace in services, and abated slightly in the energy sector. Reports of labor shortages persisted, spanning most industries. Some manufacturers said the difficulty finding workers was impeding their growth, and some services firms said it was driving up overtime costs. More than a quarter of firms expect that the impact of Hurricane Harvey will make finding and hiring workers more difficult over the next six months. In construction, builders were concerned that once posthurricane repair and rebuilding work begins, there likely will be skilled-worker shortages and increases in labor costs. Other contacts

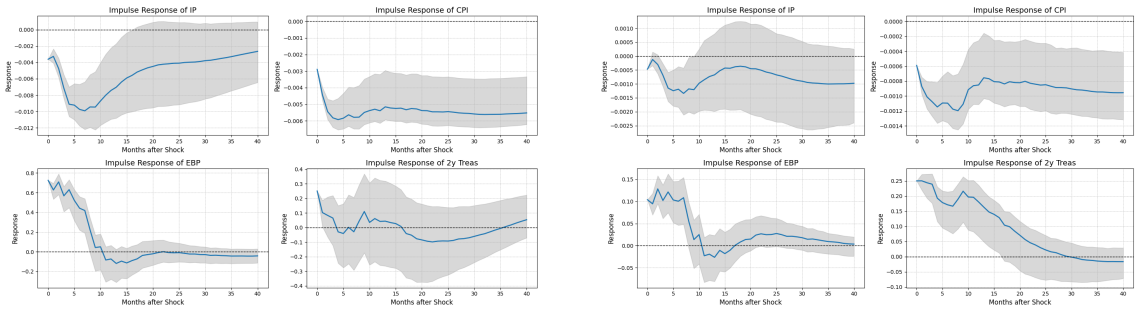
noted that they also pull from a labor pool that is likely to be in higher demand in the aftermath of the storm." FOMC, 2017b

- "Robust expansion in the manufacturing sector continued, despite some disruption among Texas Gulf Coast producers in the wake of Hurricane Harvey. Output growth picked up further for durable goods in September, led by increases in computer and electronic product manufacturing. Fabricated metals production rebounded, and output among energy-related firms overall continued to exhibit strength. Meanwhile, nondurable goods production slowed. A majority of chemical producers noted production held steady or declined over the reporting period, with a number of executives saying Hurricane Harvey had a negative impact on logistics like transportation and availability of raw materials. Refinery capacity hampered by the storm was ramping back up quickly, with little damage to infrastructure. While it may take some time for supply chains to recover, the storm's impact on the refining and petrochemical industry are projected to be transitory. For Texas manufacturing overall, outlooks were positive and more optimistic than during the prior reporting period". FOMC, 2017b

- "Crop conditions remained favorable, although Hurricane Harvey hampered agriculture in the Coastal Plains. The extent of the impact is not yet known, but some livestock were lost and a small portion of the Texas cotton crop was damaged. Some rice and soybeans were also affected, but likely minimally. Overall, grain production was strong, with particularly robust yields in Northeast Texas." FOMC, 2017b

Insurance Sector: Increased frequency and severity of natural disasters have strained the insurance industry. Higher claims volumes have resulted in increased premiums and tighter underwriting standards. For instance, the 2017 hurricane season led to record-breaking claims, prompting insurers to reassess risk models.

Appendix 5



(a) orthogonalized MPS

(b) conventional MPS

Figure 9: Replication of Bauer and Swanson (2023b) SVAR impulse response functions to a 25bp monetary policy shock, identified using orthogonalized and conventional high-frequency mps measure around FOMC announcements for 1988:1–2020:2. Shaded regions report bootstrapped 90% standard-error bands.

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