Monetary Policy Uncertainty: Sources and Consequences

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Abstract

Why do stocks and bonds sometimes hedge each other and sometimes move together? We show that an unexplored explanation lies in the source of uncertainty about the future path of monetary policy. Using daily revisions in policy rate expectations, we decompose a novel market-based measure of policy path uncertainty into macroeconomic uncertainty and uncertainty about the Federal Reserve's reaction function. These two components generate sharply different macroeconomic dynamics. Macroeconomic uncertainty lowers output and inflation, prompting monetary policy easing, while reaction function uncertainty produces stagflationary pressures and monetary policy tightening. These contrasting dynamics carry through to financial markets. Both uncertainty sources reduce equity valuations, but macroeconomic uncertainty lowers Treasury yields whereas policy response uncertainty raises yields through higher real term premia. Consequently, stock-bond correlations turn negative when macroeconomic uncertainty dominates and positive when reaction function uncertainty prevails. Our decomposition thus provides a structural explanation for why the stock-bond correlation switches sign over time.

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1 Introduction

When investors are uncertain about the future path of interest rates, what exactly are they uncertain about? Uncertainty about the policy rate path can arise from two distinct sources: uncertainty about macroeconomic outcomes and uncertainty about how the central bank will respond to those outcomes. The first reflects uncertainty about economic fundamentals, while the second reflects uncertainty about the mapping from economic conditions to policy decisions, namely, the central bank's reaction function.

This distinction is easiest to see through two noteworthy episodes of elevated policy rate uncertainty. During the 2008 financial crisis, uncertainty about the future path of the federal funds rate rose dramatically, but the source was predominantly time varying-uncertainty about the macroeconomy (Ludvigson, Ma, and Ng, 2021). Investors faced extraordinary uncertainty about the depth and duration of the recession, but the Federal Reserve's reaction function was braodly understood: markets expected the central bank to ease aggressively to contain the financial collapse. The tightening cycle of 2022 presents a different case. Inflation had accelerated well above target, yet disagreement about the macroeconomic outlook was not the dominant source of uncertainty. Instead, investors were uncertain about how aggressively the Federal Reserve would respond to elevated inflation and how long it would maintain a restrictive stance. Indeed, Bauer, Pflueger, and Sunderam (2024) document substantial revisions in the perceived response of the policy rate to inflation during this period, highlighting the importance of uncertainty about the central bank's reaction function.

Does this distinction matter? A growing literature measures time-varying monetary policy uncertainty and explores the role it plays in macroeconomic fluctuations, beginning with Swanson (2006) and, more recently, Baker, Bloom, and Davis (2016) and Husted, Rogers, and Sun (2020). These studies demonstrate that policy uncertainty is economically meaningful and relevant for both macroeconomic and financial outcomes. Most existing measures, however, implicitly assume that the macroeconomic effects of monetary policy uncertainty depend on its magnitude, not on its source. If uncertainty about macroeconomic fundamentals and uncertainty about the central bank's reaction function affect the

economy through different channels, then treating them as equivalent may obscure important differences in how uncertainty shocks propagate. To fill this gap in the literature, we decompose time-varying uncertainty about the path of the policy rate into macroeconomic uncertainty and monetary policy response uncertainty and empirically show that these two sources generate fundamentally different consequences for macroeconomic activity and financial markets.

We show that these two sources generate sharply different macroeconomic and financial market dynamics. Macroeconomic uncertainty behaves like a demand shock, lowering output and inflation and leading to monetary policy easing. In contrast, uncertainty about the monetary policy response produces stagflationary dynamics: output declines while inflation rises, and monetary policy tightens. These differences have important implications for financial markets. Both types of uncertainty depress equity prices, but they have opposite effects on Treasury yields. Macroeconomic uncertainty lowers yields, generating negative stock-bond correlations and flight-to-safety dynamics. Monetary policy response uncertainty raises yields, driven primarily by higher real term premia, causing bonds to amplify rather than hedge equity losses. The source of monetary policy uncertainty therefore plays a central role in determining whether stocks and bonds move together or offset one another.

To investigate the sources and consequences of uncertainty about the future path of the policy rate, we first construct a measure of time-varying policy path uncertainty (PPU) for the United States and examine its evolution from 1991 to 2025. Our measure is based on daily revisions in expectations of the near-term path of the policy rate, extracted from federal funds futures and Overnight Index Swap (OIS) quotes. More precisely, for each intermeeting period—the window between consecutive meetings of the Federal Open Market Committee (FOMC)—we compute the realized volatility of these daily revisions across multiple horizons spanning roughly the next year and a half, and aggregate them into a single index that captures the intensity of belief updating about the expected path of monetary policy between FOMC meetings.

The key empirical challenge is to disentangle the sources of this uncertainty. We address this identification challenge using a structural vector autoregressive (SVAR) model

that explicitly distinguishes between macroeconomic uncertainty and monetary policy response uncertainty. The model includes industrial production, inflation, the expected forward rate, the financial uncertainty index of Jurado, Ludvigson, and Ng (2015) and Ludvigson et al. (2021), and our policy path uncertainty measure. Following Antolín-Díaz and Rubio-Ramírez (2018) and Ludvigson et al. (2021), we combine sign restrictions with narrative restrictions based on well-understood historical episodes to identify the two types of shocks. Sign restrictions impose the macroeconomic predictions of uncertainty shocks that operate like demand disturbances, while narrative restrictions ensure that the identified shocks align with salient historical episodes such as the 2008 financial crisis and the 2022 tightening cycle. Combining sign and narrative restrictions substantially sharpens identification relative to either approach alone, yielding a set of structural parameters consistent with the documented consequences of macroeconomic uncertainty shocks and with the economic properties of each shock during salient historical episodes.

The estimated macroeconomic effects of the two types of uncertainty are strikingly different. An increase in macroeconomic uncertainty produces a contraction in output, a decline in inflation, and a fall in the federal funds rate, a pattern consistent with a negative demand shock. An increase in monetary policy response uncertainty also reduces output but raises inflation and leads to monetary tightening. The inflation response provides the sharpest point of contrast between the two shocks: macroeconomic uncertainty is disinflationary, whereas monetary policy response uncertainty generates inflationary pressure despite declining economic activity. This divergence in inflation dynamics leads monetary policy to respond in oppsoite directions across the two environments. Our decomposition also reveals that each type of uncertainty accounts for a substantial share of the forecast error variance of output and inflation, but through different channels and at different horizons.

These macroeconomic differences translate directly into financial markets. Using local projections that propagate the full posterior uncertainty from the SVAR, we show that both types of uncertainty reduce equity prices, but through different channels. Macroeconomic uncertainty shocks depress equity valuations primarily through weaker expected cash flows. Specifically, value stocks, whose valuations depend on near-term cyclically

sensitive earnings, decline more than growth stocks. Monetary policy response uncertainty shocks, in contrast, raise discount rates and reduce equity valuations primarily through teh discount rate channel, with growth stocks, whose valuations depend more on distant cash flows, declining more than value stocks. The cross-sectional evidence confirms that the two shocks operate through the cash-flow and discount-rate channels predicted by models of duration-based equity pricing (Lettau and Wachter, 2007; Weber, 2018).

Since both shocks reduce equity prices, the sign of the stock-bond correlation depends entirely on how each shock transmits to Treasury yields. We show that macroeconomic uncertainty shocks reduce yields across the maturity spectrum, steepening the yield curve as markets anticipate monetary policy easing. In contrast, monetary policy response uncertainty shocks raise yields across the maturity spectrum, flattening the yield curve as inflation concerns keep short-term rates elevated. Because the two shocks push bond prices in opposite directions while both depressing equity prices, our decomposition provides a structural account of why the stock-bond correlation switches sign over time (Campbell, Sunderam, and Viceira, 2017; Song, 2022). Periods dominated by macroeconomic uncertainty generate the negative stock-bond correlations, with Treasury securities serving as effective hedges against equity losses. Periods dominated by monetary policy response uncertainty generate a positive stock-bond correlation, with Treasury securities amplifying rather than offsetting equity losses.

The response of real yields sheds lights on the mechanism underlying these dynamics. We find that the increase in nominal yields following monetary policy response uncertainty shocks is driven primarily by higher real term premia, rather than by by higher inflation expectations or inflation risk premia. When investors are uncertain about how the Federal Reserve will respond to economic conditions, Treasury securities become less effective portfolio hedges and bondholders demand additional compensation for bearing duration risk. In contrast, real yields decline following macroeconomic uncertainty shocks, consistent with expectations of lower future real rates as the Federal Reserve eases monetary policy. In this environment, long-duration inflation-protected securities become more attractive as hedges against economic downturns, compressing real term premia. These findings are consistent with Campbell, Pflueger, and Viceira (2020), who argue that the hedg-

ing properties of nominal bonds shift depending on whether inflation risk or real rate risk dominates the yield curve. Our decomposition also helps reconcile conflicting evidence on whether bond risk premia are countercyclical or procyclical: macroeconomic uncertainty shocks compress term premia, while monetary policy response uncertainty shocks expand them.

Related Literature: This paper contributes to several strands of literature examining monetary policy surprises, policy uncertainty, learning about the central bank's reaction function, and the asset-pricing implications of inflation risk and bond–equity comovement. A foundational literature identifies monetary policy surprises using high-frequency financial data. Kuttner (2001) measures unexpected changes in policy rates using federal funds futures, while Gürkaynak, Sack, and Swanson (2005) decompose monetary policy announcements into target and path factors. These studies establish that revisions in expected policy paths are central for understanding how monetary policy affects asset prices. However, this literature focuses on the level of policy surprises rather than on uncertainty surrounding the evolution of policy expectations.

More recent work develops explicit measures of monetary policy uncertainty. Husted et al. (2020) and Baker et al. (2016) construct newspaper-based monetary policy uncertainty indices, while Bundick, Smith, and der Meer (2024) propose an option-implied policy rate uncertainty (PRU) measure. De Pooter, Favara, Modugno, and Wu (2021) show that policy uncertainty interacts with the transmission of monetary policy to longer-term yields, highlighting its importance for financial conditions. These contributions demonstrate that monetary policy uncertainty is economically meaningful and relevant for macro-financial dynamics. Our paper builds on this literature by showing that policy-path uncertainty is not a single object but reflects distinct underlying sources. Existing measures typically treat policy uncertainty as a scalar object. In contrast, we construct a market-based measure that aggregates revisions in policy expectations during the intermeeting period and decompose it into two economically distinct components: macroeconomic uncertainty and reaction-function uncertainty. This decomposition allows us to trace distinct macroeconomic and asset-pricing consequences for different sources of policy-path uncertainty.

Our paper is also closely related to the broader literature studying uncertainty shocks

and their macroeconomic consequences. Bloom (2009) shows that uncertainty shocks reduce output and investment, while Jurado et al. (2015) construct a comprehensive macroeconomic uncertainty factor that predicts real activity. Ludvigson et al. (2021) further distinguish between macroeconomic and financial uncertainty shocks, demonstrating that different types of uncertainty have distinct macroeconomic implications. Our results complement and extend this body of work. While these papers distinguish between uncertainty about macroeconomic fundamentals and uncertainty originating in financial markets, we focus on a different dimension: uncertainty about how the central bank responds to economic conditions. In the context of monetary policy, Leduc and Liu (2016) argue that uncertainty shocks behave like aggregate demand shocks, lowering both output and inflation. Consistent with this mechanism, we find that the macroeconomic component of policy-path uncertainty behaves like an aggregate demand shock. However, we show that a distinct component, reaction-function uncertainty, has markedly different implications, raising inflation while contracting output and generating stagflationary dynamics. By distinguishing between uncertainty about economic fundamentals and uncertainty about the policy response itself, our framework helps reconcile mixed evidence on the inflationary consequences of uncertainty shocks.

Our work also relates to the literature studying belief formation and learning about the Federal Reserve's reaction function. Bauer et al. (2024) document substantial revisions in the perceived response of policy rates to inflation, highlighting time variation in beliefs about the structure of the policy rule. Bauer and Swanson (2023) revisit high-frequency identification of monetary policy shocks and emphasize the role of information effects embedded in announcement-day surprises. These studies underscore that financial markets continuously update their views about policy conduct and macroeconomic conditions. Andrei and Hasler (2025) develop a model in which investors learn about the transmission of monetary policy to macroeconomic outcomes, generating time variation in risk premia. This work highlights how uncertainty about policy effectiveness can influence asset pricing. We complement this literature by providing a high-frequency, market-based measure of uncertainty about the mapping from macroeconomic conditions to policy outcomes. Whereas Bauer et al. (2024) focus on shifts in the perceived level of reaction-function pa-

rameters, we focus on uncertainty surrounding the reaction function itself. By quantifying reaction-function uncertainty and tracing its macroeconomic and financial consequences, we provide a measurable market-based object for studying belief dynamics about monetary policy.

Finally, our findings contribute to the literature on bond risk premia and the time-varying correlation between stocks and bonds. Campbell, Sunderam, and Viceira (2009) show that stock-bond correlation regimes are closely tied to inflation risk and real rate dynamics. Bekaert, Engstrom, and Xu (2022) link inflation risk to equity risk premia, highlighting how inflation dynamics shape cross-asset pricing. Baele, Bekaert, Inghelbrecht, and Wei (2020) document flight-to-safety episodes in which bonds hedge equity risk during demand-driven downturns. We provide a structural mechanism linking policy-path uncertainty to these cross-asset dynamics. Macroeconomic uncertainty lowers real yields and generates negative stock-bond correlations, consistent with demand-driven flight-to-safety episodes. In contrast, reaction-function uncertainty raises real yields and weakens the hedging properties of bonds, generating positive stock-bond correlations. By linking different sources of policy-path uncertainty to distinct stock-bond correlation regimes, our results provide a unified explanation for time variation in bond–equity comovement grounded in monetary policy uncertainty.

2 A Market-Based Measure of Monetary Policy Path Uncertainty

This section introduces a market-based measure of uncertainty about the near-term path of the monetary policy target rate. Our measure builds on information revealed continuously through quotes on derivatives tied to expectations of the federal funds rate: federal funds futures and Overnight Index Swaps (OIS). For each intermeeting period, we compute the realized volatility of these daily revisions across multiple horizons, aggregating them into a single index that captures investors' uncertainty about the expected policy path over the near-term. This measure has three important properties for our purposes. First, it is model-free as we do not impose assumptions about the stochastic process generating belief revisions. Second, it embeds all the information revealed to financial markets between

FOMC meetings, such as economic news and central bank communications, including the FOMC meeting policy announcement. Third, it is purely market-based, reflecting actual uncertainty priced in by investors with money at stake. We first describe the construction of our policy path uncertainty (PPU) measure from 1991 to 2025, examine its behavior over the business cycle, and compare it with other proxies for monetary policy uncertainty used in the literature.

2.1 A Market-Based Measure of Policy Rate Uncertainty

Our approach builds on the high-frequency identification literature pioneered by Kuttner (2001) and extended by Gürkaynak et al. (2005). We take this framework and push it further. Rather than focusing solely on announcement-day surprises, we recognize that information about monetary policy flows to markets continuously. Over each intermeeting period—those six weeks between FOMC meetings—markets are anything but dormant. Every day, investors update their beliefs about the economic outlook, and the Federal Reserve's likely path for interest rates as they digest new data on economic activity and inflation, as well as central bank communications. These daily revisions in expectations contain information that announcement-day surprises alone miss entirely.

We construct our measure of monetary policy rate path uncertainty as follows. First, we compute a daily measure of how much financial markets' view of the near-term policy path changed, combining information from both fed funds futures and OIS quotes. More precisely, the one-day revision in expectations about the policy rate h meetings ahead is:

$$\Delta i_{t_j}^{(h)} \equiv \left(\mathbb{E}_{t_j} - \mathbb{E}_{t_{j-1}}\right) i^{(h)} \tag{1}$$

where i^n is the federal funds target rate set h FOMC meetings ahead. For the next four meetings ($h = 1, \ldots, 4$) we use federal funds futures to capture how much financial markets' view of the policy rate h meetings ahead changed from one day to the next. For horizons beyond four meetings, where fed funds futures liquidity becomes unreliable (particularly in the 1990s and early 2000s), we switch to using the expected path for the federal funds rate implied by the OIS zero curve. The daily revision $\Delta i_{t_j}^{(h)}$ at these longer horizons comes

from changes in the spline-fitted policy forward rates rather than directly from futures contracts.[1]

Using the daily revisions in policy expectations, we construct the realized volatility of the path of the policy rates at various horizons. Let t index FOMC meetings and J denote the trading days between meetings t and $t+1$. On each day j, we observe a revision in expectations about the near-term policy path, $\Delta i_{t_j}^{(h)}$ for $h > 0$. The realized volatility of policy expectations over this intermeeting period for the policy rate h meetings ahead is computed as:

$$\text{RVol}_t^{(h)} = \sqrt{\sum_{j=1}^{J} \left(\Delta i_{t_j}^{(h)}\right)^2} \tag{2}$$

To obtain a single measure of uncertainty about the near-term path of the policy rate, we average the realized volatility measure across the next 12 meetings ($h = 1, \ldots, 12$), covering roughly one year and half, and we label this measure as policy path uncertainty:

$$\text{PPU}_t = \frac{1}{H} \sum_{h=1}^{H} \text{RVol}_t^{(h)} \tag{3}$$

We set $H = 12$ because this horizon covers the portion of the policy path most relevant for monetary transmission, as asset prices and macroeconomic outcomes are particularly sensitive to expectations about the policy rate over the next several quarters. Restricting attention to twelve meetings also avoids placing excessive weight on very long-horizon contracts, which are less liquid and more likely to embed a term premium.

2.2 Some Empirical Facts About Policy Path Uncertainty

Table 1 presents summary statistics for our measure of policy path uncertainty (PPU) over our sample of 275 FOMC meetings from August of 1991 to December of 2025. The mean of this measure is around 0.79 percent, with a standard deviation of 0.49 percent. It is also evident that the series exhibits considerable serial correlation and is predictable, with the first-order autocorrelation of 0.70 declining gradually to 0.55 at the fourth lag. When is

[1] Appendix A describes in detail our data sources and methodologies to extract surprises about the policy rate using quotes on federal funds futures and OIS zero curve.

uncertainty about the policy path high? Table 2 shows that PPU is higher during Federal Reserve easing cycles and during NBER recessions. As shown in Column 1, during easing cycles, realized volatility increases 0.53 percentage points above normal, a roughly 80% increase. On the other hand, during tightening cycles, the increase is only 0.14 percentage points and statistically insignificant. Column 2 shows that PPU also increases during NBER recessions by about 0.5 percentage points.

Figure 1 plots the estimated PPU series over our sample period along with a line marking moves one standard deviation above its unconditional mean. Consistent with our previous results, PPU exhibits large spikes around periods of high financial and economic uncertainty: September 11; the 2008 global financial crisis; the onset of the COVID-19 virus in early 2020; and the banking panic in March of 2023 precipitated by the failures of Silicon Valley Bank (SVB), Signature Bank, and First Republic Bank. The spikes of PPU around these periods suggests that uncertainty about the economic outlook translates into uncertainty about monetary policy path.

Figure 1 shows that uncertainty about the policy path was also relatively high during times when investors were uncertain about how the Federal Reserve would react to economic shocks: the tightening of monetary policy in early 1994, occurring in an environment with declining inflation; the reductions in the federal funds rate following the Russian debt default in the fall of 1998 despite the view at the time that the economy was expanding; and the tightening of 2022, when investors were uncertain if the central bank would stick with its customary gradual approach, raising rates by 25 basis point at a time, or move aggressively given the rise in inflation. These periods highlight that uncertainty about the monetary policy path can also increase in times when investors are uncertain about the Federal Reserve's reaction function as opposed to uncertainty about the economy.

Our measure of policy path uncertainty shares several attractive properties with the model-free realized volatility estimators developed in the high-frequency finance literature (Andersen, Bollerslev, Diebold, and Labys, 2001, 2003; Barndorff-Nielsen and Shephard, 2002). First, the measure is model-free as we do not impose assumptions about the stochastic process generating belief revisions. Under standard semimartingale assumptions for forward rates, realized volatility computed as the sum of squared daily revisions

Table 1: Summary Statistics of Policy Path Uncertainty

	Mean	Std Dev	AC(1)	AC(2)	AC(3)	AC(4)
PPU	0.79	0.49	0.70	0.66	0.59	0.55
	(0.11)	(0.04)	(0.10)	(0.12)	(0.14)	(0.16)

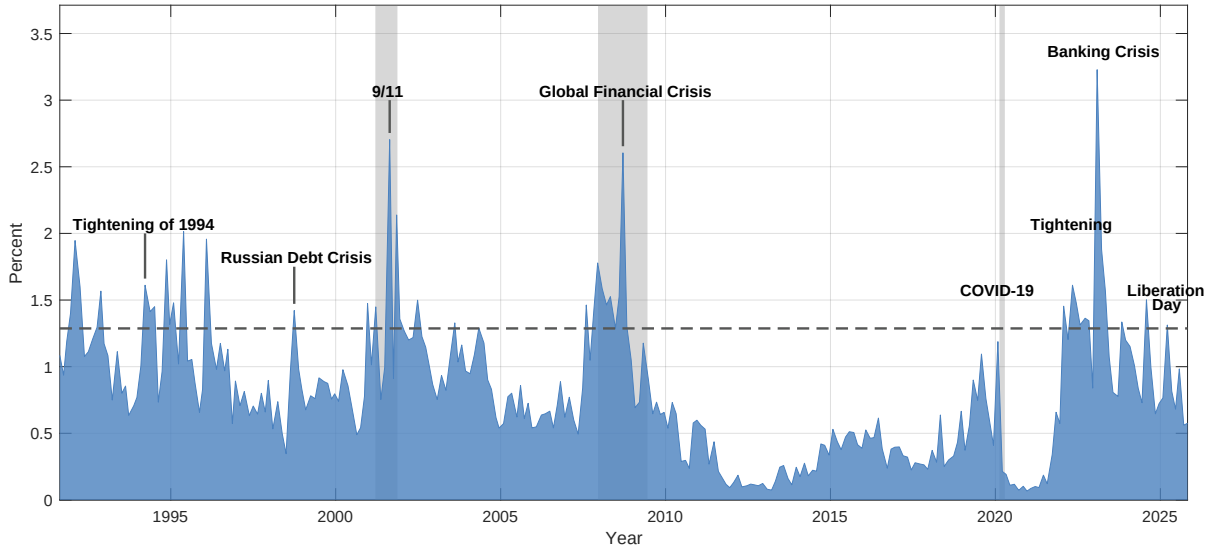
This table reports summary statistics for our measure of policy path uncertainty (PPU) expressed in annual percentage points. The sample covers 275 FOMC meetings from August 1991 to December 2025. The table reports the mean, standard deviation, and autocorrelations at lags 1 through 4. Bootstrap standard errors using 5,001 replications of the stationary bootstrap of Politis and Romano (1994) are reported in parentheses.

Table 2: Policy Path Uncertainty over the Business Cycle

	Dep. Variable: PPU	
	(1)	(2)
Easing	0.531	
	(0.16)	
Tightening	0.139	
	(0.17)	
Recession		0.531
		(0.28)
Constant	0.661	0.754
	(0.11)	(0.11)
R^2	0.159	0.079
Observations	275	275

This table reports coefficients from OLS regressions of policy path uncertainty (PPU) measured around FOMC meetings on dummy variable indicators. Column (1) includes dummy variables for Federal Reserve easing and tightening periods. Column (2) includes a dummy variable equal to one during NBER-dated recessions. PPU is measured in percentage points. Bootstrap standard errors using 5,001 replications of the stationary bootstrap of Politis and Romano (1994) are reported in parentheses.

Figure 1: **Market-based Monetary Policy Path Uncertainty**



This figure plots the time series of our measure of policy path uncertainty (PPU) expressed in annual percentage points. The sample covers 275 FOMC meetings from August 1991 to December 2025. The horizontal line corresponds to 1 standard deviation above the unconditional mean. Shaded areas correspond to NBER recession dates.

provides a consistent estimator of the underlying quadratic variation of the expected policy path (Andersen et al., 2003). In other words, our measure recovers the latent variance of belief revisions without requiring a parametric model for the stochastic process governing expectations. Second, our measure directly aggregates all the information revealed to financial markets between FOMC meetings, not just the post-meeting announcement or days when financial news pay more attention to monetary policy, but also macroeconomic data releases, Federal Reserve communications, and financial market developments that arrive throughout the intermeeting period. This is a meaningful advantage over announcement-day measures, which capture only one source of news in a narrow window. Finally, the measure is constructed from federal funds futures and OIS quotes, which are among the most liquid instruments in fixed income markets. This is a key feature because the one measure closer to ours, the option-implied policy rate uncertainty measure of Bundick et al. (2024), is subject to two concerns. Option-implied volatility reflects the risk-neutral distribution of future policy outcomes, and therefore conflates actual uncertainty with the variance risk premium, the price investors are willing to pay to insure against volatility risk. Mueller,

Vedolin, and Zhou (2019) show that the variance risk premium in interest rate markets is economically large and time-varying, and that it predicts short-run bond risk premia with power that is orthogonal to standard bond return predictors. If option-implied measures commingle actual uncertainty with a component that independently predicts bond returns, using them as regressors in financial market analysis introduces a mechanical confound that is difficult to control for. Our realized volatility measure sidesteps this problem. Furthermore, the Bundick et al. (2024) measure is based on Eurodollar options for most of its sample. These contracts became increasingly illiquid and were eventually phased out, raising additional concerns about the reliability of the option-implied signal, particularly during periods of financial stress when a clean measure of uncertainty is most needed.[2]

The distinction between realized and option-implied volatility is not merely a matter of measurement, the two objects have fundamentally different economic content. Berger, Dew-Becker, and Giglio (2020) show that innovations in realized stock market volatility are followed by economic contractions, while shocks to forward-looking option-implied volatility have no significant effect on real activity. Their results suggest that it is the realization of large shocks, not the expectation that future shocks will be large, that matters for economic outcomes. Similarly, our measure is designed to capture the actual intensity of belief updating about the policy path, rather than the market's risk-adjusted expectation of future policy rate dispersion.

With these properties in mind, we examine how our measure relates to other widely cited uncertainty indicators. Table 3 reports correlations and bootstrap confidence intervals with five prominent measures: the Economic Policy Uncertainty (EPU) index of Baker et al. (2016), the Monetary Policy Uncertainty (MPU) index of Husted et al. (2020), the Kansas City Fed's option-implied Policy Rate Uncertainty (KCPU) measure of Bundick et al. (2024), and the macroeconomic (MU) and financial (FU) uncertainty factors of Jurado et al. (2015) and Ludvigson et al. (2021).

The first row of Table 3 shows that the correlation with Baker et al. (2016)'s EPU index is essentially zero, suggesting that general economic policy uncertainty (i.e., fiscal, regu-

[2]The term premium embedded in federal funds futures expectations at short horizons is documented to be small. For example, Diercks and Carl (2019) reports a term premium that fluctuates between negative 2 and 2 basis points at the 6-month horizon.

latory, and trade policy uncertainty) is distinct from uncertainty about the near-term path of interest rates. The correlation with the Husted et al. (2020) MPU index is positive but surprisingly modest ($\rho = 0.14$). This low correlation reflects fundamental differences in what the two measures capture. The MPU index counts newspaper articles mentioning monetary policy uncertainty. Newspapers write about monetary policy uncertainty when dramatic events occur or when commentators speculate about Federal Reserve intentions, making the index a noisy proxy for actual market uncertainty. Our measure, in contrast, captures the realized intensity of belief revisions when new information arrives, providing a tighter link to policy rate uncertainty.

The correlation with the Kansas City Fed's option-implied uncertainty is strong ($\rho = 0.80$), indicating that both measures track similar movements in policy rate uncertainty. The high correlation is reassuring as it confirms that our realized volatility measure captures the same underlying uncertainty dynamics that option prices reflect. At the same time, the two measures are not identical, and the discussion above explains why. The twenty percent of variation that is not shared likely reflects time-varying risk premia embedded in option prices, precisely the component that Mueller et al. (2019) show predicts bond returns independently of actual uncertainty, and that Berger et al. (2020) show is unrelated to real economic outcomes.

Finally, the last two rows of Table 3 present the correlations with Ludvigson et al. (2021)'s macroeconomic uncertainty (MU) and financial uncertainty (FU) factors. The correlations, for various forecast horizons, are positive but modest, ranging from 0.08 to 0.18. This low correlation is consistent with the narrative events we highlighted in Figure 1, and is a key motivating fact for our subsequent analysis. If uncertainty about the policy path were driven exclusively by macroeconomic uncertainty, these correlations would be substantially higher. The fact that they are low confirms that uncertainty about the Federal Reserve's reaction function is a quantitatively important and distinct source of policy path uncertainty, one that existing macroeconomic uncertainty measures do not capture.

Table 3: Correlation of Policy Path Uncertainty with Alternative Uncertainty Measures

Uncertainty Measure	Correlation	95% CI
EPU	-0.15	$[-0.30, 0.07]$
MPU	0.14	$[-0.02, 0.31]$
KCPU	0.80	$[0.70, 0.85]$
$\text{FU}_{h=1}$	0.17	$[-0.10, 0.42]$
$\text{MU}_{h=1}$	0.08	$[-0.20, 0.42]$
$\text{FU}_{h=3}$	0.17	$[-0.10, 0.42]$
$\text{MU}_{h=3}$	0.10	$[-0.18, 0.43]$
$\text{FU}_{h=12}$	0.17	$[-0.10, 0.44]$
$\text{MU}_{h=12}$	0.18	$[-0.13, 0.50]$

This table reports correlations between policy path uncertainty (PPU) and alternative uncertainty measures. The EPU is the Economic Policy Uncertainty of Baker et al. (2016). MPU is the Monetary Policy Uncertainty Index of Husted et al. (2020). KCPU is the Kansas City Fed Policy Rate Uncertainty of Bundick et al. (2024). FU_h and MU_h are the Financial and Macroeconomic uncertainty factors at h-month horizons of Jurado et al. (2015) and Ludvigson et al. (2021). The table reports 95% confidence intervals computed via stationary bootstrap with 5,001 replications (Politis and Romano, 1994). The sample for EPU, KCPU, and PPU covers 275 FOMC meetings from August 1991 to December 2025; the sample for FU_h and MU_h covers August 1991 to May 2025; the sample for MPU covers August 1991 to [XX].

3 Macroeconomic Uncertainty and Monetary Policy Response Uncertainty as Drivers of Policy Path Uncertainty

The empirical behavior of PPU suggests that uncertainty about the policy path rises in times when the economic outlook is uncertain, and also in times when investors are uncertain about the Federal Reserve's reaction function. This section develops a structural VAR to decompose our market-based measure of policy path uncertainty, PPU, into two distinct shocks: macroeconomic uncertainty (MU) and monetary policy response uncertainty (MPRU).

3.1 The Structural Vector Autoregression: Identification and Estimation

We estimate a structural vector autoregression (SVAR) of the following form,

$$\mathbf{y}_t'\mathbf{A}_0 = \sum_{\ell=1}^{p} \mathbf{y}_{\ell-1}'\mathbf{A}_\ell + \mathbf{c} + \boldsymbol{\varepsilon}_t' \tag{4}$$

where the vector $\mathbf{y}_t$ contains the cyclical component of industrial production, core CPI inflation, the expected policy rate eight meetings ahead, the financial uncertainty index of Jurado et al. (2015) and Ludvigson et al. (2021), and our policy path uncertainty measure (PPU). The vector of structural shocks, ε_t, is assumed to be Gaussian with mean zero and covariance matrix $\mathbf{I}_n$. We set the lag length to $p = 8$ intermeeting periods, covering roughly one year of lagged information.

We want to isolate two specific structural shocks: macroeconomic uncertainty (MU) and monetary policy response uncertainty (MPRU). It is well known that the SVAR in Equation (4) is not identified as infinitely many different structural decompositions can generate the same reduced-form correlations. The standard approach to this problem in the empircal literature estimating the macroeconomic consequences of uncertainty has been to impose a recursive (Cholesky) ordering on the variables. Such an ordering is problematic in our setting because it would require taking a stand on whether macroeconomic uncertainty is ordered before or after monetary policy response uncertainty, a restriction for which we have no theoretical guidance. In practice, both types of uncertainty can respond to the same events within an intermeeting period, and there is no reason to assume that one is predetermined with respect to the other.

An alternative is to use sign restrictions alone, which avoid the need for a specific ordering. As Wolf (2020) demonstrates, however, sign restrictions often yield wide identified sets, and the resulting impulse responses may include structural decompositions with very different economic interpretations. In our context, sign restrictions alone may not distinguish between MU and MPRU shocks if both can produce short-run declines in output and increases in policy path uncertainty.

Following Arias, Rubio-Ramírez, and Waggoner (2018) and Antolín-Díaz and Rubio-Ramírez (2018), we address both limitations by combining sign restrictions on the impulse response functions with narrative restrictions on the structural shocks around specific historical events. The combination dramatically sharpens the identified set relative to either approach alone, yielding a set of structural parameters consistent with the documented consequences of macroeconomic uncertainty shocks and with the economic properties of each shock during salient historical episodes.

Sign Restrictions on the IRFs. As shown in Table 4, we impose that the MU shock (ε_t^{MU}) operates like an aggregate demand shock. Bloom (2009) and Leduc and Liu (2016), among others, show that uncertainty about economic fundamentals induces precautionary behavior by firms and households. Firms delay hiring and investment, and households postpone purchases of durable goods. More importantly, they show that inflation falls as the demand contraction puts downward pressure on prices.[3] Consistent with this evidence, we require that for a positive macroeconomic uncertainty shock: financial uncertainty (FU) increases on impact and for the next three periods, as a macroeconomic uncertainty shock should have a positive and persistent effect on measured macroeconomic uncertainty; industrial production and inflation fall for the first three periods, as precautionary behavior reduces aggregate demand; and the measure of policy path uncertainty rises, as investors, unclear about where the economy is going, are uncertain about the appropriate path for the policy rate, even as the Federal Reserve's reaction function is known.

For the MPRU shock (ε_t^{MPRU}), we assume that uncertainty about future policy rates raises its own real options problem: investors are uncertain about how the Federal Reserve will respond to economic developments, so firms and households face uncertainty about future financing costs. When the interest rate environment is unclear, delay becomes an optimal response, and output falls. We leave the response of inflation unrestricted for this shock since the theoretical effect is ambiguous. On one hand, reduced investment and production suggest a contraction of economic activity. On the other hand, if MPRU reflects uncertainty about whether the Federal Reserve will respond aggressively to inflation, it could operate like a supply shock—raising inflation risk premia and long-term nominal interest rates—generating stagflationary dynamics. We let the data tell us which force dominates.

Narrative Restrictions. Sign restrictions alone may not uniquely identify structural shocks, particularly when multiple shocks can produce similar short-run responses (Wolf, 2020). Following Antolín-Díaz and Rubio-Ramírez (2018), we augment sign restrictions with narrative restrictions that constrain both the signs and the relative contributions of

[3] See also Basu and Bundick (2017), who show in a New Keynesian model with Epstein-Zin preferences that uncertainty shocks generate demand-like contractions when prices are sticky, and Cascaldi-Garcia, Sarisoy, Liao, Sun, Ghironi, Ozturk, Doh, Ferreira, and Phan (2023), who provide a comprehensive survey of the empirical evidence on the macroeconomic effects of uncertainty.

Table 4: Sign Restrictions on Impulse Responses

	Shock			
	Macro Uncertainty (ε^{MU})		Monetary Policy Response Uncertainty (ε^{MPRU})	
Variable	Sign	Horizons	Sign	Horizons
Industrial Production	$-$	0–2	$-$	0–2
Inflation	$-$	0–2		
Financial Uncertainty	$+$	0–4		
Policy Path Uncertainty	$+$	0–2	$+$	0–4

the structural shocks during specific historical episodes where we have strong priors about which type of uncertainty dominated. As Ludvigson et al. (2021) demonstrate, these types of restrictions help ensure that identified shocks align with established accounts of macroeconomic fluctuations during critical periods.

We impose the following narrative restrictions:

1. **Tightening of 1994:** *The monetary policy response uncertainty shock, ε^{MPRU}, must be positive between the February and March 1994 FOMC meetings, and ε^{MPRU} (not ε^{MU}) must dominate the contribution to policy path uncertainty during the first three inter-meeting periods, February to May.* On February 4, 1994, the FOMC raised the federal funds rate for the first time in five years. As noted in the minutes of this meeting, financial markets considered a firming of monetary policy as likely in the next few months, but not in the very near term since there were no signs of inflationary pressures. Greenspan himself acknowledged that the rate increase caught financial markets off guard: "We have created a degree of uncertainty... we probably have imparted or have been associated with a larger degree of restraint than we had anticipated."[4] Over this period, several Federal Reserve officials, including former Vice Chair Alan Blinder, voiced concerns that the rapid hikes might have gone too far. This created genuine uncertainty about how the Federal Reserve would respond to macroeconomic conditions going forward.

[4]The Federal Open Market Committee Conference Call, February 28, 1994.

2. **The 2008 Financial Crisis:** *The macroeconomic uncertainty shock, ε^{MU}, must be positive between August and December of 2008, and ε^{MU} (not ε^{MPRU}) must be the dominant contributor to the spike in financial uncertainty during this period.* The collapse of Lehman Brothers and the subsequent financial crisis created extreme uncertainty about economic fundamentals. As in Ludvigson et al. (2021), we assume that this was quintessentially a macroeconomic uncertainty shock. On the other hand, there was not much uncertainty about how the Fed would respond. Everyone understood that Chair Bernanke, a scholar of the Great Depression, would do whatever it took to avert a financial collapse.

3. **Onset of COVID-19:** *The macroeconomic uncertainty shock, ε^{MU}, must be positive January through March 2020, and ε^{MU} (not ε^{MPRU}) must be the dominant contributor to the spike in financial uncertainty during this period.* COVID-19 created massive uncertainty about the economic outlook. The U.S. unemployment rate spiked at the fastest rate in recorded history. Economic forecasters had no idea how severe or persistent the effects would be. Again, this was a shock to macroeconomic uncertainty, not uncertainty about the Federal Reserve's reaction function. The Federal Reserve's response was as expected: immediate and aggressive easing.

4. **Spring of 2022:** *The monetary policy response uncertainty shock, ε^{MPRU}, must be positive between the January and May 2022 FOMC meetings, and ε^{MPRU} (not ε^{MU}) must dominate the contribution to policy path uncertainty during this period.* By early 2022, inflation had clearly accelerated, and the Federal Reserve began increasing the policy rate in March 2022. At this time, markets faced genuine uncertainty about how aggressive the response would be. Bauer et al. (2024) provides evidence that professional forecasters were highly uncertain about the monetary policy rule's response to inflation over this period and updated their perceptions toward a stronger policy response as the Federal Reserve increased interest rates.

5. **March 2023:** *The macroeconomic uncertainty shock, ε^{MU}, must be positive during March 2023.* The failure of Silicon Valley Bank in March 2023, followed by the collapse of Signature Bank, triggered fears of a broader regional banking crisis. This episode created

high uncertainty about financial stability and its real economic consequences. The uncertainty was about the severity and persistence of financial stress, not about the monetary policy rule.

These narrative restrictions are chosen to represent clear cases where one type of uncertainty dominated, while remaining agnostic about whether other shocks might have also been at play during those events. The 2008 financial crisis, the COVID-19 pandemic, and the spring 2023 banking crisis created uncertainty about economic outcomes, not about how the Federal Reserve would respond to those outcomes. In contrast, the 1994 and 2022 episodes involved markets learning that the Federal Reserve's reaction function differed from their prior beliefs. By anchoring the identification to these episodes, we ensure the shocks we extract have sensible interpretations that align with the historical narrative.

We estimate the reduced-form VAR using Bayesian methods with a standard Normal-inverse-Wishart prior on the reduced-form parameters (Kadiyala and Karlsson, 1997). To sample from the set of structural parameters satisfying our identifying restrictions, we follow the algorithm of Arias et al. (2018). The algorithm proceeds in two stages. In the first stage, for each draw of the reduced-form parameters from the posterior, we draw orthogonal rotation matrices from a uniform distribution over the space of orthogonal matrices and retain those that satisfy the sign restrictions in Table 4. We generate 30,000 draws at this stage. In the second stage, following Antolín-Díaz and Rubio-Ramírez (2018), we use importance sampling to re-weight the accepted draws so that the posterior properly reflects the narrative restrictions. For each retained draw, we compute an importance weight proportional to the likelihood that the draw satisfies the narrative sign restrictions and the narrative contribution restrictions described above. We use 5,000 draws to compute the importance weights. After re-weighting, we retain 1,670 draws from the posterior distribution of structural parameters consistent with both the sign and narrative restrictions. The effective sample size—a measure of how many independent draws the importance-weighted sample is equivalent to—is approximately 250, indicating that the narrative restrictions are informative but do not concentrate the posterior on a negligibly small region

of the parameter space.[5] All impulse responses, forecast error variance decompositions, and historical decompositions reported below are computed across the full set of retained posterior draws, and we report point-wise medians along with 68 percent highest posterior density credible intervals.

3.2 The Disparate Effects of Uncertainty Shocks

We now turn to the estimated impulse responses. The central question is whether the two sources of policy path uncertainty, macroeconomic uncertainty and monetary policy response uncertainty, produce different macroeconomic dynamics. The answer is unambiguous.

Figure 2 presents impulse responses to a one-standard-deviation macroeconomic uncertainty shock, ε^{MU}. The solid lines are the point-wise median responses and the shaded areas represent the 68 percent highest posterior density credible sets. Industrial production falls almost half a percentage point on impact and is down by 0.7 percent about 8 intermeeting periods (roughly 1 year) after the macroeconomic uncertainty shock hits the economy. Inflation also declines by roughly 0.1 percentage point on impact. The expected policy rate falls by approximately 0.2 percentage points after 1 year, consistent with the Federal Reserve easing policy to offset the contractionary effects of heightened uncertainty. Financial uncertainty rises persistently, remaining elevated for almost two years. Policy path uncertainty also increases, though the effect is short-lived. This pattern—output and inflation decline, the central bank eases, uncertainty rises—is the signature of a negative demand shock, consistent with the theoretical predictions of Leduc and Liu (2016) and Basu and Bundick (2017) and with the empirical evidence in Ludvigson et al. (2021).

Figure 3 shows the macroeconomic effects of a monetary policy response uncertainty shock, ε^{MPRU}. As with a macroeconomic uncertainty shock, an increase in MPRU leads to a decline in industrial production, with output falling around 0.4 percent on impact. But the response of inflation is strikingly different, inflation increases by around 0.2 percentage point on impact and remains above trend for roughly 8 intermeeting periods. The ε^{MPRU}

[5] This effective sample size is comparable to those reported in Antolín-Díaz and Rubio-Ramírez (2018) and Ludvigson et al. (2021) for applications with a similar number of narrative restrictions.

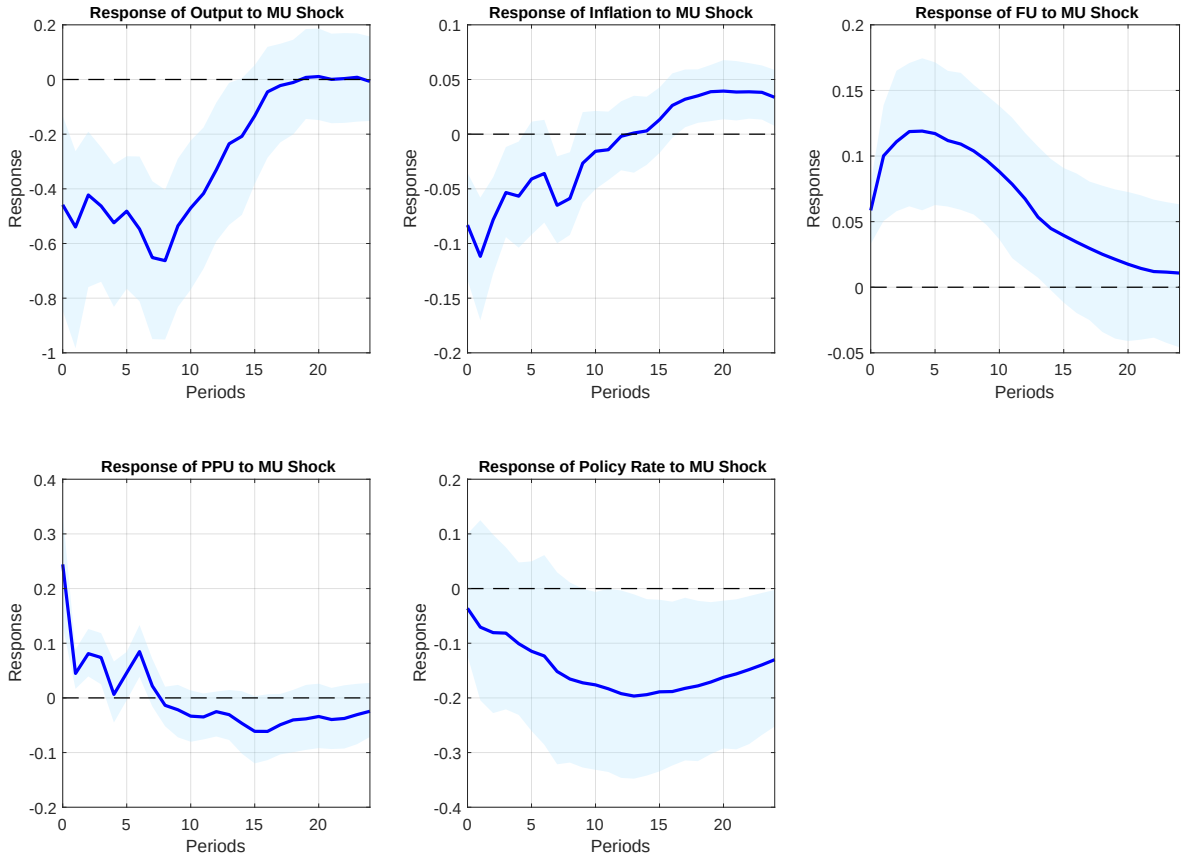
shock creates a supply-like shock pattern: economic activity declines and inflation rises. The increase in the expected policy rate suggests that the Federal Reserve leans against the inflationary pressure despite the output contraction: when the Federal Reserve faces the risk of losing credibility or clarity about its reaction function, it tightens policy to maintain credibility, even when growth is already weak.

The stagflationary behavior of ε^{MPRU} is a novel and key empirical finding. Recall that our sign restrictions leave the inflation response to ε^{MPRU} unrestricted, the positive inflation response is not imposed but emerges from the data. This result distinguishes our paper from the existing literature on monetary policy uncertainty, which has treated all policy uncertainty as generating demand-like contractions (Husted et al., 2020; Bauer, Lakdawala, and Mueller, 2022). Our results highlight that the distinction matters, whether an increase in policy path uncertainty acts as a demand shock or a supply shock depends on its source, and conflating the two sources obscures the economics of the transmission mechanism.

Figure 3 also shows that an ε^{MPRU} shock leads to a persistent increase in policy path uncertainty that keeps PPU above normal for about 2 years (16 intermeeting periods). In contrast, financial uncertainty barely moves in response to an ε^{MPRU} shock, increasing only modestly over the next few periods, though the effect is estimated imprecisely. This lends further support to our interpretation: MPRU reflects uncertainty about the Federal Reserve's policy response, not about macroeconomic fundamentals.

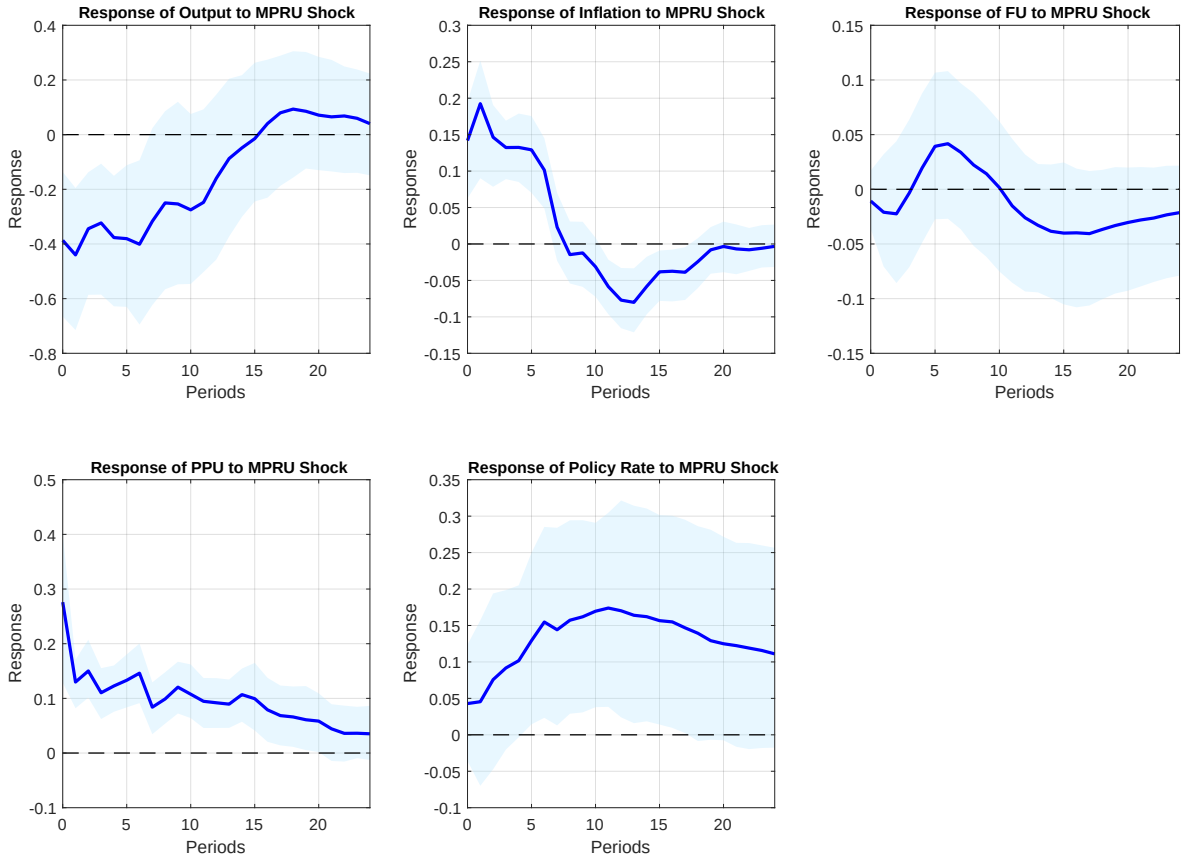
The results of the forecast error variance decomposition (FEVD) provide further support for this interpretation. Table 5 presents the median estimated contribution of MU and MPRU shocks to the mean squared forecast error for the variables in the SVAR at selected horizons from 0 to 12 periods. For financial uncertainty (FU), as shown in Panel C, MU shocks dominate MPRU shocks in explaining unexpected fluctuations across all horizons, accounting for roughly 20 to 30 percent of the variance. MPRU shocks play a negligible role, explaining less than 6 percent of the variance, though their contribution does increase modestly over time from about 3 percent on impact to nearly 6 percent at the 12-period horizon. The results for policy path uncertainty (PPU), shown in Panel D, tell a different story. Both shocks are important in explaining PPU's unexpected variation, jointly

Figure 2: **Responses to a Macroeconomic Uncertainty Shock**



This figure plots the impulse responses to a one-standard-deviation macroeconomic uncertainty shock, ε^{MU}, of industrial production, core CPI inflation, the financial uncertainty index of Jurado et al. (2015) and Ludvigson et al. (2021), our policy path uncertainty measure (PPU), and the expected policy rate eight meetings ahead. The solid lines display the point-wise median responses and the shaded areas represent the 68 percent (point-wise) highest posterior density credible set for the IRF. The sample covers 272 FOMC meetings from August 1991 to June 2025.

Figure 3: **Responses to a Monetary Policy Response Uncertainty Shock**



This figure plots the impulse responses to a one-standard-deviation monetary policy response uncertainty shock, ε^{MPRU}, of industrial production, core CPI inflation, the financial uncertainty index of Jurado et al. (2015) and Ludvigson et al. (2021), our policy path uncertainty measure (PPU), and the expected policy rate eight meetings ahead. The solid lines display the point-wise median responses and the shaded areas represent the 68 percent (point-wise) highest posterior density credible set for the IRF. The sample covers 272 FOMC meetings from August 1991 to June 2025.

accounting for approximately 40 to 50 percent of the variance. The relative importance of the two shocks, however, shifts over time. On impact, MU and MPRU shocks contribute roughly equally, explaining 19 and 23 percent of the variance, respectively. As the horizon increases, MU shocks become less important, declining to about 16 percent, while MPRU shocks grow in importance, explaining nearly 37 percent of the variance at the 12-period horizon.

For industrial production, as shown in Panel A, MU and MPRU shocks contribute similarly on impact, jointly explaining almost 20 percent of the variance. MU shocks, however, become an increasingly important source of unexpected fluctuations as the horizon lengthens, explaining more than 20 percent of the variance after 8 intermeeting periods (approximately 1 year) and nearly 24 percent at the 12-period horizon. In contrast, the contribution of MPRU shocks remains relatively stable, fluctuating between 8 and 12 percent across all horizons.

Notably, for inflation, shown in Panel B, MPRU shocks explain a substantially larger fraction of unexpected fluctuations than MU shocks. MPRU shocks account for 35 to 44 percent of the variance across all horizons, while MU shocks explain only about 12 percent. This asymmetry is consistent with the role of central banks in anchoring inflation expectations: macroeconomic uncertainty generates relatively modest inflationary pressures, while uncertainty about the Federal Reserve's policy response, particularly whether it will act decisively to stabilize prices, has a much larger effect on inflation dynamics. The finding connects to Bekaert and Engstrom (2010), who show that the positive correlation between expected inflation and equity yields coincides with periods of heightened economic uncertainty and high risk aversion. Our decomposition suggests a refinement: it is not uncertainty in general that drives this correlation, but specifically uncertainty about the monetary policy reaction function.

Taken together, these results have important implications for interpreting the effects of increased uncertainty about the path of interest rates. In any given episode, whether uncertainty about the policy rate path exerts a demand-like or supply-like effect depends on the mix of underlying shocks. If MU dominates, as during the onset of the global financial crisis in 2008, the economy experiences demand-like dynamics, with output and inflation

Table 5: Forecast Error Variance Decomposition: Contribution of Macro Uncertainty and Monetary Policy Response Uncertainty Shocks

	Panel A: Output		Panel B: Inflation	
Horizon	ε^{MU}	ε^{MPRU}	ε^{MU}	ε^{MPRU}
0	0.105	0.081	0.121	0.352
1	0.112	0.079	0.128	0.379
4	0.152	0.106	0.121	0.437
8	0.227	0.116	0.125	0.412
12	0.236	0.113	0.127	0.396
	Panel C: Financial Uncertainty		Panel D: Policy Path Uncertainty	
Horizon	ε^{MU}	ε^{MPRU}	ε^{MU}	ε^{MPRU}
0	0.285	0.032	0.191	0.230
1	0.249	0.036	0.179	0.263
4	0.231	0.036	0.168	0.311
8	0.227	0.051	0.158	0.339
12	0.214	0.057	0.157	0.365
	Panel E: Policy Rate			
Horizon	ε^{MU}	ε^{MPRU}		
0	0.114	0.055		
1	0.118	0.055		
4	0.119	0.073		
8	0.142	0.101		
12	0.145	0.118		

This table reports the estimated contribution of macroeconomic uncertainty shocks, ε^{MU}, and monetary policy response uncertainty shocks, ε^{MPRU}, to the mean squared forecast error of industrial production, core CPI inflation, the financial uncertainty index of Jurado et al. (2015) and Ludvigson et al. (2021), our policy path uncertainty measure (PPU), and the expected policy rate eight meetings ahead. The entries report the median fraction of forecast error variance attributable to each shock. The sample covers 272 FOMC meetings from August 1991 to June 2025.

declining. If MPRU shocks dominate, as in the spring of 2022, the economy experiences supply-like dynamics, with output declining and inflation rising.

These results also have direct implications for financial markets. While both types of uncertainty depress economic activity, they should transmit to asset prices through entirely different channels because MU and MPRU have opposite effects on inflation and elicit opposite responses from monetary policy. Positive MU shocks, acting as negative demand shocks, should create flight-to-quality dynamics: equity prices and Treasury yields fall, leading to a negative stock-bond return correlation. MPRU shocks, being stagflationary, should lead to lower equity prices but higher Treasury yields, generating a positive stock-bond correlation. This divergence in asset price behavior provides an additional test of the validity of our identification strategy and sheds light on how uncertainty shocks transmit to financial markets. This is the focus of the next section.

4 Transmission of Uncertainty Shocks to Financial Markets

The SVAR estimates show that macroeconomic uncertainty and monetary policy response uncertainty have opposite effects on inflation despite both being contractionary. The disparate effects of uncertainty shocks on the economy suggest that different types of uncertainty transmit to financial markets through different channels. This section examines the dynamic response of equity prices and Treasury yields to our identified macroeconomic uncertainty shocks, ε^{MU}, and monetary policy response uncertainty shocks, ε^{MPRU}, and explores their implications for the co-movement of equity and bond prices. The results not only provide an additional validation of our identification strategy, but also shed light on the mechanisms through which uncertainty affects financial markets, and offer a structural interpretation for the time-varying correlation between stocks and government bonds.

4.1 Local Projections with Identified Shocks

To trace the dynamic response of asset prices to the identified uncertainty shocks in Section 3, we use local projections (Jordà, 2005; Jordà and Taylor, 2025). This approach is ro-

bust to VAR misspecification and provides straightforward inference for impulse responses. For equity returns, we estimate

$$r^{equity}_{t\to t+h} = \beta_{h,0} + \beta_{h,1}\varepsilon^{MU}_t + \beta_{h,2}\varepsilon^{MPRU}_t + \boldsymbol{\delta}'_h \boldsymbol{x}_{t-1} + v_{t+h} \tag{5}$$

where $r^{equity}_{t\to t+h}$ is the cumulative equity return from intermeeting period t to intermeeting period $t+h$, ε^{MU}_t and ε^{MPRU}_t are MU and MPRU shocks, respectively. For Treasury yields, we estimate

$$\Delta y^{(n)}_{t+h} = \alpha^{(n)}_{h,0} + \alpha^{(n)}_{h,1}\varepsilon^{MU}_t + \alpha^{(n)}_{h,2}\varepsilon^{MPRU}_t + \boldsymbol{\gamma}^{(n)\prime}_h \boldsymbol{x}_{t-1} + u^{(n)}_{t+h} \tag{6}$$

where $\Delta y^{(n)}_{t+h} = y^{(n)}_{t+h} - y^{(n)}_{t-1}$ is the change in the yield on an n-maturity Treasury security from intermeeting period t to intermeeting period $t+h$.

To obtain posterior distributions for the impulse response coefficients, for each posterior draw $s = 1, \ldots, S$ from the SVAR estimation, we extract the structural shocks $\{\varepsilon^{MU,s}_t, \varepsilon^{MPRU,s}_t\}^T_{t=1}$ and estimate Equations (5) and (6) via OLS. After cycling across all S posterior draws, we obtain posterior distributions for the impulse responses. We report median responses along with 68% credible intervals. This Bayesian approach propagates the full identification uncertainty from the SVAR into the second-stage local projections, ensuring that the credible intervals reflect uncertainty about the structural shocks themselves, not just sampling variation in the local projection coefficients.

The vector of controls $\boldsymbol{x}_t$ contains the yield on the 3-month Treasury bill as a measure of expectations for the policy rate, the term spread computed as the difference between the 10-year Treasury yield and the 3-month Treasury bill rate, and the yield spread between Aaa-rated corporate bonds and Treasury securities to capture shifts in demand for the liquidity and safety of long-term Treasury securities documented in Krishnamurthy and Vissing-Jorgensen (2012).

4.2 Uncertainty Shocks and Equity Prices

Figure 4 presents the responses of the excess equity market return to a one-standard-deviation macroeconomic uncertainty shock (ε^{MU}) and monetary policy response uncer-

tainty shock (ε^{MPRU}). The reported responses correspond to cumulative excess returns from intermeeting period t to $t+h$. The excess return is the value-weighted return on all CRSP firms incorporated in the U.S. and listed on the NYSE, AMEX, or NASDAQ less the one-month Treasury bill rate, as defined in Fama and French (1993).

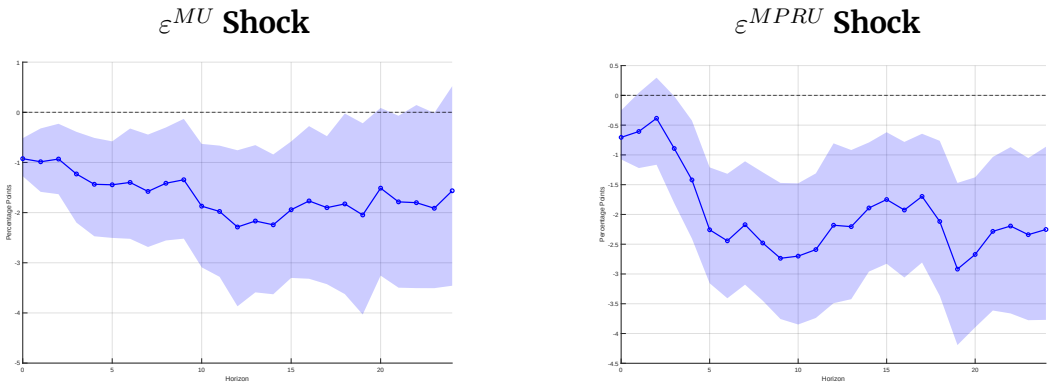
Both types of uncertainty reduce equity prices, but their dynamic effects differ. Following a ε^{MU} shock, cumulative excess returns decline by roughly 2 percent, though the response is estimated with relatively wide credible intervals. Following a ε^{MPRU} shock, the decline is more pronounced and more persistent. Cumulative excess returns fall by nearly 3 percent, with the estimated effect remaining strongly statistically significant across horizons.

That both shocks depress equity valuations is not surprising. Higher uncertainty about the macroeconomy or about the monetary policy response increases required risk compensation and can worsen expectations about future economic conditions, both of which lower equity valuations. What is more surprising is that the two shocks produce equity declines of similar magnitude despite having opposite effects on inflation and opposite implications for monetary policy. If both shocks reduce stock prices but one lowers bond yields while the other raises them, then the source of uncertainty becomes a key determinant of the stock–bond correlation. Understanding how different sources of uncertainty transmit to equity and government bond prices is central to asset pricing, since the hedging properties of government bonds depend on whether bonds and stocks move in the same or opposite directions. We return to this question after examining the evidence from the Treasury market.

The aggregate equity response, while informative, masks important differences in how the two shocks affect different types of firms. The distinction between demand-like and supply-like shocks has clear predictions for the cross-section of equity returns. Demand shocks should disproportionately affect firms whose valuations depend on near-term, cyclically sensitive cash flows (e.g., value stocks). Stagflationary shocks that raise real discount rates should disproportionately affect firms whose valuations depend on distant cash flows (e.g., growth stocks).

We now estimate the response of the excess return on portfolios sorted by book-to-

Figure 4: Responses of Excess Market Returns to Macro Uncertainty and Monetary Policy Response Uncertainty Shocks



The left column plots the impulse response of cumulative excess equity market returns to a one-standard-deviation macroeconomic uncertainty shock, ε^{MU}, and the right column presents the response to a monetary policy response uncertainty shock, ε^{MPRU}. The solid lines display the point-wise median responses and the shaded areas represent the 68 percent (point-wise) highest posterior density credible set. The sample covers 272 FOMC meetings from August 1991 to June 2025.

market, and the Fama-French value factor (HML) (Fama and French, 1993). HML (High Minus Low) is the return on a portfolio long high book-to-market (value) stocks and short low book-to-market (growth) stocks, capturing the value premium.

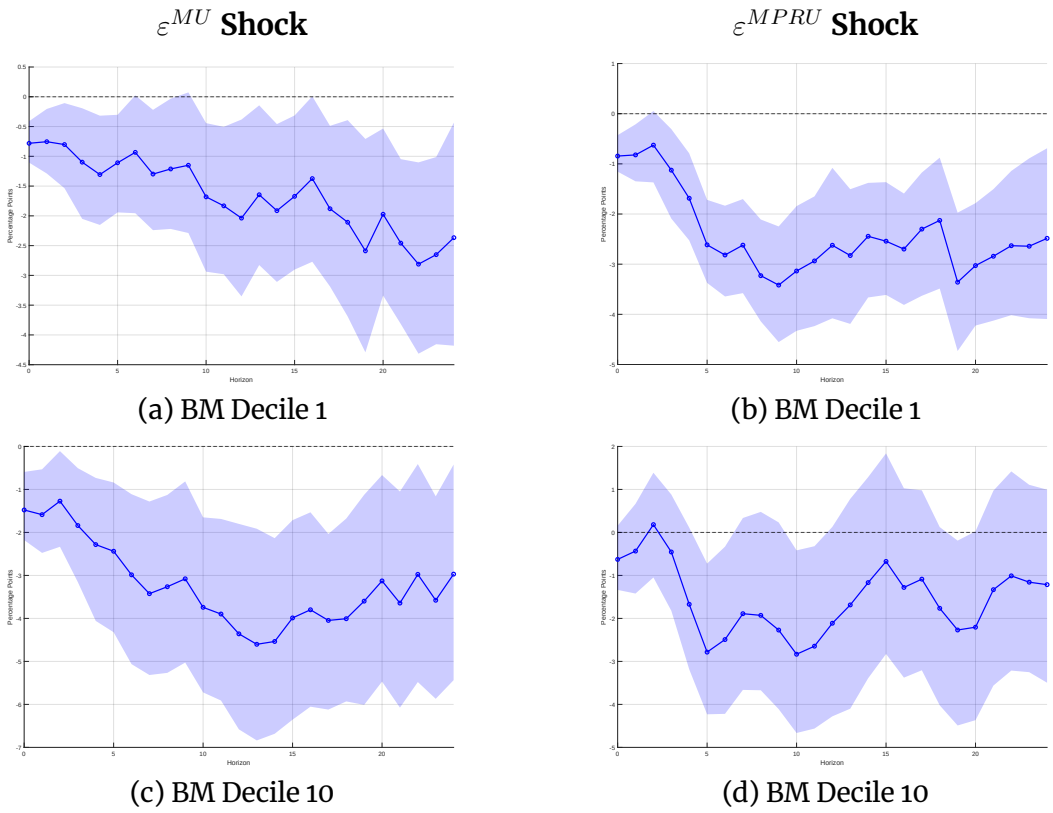
We focus on book-to-market sorted portfolios because cash-flow duration varies systematically across the book-to-market spectrum, making these portfolios natural test assets for distinguishing between cash-flow and discount-rate channels. Lettau and Wachter (2007) show that the value premium can be understood as compensation for differences in cash-flow duration: value firms derive a larger share of their market value from near-term cash flows, while growth firms derive a larger share from distant cash flows. Weber (2018) provides direct evidence that cash-flow duration varies across book-to-market deciles and that this variation explains cross-sectional differences in the sensitivity of equity returns to discount-rate shocks. Koijen, Lustig, and Van Nieuwerburgh (2017) show that the joint dynamics of stock and bond returns can be understood through the lens of cash-flow strips at different maturities, with short-duration equity claims behaving differently from long-duration claims in response to macroeconomic shocks. Our two identified uncertainty shocks, one operating primarily through cash flows and the other through discount rates, map directly onto this framework, and book-to-market sorted portfolios provide a sharp test of this distinction.

Figure 5 reports the responses of two book-to-market portfolios, BM decile 1 (growth) and BM decile 10 (value), to the two identified uncertainty shocks. Two patterns stand out. First, macroeconomic uncertainty shocks (ε^{MU}) generate a larger and more precisely estimated decline for value stocks than for growth stocks. Following a ε^{MU} shock, value stocks (BM decile 10) fall by nearly 5 percent, while growth stocks (BM decile 1) decline by roughly 3 percent. The larger decline for high book-to-market firms is consistent with ε^{MU} operating as a demand-type contraction: expected cash flows deteriorate broadly, but the impact is more severe for firms whose earnings are more cyclically exposed and whose valuations rely more heavily on near-term fundamentals.

Second, monetary policy response uncertainty shocks (ε^{MPRU}) generate a sharper and more persistent decline for growth stocks than for value stocks. Growth stocks fall quickly, reaching roughly negative 3 percent by around horizon 5 and remaining depressed thereafter, with strong statistical significance. Value stocks also decline initially by a similar magnitude but then partially rebound, ending closer to negative 2 percent with wider credible intervals. This pattern is consistent with ε^{MPRU} operating primarily through the discount-rate channel and the repricing of long-duration equity claims. Higher real discount rates disproportionately reduce the present value of distant cash flows, which is a defining feature of growth firms. The faster, more persistent decline for growth stocks therefore aligns with a duration-based valuation mechanism, while the weaker and less persistent response for value stocks suggests that this portfolio is less exposed to this channel and may recover as discount rate pressure stabilizes.

Figure 6 confirms these cross-sectional patterns through the lens of the value-minus-growth spread. Following a ε^{MU} shock, HML declines, reaching roughly -1.5 percent by horizon 6 before gradually rebounding back. This negative response indicates that value stocks underperform growth stocks after a demand-type uncertainty shock, consistent with the larger and more statistically significant decline in BM decile 10 relative to BM decile 1 documented above. Following a ε^{MPRU} shock, HML rises steadily, reaching approximately 1.5 percent by horizon 10 and remaining elevated. Value stocks outperform growth stocks when uncertainty concerns the monetary authority's reaction function, consistent with higher real discount rates disproportionately affecting long-duration equity valuations.

Figure 5: Responses of Book-to-Market Portfolios to Macro Uncertainty and Monetary Policy Response Uncertainty Shocks



(a) BM Decile 1

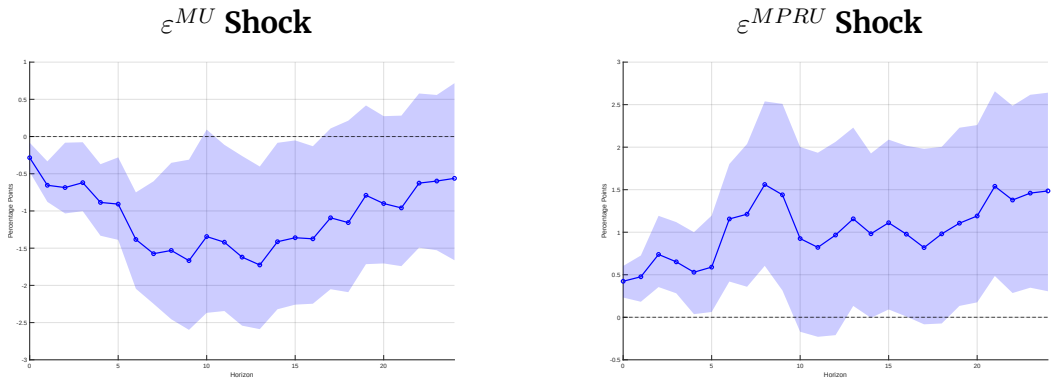
(b) BM Decile 1

(c) BM Decile 10

(d) BM Decile 10

The left column plots the impulse responses of book-to-market portfolios to a one-standard-deviation macroeconomic uncertainty shock, ε^{MU}, and the right column presents the responses to a monetary policy response uncertainty shock, ε^{MPRU}. The solid lines display the point-wise median responses and the shaded areas represent the 68 percent (point-wise) highest posterior density credible set. The sample covers 272 FOMC meetings from August 1991 to June 2025.

Figure 6: Responses of High Minus Low Portfolio to Macro Uncertainty and Monetary Policy Response Uncertainty Shocks



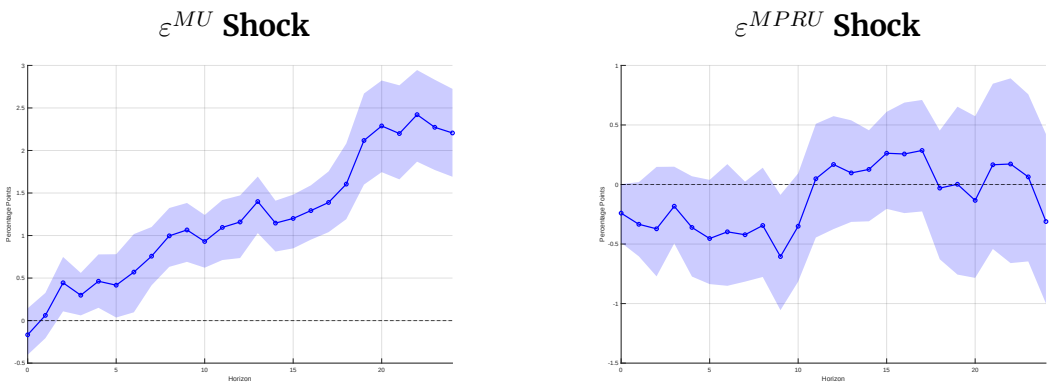
The left column plots the impulse response of the High Minus Low (HML) portfolio to a one-standard-deviation macroeconomic uncertainty shock, ε^{MU}, and the right column presents the response to a monetary policy response uncertainty shock, ε^{MPRU}. The solid lines display the point-wise median responses and the shaded areas represent the 68 percent (point-wise) highest posterior density credible set. The sample covers 272 FOMC meetings from August 1991 to June 2025.

We complement the book-to-market analysis with portfolios sorted by firm size. While book-to-market captures variation in cash-flow duration, size captures variation in exposure to aggregate economic conditions and credit market frictions. Gertler and Gilchrist (1994) show that small firms are more sensitive to monetary policy tightening because they face tighter credit constraints and have less access to capital markets, while Perez-Quiros and Timmermann (2000) find that small-firm returns are more sensitive to credit conditions over the business cycle. If macroeconomic uncertainty operates as a demand shock, we would expect it to generate size-based dispersion. Large firms, with greater exposure to aggregate demand and global conditions, should be affected more strongly than small firms. If monetary policy response uncertainty operates through an aggregate discount-rate channel, the effect should be more uniform across firms of different sizes.

Figure 7 presents the response of the size factor (SMB), the return on a portfolio long small-cap stocks and short large-cap stocks, to the two identified uncertainty shocks. Following a ε^{MU} shock, SMB rises steadily and significantly, reaching approximately 2.5 percent at longer horizons. Although aggregate equity prices decline, large firms experience a larger cumulative repricing than small firms, consistent with macroeconomic uncertainty disproportionately affecting firms with greater exposure to aggregate output fluctuations and global demand. In contrast, the response of SMB to a ε^{MPRU} shock is economically

small and statistically insignificant. While ε^{MPRU} depresses aggregate equity valuations through higher real yields and inflation risk, these discount-rate effects operate relatively uniformly across firms of different sizes, generating little dispersion along the size dimension. The contrast between the two shocks reinforces the interpretation that macroeconomic uncertainty transmits to the cross-section through a cyclical cash-flow channel that generates firm-size heterogeneity, while monetary policy response uncertainty transmits through an aggregate discount-rate channel that does not.

Figure 7: Responses of Small Minus Big Portfolio to Macro Uncertainty and Monetary Policy Response Uncertainty Shocks



The left column plots the impulse responses of the Small Minus Big (SMB) portfolio to a one-standard-deviation macroeconomic uncertainty shock, ε^{MU}, and the right column presents the responses to a monetary policy response uncertainty shock, ε^{MPRU}. The solid lines display the point-wise median responses and the shaded areas represent the 68 percent (point-wise) highest posterior density credible set for the IRF. The sample covers 272 FOMC meetings from August 1991 to June 2025.

Taken together, the cross-sectional equity results reinforce the central distinction between the two sources of policy path uncertainty. Macroeconomic uncertainty operates primarily through a cash-flow channel: aggregate excess returns decline, value stocks underperform growth stocks, and small stocks outperform large stocks, a pattern consistent with a demand-driven contraction where cyclically exposed near-term cash flows deteriorate most. Monetary policy response uncertainty operates primarily through a discount-rate channel: aggregate returns fall more sharply and persistently, growth stocks underperform value stocks, and there is little systematic dispersion along the size dimension, a pattern consistent with higher real yields and increased compensation for bearing duration risk disproportionately affecting long-duration equity valuations.

These equity results have a direct implication for bond markets. Since both shocks re-

duce stock prices, the sign of the stock-bond correlation depends entirely on how each shock transmits to Treasury yields. If ε^{MU} lowers bond yields while ε^{MPRU} raises them, then periods dominated by macroeconomic uncertainty should exhibit negative stock-bond correlations, while periods dominated by monetary policy response uncertainty should exhibit positive stock-bond correlations. This prediction connects to a central puzzle in the term structure literature: the sign of the stock-bond correlation has shifted over time, turning from predominantly positive before the late 1990s to predominantly negative thereafter, with episodes of positive correlation re-emerging during periods of rising inflation concerns (Campbell et al., 2017; Baele, Bekaert, and Inghelbrecht, 2010). Song (2022) argues that the relative importance of demand-like versus supply-like shocks is the key structural determinant of this time variation. Our decomposition provides direct empirical evidence for this interpretation. The two types of uncertainty shocks we identify map precisely onto the demand and supply channels that theory predicts should drive the stock-bond correlation. Next, we turn to the bond market evidence.

4.3 Uncertainty Shocks and Treasury Yields

Figure 8 presents the responses of nominal Treasury yields to the two identified uncertainty shocks. The first column shows the response to a macroeconomic uncertainty shock (ε^{MU}), and the second column shows the response to monetary policy response uncertainty shock (ε^{MPRU}). We estimate the response of yields on zero-coupon Treasury securities with maturities of 2 and 10 years for up to 24 intermeeting periods (approximately 3 years).

The first column shows the response to a ε^{MU} shock. Treasury yields decline across all maturities. The 2-year yield declines about 10 basis points over the first few intermeeting periods, dropping around 30 basis points over the next 16 intermeeting periods (about 2 years). The 10-year yield exhibits a similar pattern, declining initially by roughly 5 basis points and experiencing a cumulative decline of close to 20 basis points over the same horizon. The decline is larger at shorter maturities, particularly as the time horizon increases. This steepening of the yield curve is consistent with the demand-shock interpretation of ε^{MU}: short rates are expected to fall as the Federal Reserve eases monetary policy, and to re-

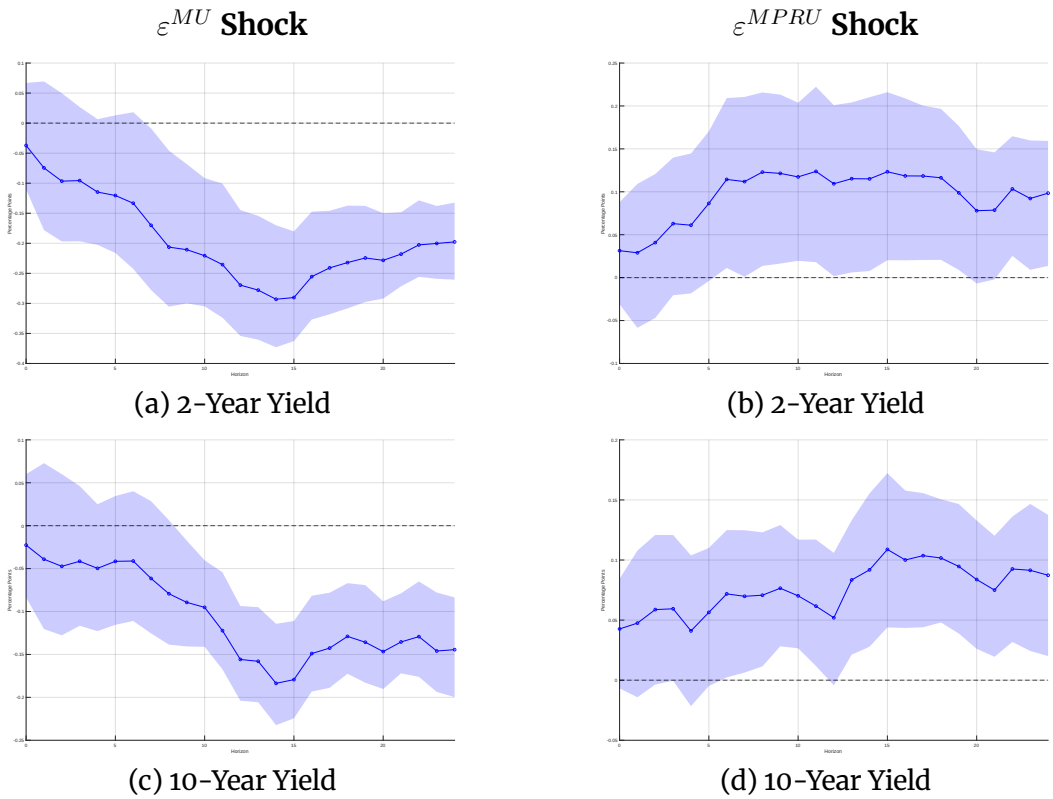
main low as long as the macroeconomic contraction caused by the macro uncertainty shock persists.

The responses of yields to monetary policy response uncertainty, shown in the second column of Figure 8, present a stark contrast. Treasury yields rise across all maturities following a ε^{MPRU} shock. The 2-year and 10-year yield both initially increase by around 5 basis points, and the effects increase as we extend the horizon. After 16 intermeeting periods (or about 2 years), the 2-year yield increases a little below 10 basis points, while the 10-year yield is up a little more than 10 basis points.

Taken together, the responses of Treasury yields and equity prices imply that the hedging properties of government bonds depend on the source of uncertainty. Macroeconomic uncertainty shocks reduce equity prices while also reducing bond yields, the signature of a negative stock-bond correlation, with Treasuries serving as effective hedges against equity losses. Monetary policy response uncertainty shocks reduce equity prices while raising bond yields, the signature of a positive stock-bond correlation, with Treasuries amplifying rather than offsetting equity losses. Our decomposition therefore provides a structural account of why the stock-bond correlation switches sign over time: it depends on which type of uncertainty dominates. This result is consistent with Campbell et al. (2020), who argue that the hedging properties of nominal bonds shift depending on whether inflation risk or real rate risk dominates the yield curve.

To further examine the transmission of uncertainty shocks to Treasury markets, we analyze the response of the term spread, defined as the difference between the 10-year Treasury yield and the 3-month Treasury bill rate. Following a ε^{MU} shock, as shown in the left column of Figure 9, the term spread increases persistently, rising to approximately 15 basis points after 16 intermeeting periods (about 2 years). This steepening is consistent with investors anticipating that the Federal Reserve will ease policy in response to the demand-like contraction, pushing short-term yields down relative to long-term yields. In contrast, the right column of Figure 9 shows that ε^{MPRU} shocks generate markedly different dynamics: after an initial modest increase, the term spread declines sharply, falling approximately 10 basis points after 2 years. This flattening reflects the stagflationary nature of ε^{MPRU} shocks. With inflation rising and output falling, the Federal Reserve faces

Figure 8: Responses of Treasury Yields to Macro Uncertainty and Monetary Policy Response Uncertainty Shocks



(a) 2-Year Yield

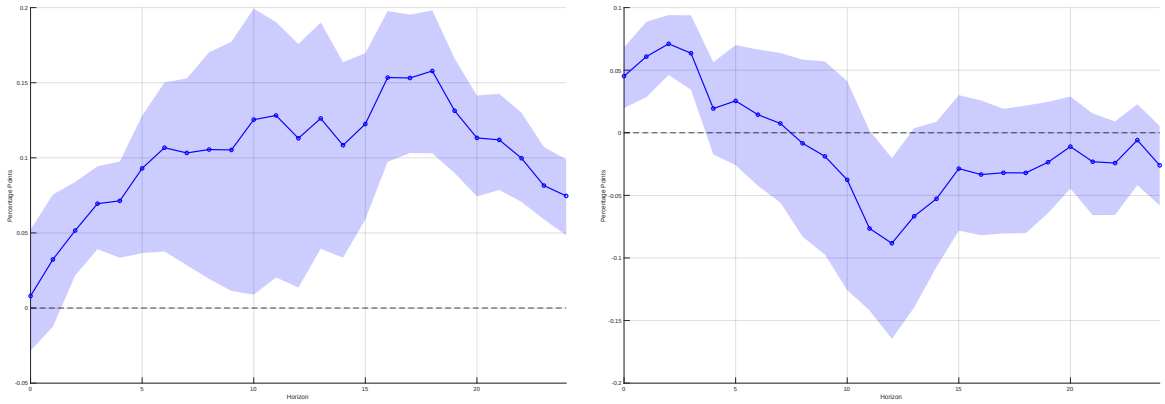
(b) 2-Year Yield

(c) 10-Year Yield

(d) 10-Year Yield

The left column plots the impulse responses of Treasury yields to a one-standard-deviation macroeconomic uncertainty shock, ε^{MU}, and the right column presents the responses to a monetary policy response uncertainty shock, ε^{MPRU}. The solid lines display the point-wise median responses and the shaded areas represent the 68 percent (point-wise) highest posterior density credible set for the IRF. The sample covers 272 FOMC meetings from August 1991 to June 2025.

Figure 9: Responses of the Term Spread to Macro Uncertainty and Monetary Policy Response Uncertainty Shocks



(a) MU Shock (b) MPRU Shock

The left column plots the response of the term spread (10-year minus 3-month Treasury bill) to a one-standard-deviation macroeconomic uncertainty shock, ε^{MU}, and the right column presents the response to a monetary policy response uncertainty shock, ε^{MPRU}. The solid lines display the point-wise median responses and the shaded areas represent the 68 percent (point-wise) highest posterior density credible set for the IRF. The sample covers 272 FOMC meetings from August 1991 to June 2025.

a policy dilemma: easing would accommodate inflation, while tightening would deepen the contraction. Confronted with heightened uncertainty about how the central bank will react, investors keep short-term rates elevated relative to long-term rates as inflation concerns dominate and government bonds become riskier to hold. The divergent term spread responses echo the yield curve decomposition of **?**, who find that the relative importance of short-rate expectations and term premium volatility shifts over time with the stance of monetary policy. Our results provide a shock-based interpretation for this finding: periods in which macroeconomic uncertainty dominates are characterized by volatile short-rate expectations (as markets reprice the easing path), while periods in which monetary policy response uncertainty dominates are characterized by volatile term premia. More broadly, the slope of the yield curve may serve as a useful real-time signal for distinguishing between ε^{MU} and ε^{MPRU} shocks.

The disparate nominal yield responses to ε^{MU} and ε^{MPRU} shocks raise a natural question about the underlying transmission mechanism. If ε^{MPRU} shocks raise nominal yields because they are inflationary, the effect should operate primarily through inflation expectations or inflation risk premia, and real yields should remain largely unaffected. If, how-

ever, these shocks also alter the compensation investors demand for holding long-duration bonds, we should observe movements in real yields as well. Figure 10 presents the response of 2-year and 10-year yields on Treasury Inflation-Protected Securities (TIPS) to ε^{MU} and ε^{MPRU} shocks.

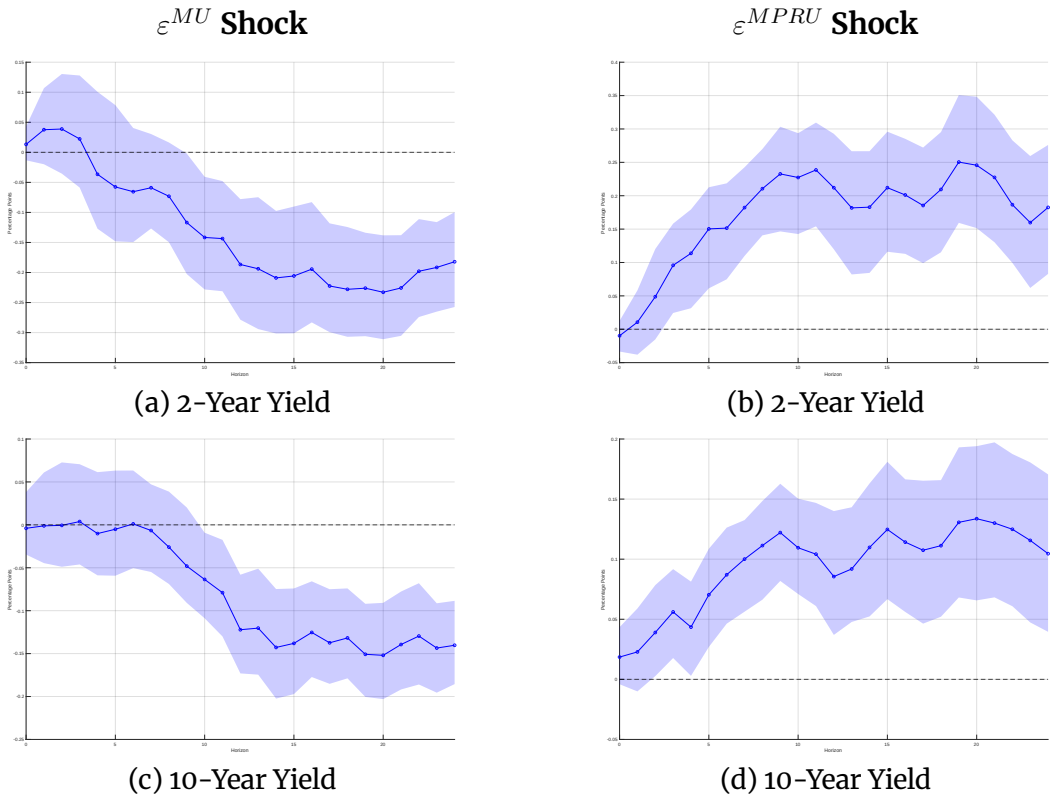
As shown in the left panel of Figure 10, real yields decline across maturities in response to a ε^{MU} shock. The 2-year real yield falls by approximately 10 basis points, while the 10-year real yield declines by roughly 15 basis points. This pattern is consistent with flight-to-quality dynamics and expectations of monetary easing in response to the demand-like contraction: when macroeconomic uncertainty rises, investors anticipate lower future real rates as the Federal Reserve moves to support economic activity, and long-duration inflation-protected securities become more attractive as hedges against economic downturns, compressing real term premia and reinforcing the decline in long-term real yields.

The response of real yields to ε^{MPRU} is strikingly distinct. Real yields rise in response to a ε^{MPRU} shock, with 10-year real yields increasing by approximately 10 basis points. This finding suggests that the increase in nominal yields following a ε^{MPRU} shock is not driven by higher inflation expectations, but mostly by higher long-term real yields. The increase in real yields likely reflects a rise in real term premia as the hedging properties of Treasury securities deteriorate. When uncertainty stems from the monetary policy reaction function rather than economic fundamentals, long-term bonds become less effective portfolio hedges. Investors face a two-sided risk: if the Federal Reserve tightens aggressively, bond prices fall, but if the Federal Reserve remains accommodative and allows inflation to persist, real returns on government bonds suffer. This heightened uncertainty about the policy response raises the compensation investors demand for bearing duration risk, pushing real yields higher. The result is consistent with Campbell et al. (2020), who argue that whether nominal bonds serve as "inflation bets" or "deflation hedges" depends on the nature of the macroeconomic risks investors face.

These empirical findings also speak to the puzzle of whether bond risk premia are countercyclical or procyclical. The literature has found conflicting evidence on this question, with Cochrane and Piazzesi (2005) and Ludvigson and Ng (2009) documenting predictability patterns consistent with countercyclical premia, while other studies find procyclical

movements.[6] Our decomposition suggests that both findings can be correct, depending on the source of uncertainty. Macroeconomic uncertainty shocks compress term premia as bonds become better hedges during demand-driven contractions, reducing the compensation investors demand for holding duration. On the other hand, monetary policy response uncertainty shocks increase term premia as bonds become worse hedges during stagflationary episodes, increasing the compensation for duration risk. Whether bond risk premia appear countercyclical or procyclical in a given sample depends on which type of uncertainty dominates.

Figure 10: Responses of Real Yields to Macro Uncertainty and Monetary Policy Response Uncertainty Shocks



(a) 2-Year Yield

(b) 2-Year Yield

(c) 10-Year Yield

(d) 10-Year Yield

The left column plots the impulse responses of TIPS yields to a one-standard-deviation macroeconomic uncertainty shock, ε^{MU}, and the right column presents the responses to a monetary policy response uncertainty shock, ε^{MPRU}. The solid lines display the point-wise median responses and the shaded areas represent the 68 percent (point-wise) highest posterior density credible set.

[6] See Mueller et al. (2019) for evidence on the distinct short-run and long-run components of bond risk premia, and ? for a decomposition of yield curve volatility into short-rate expectations and term premium components.

5 Conclusion

During the past several decades, nominal government bonds and stocks have at times tended to co-move positively, whereas other times they have tended to co-move negatively. This paper shows that one fundamental reason behind this switching correlation is the source of uncertainty about the future path of monetary policy. Using daily revisions in near-term rate expectations from fed funds futures and OIS rates, we construct a novel market-based measure of policy path uncertainty and decompose it into two economically distinct components: uncertainty about macroeconomic outcomes and uncertainty about how the central bank will respond to those outcomes. Using a Bayesian SVAR with sign and narrative restrictions, we show that these two components generate sharply different macroeconomic dynamics. Macroeconomic uncertainty behaves like an aggregate demand shock: output and inflation decline together and the Federal Reserve responds with easing monetary policy. In contrast, uncertainty about the monetary policy response generates stagflationary dynamics: output contracts while inflation rises, and the Federal Reserve tightens the policy rate. These contrasting dynamics carry through to financial markets. Both components depress equity prices, but macroeconomic uncertainty lowers Treasury yields and compresses real term premia, while policy response uncertainty raises nominal yields through higher real term premia, deteriorating the hedging properties of Treasury securities.

The implication of our findings is direct, the source of policy path uncertainty plays a central role in determining whether stocks and bonds move together or offset one another. Stock-bond correlations are negative when macroeconomic uncertainty dominates, bonds hedge equity losses in the manner of a flight-to-safety, and positive when reaction-function uncertainty dominates, bonds amplify rather than offset equity losses. Our decomposition thus provides a structural account of why the stock-bond correlation switches sign over time.

These findings have broad implications for research on uncertainty shocks and asset pricing. The existing literature has largely proceeded under the implicit assumption that different types of policy uncertainty can be aggregated into a single index. Our framework

shows that this aggregation is not innocuous as measures that aggregate across different sources of uncertainty obscure important differences in their economic consequences. For example, mixed evidence on whether uncertainty raises or lowers economic activity or inflation may reflect variation in the composition of uncertainty over time rather than genuine disagreement about the underlying mechanism. Similarly, conflicting findings on whether bond risk premia are countercyclical or procyclical may be explained by which component of uncertainty dominates in a given episode. Finally, our decomposition connects the measurement of uncertainty to the literature on learning about the central bank's reaction function and to the asset pricing literature on inflation risk and bond-equity co-movement. In particular, our finding that monetary policy path uncertainty operates through real term premia rather than inflation risk premia speaks directly to recent evidence that the positive bond-stock betas is driven primarily by the positive co-movement of the real component of yields and stock prices (Campbell, Pflueger, and Viceira, 2025), grounding that empirical regularity in a measurable and structurally identified source of monetary policy uncertainty.

Our results also point to several important open questions. The stagflationary dynamics of monetary policy uncertainty is not a natural prediction of standard New Keynesian models, and understanding their theoretical foundations remains an important challenge. The two components also likely have implications to understand the cross-sectional variation in equity returns from a structurally identified source uncertainty (e.g., firms with long-duration investment projects and sectors differentially exposed to interest rate risk) that a disaggregated analysis could quantify. Taken together, these questions suggest that the distinction between uncertainty about economic fundamentals and uncertainty about the policy response is not merely a measurement refinement but a conceptually foundational one for understanding how monetary policy uncertainty propagates through the economy.

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Appendix

A Market-based Revisions of the Monetary Policy Path

This appendix describes the construction of the daily revisions in expected policy rates, $\Delta i_{t_j}^{(h)}$, that serve as the building blocks for our policy path uncertainty (PPU) measure. We use two types of interest rate derivatives: federal funds futures for the near term ($h = 1, \ldots, 4$), and Overnight Index Swap (OIS) rates for longer horizons ($h = 5, \ldots, 12$). The two instruments are complementary. Federal funds futures are highly liquid at short horizons but become unreliable beyond roughly six months, particularly in the first decade of our sample. OIS contracts remain actively traded at longer maturities and provide a natural extension of the policy expectations curve.

A.1 Policy Path based on Federal Funds Futures

Federal funds futures contracts settle based on the arithmetic average of the daily effective federal funds rate over the contract's settlement month. Because the settlement price reflects the average rate over the month rather than the rate on a specific day, extracting the market's expectation of the policy rate after a particular FOMC meeting requires a scaling adjustment.

For an FOMC meeting occurring on day d of month M, the one-day revision in expectations about the policy rate after the next FOMC meeting is:

$$\Delta i_{t_j}^{(1)} \equiv \left(\mathbb{E}_{t_j} - \mathbb{E}_{t_{j-1}}\right) i^{(1)} = \frac{D}{D-d}\left(f_{t_j}^{M} - f_{t_{j-1}}^{M}\right) \tag{A.1}$$

where $i^{(1)}$ is the federal funds target rate expected at the upcoming FOMC meeting, $f_{t_j}^{M}$ is the rate implied by the federal funds futures contract maturing in month M on day t_j, D is the number of calendar days in month M, and d is the day of the month on which the policy rate is expected to change. The scaling factor $D/(D-d)$ accounts for the fact that the futures contract settles on the monthly average rate: only the remaining $D-d$ days of the

month are affected by the new rate, so the daily change in the futures price understates the actual revision in the expected policy rate by a factor of $(D-d)/D$.

For the policy rate $h > 1$ meetings ahead, the calculation extends to account for the fact that the futures contract covering month M_h may also embed information about rates set at prior meetings. The one-day revision is:

$$\Delta i_{t_j}^{(h)} \equiv \left(\mathbb{E}_{t_j} - \mathbb{E}_{t_{j-1}}\right) i^{(h)} = \frac{D_h}{D_h - d_h}\left(f_{t_j}^{M_h} - f_{t_{j-1}}^{M_h} - \frac{d_h}{D_h}\Delta i_{t_j}^{(h-1)}\right) \tag{A.2}$$

where D_h is the number of days in the month of the h-th meeting, and d_h is the day of the month on which the h-th meeting occurs. The subtraction of $(d_h/D_h)\Delta i_{t_j}^{(h-1)}$ removes the portion of the futures price change that is attributable to the revision in the rate expected at the prior meeting, which affects the average rate during the first d_h days of the month.[7]

We apply Equations (A.1) and (A.2) recursively for $h = 1, \ldots, 4$, using the sequence of federal funds futures contracts covering the months in which the next four FOMC meetings are scheduled.

A.2 Policy Path based on OIS rates

For horizons beyond the fourth meeting ($h = 5, \ldots, 12$), we switch to Overnight Index Swap rates. OIS contracts reference the geometric average of the overnight federal funds rate over the life of the swap and are available at a range of maturities, providing information about market expectations of the policy rate at horizons where fed funds futures liquidity is thin.

We extract the expected policy rate at each meeting horizon from the OIS term structure using a cubic spline methodology. The procedure has three steps:

1. **Input data.** On each trading day t_j, we collect OIS par swap rates at available maturities: 1–4 weeks, 1–12 months, 15 months, 18 months, 1–10 years.

2. **Spline fitting.** We fit a penalized cubic spline to the observed OIS rates to recover a

[7] In some calendar configurations, the FOMC meeting falls very late in the month, making the scaling factor $D/(D-d)$ very large and amplifying measurement noise. In these cases, we use the futures contract maturing in month $M+1$ instead, for which the revision is simply $\Delta i_{t_j}^{(h)} = f_{t_j}^{M+1} - f_{t_{j-1}}^{M+1}$, since the entire settlement period falls after the meeting.

smooth zero-coupon discount curve $P(t_j, T)$ for all maturities T. The spline minimizes the sum of squared pricing errors across the observed OIS quotes subject to a roughness penalty:

$$\min_{\{P(t_j,T)\}} \sum_{k=1}^{K} \left[r_k^{OIS} - \hat{r}_k^{OIS}(P) \right]^2 + \lambda \int \left[P''(t_j, T) \right]^2 dT \tag{A.3}$$

where r_k^{OIS} is the observed OIS par rate for maturity k, $\hat{r}_k^{OIS}(P)$ is the model-implied par rate under the fitted discount curve, and $\lambda > 0$ is a smoothing parameter that penalizes curvature in the discount function. The penalty is necessary to avoid non-smoothness in the fitted curve caused by microstructure noise or temporary illiquidity at specific maturities.

3. **Forward rate extraction.** From the fitted zero curve, we extract the instantaneous forward rate at any horizon T:

$$f(t_j, T) = -\frac{\partial \ln P(t_j, T)}{\partial T} \tag{A.4}$$

For each FOMC meeting h meetings ahead, we evaluate the forward rate at the date of that meeting to obtain the market's expectation of the overnight rate at that point. The daily revision in the expected policy rate at horizon h is then:

$$\Delta i_{t_j}^{(h)} = f(t_j, T_h) - f(t_{j-1}, T_h) \tag{A.5}$$

where T_h is the date of the h-th upcoming FOMC meeting.

The resulting daily revisions $\Delta i_{t_j}^{(h)}$ for $h = 5, \ldots, 12$ are combined with the futures-based revisions for $h = 1, \ldots, 4$ to form the complete set of policy path revisions used in the construction of PPU in Equation (3) of the main text.

Two practical considerations are worth noting. First, the smoothing parameter λ is calibrated to balance fit and smoothness. We select λ via generalized cross-validation, which penalizes overfitting while preserving economically meaningful variation in the forward curve. Second, the transition from federal funds futures to OIS at $h = 5$ is smooth in prac-

tice because both instruments reference the overnight federal funds rate, and at the four-meeting horizon (roughly six months), the two sources produce nearly identical policy rate expectations on days when both are available. We have verified that the PPU measure is not sensitive to the specific cutoff meeting at which we switch from futures to OIS.

B Data Sources

This appendix describes the data used throughout the paper. The sample covers 275 FOMC intermeeting periods from August 1991 to December 2025 unless otherwise noted. All variables measured at monthly or higher frequency are aggregated to the intermeeting frequency using simple averages over the trading days or calendar days within each intermeeting period.

We collect Daily settlement prices for federal funds futures contracts with maturities up to six months from CME Group Inc. DataMine available at the Federal Reserve Board. We also collect daily mid-market OIS swap rates at maturities of 1 week to 4 weeks, 1 month to 12 months, 15 months, 18 months, 21 months, and 1 year to 10 years from JP Morgan Chase & Co.

Our SVAR in Section 3 relies on the following data: Industrial production from the Federal Reserve Board; core inflation based on the Consumer Price Index (CPI) excluding food and energy comes from the Bureau of Labor Statistics obtained through the FRED database of the Federal Reserve Bank of St. Louis; the financial uncertainty index of Jurado et al. (2015) and Ludvigson et al. (2021), available at one-month, three-month, and twelve-month forecast horizons obtained from Sydney Ludvigson's website (https://www.sydneyludvigson.com/macro-and-financial-uncertainty-indexes).

Our empirical analysis also relies on zero-coupon nominal and real yields on 2- and 10-year Treasury securities obtained from the smoothed yield curve of Gürkaynak et al. (2005) and updated by the Federal Reserve Board. From Kenneth French's website (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html) we collect dat on the value-weighted return on all CRSP firms incorporated in the U.S. and listed on the NYSE, AMEX, or NASDAQ, less the one-month Treasury bill rate; the return on a portfolio long high book-to-market (value) stocks and short low book-to-market (growth) stocks; the return on a portfolio long small-cap stocks and short large-cap stocks; and value-weighted returns on portfolios sorted by book-to-market ratio into deciles.