The Diminishing Impact of Monetary Policy on Asset Prices Around Non-FOMC Macroeconomic Announcements

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Abstract

I examine the effects of monetary policy surprises on asset prices around non-FOMC macroeconomic announcements that are directly relevant to the Fed's monetary policy decisions. While FOMC announcements are known to have similar effects during periods of conventional and unconventional monetary policies, I show that non-FOMC announcements affect asset prices much less in the latter period. Moreover, bond premium, volatility and the overall resolution of uncertainty decrease on these announcements. These findings are described in an information framework. Taken together, the evidence suggests unconventional monetary policies deter market's ability to anticipate Fed actions, which has implications for its transmission to asset prices.

Keywords: Monetary Policy, Federal Reserve, Equity Prices, UST yields, Corporate Bond Yields, Exchange Rates, Financial Conditions, Principal Component Analysis, Sign Restrictions.

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1 Introduction

Following the Great Financial Crisis (GFC), the Federal Reserve pushed the Federal Funds Rate (FFR), the conventional policy instrument, to the effective lower bound, and relied on unconventional measures, such as purchasing mortgage backed securities and providing forward guidance on policy in the distant future. Empirical evidence suggests that these unconventional actions had strong impacts in moving asset prices.[1] Common among these empirical studies is the exclusive focus on Fed-related announcements to measure monetary policy surprise when assessing the effectiveness of monetary policy actions on asset prices.

While the literature suggests that market participants are able to make reasonable predictions of Fed stance ahead of an announcement, they do not quantify the effect of these expectations. Endogeneity concerns seem to be the primary reason for this almost exclusive focus on Fed-related events alone. The reasoning it seems is that while it may be sensible to attest asset price movements in narrow windows on such events to monetary policy, doing so on other events may pose challenges. Thus, the literature's standard has been to carry out event studies, typically focusing on scheduled Federal Open Market Committee (FOMC) meetings, when the Fed communicates its monetary policy stance to the public. It is important to note that there are only 8 such meetings in a year. So if one could overcome this econometric challenge, there may be room to also learn from the remaining days of the year.

Some recent work indicates that news regarding monetary policy occurs outside of FOMC announcements as well. Laarits (2019) suggests that the nature of FOMC announcement depends on recent news about economic fundamentals. Cieslak and Vissing-Jorgensen (2020) show that recent stock returns predict the Fed's monetary policy stance. Lucca and Moench (2015) document a potentially anomalous rise in equity prices just prior to FOMC announcements. Boguth, Gregoire and Martineau (2019a) find that this pre-FOMC drift has shifted to those FOMC announcements that have an associated press conference. Cieslak, Morse and Vissing-Jorgensen (2019) expand the window even further by examining equity returns over weeks around FOMC announcements. They offer insights as how markets might be absorbing private insider information outside of FOMC announcements via leaks from the Fed to selected journalists. Finally, Neuhierl and Weber (2018) document momentum in equity returns, i.e. the tendency for stock prices to move for several days after FOMC announcements. Going beyond Fed-related announcements has helped shed light on some interesting issues in this field.

[1] See for example, Gilchrist, Lopez-Salido and Zakrajsek (2015), who focus on sovereign and corporate bonds. Swanson (2018) examines equity prices and exchange rates in addition to bonds. Rogers et al (2014) too examine a variety of financial assets. Ferrari, Kearns and Schrimpf (2016) focus exclusively on US bilateral exchange rates.

In this spirit, I measure monetary policy surprises on 4 public information announcements (GDP, CPI, unemployment and industrial production) and examine their impact on a variety of financial asset prices. I analyze reactions of equity prices, UST yields, corporate bond yields, exchange rates and financial conditions. Selection of GDP, CPI, unemployment and industrial production announcements is based on their direct relevance to monetary policy. The Fed has a dual mandate of maximum employment and price stability. Therefore, CPI and unemployment announcements are natural candidates.[2] GDP is included because all 5 policy rules (mentioned below) directly include GDP as one of the variables. Industrial production is included because these statistics are released by the Fed. As some confirmation regarding the relevance of these announcements, evidence suggests that agents tend to extract monetary policy information on macroeconomic announcements, as Fisher, Martineau and Sheng (2020) document that attention to monetary policy rises around CPI and unemployment announcements. Hence, markets might develop expectations of forthcoming Fed actions on these announcements. Ability to anticipate Fed behavior is central to the effectiveness of its actions. Cechetti and Schoenholtz (2019) while emphasizing the importance for simplicity in Fed communication note:

"When policy is transparent and effective, people in the economy and financial markets respond to the data, not to the policymakers." (Cecchetti and Schoenholtz, 2019).

In this paper I quantify how markets "respond to the data". As aforementioned, the Fed almost exclusively relied on unconventional measures post-GFC, as it pushed its conventional instrument (FFR) to zero soon after Lehman's collapse in September 2008. While there are various policy rules to describe how the Fed might set the FFR, the same is not true for unconventional monetary policies, which seem to rely more on the judgement of policy makers. The Fed's website describes 5 such well-known policy rules, and eyeballing the realized FFR against predictions of these various rules reveals how well these different reaction functions perform.[3] Without such simple singular equations to guide markets, forecasting Fed behavior using public information may be challenging during a period dominated by unconventional monetary policies.

I document that during periods of conventional monetary policy by the Fed, financial markets display strong reactions to monetary policy surprises embedded in these non-FOMC macroeconomic announcements. However, asset price reactions to monetary policy surprises on these 4 announcements diminishes in the post-GFC era. Thus, by examining the impacts of monetary

[2] Formally, the Fed targets the Personal Consumption Expenditure (PCE) price index. However, the high correlation of these statistics, as well as the timing of these announcements, whereby CPI are **always** announced before PCE, typically 2 weeks earlier, suggest that from the market's perspective, PCE price index statistics may be stale information. See Section 2.1 for more details.

[3] Among the 5 rules described, the "first-difference" and "inertial rules" appear to match the realized FFR most closely. Link to the web page is here

policy on *non-FOMC announcements* and finding that these effects diminished during the unconventional period, this paper documents a novel finding in the literature. The literature has traditionally focused on asset price reactions on Fed-related announcements alone. The extant evidence indicate that impacts during conventional and unconventional, or equivalently pre and post-GFC, are similar.[4] Furthermore, while the broader Finance literature appreciates the importance of such macroeconomic events in the context of equity and bond premium (e.g. Savor and Wilson, 2013 and 2014; Ai and Bansal, 2018) or on the second moment of equity and bond prices (e.g. Brenner, Pasquariello and Subrahmanyam, 2009; Huang, 2018), the monetary policy content of these announcements has not been extensively examined.

To reach my main result that overall monetary policy impacts on asset prices are lower post-GFC, the analysis I present proceeds as follows. First and foremost, I need to have a measure of monetary policy surprise that I can use as my regressor in my analysis with this shock measure on the right-hand-side and asset price movements on the left-hand-side. The words "surprise" and "shock" are used interchangeably in this paper. Thus, I begin by showing that standard techniques used to measure monetary policy shocks on FOMC announcements do not "work" on these 4 macroeconomic announcements. For instance, the change in the 2-year UST yield positively (and significantly) comoves with equity price changes on non-FOMC announcements.[5] This contrasts the negative comovement that would be predicted if the surprise driving yield and equity price changes were of monetary policy type. To identify monetary policy surprise, I exploit the difference in the way that monetary policy shocks are assumed to affect bond yields and equity prices. The identifying assumptions are: a "contractionary monetary policy surprise" increases yield but decreases equity prices, while "positive news" increases both yield and equity prices. These assumptions can be implemented as sign restrictions in a VAR to extract exogenous monetary policy shocks, as is done in studies such as Jarocinski and Karadi (2020), Cieslak and Schrimpf (2019), Matheson and Stavrev (2014), among others. Alternatively, I propose conducting principal component analysis (PCA) on UST yields and equity prices, and use the identifying assumptions stated above to interpret the resulting components. Comparing them with their sign restriction counterparts reveals high correlation. Thus, this simpler approach which also avoids the set identification issue inherent to sign restriction VARs is considered as a benchmark. Nonetheless, a series of robustness checks suggest that using either method does not change the results discussed in this paper.

Equipped with a measure of monetary policy surprise, I proceed to my main regression analyses. Comparison of event-day effects pre and post-GFC show that the impact of monetary policy on

[4]The exception may be in exchange rates. Ferrari, Kearns and Schrimpf (2016) document that the impacts post-GFC may be greater.

[5]Change in the 2-year yield was used in Hanson and Stein (2015), Gilchrist, Lopez-Salido and Zakrajsek (2015), Ferrari, Kearns and Schrimpf (2016) and recently in Wang et al (2020).

asset prices was significantly stronger pre-GFC. This pattern holds for all assets, and is visible in overall financial conditions too. The only exception is exchange rates, for which the impacts are similar pre and post GFC. Neuhierl and Weber (2018) present evidence that equity prices continue to drift for several days after FOMC announcements. While my focus is on non-FOMC announcements, I allow for delayed reactions by implementing local projections of Jorda (2005). The evidence suggests that while impacts are strong and significant for well over a quarter pre-GFC, they decay in a few weeks after announcement post-GFC. Again, this holds for all assets and financial conditions, with the exception of exchange rates.

All these findings are checked for robustness in two dimensions: across measures of monetary policy surprise; and cutoff dates determining pre and post-GFC samples. Firstly, the PCA based measure described above is estimated through comparisons of equity prices with UST bonds of a variety of maturities. Then, sign restriction shocks are used with the set identification issue overcome by selecting the model that has impulse responses closest to the median, as in Matheson and Stavrev (2014) and discussed in Fry and Pagan (2011). The benchmark dates for pre and post GFC samples follow those in Nakamura and Steinsson (2018), with the pre-GFC era including observations falling on or before Jun 30, 2008, and the post-GFC era including all observations on or after Jul 01, 2009.

These findings have implications for the literature that examines the effects of monetary policy on asset prices. Empirical literature that has compared the effectiveness of conventional and unconventional monetary policies on asset prices does not document evidence of reduced effectiveness of monetary policy post-GFC, or during the period in which the Fed used unconventional measures.[6] These empirical observations contrast the slow recovery of US GDP following the Crisis, and thus gave rise to the "forward guidance puzzle", the observation that while traditional macro models predict an almost explosive impact of forward guidance on financial and real outcomes, economic data from the post-GFC era does not offer evidence for it (see e.g., Del Negro, Giannoni and Patterson, 2015; McKay, Nakamura and Steinsson, 2016). By collectively analyzing FOMC and non-FOMC events to quantify the "overall impact of monetary policy" on asset prices, this paper finds that the sum effects appear to be higher in the conventional than in the unconventional period.

This paper also relates to the literature that explores bond premium on macroeconomic announcements (e.g. Savor and Wilson, 2014). I find that while bond premium on the 4 macroeconomic announcements I analyze is significant for the entire yield curve during the conventional

[6]As earlier described, the findings in Gilchrist, Lopez-Salido and Zakrajsek (2015) and Swanson (2018) do not indicate strong differences in effectiveness across the two regimes. Ferrari, Kearns and Schrimpf (2016) on the other hand find that effects on bilateral US exchange rates are stronger post-GFC.

policy period (i.e. pre-GFC), it is insignificant during the unconventional period (post-GFC). This study also relates to the section of literature examining interest rate uncertainty on macroeconomic announcements (see e.g., Brenner, Pasquariello and Subrahmanyam, 2009; Huang, 2015; Benamar, Foucault and Vega, 2020). I document that interest uncertainty, as measured by the option implied volatility of the yield curve (MOVE index), falls significantly less post-GFC by a factor of 2, while the fall on FOMC announcements is similar across the two regimes. There are only 8 FOMC announcements in a year, while there are typically 48 of these 4 non-FOMC macroeconomic announcements each year. Thus, the onus falls heavily on the Fed to reduce interest rate uncertainty when it uses unconventional measures, as the evidence reported here suggests that non-FOMC announcements' ability to reduce interest rate uncertainty diminishes. Such interest rate uncertainty can have real implications. Husted, Rogers and Sun (2019) document the negative relation between their text-based Monetary Policy Uncertainty (MPU) measure and GDP. They dig deeper into firm-level investment to show that higher MPU reduces firm investment. Cremers, Fleckenstein and Gandhi (2020) show that treasury implied volatitilies are significant predictors of various real outcomes, such as GDP, industrial production, employment and consumption.

Finally, a simple information framework is presented to discuss the economic forces driving the lower impact estimated post-GFC. In the model, agents receive signals on economic outlook and forthcoming monetary policy on non-FOMC events. It is argued that the reduced effectiveness of monetary policy on asset prices on non-FOMC announcements arises out of the reduced precision of the monetary policy signal. Conventional policy that mainly involves tweaking the Fed Funds Rate is well-described by standard monetary policy rules. Given its nature, unconventional policy does not have such counterpart simple equations to describe them. The Fed has to step in and announce its policy; agents cannot precisely anticipate it ahead of announcement. The evidence in this paper supports this intuition, and discusses its implications on monetary policy's transmission to asset prices.

The rest of this paper is organized as follows. Section 2 discusses the data, and shows covariances between bond yields and stock prices on non-FOMC announcements to illustrate that yield movements on non-FOMC require some structure on the data to extract a measure of monetary policy surprise. Section 3 then introduces the proposed PCA based shock measure, and compares it with the sign restriction measure. Section 4 then turns to the main results. It shows event-day regressions and local projections to illustrate that the impact of monetary policy on asset prices fall post-GFC. Section 5 then goes on to show that these 4 non-FOMC announcements had reduced ability to influence bond market outcomes. Finally, Section 6 presents the information framework used to discuss the drivers behind the analyses presented in this paper.

2 Data Characteristics

2.1 Data and Sample Description

Equity price data considered here is the S&P 500 Index available from the Federal Reserve Economic Data (FRED) website. Similarly, all US Treasury (UST) and corporate bond yields data are also obtained from FRED, as are VIX and VXO indices. Data on US NEER are obtained from the BIS, while data on MOVE and Financial Conditions Index (FCI) are obtained from Bloomberg Terminal. FCI are weighted averages of equity prices, exchange rates, corporate and sovereign bond yields, and so help to summarize the overall impact on financial markets.[7] All these variables are available at daily frequency, and aside from corporate bond yields all are available since 1994, the start of the sample considered in this paper. Yields on AAA, A and BBB rated yields are available since January 1997.

FOMC announcement dates are obtained from the Federal Reserve's website, while data on non-FOMC announcement dates are obtained from the Bloomberg Terminal. The first FOMC announcement date in the sample is Feb 04, 1994. It was the first time the Fed began to announce its monetary policy decisions with its policy announcement. Prior to this markets had to infer policy from its implementation in the days following FOMC announcements. Non-FOMC announcement dates start near the end of 1996.[8]

I focus on four non-FOMC announcements that are directly related to the Fed and its conduct of monetary policy. The Fed has a clear dual mandate: 1) maximum employment; 2) stable prices.[9] Thus, unemployment and CPI announcements are natural candidates. Fed formally targets the Personal Consumption Expenditure (PCE) price index, which are released by the Bureau of Economic Analysis (BEA). CPI data is released by the Bureau of Labor Statistics (BLS). CPI statistics are **always** released before PCE, typically 2 weeks sooner. Therefore, PCE price index statistics may be stale information by the time they are released, and hence CPI announcements are used throughout this analysis. Nonetheless, robustness of these findings are also checked for PCE announcements. The other announcement analyzed is GDP. GDP is not only closely related to the Fed's objective of maximum employment, but appears directly in all five policy rules discussed by the Fed on its website.[10] The Fed also frequently releases projections of all three of these variables

[7]Financial Conditions Index (FCI) data are produced by Goldman Sachs, and are available on the Bloomberg Terminal. These are weighted averages of the FFR, nominal 10-year risk-free rate, corporate bond spreads of investment grade bonds (iBoxx domestic non-financials BBB 15Y+ with the 10-year treasury), sovereign spreads, equity prices (S&P 500), and trade-weighted exchange rates (weighted average of 36 bilateral exchanges).

[8]The first GDP announcement is on Aug 01, 1996. The first CPI announcement is on Dec 12, 1996. The first unemployment announcement is on Jan 10, 1997. The first Industrial Production announcement is on Nov 15, 1996.

[9]Fed's mandate can confirmed by the following the link here.

[10]Link to discussion of policy rules can be found here.

with its policy announcements.[11] Industrial production announcements are also included in the set of non-FOMC announcements because these numbers are released by the Fed, are closely related to overall GDP and unemployment, and therefore can be considered an important indicator for monetary policy.

For the main analysis, my data span 1996-2019. In 1994, the Fed began to make interest rate changes on FOMC announcement days. Prior to 1994, the Fed would move interest rates in between, rather than at, scheduled FOMC meetings. I am only able to go as far back as end of 1996 owing to data constraints: macro announcement data are obtained from Bloomberg, and the first announcement I have falls on Aug 1996. My pre-GFC sample runs from the start of sample through the end of June 2008, while my post-GFC sample spans July of 2009 - 2019. The Crisis period, which in the benchmark is considered to be between July 2008 - June 2009 is thus removed from the sample. This baseline definition of the Crisis follows Nakamura and Steinsson (2018). In robustness checks, I define the Crisis period to be the NBER recession period, which is defined as the period between December 2007 - June 2009. To ensure that my inferences are not affected by the run-up to the Crisis, in further robustness checks, I define the GFC period to start in January 2007 and end in June 2009. To conclude, unless otherwise specified, the pre-GFC sample includes all available observations on or before June 30, 2008, while the post-GFC sample includes all observations on or after July 01, 2009, but before Jan 2020, so that the COVID-19 pandemic period is not captured.

2.2 Non-monetary News Driving Yields on non-FOMC Announcement Days

The positive coefficient of a regression of equity price changes against yield changes on the four non-FOMC announcement days considered in this paper reveals that the dominant factor moving both yields and equity prices on these days does not appear to be of "monetary policy type". To be close to the extant literature, I begin by considering the change in the 2-year UST yield on these macroeconomic announcement days. A number of recent papers have used the change in the 2-year UST on Fed-related announcement days as a measure of monetary policy surprise. Among these include Hanson and Stein (2015), Gilchrist, Lopez-Salido and Zakrajsek (2015), Ferrari, Kearns and Schrimpf (2016) and Wang, Whited, Wu and Xiao (2020). The idea is that the change in the 2-year yield not only captures the current stance of policy, but also forward guidance. Capturing guidance is important since much of the surprise about monetary policy at the time of FOMC announcements arises from signals about the Fed's intention about future monetary policy, as Gurkaynak, Sack and Swanson (2007) argue. However, as Table 1 shows this measure fails to "work" on non-FOMC days.

[11] Formally, it releases projections of GDP, unemployment and PCE inflation, but as discussed above, CPI is preferred over PCE announcements in the baseline analysis.

The positive covariance means that a decrease interest rates is associated with a *fall* in equity prices. All else equal, a monetary policy easing surprise should raise equity prices.

The literature examining the impact of monetary policy on asset prices also considers other shock measures. Accordingly, Table 1 also reports regressions with changes in the 3-month Eurodollar rate, the first principal component of changes in the yield curve and changes in the risk-neutral rate in the right-hand-side.[12] The coefficients in all these regressions are significantly positive, suggesting the same problem mentioned above: the dominant shock moving equities and bonds does not appear to be of monetary policy type.

Table 1: Non-monetary Policy Drives of Yields and Stock Prices on Macro Announcements

	$\Delta 2y$	$\Delta 3mED$	PC1	$\Delta 2yRN$
Shock (β)	4.21***	1.36	0.12***	4.17***
	(5.450)	(1.526)	(6.116)	(4.085)
Constant	0.089***	0.068*	0.072**	0.077**
	(2.605)	(1.943)	(2.098)	(2.222)
Observations	944	937	944	934

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: This table reports the following regression estimated on all non-FOMC macro announcements. The LHS variable is the 1-day equity return (in percent) on macro announcement day, and the RHS includes a constant and the 1-day change, on announcement day, in the shock measure noted in columns 2-5.

$$equityreturn_t = \alpha + \beta Shock_t + \epsilon_t$$

Bloomberg releases survey-based expectations of all these macroeconomic variables which one might consider to remove these non-monetary drivers. For instance, one could consider regressing the 2-year yield against the difference between the announced value of the macroeconomic variable and its expectation (based on Bloomberg data) and using the residual as the monetary policy surprise variable. However, using this residual as an explanatory variable in subsequent regressions with equity returns in the left-hand-side (as in Table 1) shows results similar to the ones displayed in Table 1. The coefficients of these regressions remain positive and significant, and are available upon request.

[12]Principal components will be estimatetd differently later. Here, the first principal component explaining changes in the 2y, 3y, 5y, 7y and 10y yields is extracted and labelled as "PC1" in Table 1 above. Data on risk neutral changes are obtained from the yield curve decomposition of Adrian, Crump and Moench (2013).

Issues with using survey-based expectation data to explain asset price reactions on such macroeconomic announcements has been well explained in Rigobon and Sack (2006). Ideally, one would like the survey to reflect expectations just prior to the macro news release. However, given that these surveys are carried out well in advance, there is a concern that these surveys may reflect stale information. Furthermore, a news report includes a variety of information, of which only a select are surveyed. For example, the GDP report released by the Bureau of Economic Analysis includes information not just on GDP growth, deflator and personal consumption (which are also surveyed), but may also include information on corporate profits, granular data on various sectors of the economy as well as a variety of other data market participants may use to update their views on the state of the economy.

Rigobon and Sack (2006) suggest using principal components on a variety of US bond yields to better capture the effect of such news releases on asset prices. In a similar vein, I use principal components to parse out non-monetary drivers to extract monetary shocks around these announcements. This is discussed further in Section 3.1 below.

3 Developing Monetary Policy Shock Measure on Non-FOMC Macro Announcements

3.1 Exploiting Difference in Stock and Bond Reactions to Extract Monetary Policy Shock

The preceding section shows the dominance of non-monetary news on non-FOMC announcements. In fact, as recently argued by Cieslak and Schrimpf (2019), yield changes even on FOMC announcements are confounded by both monetary and non-monetary news. It is only natural that a raw comparison of yields and equity returns on *non-FOMC announcements* (as in Table 1) shows that non-monetary news dominates these events, whose primary function is to inform the public about latest figures about the economies' fundamentals.

To extract "monetary policy" surprises from "news" on announcement day, I make the following assumptions listed in Table 2. Note, "news" refers to all non-monetary news. It likely subsumes surprises regarding the economy's fundamentals, but could very well also capture risk premium shocks, as argued in Cieslak and Schrimpf (2019). However, this paper focuses on monetary policy surprises, so these two potential drivers of what is labelled as "news" in this paper are not carefully separated.

Table 2: Identifying Assumptions

	Yields	Equity Prices
Good News	+ ($\delta_1 > 0$)	+ ($\alpha_1 > 0$)
Expansionary Monetary Policy	- ($\delta_2 < 0$)	+ ($\alpha_2 > 0$)

The identifying assumptions in Table 2 commonly appear in VAR settings to estimate the impact of monetary policy on real and financial variables (e.g., in Jarocinski and Karadi, 2020). While a sign restriction VAR could also be used in this instance to obtain monetary policy shocks on non-FOMC macro announcements, a simpler method is initially used instead. I extract the first two principal components explaining changes in equity prices and bond yields on macroeconomic announcement day. This helps to avoid the set identification issue in sign restriction VARs. Specifically, consider the following setup, where stock returns and changes in the 5-year UST yield are determined by two shocks on these macroeconomic announcements:

$$\Delta 5y_t = \delta_1 News_t + \delta_2 MonetaryPolicy_t \tag{1}$$

$$\Delta equityprice_t = \alpha_1 News_t + \alpha_2 MonetaryPolicy_t \tag{2}$$

3.2 PCA Based Monetary Policy Shock Measure Characteristics

Parameters in (1) and (2) can be identified by contemporaneous sign restrictions summarized in Table 2. But as aforementioned, this would introduce a set identification issue, raising challenges when estimating the impact of monetary policy not only on equity prices but a variety of other assets examined in this paper. Therefore, I use principal components to extract two factors explaining equity returns and 5-year UST yield changes. Their interpretation is guided by the identification assumptions listed in Table 2. Since monetary policy was conducted differently in pre and post-GFC eras, I estimate the principal components separately in pre and post-GFC samples. In both samples, the first component has a "news" shock interpretation, while the second component has a "monetary policy" shock interpretation. Table 3 lists the correlation of the first two principal components with changes in the 5-year UST and equity returns.

Table 3: Correlation of Principal Components with Yield Changes and Equity Returns

	1st Component	2nd Component	$\Delta 5yUST$	Equity Return
1st Component	1.00			
2nd Component	0.00	1.00		
$\Delta 5yUST$	0.74	0.59	1.00	
Equity Return	0.78	-0.61	0.23	1.00

Note: The principal components explaining changes in the 5-year UST yield and equity returns are estimated on non-FOMC macro announcements. They are estimated separately for pre-GFC and post-GFC samples to account for the fact that monetary policy was conducted differently in these two eras. In both samples, the 1st principal component comoves positively with bond yields and stock returns, while the 2nd principal component comoves negatively with equity returns and positively bond yields. These principal component series, estimated separately over the two samples, are then appended to carry out empirical analysis, including the correlations reported here.

Following the identifying assumptions in Table 2, the second (first) component is interpreted as capturing monetary policy ("news") shock. The second component estimated using equity prices and 5y UST yield is referred as the PCA based benchmark shock measure in the rest of this paper. Selection of 5-year UST yield as a benchmark is similar to Bu, Rogers and Wu (2019), but the idea here is that the intermediate 5-year series responds both to "news" and "monetary policy" type shocks around these non-FOMC macro announcements in sufficient proportions to allow for a clean separation between these two sources of variation. Moreover, the 5-year UST is short-term enough to respond to expectations of forthomcing Fed policy regarding the short-term rate, and also to its policy regarding the path of monetary policy. So, it is felt that it can be used to comprehensively capture the stance of monetary policy. Nonetheless, this method can be implemented with a variety of UST bonds. In robustness checks, I perform the same analysis by replacing the 5-year UST with 2-year and 10-year UST yields. For these alternative selections, the first component remains what can be interpreted as a "news" shock, while the second component as the "monetary policy" shock. This is intuitive as the dominant information released on these announcements is not of monetary policy type. This intuition is also consistent with the positive covariance between stock price and bond yields reported in Section 2.2.

While the shock estimated using the 5-year UST is used as a benchmark, monetary policy shocks estimated via different bonds look very similar. For further comparison, the shocks developed using the proposed principal component method are also compared with those using sign restriction VAR as in Matheson and Stavrev (2014). The set identification issue is overcome by selecting the model whose impulse responses are closest to the median response, as in Matheson and Stavrev (2014) and discussed in Fry and Pagan (2011).[13]

Table 4: Correlations of PCA Based Shocks and Sign Restriction Shock

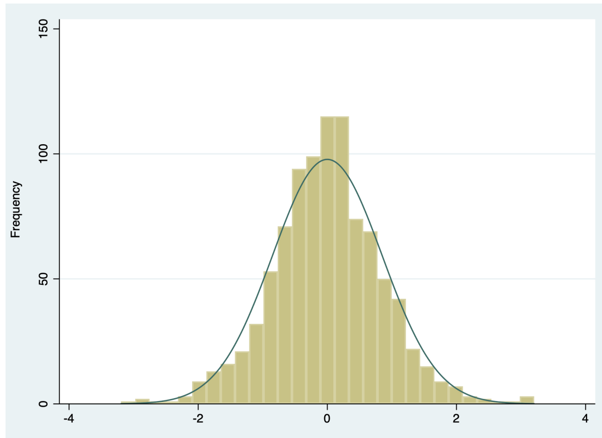
	PCA Based (5y)	PCA Based (2y)	PCA Based (10y)	Sign Restriction
PCA Based (5y)	1.00			
PCA Based (2y)	0.94	1.00		
PCA Based (10y)	0.96	0.87	1.00	
Sign Restriction	0.99	0.93	0.96	1.00

The first three rows in Table 4 show that the proposed PCA based method to extract monetary policy shocks is not sensitive to selection of different bonds. The final row reports the sign restriction shock, where the unique model is identified by selecting the model whose impulse responses are closest to the median. In this application, this method of model selection leads to a shock measure that is closely related to PCA based shock measures.

The remainder of the analysis in this paper uses the benchmark PCA based shock estimated using the 5-year UST (and of course equity returns). All the analysis carried out in this paper is checked for robustness across all the different shock measures compared in Table 4. Figure 1 shows that the benchmark PCA based shock measure is centered around zero and appears to be normally distributed.

[13] Matheson and Stavrev (2014) impose the sign restrictions in Table 2 on a bivariate VAR comprising equity returns and 10-year yields. I estimate the same system, but replace the 10-year with the 5-year UST to allow better comparison with the benchmark PCA based shock.

Figure 1. Distribution of Benchmark PCA Based Monetary Policy Shock Measure



Note: The histogram shows the frequency of various values the benchmark shock measure takes. The histogram is overlaid by a hypothetical normal distribution that shares the mean and variance of the shock measure. As explained in Section 3.1, the benchmark extracts principal component with a monetary policy interpretation estimated by examining the reactions of 5-year UST and equity returns on non-FOMC macro announcements.

3.3 Diminished Role of Monetary Policy in Explaining Asset Price Movements on Non-FOMC Macro Announcements

Before turning to regressions, Table 5 reports R^2 from regressions of changes in asset prices (noted in the first column), against the benchmark monetary policy shock measure. These regressions are performed separately for pre and post-GFC samples. For all assets, a relatively larger share of the variance in asset price is explained by monetary policy pre-GFC compared to post-GFC (comparing columns 2 and 3).

Table 5: R^2 from Regressions of Asset Price Changes Against Monetary Policy Shock

	Pre-GFC	Post-GFC
Panel A: Assets Used for Identification		
5y UST	0.41	0.30
Equity Prices	0.41	0.30
Panel B: Other Assets		
10y UST	0.43	0.18
A-Rated Corp. Yields	0.41	0.28
NEER	0.06	0.08
FCI	0.71	0.54

Note: The table reports R^2 from the following regressions estimated on all non-FOMC macro announcements: $\Delta AssetValue_t = \alpha + \beta MPShock_t + \epsilon_t$, where $MPShock_t$ is the PCA based shock measure described in Sections 3.1 and 3.2. The LHS variable in these regressions are noted in column 1. These regressions are performed separately for pre-GFC and post-GFC samples.

Table 5 broadly confirms the findings in Section 2.2. For bonds and equities the R^2 values are less than 0.5, suggesting that the driver of variation in these assets on non-FOMC macro announcements is non-monetary news. Yet, the R^2 values are still non-trivial, suggesting that monetary policy is responsible for substantial variation in explaining movements in asset prices on these events. Exchange rates appear to be the only exception.

Finally, and perhaps most importantly, comparing columns 2 and 3 reveals that a greater variation in asset prices is explained by monetary policy pre-GFC than post-GFC. This holds for all assets, except for exchange rates where the R^2 is modestly higher post-GFC. These findings offer suggestive evidence that markets absorb more monetary policy information from non-FOMC announcements pre-GFC. Intuitively, when policy was conventional in the pre-GFC era, markets could perhaps more precisely pin down forthcoming Fed policy from these non-FOMC macro announcements. However, as policy became unconventional post-GFC, these announcements' ability to provide precise information regarding forthcoming Fed actions diminished.

While Table 5 provides an overall picture that suggests a diminished role of monetary policy in explaining asset price movements on non-FOMC announcements, the next section better understands how the transmission of monetary policy to asset prices evolved as the Fed employed unconventional policy measures.

4 Regression Results

4.1 Impact of Monetary Policy on Asset Prices on non-FOMC Macro Announcements: Event-Day Estimates

The main message of this paper is conveyed by Table 6. To examine if there was a difference in monetary policy's impact when monetary policy was conventional (pre-GFC) and unconventional (post-GFC), I estimate the following for each asset "i" on all non-FOMC macro announcements:

$$\Delta y_{i,t} = \alpha_i + \beta_{i,1} MPShock_t + \beta_{i,2} MPShock_t * PostGFC_t + \beta_{i,3} PostGFC_t + \epsilon_{i,t} \tag{3}$$

Estimates of the interaction term ($\beta_{i,2}$) help assess whether the impact changed after the Crisis or not. The "$MPShock_t$" variable is the benchmark PCA based shock measure described in Section 3. "$PostGFC_t$" is a dummy variable that takes a value of 1 on all values on and after Jul 01, 2009, and takes a value of 0 for all values on or before Jun 30, 2008. This is consistent with Nakamura and Steinsson (2018). $\Delta y_{i,t}$ notes movements in equity prices, UST yields, corporate bond yields, NEER and FCI on non-FOMC macro announcement day. This change is measured by comparing the close-of-day values at the day before announcement with the close-of-day value on announcement day. While I examine the impact of monetary policy on equity prices, UST yields (1y - 30y), corporate bond yields of various ratings (AAA, A and BBB), nominal effective exchange rates (NEER) and overall financial conditions index (FCI), Table 6 shows a subset that sufficiently conveys the message and helps conserve space. Results of the remaining UST yields (1y - 30y, excluding 10y) and corporate bond yields (AAA and BBB) are placed in Appendix A. Other UST yields tend to follow the same patterns as that of 10y UST, while the results for other corporate bond yields tend to be similar to those for A-rated yields.

To avoid any confusion, here I define the LHS variable in the regressions of (3). For equity prices, NEER and FCI $\Delta y_{i,t}$ takes the following form, where $y_{i,t}$ represents close-of-day value of asset "i" on day t, and "t" represents non-FOMC macro announcement day.

$$\Delta y_{i,t} = ((y_{i,t}/y_{i,t-1}) - 1) * 100 \tag{4}$$

For UST and corporate bond yields, the LHS variable of equation (3) is as follows. Here $y_{i,t}$ represents close-of-day yield values (in basis points) of asset "i" on non-FOMC macro announcement day.

$$\Delta y_{i,t} = y_{i,t} - y_{i,t-1} \tag{5}$$

Comparing estimates of $\beta_{i,1}$ and $\beta_{i,2}$ suggest that the impact of monetary policy was strong and significant pre-GFC, but that these impacts diminished post-GFC, given that the interaction term ($\beta_{i,2}$) is significant but has **opposite sign of the main coefficient** ($\beta_{i,1}$). This pattern holds for assets and is visible in overall financial conditions as well. Only exchange rates exhibit a weak defiance of this pattern, where the interaction term is positive, indicating strengthening of effects post-GFC. However, this interaction term is insignificant.

Overall, while impacts drop post-GFC, they are not zero: $\beta_{i,1} + \beta_{i,2}$ is statistically different from zero for all assets. Hence, these results also illustrate the importance of non-FOMC macro announcements in generating monetary policy surprises over the entire sample.

Table 6: $\Delta y_{i,t} = \alpha_i + \beta_{i,1} MPShock_t + \beta_{i,2} MPShock_t * PostGFC_t + \beta_{i,3} PostGFC_t + \epsilon_{i,t}$

	Equity Prices	10y UST Yield	A-Rated Yield	NEER	FCI
MPShock (β_1)	-0.838***	4.796***	4.635***	0.146***	0.063***
	(-16.26)	(16.95)	(17.73)	(5.01)	(33.63)
MPShock*PostGFC (β_2)	0.165**	-1.850***	-1.913***	0.073	-0.007**
	(2.01)	(-3.74)	(-5.10)	(1.46)	(-2.23)
Observations	944	944	925	944	944

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: The table reports estimates from regressions (see table title) evaluated on all non-FOMC macro announcements for each asset "i". $MPShock_t$ is the PCA based benchmark shock measure described in Section 3. As the shock is measured via PCA, the magnitude of coefficients do not have a clear meaning. The emphasis is on the sign and statistical significance of coefficients instead. Estimates of the coefficients associated with $PostGFC_t$ are suppressed for brevity. The LHS variable in these regressions are noted in columns 2-6. See equations 4 and 5 for precise definitions of LHS variables. PostGFC is a dummy variable that takes a value of 1 on all values on and after Jul 01, 2009, and takes a value of 0 for all values on or before Jun 30, 2008.

These results are checked for robustness in two dimensions: across different shock measures; across cutoff dates determining pre and post GFC samples. The benchmark PCA based shock measure estimated by using equity prices and the 5y UST is replaced with PCA based shock measures that are estimated with the 2y UST and stock prices, or with 10y UST yields and stock prices. The sign restriction shock is also used as an additional robustness check. Then different GFC sample definitions, stated at the end of Section 2.1, are used. The results are posted in the Internet Appendix.

While event-analysis is revealing and indicates monetary policy's effect on non-FOMC macro announcements attenuate post-GFC, they remain silent on persistence of these effects. Examining effects of monetary policy beyond event-day may be relevant, as Neuhierl and Weber (2018) suggest that equity prices tend to continue to drift for several days after announcement day. Korencke, Schmeling and Schrimpf (2021) also find supporting evidence for this drift. Both these papers exclusively focus on FOMC announcements, in contrast to this study. Yet, I examine effects over a broader window to capture any differences due to delayed reactions. This is done below.

4.2 Examining the Dynamics of Effects Across the Two Monetary Policy Regimes

Here I carry out regressions, following local projection of Jorda (2005) to assess the effects of shocks, computed on non-FOMC announcements, on asset values. Specifically, I estimate equation (6) for the 4 non-FOMC macroeconomic announcements by OLS, using robust standard errors for inference. Again, I use close-of-day price and yield data.

$$\Delta y_{i,t+h} = \alpha_{i,h} + \beta_{i,1,h} MPShock_t + \beta_{i,2,h} MPShock_t * PostGFC_t + \beta_{i,3,h} PostGFC_t + \epsilon_{i,t+h} \quad (6)$$

The notation of equation (6) is as follows. As before, $MPshock_t$ is the PCA based benchmark shock measure described in section 3. Also as before, "$PostGFC_t$" is a dummy variable that takes a value of 1 for all values on or after Jul 01, 2009, and a value of 0 on all values on or before Jun 30, 2008. The difference from the specification 3 is the introduction of horizon represented by "h". If $h = 0$, my LHS variable is the change in the asset price (or yield change in the case of corporate bonds) on a macro announcement day, and takes values as explained in equations (4) and (5).

For equity prices, NEER and FCI, when $h \geq 1$, my LHS variable is calculated as below. Consistent with the notation introduced earlier, $y_{i,t-1}$ represents the close-of-day price of asset "i" before non-FOMC macro announcement day. Similarly, $y_{i,t+h}$ represents close-of-day values of asset price h days after announcement day.

$$\Delta y_{i,t+h} = ((y_{i,t+h}/y_{i,t-1}) - 1) * 100 \quad (7)$$

Similarly, for UST and corporate bond yields, when $h \geq 1$, my LHS variable is calculated as below. Again, $y_{i,t-1}$ represents close-of-day yield values (in basis points) on non-FOMC macro announcement day, while $y_{i,t+h}$ represents yield values h days after announcement.

$$\Delta y_{i,t+h} = y_{i,t+h} - y_{i,t-1} \quad (8)$$

I set the maximum horizon to be 60 business days, to help capture effects over a quarter. The results are illustrated in Figure 2. Again to conserve space, Figure 2 excludes results for AAA and BBB rated corporate bond yields, and only shows the 10y UST. All other sovereign and corporate bonds show similar results, which can be found in Appendix B.

Figure 2. Impact Dynamics on non-FOMC Macro Announcements

Note: 95% confidence intervals are constructed using robust standard errors. CIs of the $MPShock_t$ and ($MPShock_t + MPShock_t * PostGFC$) term is shown on the vertical axis in the left (right) column. See equation (6) for the regression specification. $MPShock_t$ is the benchmark PCA based shock measure described in Section 3. The x-axis notes the horizon "h" of equation (6). It records the number of business days from announcement. h=0 represents the day of announcement. All 4 macroeconomic announcements (GDP, CPI, unemployment and industrial production) are clubbed together to form one singular non-FOMC announcement variable.

Figure 2 strengthens the message of the event-analysis shown in the preceding section. Not only are announcement-day effects weaker post-GFC (Section 4.1), they decay much quicker as well. Pre-GFC, the confidence intervals remain strong and significant over a horizon spanning a quarter (60 business days). Post-GFC, however, these effects tend to decay in about a month, with impacts on equity prices collapsing to insignificance in about a week.

As is the case elsewhere, these results are checked for robustness in a couple of dimensions: across different shock measures; across cutoff dates determining pre and post GFC samples. The benchmark PCA based shock measure estimated by using equity prices and the 5y UST is replaced with PCA based shock measures that are estimated with the 2y UST and stock prices, or with 10y UST yields and stock prices. The sign restriction shock is also used as an additional robustness check. Then different GFC sample definitions, stated at the end of Section 2.1, are used. The results are posted in the Internet Appendix.

So far, this paper documents that monetary policy played a reduced role post-GFC in moving asset prices on non-FOMC macro announcements, as shown by R^2 reported in Section 3.3. Then regression results shown in this section reveal that post-GFC, asset prices moved less per unit of shock as well. This reduced effectiveness of surprises appears to be an outcome of the reduced ability of these announcements to offer indications of monetary policy actions. The following section explores the ability of non-FOMC announcements to move interest rate levels and their second moments. This ability tends to drop post-GFC. Finally, Section 6 presents a simple information framework, closely following the empirical analysis thus far, to understand the economic forces driving the differences in effects pre and post-GFC. Overall, the empirical evidence and the model collectively suggest that an ***inadvertent*** **by-product of Fed's use of unconventional monetary policies has been the reduced ability of markets to anticipate Fed actions ahead of time using publicly released data.** This has implications for how monetary policy transmits to asset prices as the regression analyses in this section suggest. One can add the set of FOMC announcements to the set of non-FOMC macro announcements analyzed in this paper by computing monetary policy surprises on FOMC days using the PCA approach or via sign restrictions to ensure monetary policy shocks are consistently measured. The estimates over this larger set of observations do not change the results presented in Table 6 and Figure 2. All assets and financial conditions display a common pattern: the impacts are stronger and more persistent pre-GFC than they are post-GFC. These estimates can be found in Appendix C.

One important detail to note is that there are only 8 FOMC announcements a year. In contrast, all 4 non-FOMC announcements considered here occur monthly. Hence, there are roughly 48 non-FOMC announcements in a year; many more than FOMC announcements. Thus, it is natural to think that the reduced effectiveness of monetary policy shocks on these non-FOMC announcements would have broader implications on the overall transmission of monetary policy to asset prices.

5 Further Investigations: Diminishing Ability of Non-FOMC Macro Announcements in Determining Bond Outcomes

It was earlier shown that the impact on a variety of assets of monetary policy surprises from non-Fed events, that are nonetheless relevant to monetary policy, diminished post-GFC. But what has changed about these announcements? Not much if one reads through the information releases on these announcements. Still, their impacts on bond markets appear to have changed. This section helps to show that post-GFC, non-FOMC announcements also had reduced ability to move yields and reduce their (implied) uncertainty. The overarching message is that these announcements had a reduced ability to reduce bond market uncertainty post-GFC.

5.1 Bond Premium on Non-FOMC Announcements

The importance of macroeconomic announcements in asset pricing is well documented in the literature, which finds substantial equity and bond premia are earned on such days (e.g. Savor and Wilson, 2013; Ai and Bansal, 2018). Ai and Bansal (2018) argue that the source of equity premium is an aversion to uncertainty, while Savor and Wilson (2013) follow Bansal and Yaron (2004) to argue that equity and bond premia are observed because agents learn about the state of the economy on such events. In either interpretation, it is the ability of these announcements to remove uncertainty that is ultimately revealed in asset premia. A simple check to see if non-FOMC macro announcements had similar ability to remove uncertainty in bond outcomes is thus to see how bond premia evolved. In this spirit, the following specification is estimated.

$$\Delta y_{i,t} = \alpha + \beta_{i,1} NonFOMC_t + \beta_{i,2} NonFOMC_t * PostGFC_t + \beta_{i,3} PostGFC_t + \epsilon_{i,t+h} \tag{9}$$

Table 7 reports Newey-West estimates of the above equation. $\Delta y_{i,t}$ notes the daily change in the spread of each bond i with the 1-month bill. "$NonFOMC$" is a dummy variable that takes a value of 1 at each of the 4 non-FOMC macro announcements, and 0 otherwise. "$PostGFC$" is also a dummy variable that, as before, is 1 for all values after Jul 01, 2009, and 0 for all value on or before Jun 30, 2008. The interaction term helps assess if there was any difference in bond premia before or after the Crisis.

Table 7 documents that while bond premia tended to exist for the entire yield curve pre-GFC, this tends to vanish post-GFC. Note that the interaction term coefficients are of opposite sign and of equal magnitude, suggesting a total absence of any premia post-GFC. This pattern holds for the entire yield curve. Thus, it appears that the ability of the 4 non-FOMC macro announcements I analyze to remove bond market uncertainty was only a phenomenon that existed in the pre-GFC era.

Table 7: Regressing Daily Changes in Spreads on Non-FOMC Announcement Dummies

	1y	2y	5y	10y	30y
NonFOMC	1.229**	1.432**	1.458**	1.520**	1.516**
	(2.10)	(2.28)	(2.29)	(2.399)	(2.36))
NonFOMC*PostGFC	-1.107*	-1.361**	-1.551**	-1.607**	-1.543**
	(-1.85)	(-2.05)	(-2.21)	(-2.29)	(-2.17)
Observations	5,787	5,787	5,787	5,787	5,782

t-statistics computed via Newey-West regressions with 14 lags in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Each column in this table reports output from a separate regression of daily changes in bond yield spreads against a dummy variable that takes a value of 1 for each of the 4 non-FOMC announcement dummies. See equation (9). This dummy variable is interacted with a dummy variable that takes a value of 1 for the post-GFC era. Spreads are the difference between UST bond (noted in columns) yields and the 1-month bill. Changes in spreads are measured in basis points. 14 lags are used for these regressions, based on the rule-of-thumb: $Lags = 0.75 * (N^{1/3})$.

5.2 Diminishing Ability of Non-FOMC Announcements to Reduce Interest Rate Uncertainty

Not just UST yield levels, but also option implied volatility of interest rates (MOVE Index) tends to drop more on non-FOMC macroeconomic announcements in the pre-GFC era during which Fed used conventional policies. Table 8 reports Newey-West regressions of daily changes in the MOVE index against dummies for FOMC and non-FOMC macroeconomic announcements, as well as their interactions with a dummy variable that takes a value of 1 after the Financial Crisis. The regression specification thus takes the following form:

$$\begin{aligned}\Delta y_{i,t} = \alpha_i + \beta_{i,1} FOMCAnnouncement_t + \beta_{i,2} FOMCAnnouncement_t * PostGFC_t \\ + \beta_{i,3} NonFOMC_t + \beta_{i,4} NonFOMC_t * PostGFC_t + \beta_{i,5} PostGFC_t + \epsilon_{i,t}\end{aligned} \quad (10)$$

Pre-GFC, implied volatility dropped about 2 times more on non-FOMC announcements than it did post-GFC, while the drop on FOMC announcements is similar. This drop is significant, as the interaction term has a t-stat of 2.76. Additionally, the point estimate on both dummies (FOMC and non-FOMC) are comparable pre-GFC, further highlighting the importance non-Fed macro announcements had for interest rates. This can have substantial implications for uncertainty reduction as the non-FOMC announcements considered here occur monthly. Since this paper considers four such announcements, it implies that there are roughly 48 non-FOMC announcements versus 8 FOMC announcements in a year. Hence, back of the envelope calculations suggest that annual drops pre-GFC would be about 84.62, while the drop post-GFC is about 45.10.[14] For context, the unconditional average of the MOVE index over the entire sample is about 90.32.

Each FOMC announcement contributes a larger share in reducing interest rate uncertainty than each non-FOMC announcement, given its larger coefficient estimate. Yet, majority of the drop in the above rough calculations is contributed by non-FOMC announcements. This is simply because there are only 8 FOMC announcements in a year, while the public learns about public data directly relevant to the Fed's objectives far more frequently.

Table 8: Movement of Uncertainty Proxies on Announcement

	MOVE		VIX		VXO	
	Pre-GFC	Post-GFC	Pre-GFC	Post-GFC	Pre-GFC	Post-GFC
FOMC	-2.178***	-1.732***	-0.525***	-0.445*	-0.462***	-0.407
	(-4.70)	(-3.96)	(-4.31)	(-1.92)	(-3.64)	(-1.56)
Non-FOMC	-1.40***	-0.651***	-0.264***	-0.169**	-0.233***	-0.117
	(-6.63)	(-3.83)	(-3.89)	(-1.98)	(-2.89)	(-1.39)

t-statistics computed via Newey-West regressions with 14 lags in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: This table reports regressions of the following form: $\Delta y_{i,t} = \alpha_i + \beta_{i,1} FOMCAnnouncement_t + \beta_{i,2} FOMCAnnouncement_t * PostGFC_t + \beta_{i,3} NonFOMC_t + \beta_{i,4} NonFOMC_t * PostGFC_t + \beta_{i,5} PostGFC_t + \epsilon_{i,t}$. Here $\Delta y_{i,t}$ denotes the daily change in the respective index (MOVE, VIX, VXO), while the RHS includes a constant, dummies for FOMC and non-FOMC announcements and post-GFC period. The FOMC and non-FOMC announcement dummies are interacted with the post-GFC dummy. The pre-GFC columns list $\beta_{i,1}$ and $\beta_{i,3}$ coefficients, and associated t-stats, for FOMC and non-FOMC, respectively. The post-GFC column reports estimates and t-stats of $\beta_{i,1} + \beta_{i,2}$ for the FOMC row, and $\beta_{i,3} + \beta_{i,4}$ in the non-FOMC row.

It is interesting to note that the MOVE Index, which captures implied volatility of UST bond yields with maturities ranging from 2-year to 30-years, tends to drop less overall in the post-GFC

[14] These are calculated by multiplying the coefficient with their annual frequency. Since there are 8 FOMC and 48 non-FOMC announcements in a year, the implied drop pre-GFC is equal to (2.178*8) + (1.40*48) = 84.62. The drop post-GFC is thus (1.732*8) + (0.651*48) = 45.10

era, where short-term rates were brought to zero, and forward guidance and asset purchases would have brought stability to the yield curve. To ensure that the smaller changes were not an outcome of lower level of implied volatility, I demean the MOVE index based on their respective sample means, calculated separately for the pre and post-GFC periods. Table 9 reports estimates of a similar regression, using de-meaned series this time. As Table 9 shows, the results are qualitatively the same. Also as before, the interaction term of non-FOMC announcements is significant (t-stat 2.35) in the MOVE index regression.

Other standard uncertainty proxies, such as the VIX and VXO indices, which measure option implied volatility in equity markets, also display a similar pattern: the drop pre-GFC is larger compared to the drop post-GFC. However, the interaction terms of both FOMC and non-FOMC announcement dummies are insignificant. Nonetheless, the suggestive evidence indicates that these indices tend to decrease less post-GFC.

Table 9: Movement of De-meaned Uncertainty Proxies on Announcement.

	MOVE		VIX		VXO	
	Pre-GFC	Post-GFC	Pre-GFC	Post-GFC	Pre-GFC	Post-GFC
FOMC	-0.098***	-0.087***	-0.079***	-0.075*	-0.060***	-0.066
	(-4.70)	(-3.96)	(-4.31)	(-1.92)	(-3.64)	(-1.56)
Non-FOMC	-0.063***	-0.033***	-0.040***	-0.029**	-0.030***	-0.019
	(-6.63)	(-3.84)	(-3.89)	(-1.98)	(-2.89)	(-1.39)

t-statistics computed via Newey-West regressions with 14 lags in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: This table reports regressions of the following form: $\Delta y_{i,t} = \alpha_i + \beta_{i,1} FOMCAnnouncement_t + \beta_{i,2} FOMCAnnouncement_t * PostGFC_t + \beta_{i,3} NonFOMC_t + \beta_{i,4} NonFOMC_t * PostGFC_t + \beta_{i,5} PostGFC_t + \epsilon_{i,t}$. Here $\Delta y_{i,t}$ denotes the daily change in the respective index (MOVE, VIX, VXO), where the series are de-meaned separately for the pre-GFC and post-GFC samples, to account for any differences in means in either subsamples. The pre-GFC columns list $\beta_{i,1}$ and $\beta_{i,3}$ coefficients, and associated t-stats, for FOMC and non-FOMC, respectively. The post-GFC column reports estimates and t-stats of $\beta_{i,1} + \beta_{i,2}$ for the FOMC row, and $\beta_{i,3} + \beta_{i,4}$ in the non-FOMC row.

The diminishing ability of these non-FOMC macro announcements to reduce interest rate uncertainty can have broader implications. Husted, Rogers and Sun (2019) show comovement of their monetary policy uncertainty (MPU) index with option implied volatilities of 1-year swap rates. Table 10 shows that this co-movement extends to implied volatilities of interest rates with much longer maturities. Additionally, the co-movement appears to be persistent, as the relationship holds not just in the same month, but in the subsequent month as well. Thus, the diminishing ability of non-FOMC announcements to reduce interest rate implied volatilities may potentially raise uncertainty about monetary policies.

Table 10: Comovement of MOVE and MPU Indices

	ΔMPU_t	ΔMPU_{t+1}	ΔMPU_{t+2}	ΔMPU_{t+3}
Baker, Bloom & Davis	1.068***	1.224***	0.451	0.371
	(2.86)	(3.42)	(1.17)	(0.89)
Husted, Rogers & Sun	1.013***	0.882**	0.401	0.261
	(2.70)	(2.43)	(1.01)	(0.58)

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: This table reports regressions of the form below. Each cell lists the $\beta_{i,t}$ coefficient for a separate regression, for the index identified in each row. Each column identifies the window over which the MPU index change is calculated. For example, $\Delta MPU_t = MPU_t - MPU_{t-1}$, while $\Delta MPU_{t+3} = MPU_{t+3} - MPU_{t-1}$. In each regression, the RHS includes the 1-month change in the MOVE index, i.e. $\Delta MOVE_t = MOVE_t - MOVE_{t-1}$. Thus, "h" takes values between 0 and 3 in the regressions below; "i" identifies the relevant MPU index. $\Delta MPU_{i,t+h} = \alpha_i + \beta_{i,t}\Delta MOVE_t + \epsilon_{i,t,h}$

Some recent studies show the link between interest rate uncertainty and real outcomes as well. Husted, Rogers and Sun (2019) document that higher monetary policy uncertainty causes lower GDP growth. By going firm-level, they show that higher policy uncertainty leads to lower firm-level investment. In a somewhat similar vein, Cremers, Fleckenstein and Gandhi (2020) show that treasury implied volatilities are significant predictors of various real outcomes, such as GDP growth and volatility, industrial production, employment and consumption. Reduced ability of such non-FOMC macro announcements to reduce interest rate uncertainty could thus have broader implications on transmission of monetary policy to real outcomes.

Before concluding this paper, the following section presents a simple framework to understand the economic drivers of the empirical analysis in this paper, particularly the regressions shown in Section 4.

6 A Simple Information Framework

6.1 Model Setup

Consider a simple two-period model, where informed agents who have constant absolute risk aversion (CARA) preferences trade a risky asset in a market including noise traders. See Goldstein and Yang (2017) for a review of such models.

The figure below describes the setup. There is a continuum of informed traders, with a total mass of 1 and risk aversion coefficient of γ. The total supply of the risky asset is Q. Noise traders' aggregate demand is x, where $x \sim N(0, \tau_x^{-1})$. There are two fundamentals determining the asset's price: economic outlook and monetary policy. Informed agents have common priors. With respect to economic outlook, their priors are: $\theta \sim N(\mu_\theta, \tau_\theta^{-1})$. Regarding Fed's monetary policy, their priors are: $y \sim N(\mu_y, \tau_y^{-1})$. A non-FOMC macro announcement (e.g., GDP) occurs on $t = 1$. Here the markets receive a public signal (n) about the outlook of the economy, that becomes fully known at $t = 2$. The true value of outlook is represented by θ. The common precision of this private signal among all informed agents is τ_n. Traders also receive a private (orthogonal) signal about monetary policy (m_i) as well. Its common precision is τ_m. This orthogonalization of outlook and monetary policy signals is akin to the separation of the "Fed information effect" and monetary policy, as is done in Jarocinski and Karadi (2020), for instance. It also closely follows the empirical setup of this paper, where both PCA and sign restriction based shocks (see Section 3) are orthogonal by construction. Fed announces its policy at $t = 2$, where all uncertainty about the economy is removed, i.e. true values of monetary policy (y) and economy's outlook (θ) become known. Hence, informed agents' public signal about the economy's outlook (n), is in effect a signal about the Fed's economic outlook. Given there are two fundamentals driving asset price, I make a simplified assumption that the $t = 2$ asset value is just a sum of the true values of economic outlook and monetary policy, that are both completely known at $t = 2$. Thus, the asset's payoff, given by $v = \theta + y$, is fully realized at $t = 2$. As will be clear below, in this simple setup, it's the Fed's monetary policy interventions and its economic outlook that really are the drivers of asset prices even at $t = 1$.

Figure 3. Model Setup and Timeline

- Two economic fundamentals driving asset price: economic outlook and Fed's monetary policy.
- Total supply of risky asset: Q.
- Two types of agents: informed & noise traders
- Noise traders aggregate demand is x, where $x \sim N(0, \tau_x^{-1})$.
- Informed agents' common priors regarding economic outlook: $\theta \sim N(\mu_\theta, \tau_\theta^{-1})$.
- Informed agents' common priors regarding Fed's monetary policy: $y \sim N(\mu_y, \tau_y^{-1})$.
- Asset payoff realized in $t = 2$ with payoff $v = \theta + y$

$t = 1$

- Non-FOMC macro announcement released.
- Informed agents receive a public signal about (Fed's) economic outlook θ.
  - $n = \theta + \epsilon_n$; $\epsilon_n \sim N(0, \tau_n^{-1})$
- Informed agents receive a private signal about Fed monetary policy (y).
  - $m_i = y + \epsilon_{m,i}$; $\epsilon_{m,i} \sim N(0, \tau_m^{-1})$

$t = 2$

- Fed announcement released.
- Asset payoff (v) influenced by Fed's outlook (θ) and monetary policy (y).
  - $v = \theta + y$

To get this model's solution, first note that by the law of large numbers, noise terms in the private signals ($\epsilon_{m,i}$) will wash out in equilibrium. Thus, average private signals of monetary policy ($\bar{m}$) will be equal to the true value (y). Thus, the conjecture regarding price at $t = 1$ is written in terms of the public signal and the average of private signals as follows.

$$P_1 = P_{k1} + P_n n + P_y y + P_x x \tag{11}$$

In this environment, price will serve as an additional signal about monetary policy.

$$s_p = \frac{P_1 - P_{k1} - P_n n}{P_y} = y + \rho^{-1} x \tag{12}$$

Here, $\rho = \frac{P_y}{P_x}$, and thus $s_p \sim N(y, \tau_p^{-1})$, where $\tau_p = \rho^2 \tau_x$. Therefore, informed traders' demand function at $t = 1$ will take the following form:

$$D_{I,1} = \frac{E[v|priors, n, m_i, s_p] - P_1}{\gamma Var[v|priors, n, m_i, s_p]} = \frac{\mu_\theta \tau_\theta + \mu_y \tau_y + n\tau_n + m_i \tau_m + s_p \tau_p - (\tau_\theta + \tau_y + \tau_n + \tau_m + \tau_p)P_1}{\gamma} \tag{13}$$

The market clearing condition is: $\int_0^1 D_{I,1} \ + x = Q$. Use this to obtain the equilibrium price at $t = 1$:

$$P_1^* = \frac{\mu_\theta \tau_\theta + \mu_y \tau_y + \gamma(x - Q) + n\tau_n + y(\tau_m + \rho^2 \tau_x) + x\rho\tau_x}{\tau_\theta + \tau_y + \tau_n + \tau_m + \rho^2 \tau_x} \tag{14}$$

6.2 Discussion

The object of interest is the impact of signals of monetary policy markets receive on non-FOMC macro announcements (at $t = 1$ in the model) on asset prices. Hence, the focus is on the partial derviative of P_1^* against the average private signals regarding monetary policy, $\bar{m}$. This is the essence of the regression specifications of Section 4. Recalling that the equilibrium price in P_1^* averages individual private signals on monetary policy to re-write equation (14) in terms of $\bar{m}$ before taking the derivative below gives:

$$\frac{dP_1^*}{d\bar{m}} = \frac{\tau_m + \rho^2 \tau_x}{\tau_\theta + \tau_y + \tau_n + \tau_m + \rho^2 \tau_x} \tag{15}$$

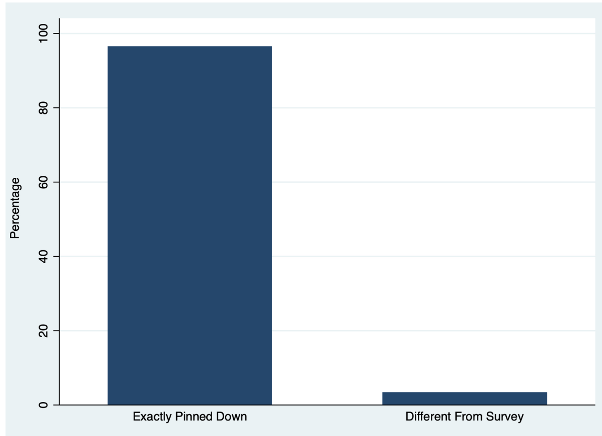
This partial derivative rises whenever precision of the private signals regarding monetary policy rise, i.e. when τ_m rises. There is reason to believe that by engaging in unconventional monetary policies, the Fed ***inadvertently*** reduced the ability of non-FOMC macro announcements to provide signals regarding its forthcoming policy decisions. Prior to the Crisis, the Fed mainly engaged in tweaking the Fed Funds Rate, with its announcements putting only slight emphasis on future actions.[15] Fed's policy decisions regarding the Fed Funds Rate instrument were fairly

[15]Review of FOMC statements from 1994 onward shows that perhaps the first occasion in which the Fed used communication as a policy instrument may have been on May 18, 1999. The FOMC provided reasons why it did not take any action, and noted its concerns that could merit future changes in policy. It stated, *"While the FOMC did not take action today to alter the stance of monetary policy, the Committee was concerned about the potential for a buildup of inflationary imbalances that could undermine the favorable performance of the economy and therefore adopted a directive that is tilted toward the possibility of a firming in the stance of monetary policy."* However, it was really starting in August 12, 2003 that the Fed began to provide guidance on a regular basis. On this occasion too, the Fed decided not to change the Fed Funds Rate, and after providing justification for its policy, the Fed stated its view about the future in the following words: *The Committee judges that, on balance, the risk of inflation becoming undesirably low is likely to be the predominant concern for the foreseeable future. In these circumstances, the Committee believes that policy accommodation can be maintained for a considerable period.*

well-explained by simple policy rules. The Fed lists 5 such policy rules on its website here, and even eye-balling the chart on its website shows that these rules did a decent job at explaining the Fed Funds Rate. Therefore, it is perhaps not surprising that nearly all of Fed's forthcoming policy announcements regarding this particular instrument were fully anticipated by market participants in the pre-GFC era. Using Bloomberg's survey data, it can be observed that pre-GFC, the markets were wrong about Fed's decision on only 4 occasions. The average survey value was off by 25 basis points in these instances. For the remaining 96% cases, the average survey value was exactly equal to the Fed's announced target. This suggests that markets' expectations of future Fed actions (occurring in the distant horizon) would be as good as their expectations of future releases of public information they base their expectations on. Hence, as long as markets update their views on the future using today's GDP release (for example), they can develop some expectations regarding Fed Funds Rate well into the future too, i.e. the path of Fed policy.

However, the nature of Fed's interventions changed post-GFC. It ceased to become a sequence of Fed Funds Rate interventions with some guidance about future policy. Instead, forward guidance become a central feature, and the Fed began to rely heavily on purchases of a variety of assets in large sums that it had not purchased ever before (QE). There is not a simple way to predict such Fed interventions ahead of time. A simple equation, such as a Taylor Rule, does not exist for forward guidance and QE. How many mortgage-backed-securities will the Fed purchase? How many long-term bonds? What kind of forward guidance will it provide in its next policy FOMC statement? These questions would be difficult to pin down from, say, GDP announcements occurring before a forthcoming Fed policy announcement. In the language of the model presented here, these institutional changes are tantamount to a **drop in τ_m post-GFC.**

Figure 4. Percentage of Fed's Conventional Policy Decisions Anticipated Ahead of Time

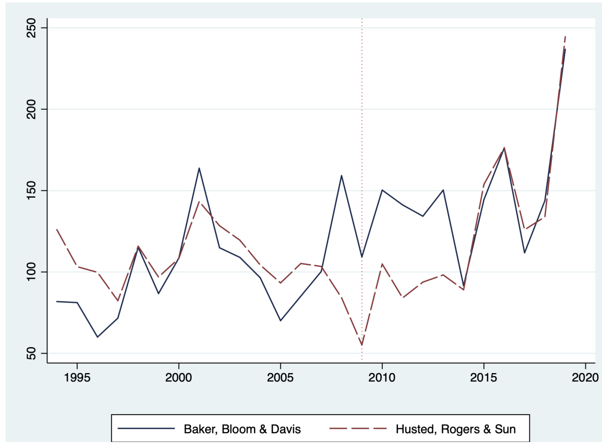


Note: The bar chart uses Bloomberg's survey data on the Fed's target rate decisions. The average survey values are compared against the announced decision. Whenever this difference is 0, it is categorized in the "exactly pinned down" bucket. For all non-zero values, they are placed in the other bucket. The bar chart uses all data available until Jun 30, 2008. There were a total of 90 observations in this pre-GFC period. 86 of these were categorized in the former bucket. The remaining 4 are consequently placed in the latter.

Another look at the partial described in equation (15) shows that Section 4's empirical finding that the impact of monetary policy, measured on non-FOMC announcements, reduced post-GFC could also be due to stronger priors regarding Fed's decisions, i.e. it could be because of a rise in τ_y. This is plausible as the Fed enhanced its communication in at least a few ways: it carried out press conferences, its FOMC statements became more detailed. However, popular empirical measures of monetary policy uncertainty that can be used to provide a rough estimate of these priors do not indicate that markets' priors became stronger post-GFC. In fact, if anything the plots in Figure 5 below suggest that these uncertainty measures have tended to rise post-GFC. Simple regressions of these indices against a constant and a dummy variable for the post-GFC era confirm this observation. The post-GFC dummy is positive and significant in both occasions, suggesting that the level of these uncertainty indices is on average higher in the post-GFC era.[16]

[16] Figure 5 shows annual averages of the two indices to help observe broad trends. The simple regressions mentioned in the text were conducted on the original monthly series. Specifically, the following was estimated: $\Delta MPU_{i,t} = constant + PostGFC$, where i notes the indices of Baker, Bloom and Davis (2016) and Husted, Rogers and Sun (2019). The $PostGFC$ dummy variable takes a value of 1 for all observations after July 01, 2009. The coefficient on this dummy was found to be positive and significant indicating that the index was on average at a higher level after the Crisis.

Figure 5. Annual Averages of Monetary Policy Uncertainty Indices



Note: The charts show text-based monetary policy uncertainty measures. The solid line plots index of Baker, Bloom and Davis (2016) based on 10 major papers. The long-dashed line shows the index of Husted, Rogers and Sun (2019). Annual averages of these indices are illustrated here. The dotted vertical line notes 2009.

The other parameters influencing the impact of signals of monetary policy on asset prices include priors about economic outlook or its signals markets receive on non-FOMC macro announcements. Let us consider them one by one. Macroeconomists often categorize the period between the mid-80s and prior to the Crisis as the "Great Moderation", an era during which major macro variables had reduced volatility. It would be hard to imagine why precision regarding economic outlook would have risen after the end of this exceptionally low volatile environment. Therefore, it would be difficult to argue that a rise in τ_θ post-GFC explains the empirical results in Section 4. Finally, it does not seem that τ_n appears to have risen either. Comparing volatility of revisions in data releases of the 4 macro announcements in this paper does not reveal any significant fall. This suggests that estimates released by authorities on these events appears to be of similar precision pre and post-GFC.

Thus, it appears that the driving factor behind the falling effects post-GFC documented in Section 4 appears to be the falling precision of signals regarding Fed policy that markets can obtain from macro announcements most relevant to the Fed's objectives.

7 Conclusion

Most analyses investigating monetary policy's effect on asset prices have been event studies that determine the impact of monetary policy actions by examining the impact on asset prices in narrow windows around Fed-related announcements. The ability of markets to anticipate Fed actions and how that might influence transmission of monetary policy to asset prices has not been deeply investigated. This is among the few studies that specifically aim to estimate monetary policy surprises on non-FOMC macroeconomic announcements, and examine their impacts on financial markets. 4 such non-FOMC announcements are examined: GDP, CPI, unemployment and industrial production. Their selection is based on the Fed's mandate of maximum employment and price stability, the presence of these variables in the most popular monetary policy rules, the fact that GDP, inflation and unemployment projections are routinely released by Fed officials, and that industrial production statistics are announced by the Fed. Thus, it would be easy to see why markets might develop expectations of monetary policy on these announcements. Positive covariance between stocks and bond yields were shown to suggest that measuring monetary policy surprises on these announcements required placing some structure on the data. Sign restrictions are one possible direction. This paper proposes a simpler PCA based method that exploits movements in bond yields and equity prices to extract monetary policy shocks. They are shown to be similar to sign restriction based shocks, and a series of robustness checks offer further evidence that a researcher may choose either direction in this particular application.

After choosing the PCA based measure as my benchmark, I carry out regression analyses and find that the impact of monetary policy surprises diminishes for a variety of assets. Thus, not surprisingly the impacts on overall financial conditions are lower post-GFC as well. The R^2 of regressions of asset prices against the monetary policy were also lower, suggesting a lower contribution of monetary policy surprises in explaining asset price movements on non-FOMC announcements post-GFC. In fact there is an overall decline in the ability of these announcements to influence bond market uncertainty. This is argued by showing the reduced bond premium on announcement, and falling ability to reduce interest rate volatility.

Finally, a simple information model was presented to help frame these empirical results. The driving economic force behind the diminishing impacts post-GFC appears to be a falling signal that markets receive regarding Fed's monetary policy actions. All these findings seem to suggest that an ***inadvertent byproduct*** of unconventional measures is the falling ability of non-FOMC announcements to reduce uncertainty about monetary policy actions. This can be critical for the transmission of monetary policy to asset prices as there are many more such non-FOMC announcements, while there are typically 8 FOMC announcements any given year. Collectively analyzing FOMC and non-FOMC announcements does not change the results that analysed non-FOMC announcements in isolation. This paper's main finding that impact of monetary policy on asset prices reduced post-GFC tends to contrast the message of the extant literature which examines monetary policy's impact on financial markets. This may interest a broader set of economists, and also policy makers when considering the use of unconventional monetary policies. After all in an influential study Bernanke and Kuttner (2005) write:

"The ultimate objectives of monetary policy are expressed in terms of macroeconomic variables such as output, employment, and inflation. However, the influence of monetary policy instruments on these variables is at best indirect. The most direct and immediate effects of monetary policy actions, such as changes in the Federal funds rate, are on the financial markets...Understanding the links between monetary policy and asset prices is thus crucially important for understanding the policy transmission mechanism."

References

[1] Adrian, Tobias, Richard Crump, Emanuel Moench (2013), "Pricing the Term Structure with Linear Regressions", Journal of Financial Economics 110 (2013) 110-138.

[2] Ai, Hengjie, and Ravi Bansal (2018), "Risk Preferences and the Macroeconmic Announcement Premium", Econometrica, Volume 86, Issue 4, Pages 1383-1430.

[3] Andersen, Torben, Tim Bollerslev, Francis Diebold, and Clara Vega (2003), "Micro Effects of Macro Announcements: Real-Time Price Discovery in Foreign Exchange", American Economic Review.

[4] Angeletos, George-Marios, and Chen Lian (2018), "Forward Guidance without Common Knowledge", American Economic Review VOL. 108, NO. 9, Sseptember 2018 (pp. 2477-2512)

[5] Baker, Scott, Nicholas Bloom, and Steven Davis (2016), "Measuring Economic Policy Uncertainty", The Quarterly Journal of Economics, Volume 131, Issue 4, November 2016, Pages 1593-1636, https://doi.org/10.1093/qje/qjw024.

[6] Bansal, Ravi, and Amir Yaron (2004), "Risks for the Long Run: A Potential Resolution of Asset Pricing Puzzles", Journal of Finance, 59, 1481-1509.

[7] Bauer, Michael, and Eric Swanson (2020), "The Fed's Response to Economic News Explains the 'Fed Information Effect'", NBER Working Paper 27013.

[8] Benamar, Hedi, Thierry Foucault, and Clara Vega (2020), "Demand for Information, Uncertainty, and the Response of U.S. Treasury Securities to News", Available at SSRN at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3162292.

[9] Bernanke, Ben and Kenneth Kuttner (2005), "What Explains the Stock Market's Reaction to Federal Reserve Policy?" Journal of Finance, 60, Issue 3, 1221â1257.

[10] Blinder, Alan, Charles Goodhart, Philipp Hildebrand, David Lipton, and Charles Wyplosz (2001), "How Do Central Banks Talk?", Geneva Report on the World Economy 3, Centre for Economic Policy Research, London, 2001.

[11] Boguth, Oliver, Vincent Gregoire, and Charles Martineau (2019a), "Price Pressure and Efficiency on FOMC Announcements", Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3350687

[12] Boguth, Oliver, Vincent Gregoire, and Charles Martineau (2019b), "Shaping Expectations and Coordinating Attention: The Unintended Consequences of FOMC Press Conferences", Journal of Financial and Quantitative Analysis, Volume 54, Issue 6 December 2019 , pp. 2327-2353.

[13] Boyarchenko, Nina, Valentin Haddad and Matthew Plosser (2016), "The Federal Reserve and market confidence", Staff Reports 773, Federal Reserve Bank of New York, revised 01 Apr 2017.

[14] Brenner, Menachem, Paolo Pasquariello, and Marti Subrahmanyam (2009), "On the Volatility and Comovement of U.S. Financial Markets Around Macroeconomic News Announcements", Journal of Fnancial and Quantitative Analysis, Vol. 44, No. 6, Dec. 2009, pp. 1265-1289.

[15] Bu, Chunya, John Rogers, and Wenbin Wu (2019), "A Unified Measure of Fed Monetary Policy Shocks", Finance and Economics Discussion Series 2019-043. Washington: Board of Governors of the Federal Reserve System, https://doi.org/10.17016/FEDS.2019.043.

[16] Campbell, John, and John Ammer (1993), "What Moves the Stock and Bond Markets? A Variance Decomposition for Long-Term Asset Returns", The Journal of Finance, Vol. 48, No. 1 (Mar., 1993), pp. 3-37.

[17] Cecchetti, Stephen, and Kermit Schoenholtz (2019), "Improving U.S . Monetary Policy Communications", Technical Report, NYU Stern 2019, Working Paper.

[18] Cieslak, Anna, Adair Morse, and Annette Vissing-Jorgensen (2019), "Stock Returns over the FOMC Cycle", The Journal of Finance, 74: 2201-2248.

[19] Cieslak, Anna, and Andreas Schrimpf (2019), "Non-monetary news in central bank communication", Journal of International Economics Volume 118, 2019, Pages 293-315, ISSN 0022-1996.

[20] Cieslak, Anna, and Annette Vissing-Jorgensen (2020), "The Economics of the Fed Put", Available on SSRN at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2951402.

[21] Coibion, Olivier, and Yuriy Gorodnichenko (2012), "What Can Survey Forecasts Tell Us About Information Rigidities?", Journal of Political Economy, vol. 120, no. 1.

[22] Cremers, Martijn, Matthias Fleckenstein, and Priyank Gandhi (2020), "Treasury Yield Implied Volatility and Real Activity", Forthcoming in Journal of Financial Economics, Available in SSRN at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3006473#.

[23] Del Negro, Marco, Marc Giannoni, and Christina Patterson (2015), "The Forward Guidance Puzzle", Federal Reserve Bank of New York Staff Reports, Staff Report No. 574.

[24] Duffee, Gregory (2012), "Forecasting Interest Rates", Chapter 7 in Handbook of Economic Forecasting Edited by Graham Elliott and Allan Timmermann.

[25] Ferrari, Massimo, Jonathan Kearns, and Andreas Schrimpf, 2017, "Monetary policy's rising FX impact in the era of ultra-low rates", BIS Working Papers No 626, April.

[26] Fisher, Adlai, Charles Martineau, and Jinfei Sheng (2020), "Macroeconomic Attention and Announcement Risk Premia", Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2703978

[27] Gilchrist, Simon, David Lopez-Salido, and Egon Zakrajsek (2015), "Monetary Policy and Real Borrowing Costs at the Zero Lower Bound", American Economic Journal: Macroeconomics, American Economic Association, vol. 7(1), pages 77-109, January.

[28] Goldstein, Itay, and Liyan Yang (2017), "Information Disclosure in Financial Markets", Annual Review of Financial Economics, 9(2017), pp. 101-125.

[29] Gurkaynak, Refet, Brian Sack, and Eric Swanson (2005), "Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements", International Journal of Central Banking, May.

[30] Gurkaynak, Refet, Brian Sack, and Eric Swanson (2007), "Market-Based Measures of Monetary Policy Expectations", Journal of Business and Economic Statistics, American Statistical Association, Vol. 25, pages 201-212, April.

[31] Hanson, Samuel, Jeremy Stein (2014), "Monetary policy and long-term real rates," Journal of Financial Economics, Elsevier, vol. 115(3), pages 429-448.

[32] Huang, Xin (2018), "Macroeconomic News Announcements, Systemic Risk, Financial Market Volatility and Jumps", Journal of Futures Market, Volume 38, Issue 5, May 2018, Pages 513-534.

[33] Husted, Lucas, John Rogers, and Bo Sun (2019), "Monetary Policy Uncertainty", Journal of Monetary Economics.

[34] Jarocinski, Marek, and Peter Karadi (2020), "Deconstrucing Monetary Policy Surprises - The Role of Information Shocks", American Economic Journal: Macroeconomics, 12 (2) (2020), pp. 1-43, 10.1257/mac.20180090.

[35] Jorda, Oscar (2005), "Estimation and Inference of Impulse Responses by Local Projections", American Economic Review Vol. 95, No. 1, March 2005 (pp. 161-182).

[36] Kroencke, Tim-Alexander, Maik Schmeling, and Andreas Schrimpf (2021), "The FOMC Risk Shift", SAFE Working Paper Series 302, Leibniz Institute for Financial Research SAFE.

[37] Laarits, Thomas (2019), "Pre-Announcement Risk", Working Paper, Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3443886.

[38] Lucca, David, and Emanuel Moench (2015), "The Pre-FOMC Announcement Drift", The Journal of Finance, 70: 329-371.

[39] Matheson, Troy, and Emil Stavrev (2014), "News and Monetary Shocks at a High Frequency: A Simple Approach", Economic Letters, September.

[40] McKay, Alisdair, Emi Nakamura, and Jon Steinsson (2016), "The Power of Forward Guidance Revisited", American Economic Review VOL. 106, NO. 10, October 2016 (pp. 3133-58)

[41] Nakamura, Emi, and Jon Steinsson (2018), "High-Frequency Identification of Monetary Non-Neutrality: The Information Effect", The Quarterly Journal of Economics, 1283-1330. doi:10.1093/qje/qjy004.

[42] Neuhierl, Andreas, and Michael Weber (2018), "Monetary Momentum", NBER Working Paper Series, June.

[43] Rigobon, Roberto, and Brian Sack (2006), "Noisy Macroeconomic Announcements, Monetary Policy, and Asset Prices", NBER Working Paper W12420.

[44] Rubio-Ramirez, Juan Francisco, Daniel Waggoner, and Tao Zha (2005), "Markov Switching Structural Vector Autoegressions: Theory and Application", Federal Reserve Bank of Atlanta 2005-27.

[45] Savor, Pavel, and Mungo Wilson (2013), "How Much Do Investors Care About Macroeconomic Risk? Evidence from Scheduled Economic Announcements", The Journal of Financial and Quantitative Analysis, Vol. 48, No. 2 (APRIL 2013), pp.343-375.

[46] Savor, Pavel, and Mungo Wilson (2014), "Asset Pricing: A Tale of Two Days", Journal of Financial Economics, 113 (2014) 171-201.

[47] Swanson, Eric (2017), "Measuring the Effects of Federal Reserve Forward Guidance and Asset Purchases on Financial Markets", NBER Working Papers 23311, National Bureau of Economic Research, Inc., June.

[48] Wang, Yifei, Toni Whited, Yufeng Wu, and Kairong Xiao (2020), "Bank Market Power and Monetary Policy Transmission: Evidence from a Structural Estimation", NBER Working Paper No. 27258, May.

Appendices

A Regression Results: Event-Day Effects

Table A.1: $\Delta y_t = \alpha + \beta_1 MPShock_t + \beta_2 MPShock_t * PostGFC_t + \epsilon_t$

	1y UST	2y UST	5y UST	30y UST	AAA-Rated	BBB-Rated
MPShock (β_1)	2.95***	4.59***	5.26***	3.77***	4.43***	4.58***
	(10.24)	(13.97)	(16.26)	(15.21)	(17.62)	(17.01)
MPShock*PostGFC (β_2)	-2.22***	-2.28***	-1.50***	-1.76***	-1.83***	-1.94***
	(-6.91)	(-5.64)	(-3.12)	(-3.46)	(-4.68)	(-5.07)
Observations	944	944	925	925	925	

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: The table reports estimates from regressions (see table title) evaluated on all non-FOMC macro announcements. $MPShock_t$ is the PCA based benchmark shock measure described in Section 3. As the shock is measured via PCA, the magnitude of coefficients do not have a clear meaning. The emphasis is on the sign and statistical significance of coefficients instead. The LHS variable in these regressions are noted in columns 2-7. See equations 4 and 5 for precise definitions of LHS variables. PostGFC is a dummy variable that takes a value of 1 on all values on and after Jul 01, 2009, and takes a value of 0 for all values on or before Jun 30, 2008.

B Regression Results: Impact Dynamics

Figure B.1. Impact Dynamics on non-FOMC Announcements

Note: 95% confidence intervals are constructed using robust standard errors. CIs of the $MPShock_t$ and ($MPShock_t$ + $MPShock_t * PostGFC$) term is shown on the vertical axis in the left (right) column. See equation (6) for the regression specification. $MPShock_t$ is the benchmark PCA based shock measure described in Section 3. The x-axis notes the horizon "h" of equation (6). It records the number of business days from announcement. h=0 represents the day of announcement. All 4 macroeconomic announcements (GDP, CPI, unemployment and industrial production) are clubbed together to form one singular non-FOMC announcement variable.

C Regression Results: Impact Dynamics on FOMC and Non-FOMC Announcements

FOMC announcements are included in the set of non-FOMC announcements to analyze "overall impacts". The PCA based shock is estimated separately on FOMC announcements, since these announcements are of a different nature. As one might anticipate the first component explaining equity price and 5y UST yield changes on FOMC announcements has a monetary policy type interpretation. The second factor has a "news" type interpretation, which the literature tends to call the "Fed Information Effect". Then the monetary policy shock series computed for non-FOMC announcements and FOMC announcements are appended together to estimate (6).

Figure C.1. Impact Dynamics on FOMC and non-FOMC Announcements Collectively Analyzed

Note: 95% confidence intervals are constructed using robust standard errors. CIs of the $MPShock_t$ and ($MPShock_t$ + $MPShock_t * PostGFC$) term is shown on the vertical axis in the left (right) column. See equation (6) for the regression specification. $MPShock_t$ is the benchmark PCA based shock measure described in Section 3. $MPShock_t$ is estimated separately for FOMC announcements. The non-FOMC and FOMC shocks are then appended to perform the analyses shown here. The x-axis notes the horizon "h" of equation (6). It records the number of business days from announcement. h=0 represents the day of announcement. All 4 macroeconomic announcements (GDP, CPI, unemployment and industrial production) are clubbed together to form one singular non-FOMC announcement variable.