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 broadly 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 and Cieslak, McMahon, and Pang (2024) argue that Federal Reserve communications introduced uncertainty about the reaction function in 2022, highlighting the importance of uncertainty about the central bank's reaction function over this period.

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.

Our results show that 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 a negative stock-bond correlation, consistent with flight-to-safety dynamics. On the other hand, 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, through its effect on Treasury yields, 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 investors' uncertainty about the expected policy path over the near-term.

The key empirical challenge is to disentangle the sources of this uncertainty. We ad-

dress 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 predictions of the macroeconomic uncertainty literature that shows that macroeconomic uncertainty shocks 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 policy 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 pressures despite leading to a decline in economic activity. This divergence in inflation dynamics leads monetary policy to respond in opposite 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. Macroeco-

nomic 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 the 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 as 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 depress equity prices, our decomposition provides a structural account of why the stock-bond correlation switches sign over time (Campbell, Sunderam, and Viceira, 2017; Campbell, Pflueger, and Viceira, 2020; Song, 2017). Periods dominated by macroeconomic uncertainty generate 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 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 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. Our decomposition also helps reconcile conflicting evidence on whether the bond risk premium is countercyclical or procyclical: macroeconomic uncertainty shocks compress the term premium, while monetary policy response uncertainty shocks expands the term premium.

Related Literature: A central question in asset pricing is why stocks and bonds sometimes hedge one another and sometimes move together. Campbell et al. (2017) and Campbell et al. (2020) show that the sign of the stock–bond correlation tracks whether nominal bonds behave as inflation bets or deflation hedges: when inflation risk dominates the yield curve, stocks and bonds move together, whereas when real-rate risk dominates, bonds insure against equity losses. Baele, Bekaert, and Inghelbrecht (2010) find that macroeconomic fundamentals explain little of the changing correlation, pointing instead to the structural source of shocks, and Baele, Bekaert, Inghelbrecht, and Wei (2020) trace flight-to-safety episodes to demand-driven contractions in which bonds are effective hedges. **?** formalizes this intuition, showing that whether demand-like or supply-like shocks dominate is the key structural determinant of bond–equity comovement.

Closest to our asset-pricing results, Cieslak and Pang (2021) identify, directly from daily stock and Treasury returns, two risk-premium shocks: a common premium shock that moves stocks and bonds in the same direction and a hedging premium shock that moves them in opposite directions. They show that the mid-1990s regime shift in stock–bond comovement reflects a change in their relative importance. Cieslak and McMahon (2023) link this decomposition to the conduct of monetary policy: using FOMC transcripts to measure the Committee's forward-looking policy stance, they show that hawkish FOMC communications lower the common risk premium on stocks and long-term bonds simultaneously. These papers characterize the conditions for the change in the regime, leaving open which macroeconomic force determines when each regime prevails. We contribute to this literature by connecting the switch in regimes to structural sources of monetary policy uncertainty: macroeconomic uncertainty drives the hedging-premium regime, generating

flight-to-safety dynamics and a negative stock–bond correlation, while reaction-function uncertainty leads to stagflationary dynamics, generating a positive stock–bond correlation. The two sources we identify map precisely onto the demand and supply channels that theory predicts should drive the correlation, and our decomposition links them to the sources of monetary policy uncertainty.

Our paper is also related to recent literature exploring the transmission of uncertainty to the term structure of interest rates. Cochrane and Piazzesi (2005) and Ludvigson and Ng (2009) document robust predictability in bond excess returns from macroeconomic factors, consistent with countercyclical risk premia, while Cieslak and Povala (2016) and Mueller, Vedolin, and Zhou (2019) show that the interest-rate variance risk premium predicts short-run bond returns independently of standard predictors. Bansal and Shaliastovich (2013) show in a long-run-risks model that real and inflation uncertainty push the bond term premium in opposite directions: real uncertainty lowers yields through a flight-to-quality channel while inflation uncertainty raises yields. Bianchi, Kung, and Tirskikh (2023) distinguish demand-side from supply-side uncertainty and show that they generate countercyclical versus procyclical term premium. Our decomposition gives this asymmetry a structurally identified empirical counterpart: macroeconomic uncertainty shocks compress the real term premium as bonds become attractive hedges in demand-driven contractions, whereas reaction-function uncertainty shocks expand the term premium as the hedging role of bonds deteriorates. Which pattern dominates in a given sample depends on the mix of the underlying shocks, reconciling conflicting evidence on whether bond risk premia are countercyclical or procyclical.

Our work also relates to the a strand of the literature studying how markets form and revise beliefs about the conduct of monetary policy. Bauer et al. (2024) document large revisions in the perceived response of policy rates to inflation, and Bauer and Swanson (2023) emphasize the information about monetary policy in announcement-day surprises, both showing that markets continuously update their views about policy. Andrei and Hasler (2025) model investors learning about the transmission of policy to the macroeconomy, generating time-varying risk premia. More closely to our paper, Cieslak et al. (2024) show that uncertainty about the Federal Reserve's reaction function following the 2020 review

of the Federal Reserve's Monetary Policy Strategy led to an increase in long-term Treasury yields between 2021 and 2022, mainly through a rise in the term premium rather than short-rate expectations. What this literature has not yet provided is direct evidence on the consequences of uncertainty about the reaction function itself, as distinct from shifts in its perceived level. We fill this gap as our measure of monetary policy response uncertainty captures the dispersion in beliefs about how the Federal Reserve maps economic conditions into policy, and we trace its causal effects on output, inflation, Treasury yields, and equity valuations.

Our paper also contributes to the literature on the macroeconomic effects of uncertainty. Bloom (2009) establishes that uncertainty shocks reduce output and investment. Jurado et al. (2015) construct a macroeconomic uncertainty factor that predicts real activity, and Ludvigson et al. (2021) distinguish financial uncertainty, which acts as an exogenous impulse, from macroeconomic uncertainty, which is largely an endogenous response to business-cycle shocks (see Cascaldi-Garcia, Sarisoy, Liao, Sun, Ghironi, Ozturk, Doh, Ferreira, and Phan, 2023, for a survey). Consistent with our findings, Leduc and Liu (2016) and Basu and Bundick (2017) show that uncertainty shocks behave like aggregate demand shocks, lowering output and inflation together under sticky prices. The evidence on whether uncertainty is inflationary or disinflationary is mixed, and there is currently no consensus. By decomposing policy path uncertainty into two structural components, we show that the ambiguity is not a genuine disagreement about mechanisms but reflects the fact that different episodes are dominated by different sources of uncertainty: when macroeconomic uncertainty dominates, output and inflation fall together and policy eases, as in Leduc and Liu (2016); when reaction-function uncertainty dominates, output contracts while inflation rises and policy tightens. The inflation response to the reaction-function shock is not imposed by our sign restrictions but emerges from the data, and it accounts for 35 to 44 percent of the forecast-error variance of inflation, far more than macroeconomic uncertainty. This refines Bekaert and Engstrom (2010), who link the positive comovement of expected inflation and equity yields to periods of high uncertainty, by identifying the specific source of that uncertainty.

Finally, our paper builds on the high-frequency identification of monetary policy. Kut-

tner (2001) measures policy surprises from federal funds futures and Gürkaynak, Sack, and Swanson (2005) decompose announcements into target and path factors, establishing that revisions in the expected policy path are central to how policy affects asset prices. Rather than focusing on announcement-day surprises, we compute the realized volatility of daily revisions in policy expectations over each intermeeting period, capturing the continuous flow of information between FOMC meetings. To the extent that short-term rates reveal the market's expected policy path, the volatility of investors' revisions measures the uncertainty around that path. A growing literature builds explicit uncertainty measures: Baker et al. (2016) and Husted et al. (2020) construct newspaper-based indices, Bundick, Smith, and der Meer (2024) an option-implied policy-rate uncertainty measure, and De Pooter, Favara, Modugno, and Wu (2021) show that policy uncertainty shapes the transmission of policy to longer-term yields. Our measure differs in two respects. First, it is based on realized rather than option-implied volatility, sidestepping the problem that option-implied measures conflate actual uncertainty and the variance risk premium. Mueller et al. (2019) shows that the variance risk premium predicts bond returns, and Berger, Dew-Becker, and Giglio (2020) show that option-implied volatility measures are unrelated to real activity. Second, and more importantly, we do not treat the measure as a scalar object but decompose it into its structural sources. Its low correlation with the macroeconomic uncertainty factor of Jurado et al. (2015) and Ludvigson et al. (2021) is a key motivating fact, as it suggests that a quantitatively important component of policy-path uncertainty is orthogonal to macroeconomic uncertainty and must reflect uncertainty about the Federal Reserve's reaction function.

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 variance of the path of the policy rates at various horizons. Let t index FOMC meetings and J denote the number of trading days between meetings t and $t+1$.[2] 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 variance of policy expectations over this intermeeting period for the policy rate h meetings ahead is computed as:

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

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

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

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.

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

[2] Intermeeting period t runs from the day markets learn the FOMC's policy action at meeting t to the day before they learn the action at meeting $t+1$. From the February 1994 meeting, it runs from the day the statement is released to the day before the next statement is released. Before 1994, when markets inferred the action the day after the meeting, it runs from the day after meeting t to the last day of meeting $t+1$.

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 278 FOMC meetings from May 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 0.69 declining gradually to 0.55 at the fourth lag. When is 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, together with a line marking the 75th percentile of PPU. The threshold is computed separately by policy-rate regime: from observations during periods away from the zero lower bound, and from observations during periods at it. 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

Table 1: Summary Statistics of Policy Path Uncertainty

	Mean	Std Dev	AC(1)	AC(2)	AC(3)	AC(4)
PPU	0.79	0.49	0.69	0.66	0.59	0.55
	(0.10)	(0.04)	(0.09)	(0.11)	(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 278 FOMC meetings from May 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.

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.

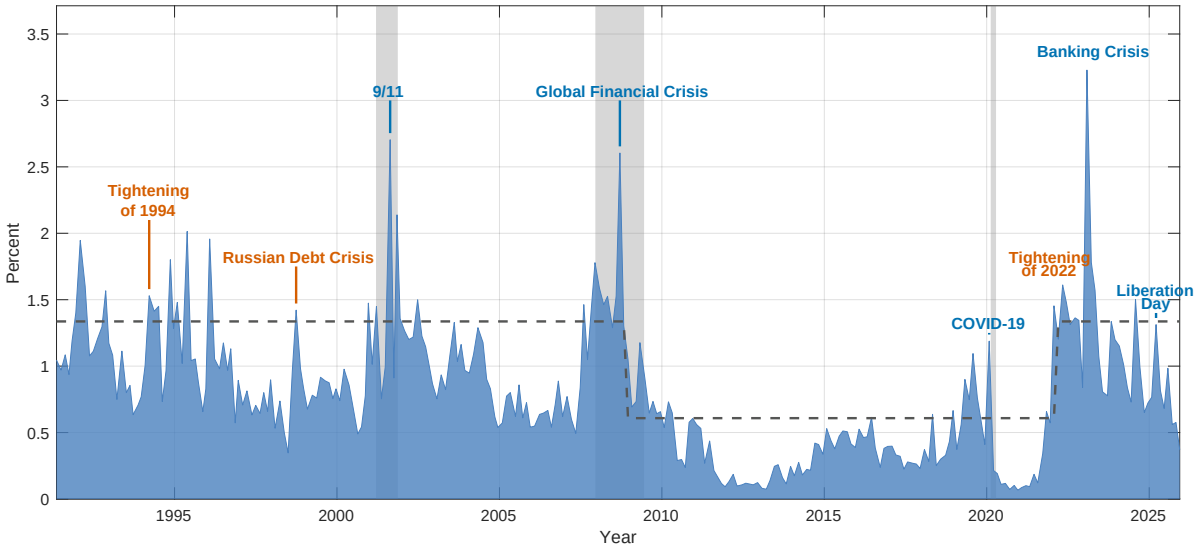
Our measure of policy path uncertainty shares several attractive properties with the model-free realized volatility estimators developed in the high-frequency finance literature (Andersen, Bollerslev, Diebold, and Labys, 2001, 2003; Barndorff-Nielsen and Shephard, 2002). First, the measure is model-free 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 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

Table 2: Policy Path Uncertainty over the Business Cycle

	Dep. Variable: PPU	
	(1)	(2)
Easing	0.529	
	(0.15)	
Tightening	0.134	
	(0.17)	
Recession		0.532
		(0.29)
Constant	0.662	0.753
	(0.11)	(0.11)
R^2	0.160	0.080
Observations	278	278

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 278 FOMC meetings from May 1991 to December 2025. The horizontal line corresponds the 75th percentile of PPU. The threshold is computed separately by policy-rate regime: from observations during periods away from the zero lower bound, and from observations during periods at it. Shaded areas correspond to NBER recession dates.

premium, the price investors are willing to pay to insure against volatility risk. Mueller et al. (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.[3]

The distinction between realized and option-implied volatility is not merely a matter of measurement, the two objects have fundamentally different economic content. Berger et al. (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

[3]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.

is essentially zero, suggesting that general economic policy uncertainty (i.e., fiscal, regulatory, 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	-0.10	$[-0.26, 0.09]$
MPU	0.14	$[-0.02, 0.30]$
KCPU	0.80	$[0.70, 0.85]$
$\text{FU}_{h=1}$	0.18	$[-0.08, 0.42]$
$\text{MU}_{h=1}$	0.08	$[-0.20, 0.42]$
$\text{FU}_{h=3}$	0.17	$[-0.09, 0.42]$
$\text{MU}_{h=3}$	0.10	$[-0.18, 0.42]$
$\text{FU}_{h=12}$	0.18	$[-0.10, 0.43]$
$\text{MU}_{h=12}$	0.17	$[-0.12, 0.48]$

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 covers 278 FOMC meetings from May 1991 to December 2025, except for the MPU measure that runs from May 1991 to June 2024?.

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, roughly one year of lagged information, which is selected using the Akaike and Bayesian information criteria on the reduced-form VAR. The sample covers May 1991 to December 2025.

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 empirical 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.[4] 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 (Bernanke, 1983; Bloom, 2009). 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,

[4] 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 et al. (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	?	
Policy Rate	?		?	
Financial Uncertainty	$+$	0–4	?	
Policy Path Uncertainty	$+$	0–2	$+$	0–4

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 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 during the February 1994 intermeeting period, marking the onset of the 1994 tightening cycle, and ε^{MPRU} must contribute more than ε^{MU} to policy path uncertainty during both the February and March 1994 intermeeting periods (spanning February 4 to May 16, 1994).* 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."[5] Over this period, several Federal Reserve officials, including former Vice Chair Alan Blinder, voiced concerns that the

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

rapid hikes might have gone too far. This created genuine uncertainty about how the Federal Reserve would respond to macroeconomic conditions going forward.

2. **The 2008 Financial Crisis:** *The macroeconomic uncertainty shock, ε^{MU}, must be positive during the August 2008 intermeeting period, marking the onset of the Global Financial Crisis, and ε^{MU} must contribute more than ε^{MPRU} to financial uncertainty during the August through December intermeeting periods (spanning August 5, 2008 to January 27, 2009).* 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 Federal Reserve 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 during the January 2020 intermeeting period, marking the onset of the COVID-19 crisis, and ε^{MU} must contribute more than ε^{MPRU} to financial uncertainty during that same period (spanning January 29 to March 17, 2020, which encompasses the March 2020 emergency policy actions).* 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 during the January 2022 intermeeting period, marking the onset of the 2022 tightening period, and ε^{MPRU} must contribute more than ε^{MU} to policy path uncertainty during the January through May 2022 intermeeting periods (spanning January 26 to June 14, 2022).* 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. Cieslak et al. (2024) provide di-

rect supporting evidence for this restriction. They document that uncertainty about the Federal Reserve's reaction function following its 2020 monetary policy framework review drove Treasury term premia substantially higher over this episode, the largest increase since 1994, and that the increase operated through the term premium rather than through revised expectations of the short-rate path, precisely the transmission channel our MPRU shock tries to capture. Additionally, Bauer et al. (2024) show that professional forecasters were highly uncertain about the monetary policy rule's response to inflation during this period and revised their perceptions toward a stronger policy response as the Federal Reserve raised rates.

5. **March 2023:** *The macroeconomic uncertainty shock, ε^{MU}, must be positive during the February 2023 intermeeting period (spanning February 1 to March 21, 2023), marking the onset of the 2023 banking crisis, including the failure of Silicon Valley Bank on March 10.* 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.[6] 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

[6] Specifically, the historical decomposition restrictions require ε^{MU} to contribute more than ε^{MPRU} (or vice versa) to the relevant variable. They do not require either shock to be the single largest contributor overall; the remaining three VAR shocks may well account for a larger share of the variation in any given episode.

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 1,581 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.[7] 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.

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 0.6 percent about 8 intermeet-

[7] 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.

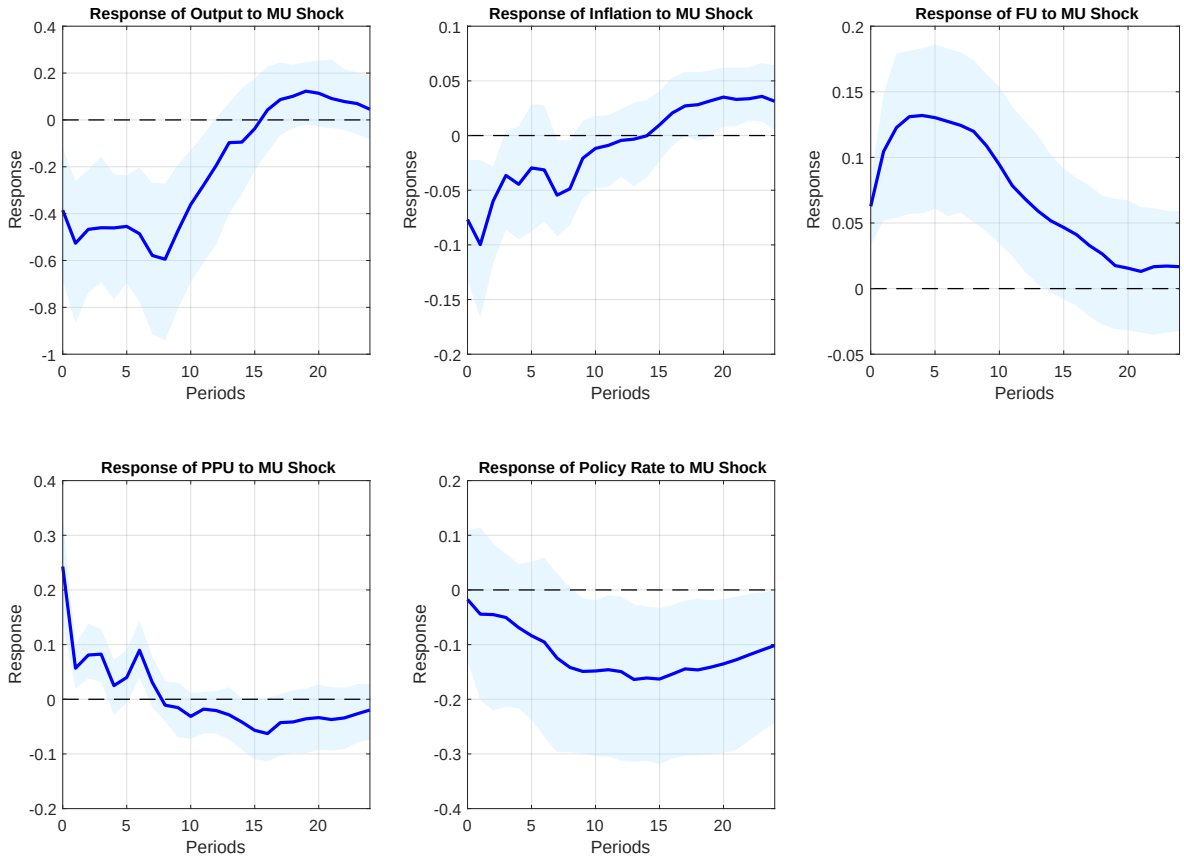
ing periods (roughly 1 year) after the macroeconomic uncertainty shock hits the economy. Inflation also declines by roughly 0.1 percentage point on impact. The expected policy rate falls by approximately 0.2 percentage points after 1 year, consistent with the Federal Reserve easing policy to offset the 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).[8]

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} 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

[8]Our estimated effects of MU on economic activity are consistent with the findings in Caldara, Fuentes-Albero, Gilchrist, and Zakrajšek (2016) and CASCALDI-GARCIA and GALVAO (2021), who find that an increase in financial uncertainty depress output, with a one standard deviation increase in Realized Volatility in equity markets leading to a drop of 0.2—0.4 percent in GDP about one year after the shock.

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



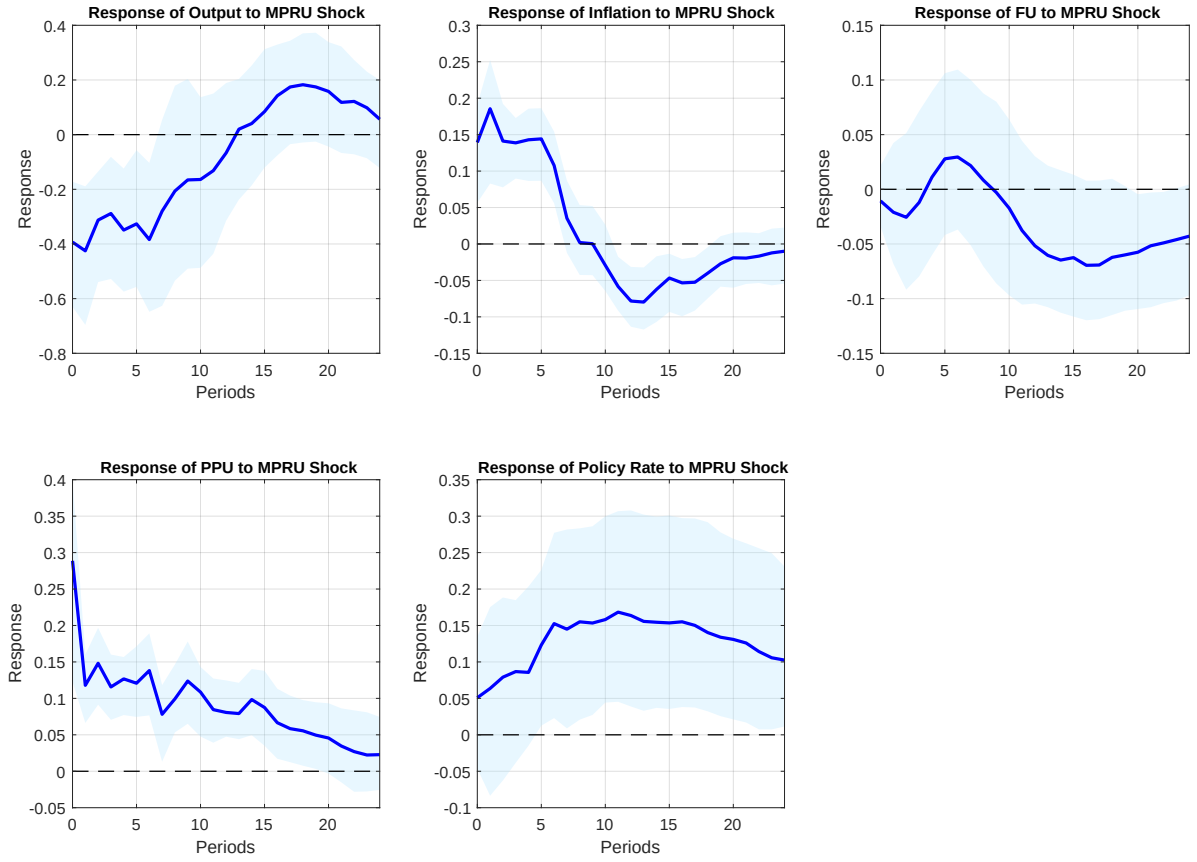
This figure plots the impulse responses to a one-standard-deviation macroeconomic uncertainty shock, ε^{MU}, of industrial production, core CPI inflation, the financial uncertainty index of Jurado et al. (2015) and Ludvigson et al. (2021), our policy path uncertainty measure (PPU), and the expected policy 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 278 FOMC meetings from May 1991 to December 2025.

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

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 278 FOMC meetings from May 1991 to December 2025.

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 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 18 and 24 percent of the variance, respectively. As the horizon increases, MU shocks become less important, declining to about 15 percent, while MPRU shocks grow in importance, explaining nearly 35 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, close to 10 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 at most about 11 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. This 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. This result also relates to Bianchi et al. (2023), who show in a theoretical model that supply-side uncertainty has larger effects on inflation than demand-side uncertainty.

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	0.093	0.097	0.108	0.362
1	0.112	0.087	0.110	0.360
4	0.171	0.094	0.090	0.422
8	0.227	0.104	0.097	0.438
12	0.234	0.103	0.099	0.397
	Panel C: Financial Uncertainty		Panel D: Policy Path Uncertainty	
Horizon	ε^{MU}	ε^{MPRU}	ε^{MU}	ε^{MPRU}
0	0.311	0.036	0.178	0.241
1	0.280	0.039	0.173	0.266
4	0.260	0.038	0.161	0.302
8	0.256	0.043	0.151	0.317
12	0.235	0.055	0.145	0.334
	Panel E: Policy Rate			
Horizon	ε^{MU}	ε^{MPRU}		
0	0.116	0.083		
1	0.107	0.082		
4	0.104	0.089		
8	0.116	0.121		
12	0.132	0.129		

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 278 FOMC meetings from May 1991 to December 2025.

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 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 robust 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 $\{\varepsilon^{MU,s}_t, \varepsilon^{MPRU,s}_t\}_{t=1}^{T}$ 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

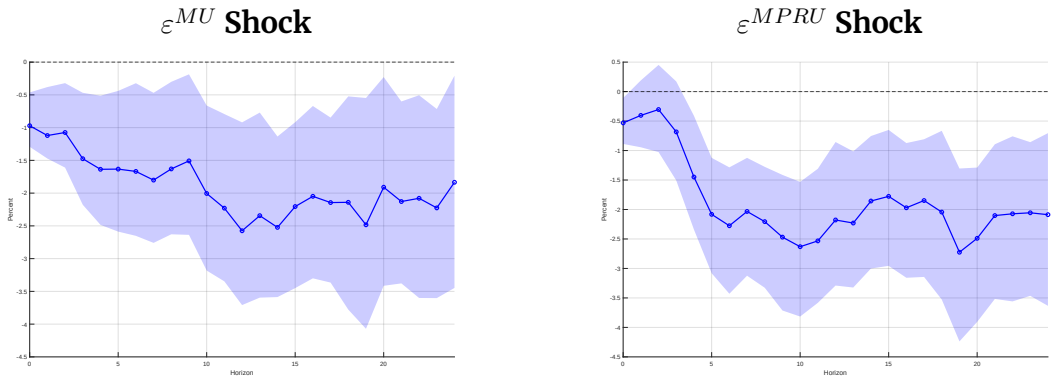
Figure 4 presents the responses of the excess equity market return to a one-standard-deviation macroeconomic uncertainty shock (ε^{MU}) and monetary policy response uncertainty shock (ε^{MPRU}). The reported responses correspond to cumulative excess returns from intermeeting period t to $t+h$. The excess 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, cycli-

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 278 FOMC meetings from May 1991 to December 2025.

cally 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-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 dif-

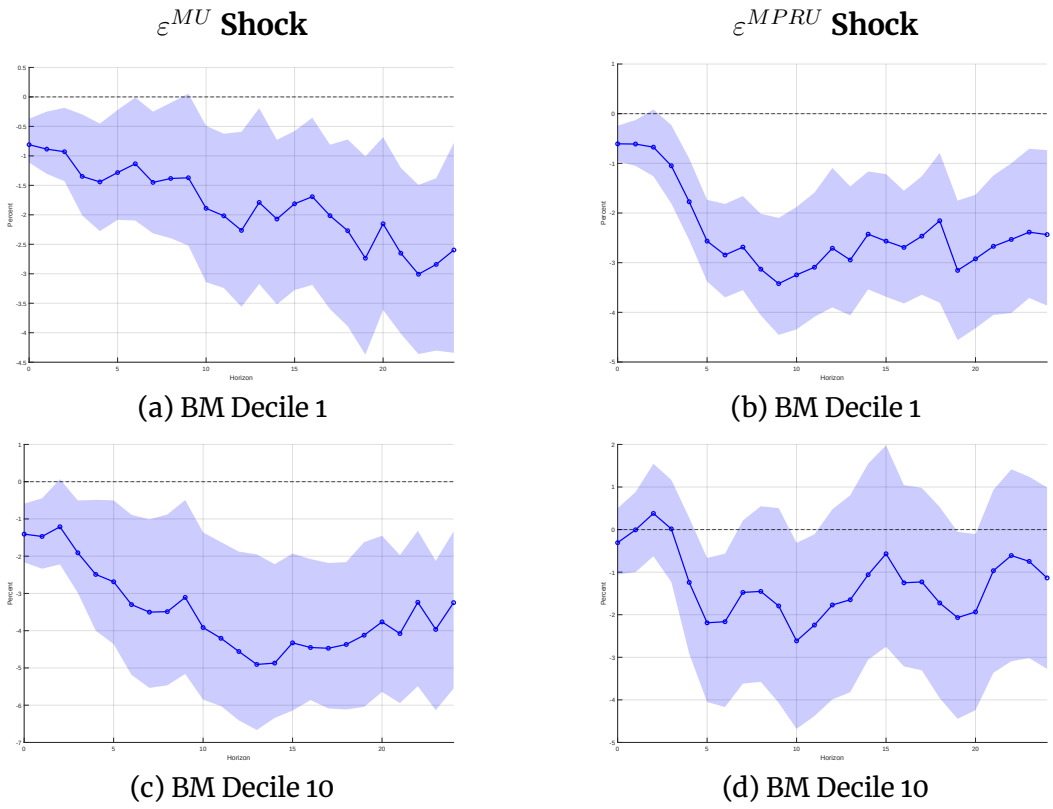
ferently from long-duration claims in response to macroeconomic shocks. Our two identified uncertainty shocks, one operating primarily through cash flows and the other through discount rates, map directly onto this framework, and book-to-market sorted portfolios provide a sharp test of this distinction.

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

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

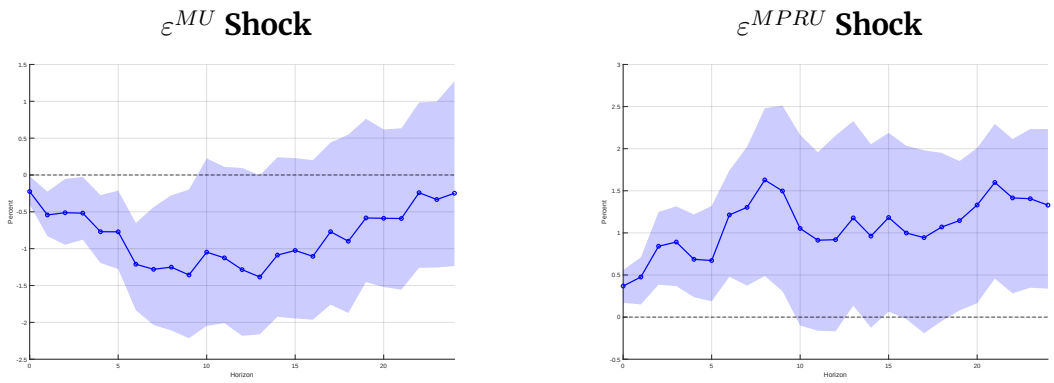
(c) BM Decile 10

(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 278 FOMC meetings from May 1991 to December 2025.

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



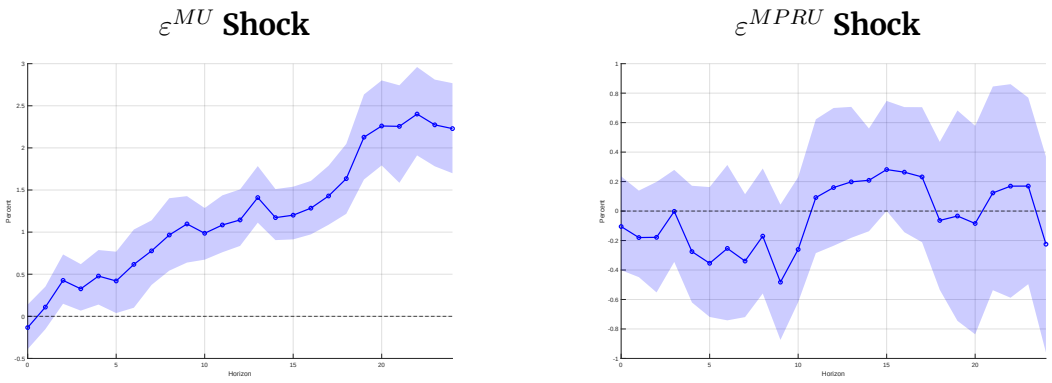
The left column plots the impulse response of the High Minus Low (HML) portfolio to a one-standard-deviation macroeconomic uncertainty shock, ε^{MU}, and the right column presents the response to a monetary policy response uncertainty shock, ε^{MPRU}. The solid lines display the point-wise median responses and the shaded areas represent the 68 percent (point-wise) highest posterior density credible set. The sample covers 278 FOMC meetings from May 1991 to December 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 per-

cent 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 278 FOMC meetings from May 1991 to December 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 under-

perform 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 reduce 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, 2020; Baele et al., 2010). Ermolov (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

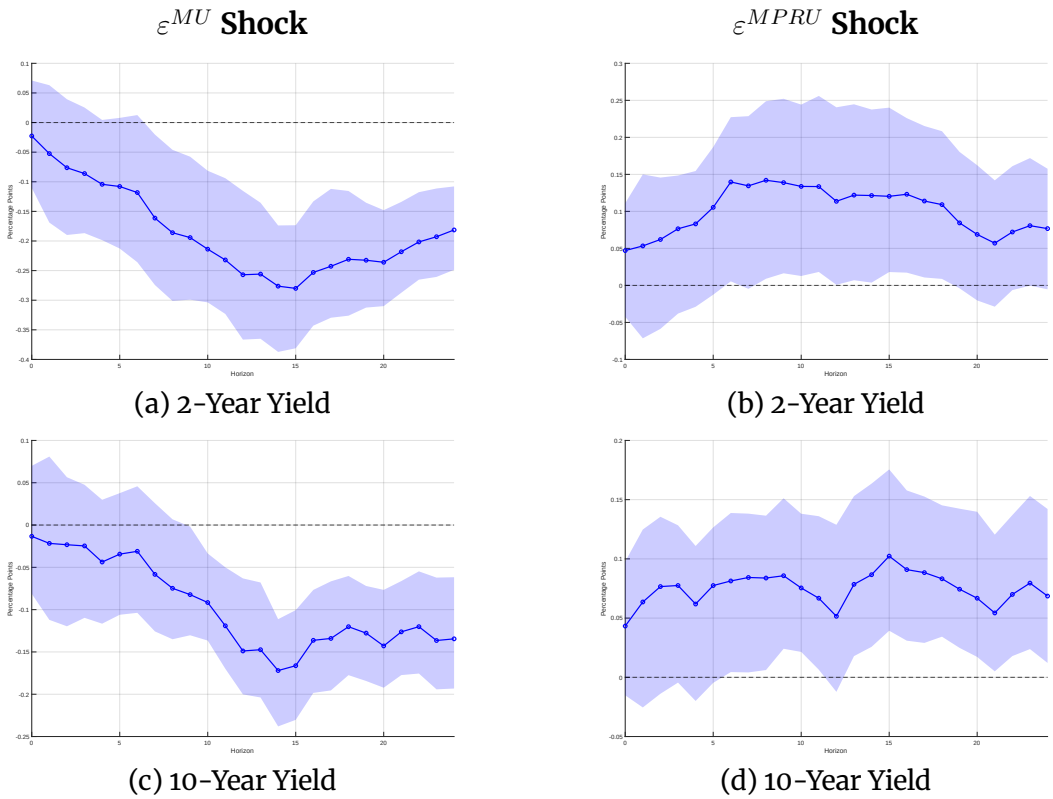
points and experiencing a cumulative decline of close to 20 basis points over the same horizon. The decline is larger at shorter maturities, particularly as the time horizon increases. This steepening of the yield curve is consistent with the demand-shock interpretation of ε^{MU}: short rates are expected to fall as the Federal Reserve eases monetary policy, and to remain 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 pattern is consistent with Cieslak and McMahon (2023), who find that reaction-function-related Fed communication raises a common risk premium that depresses both equity and bond prices, while leaving the hedging premium unaffected. This result is also 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

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



(a) 2-Year Yield

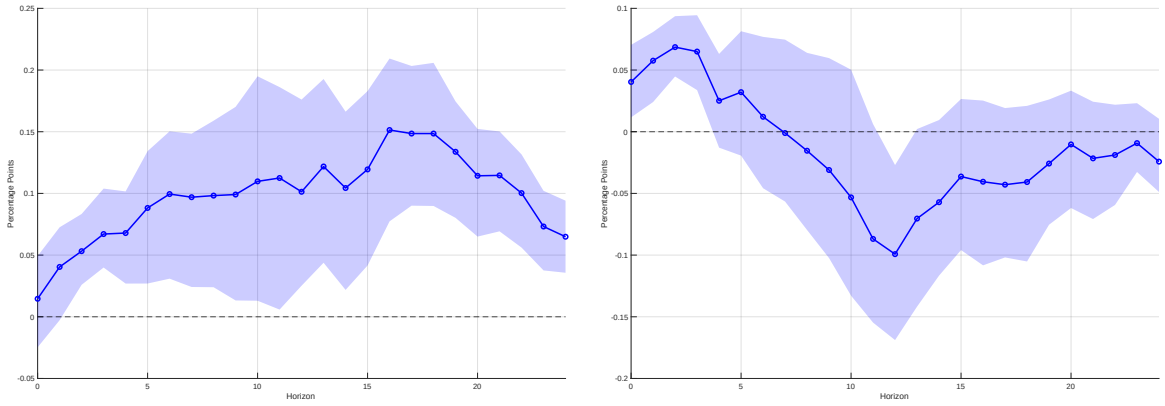
(b) 2-Year Yield

(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 278 FOMC meetings from May 1991 to December 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 278 FOMC meetings from May 1991 to December 2025.

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 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 Cieslak and Povala (2016), 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, however, 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.

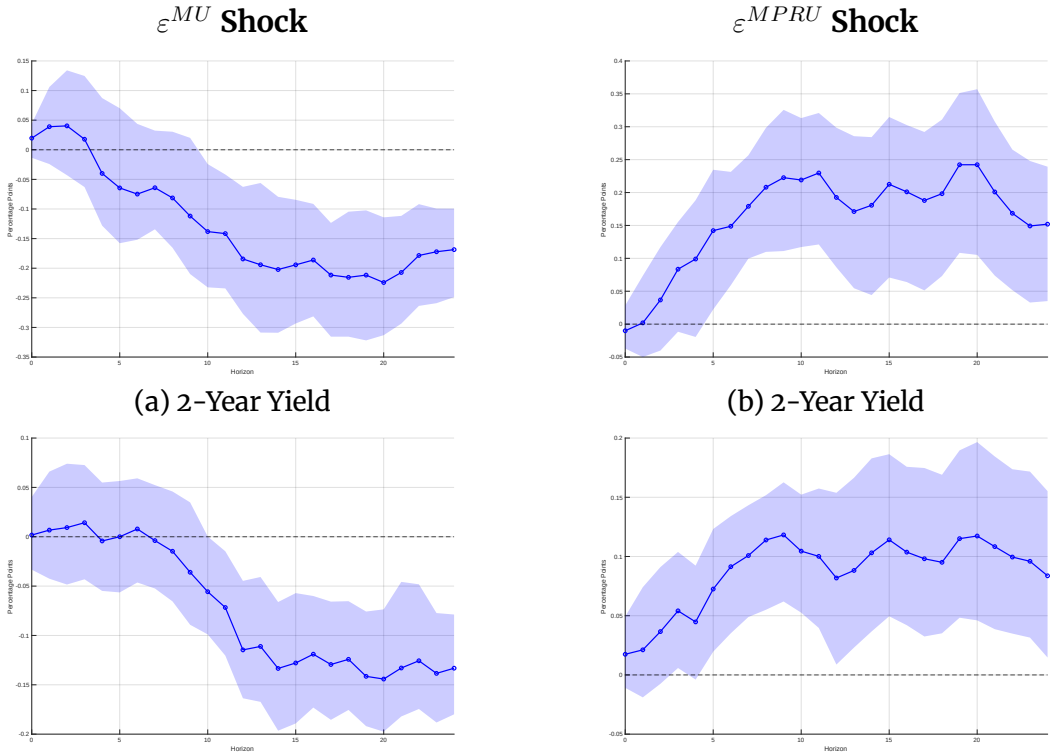
The response of real yields to ε^{MPRU} is strikingly distinct. Real yields rise in response to a ε^{MPRU} shock, with 10-year real yields increasing by approximately 10 basis points. This finding suggests that the increase in nominal yields following a ε^{MPRU} shock is not driven by higher inflation 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. This finding aligns with Cieslak et al. (2024), who document that the surge in term premia during the 2022 tightening cycle reflected uncertainty about the Federal Reserve's reaction function rather than revised expectations about the short-rate path, precisely the transmission channel our MPRU identification implies. The result is also 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.[9] 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.

[9] See Mueller et al. (2019) for evidence on the distinct short-run and long-run components of bond risk premia, and Cieslak and Povala (2016) for a decomposition of yield curve volatility into short-rate expectations and term premium components.

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.

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.

For some intermeeting periods, 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.

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 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 practice 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 278 FOMC intermeeting periods from May 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.

C Robustness of the PPU Measure

This appendix examines the robustness of the aggregate PPU measure along three dimensions: (i) whether the aggregate measure is dominated by the choice of intermeeting period horizon, (ii) whether the chosen narrative episodes are concentrated at specific horizons, and (iii) whether the measure reflects both structural shocks (macroeconomic uncertainty (MU) and monetary policy response uncertainty (MPRU)) or is primarily driven by one.

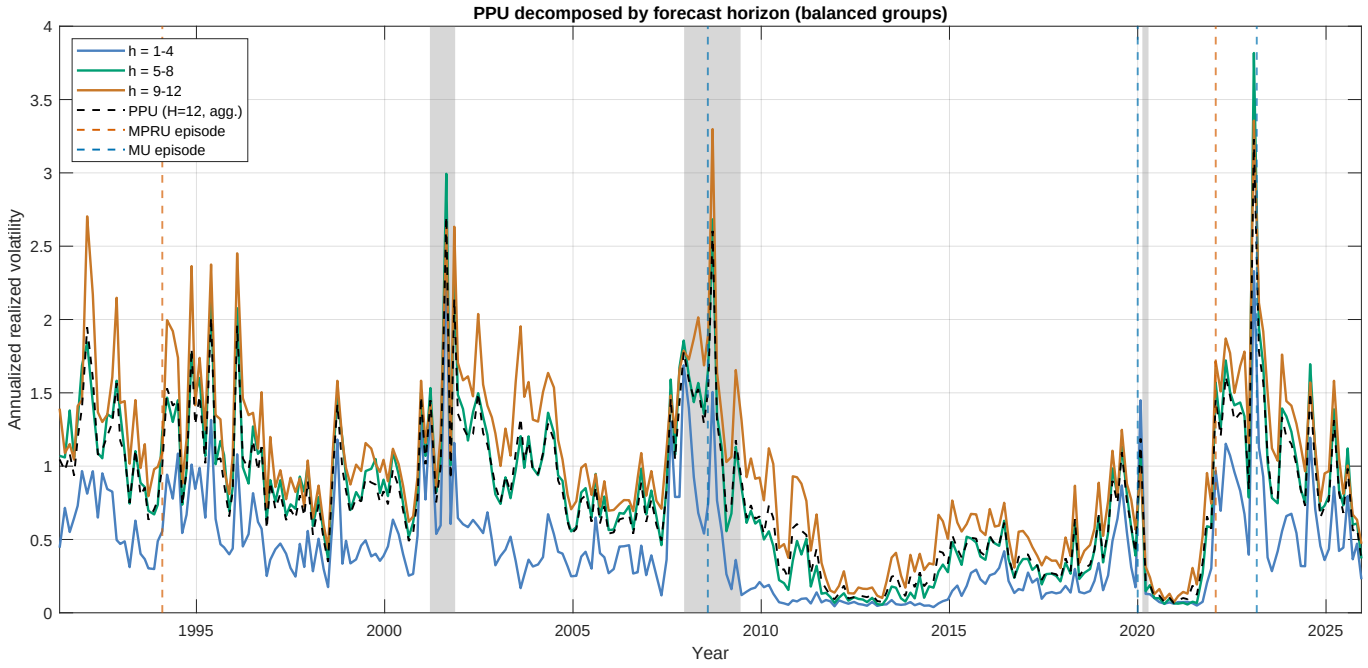
C.1 Horizon Composition of the Aggregate

The baseline PPU measure aggregates uncertainty across $h = 1$ through $h = 12$ intermeeting periods. A natural concern is that the aggregate measure may be driven disproportionately by a particular segment of the horizon spectrum. For example, a measure dominated by near-term uncertainty ($h = 1 - 4$) could capture different economic forces and have different implications for our results than a measure driven primarily by longer-run uncertainty ($h = 9 - 12$). If so, our findings could be sensitive to the choice of aggregation window. To assess this possibility, we decompose PPU into three balanced horizon groups of four intermeeting periods each: $h = 1 - 4$ (short-run), $h = 5 - 8$ (medium-run), and $h = 9 - 12$ (longer-run). We then examine whether these components co-move with the aggregate measure and with one another.

Figure 11 plots the three components alongside the aggregate PPU measure over the full sample. All three components closely track the aggregate series, with spikes occurring around the same key episodes and no single horizon consistently dominating the measure. While the short-run component is somewhat smaller in magnitude than the medium- and longer-run components, this pattern is consistent with greater certainty about the near-term path of monetary policy, potentially due in part to forward guidance. However, it is worth noting that the short-run component reaches magnitudes comparable to the other horizons during periods of heightened uncertainty, particularly around recessions and other high-uncertainty episodes. Figure 12 confirms that each group contributes persistently to the aggregate throughout the sample period.

To further assess whether the aggregate captures variation across the full horizon spec-

Figure 11: **Policy Path Uncertainty Decomposed by Intermeeting Period Horizon**



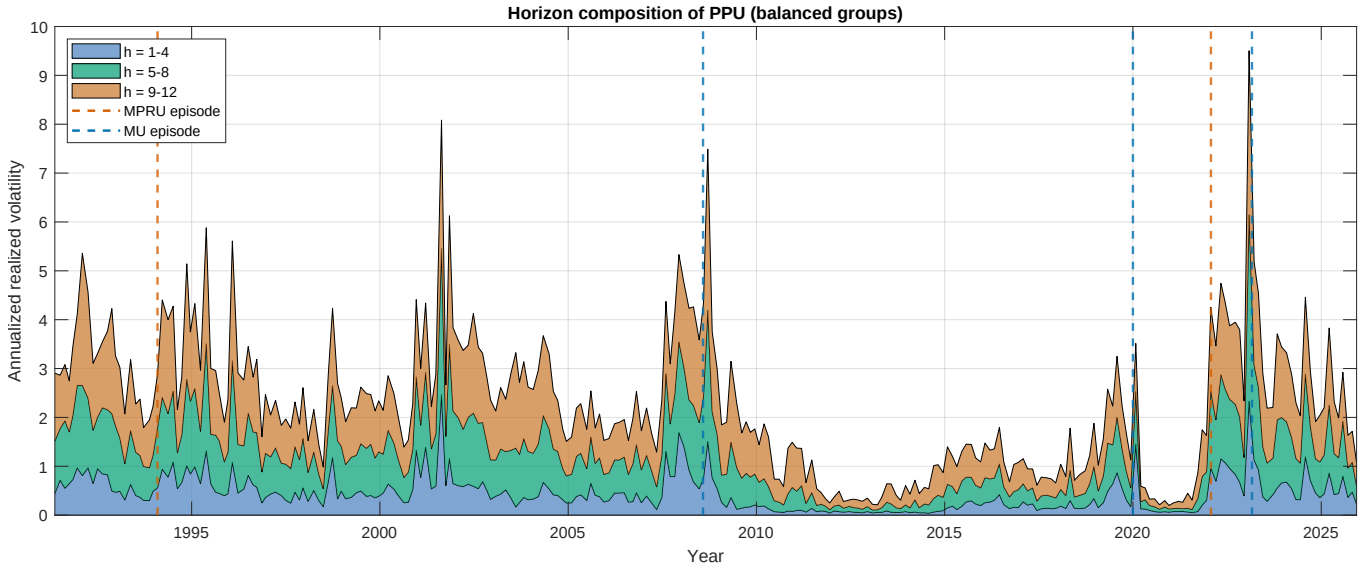
This figure plots the time series of three balanced horizon-group components of our measure of policy path uncertainty (PPU) expressed in annual percentage points: the short-run component ($h = 1{-}4$, blue), the medium-run component ($h = 5{-}8$, green), and the longer-run component ($h = 9{-}12$, orange). The dashed black line plots the aggregate PPU measure ($H = 12$). Each component is computed as the annualized realized volatility of the policy rate path, averaged equally across the four horizons within each group. The sample covers 278 FOMC meetings from May 1991 to December 2025. Vertical dashed orange lines indicate the start of narrative episodes classified as monetary policy response uncertainty (MPRU) shocks; vertical dashed blue lines indicate the start of episodes classified as macroeconomic uncertainty (MU) shocks. Shaded areas correspond to NBER recession dates.

Table A.1: Cross-Correlations of PPU Horizon Components

	h=1–4	h=5–8	h=9–12
h=1–4	1.000	0.910	0.811
h=5–8	—	1.000	0.955
h=9–12	—	—	1.000

Note: This table reports pairwise Pearson correlations between the three decomposed PPU horizon components. The short-, medium-, and longer-run components correspond to uncertainty over $h = 1{-}4$, $h = 5{-}8$, and $h = 9{-}12$ intermeeting periods, respectively.

Figure 12: **Horizon Composition of Policy Path Uncertainty**



This figure plots the stacked levels of three balanced horizon-group components of PPU expressed in annual percentage points: the short-run component ($h = 1{-}4$, blue), the medium-run component ($h = 5{-}8$, green), and the longer-run component ($h = 9{-}12$, orange). The height of each shaded region represents the level of the corresponding component at each point in time. The sample covers 278 FOMC meetings from May 1991 to December 2025. Vertical dashed orange lines indicate the start of narrative MPRU episodes; vertical dashed blue lines indicate the start of narrative MU episodes.

trum rather than being dominated by a subset of horizons, Table A.1 reports pairwise Pearson correlations between the three components over the full sample. The correlations are uniformly high (0.91 between the short- and medium-run components, 0.96 between the medium- and longer-run components, and 0.81 between the short- and longer-run components), confirming that a strong common factor underlies policy path uncertainty across all forecast horizons. This is consistent with the view that the same fundamental sources of uncertainty, about the macroeconomic outlook and the Fed's reaction function, propagate across the entire horizon spectrum rather than remaining confined to one segment.

C.2 Horizon Composition During Narrative Episodes

A related concern is that specific narrative episodes may be characterized by uncertainty concentrated in a particular segment of the horizon spectrum, such that the aggregate measure masks heterogeneity across horizons. Two natural examples are the Global Financial Crisis, during which uncertainty may have been concentrated at longer horizons due to uncertainty about the persistence of monetary accommodation and the timing of eventual normalization, and COVID-19, during which uncertainty may have been concentrated at shorter horizons due to uncertainty about the pace and scale of the immediate policy response. If these episodes are driven primarily by a single horizon component, results based on the aggregate measure could obscure economically important differences across the policy path.

Table A.2 reports mean PPU for each horizon component during five narrative episodes, with pre-episode means computed over the 10-year window preceding each episode reported in parentheses. [10]

The Global Financial Crisis provides little evidence of horizon concentration. While the longer-horizon component is largest in absolute terms, reaching 2.04% annualized volatility relative to a pre-episode mean of 1.21%, the short-run component also rises substantially, reaching 0.89% relative to a pre-episode mean of 0.55%. Moreover, when normalized by their respective pre-episode baselines, the increases are remarkably similar across horizons; the short-, medium-, and longer-run components increase by factors of 1.61, 1.65, and 1.69, respectively. Thus, the GFC represents a broad-based increase in uncertainty about the entire policy path rather than an episode driven exclusively by longer-run uncertainty.

COVID-19 exhibits greater heterogeneity across horizons, consistent with the nature of the shock. Relative to the low pre-COVID baseline, all three components increase during the episode, but the increase is largest at shorter horizons. The short-run component rises nearly fivefold (0.79% relative to a pre-episode mean of 0.16%), compared with

[10] We focus on pre-episode benchmarks because the full sample spans multiple interest rate volatility regimes. For example, the decade preceding COVID-19 and the 2022 tightening cycle was characterized by unusually low policy uncertainty, leading to baseline levels well below the full-sample averages.

Table A.2: PPU Horizon Components During Narrative Episodes

Episode	Type	$h = 1{-}4$	$h = 5{-}8$	$h = 9{-}12$	$\text{PPU}_{H=12}$
Tightening 1994	MPRU	0.759	1.335	1.669	1.316
		(0.607)	(1.155)	(1.383)	(1.105)
GFC 2008	MU	0.891	1.705	2.044	1.621
		(0.553)	(1.034)	(1.211)	(0.981)
COVID-19	MU	0.789	0.613	0.649	0.701
		(0.162)	(0.323)	(0.503)	(0.362)
Tightening 2022	MPRU	0.924	1.489	1.690	1.407
		(0.190)	(0.324)	(0.464)	(0.350)
Banking 2023	MU	1.129	1.942	2.114	1.781
		(0.287)	(0.483)	(0.633)	(0.496)

Note: This table reports mean annualized realized volatility (in percent) for three balanced horizon-group components of PPU — the short-run ($h = 1{-}4$), medium-run ($h = 5{-}8$), and longer-run ($h = 9{-}12$) components — and for the aggregate PPU measure ($H = 12$), computed within each of five narrative episodes. Each horizon group averages equally across four intermeeting-period horizons. Pre-episode means, computed over the 10-year window preceding each episode start date, are reported in parentheses; for the 1994 tightening episode, all available pre-episode observations are used given the sample begins in May 1991. MU denotes episodes classified as macroeconomic uncertainty shocks; MPRU denotes episodes classified as monetary policy response uncertainty shocks, based on the historical decomposition of the baseline SVAR. Episode windows are: Tightening 1994 (February 1994 – June 1995), GFC 2008 (August – December 2008), COVID-19 (January – March 2020), Tightening 2022 (January – May 2022), and Banking Stress 2023 (March 2023).

roughly a doubling of the medium-run component (0.61% relative to 0.32%) and a more modest increase in the longer-run component (0.65% relative to 0.50%). This pattern suggests that uncertainty was concentrated around the immediate monetary policy response, while longer-run policy expectations remained comparatively more anchored. Importantly, however, all three components remain above their pre-episode baselines, indicating that the aggregate measure captures a broad increase in policy path uncertainty rather than reflecting only short-run dynamics. Consistent with this interpretation, Table A.2 shows that MU shocks significantly increase PPU across all horizon groups, not only the short-run component.

The remaining episodes provide further support for the aggregate measure. During the 1994 tightening cycle, the 2022 tightening cycle, and the 2023 banking stress episode, all three horizon components increase relative to their respective pre-episode baselines, with no episode characterized by elevated uncertainty at only one segment of the horizon spectrum. Overall, the evidence indicates that while the relative contribution of each horizon

varies across episodes in economically intuitive ways, aggregate PPU provides a representative summary of uncertainty about the policy path rather than being driven by a single horizon component.

C.3 Attribution to MU and MPRU Shocks Across Horizons

A third concern is that PPU reflects only one of the two structural shocks (effectively serving as a proxy for MPRU alone, with MU contributing little) or that the relative contributions of MU and MPRU vary systematically with forecast horizon. The latter is especially relevant given the horizon decomposition above. For instance, if MU loads only on the short-horizon component and MPRU loads only on longer horizons, then the aggregate conflates two distinct phenomena, and for MU-dominated episodes, the appropriate measure would be the short-horizon component rather than the aggregate.

Table A.3: Effect of Structural Uncertainty Shocks on PPU Horizon Components

	MU Shock		MPRU Shock	
Horizon Group	Median	90% CI	Median	90% CI
h = 1-4	0.0851	[0.0249, 0.1578]	0.1019	[0.0021, 0.1690]
h = 5-8	0.1185	[0.0508, 0.2030]	0.1510	[0.0414, 0.2304]
h = 9-12	0.1280	[0.0524, 0.1949]	0.1498	[0.0292, 0.2246]

Note: This table reports OLS estimates of the effect of macroeconomic uncertainty (MU) and monetary policy response uncertainty (MPRU) shocks on each PPU horizon component. The dependent variable is the level of the corresponding component expressed in annual percentage points. Shocks are the contemporaneous structural shocks from the baseline SVAR identified using narrative sign restrictions and historical decomposition restrictions, as described in the text. Controls include the term spread, the 3-month Treasury bill rate, and the AAA-Treasury spread, each measured as the intermeeting period average and entered with one period lag. The regression is estimated separately for each posterior draw of the SVAR. The table reports the posterior median and 90% credible interval across draws. The sample covers 278 FOMC meetings from May 1991 to December 2025.

To examine whether the relationship between PPU and the underlying structural shocks varies across the horizon spectrum, we regress each horizon component on contemporaneous MU and MPRU shocks identified from the baseline SVAR, including the same lagged financial controls, across all posterior draws. Table A.3 reports the posterior median and 90% credible interval for each coefficient.

The results provide three main insights. First, MU shocks are positively associated with

PPU at all horizon groups: the lower bounds of the 90% credible intervals are 0.025, 0.051, and 0.052 for the $h = 1 - 4$, $h = 5 - 8$, and $h = 9 - 12$ components, respectively. Thus, the relationship between MU and PPU is not confined to a particular segment of the policy horizon.[11] Second, the estimated effects of MU and MPRU shocks are similar in magnitude across horizons. The MU coefficients are approximately 80-85% as large as the corresponding MPRU coefficients, with substantial overlap in the credible intervals, indicating that both shocks contribute meaningfully to variation in PPU. Third, both shocks load significantly on all three horizon components, providing little evidence that the aggregate measure masks horizon-specific differences in shock attribution.

Overall, these results indicate that PPU captures both macroeconomic uncertainty and monetary policy response uncertainty throughout the forecast horizon. This finding is particularly relevant for episodes such as COVID-19, where uncertainty may have been concentrated at shorter horizons. MU shocks are associated with increases in short-, medium-, and longer-horizon PPU, suggesting that the aggregate measure preserves the relevant variation rather than being driven solely by a particular horizon component.

D Robustness to the Choice of Uncertainty Control Variable

D.1 Motivation

The baseline SVAR described in Section 3 includes the financial uncertainty index of Jurado et al. (2015) and Ludvigson et al. (2021) as the third variable in the system. The choice of financial uncertainty (FU) serves two identification roles: (i) it controls for aggregate uncertainty dynamics that are common to both shock types, and (ii) it provides a sign restriction target for the MU shock, specifically a positive macroeconomic uncertainty shock must raise FU persistently (see Table 4). While natural, this choice raises a potential concern. Financial uncertainty is constructed from the forecasting errors of financial variables, including asset prices, credit spreads, and equity return volatility. Our PPU measure is itself derived from financial markets, specifically, from the distribution of futures and OIS rates.

[11] The equivalent argument holds for MPRU as well.

To the extent that FU and PPU share common financial market drivers that are unrelated to macroeconomic fundamentals, their co-movement within the VAR could artificially inflate the estimated contribution of the MU shock, which is identified in part through FU's dynamic response, to PPU fluctuations.

One direct alternative is to use the macroeconomic uncertainty index of Jurado et al. (2015) and Ludvigson et al. (2021) (MU) as the third VAR variable. Unlike FU, the macroeconomic uncertainty index is constructed from the forecasting errors of a broad panel of real activity and price variables, making it substantially less susceptible to financial market confounds. Moreover, the sign restriction requiring the MU shock to raise the uncertainty variable is more directly interpretable in this specification: by definition, positive macroeconomic uncertainty shocks should raise measured macroeconomic uncertainty. Replacing FU with MU therefore addresses the concern that FU is capturing some forward-looking effects also embedded in PPU, while at the same time sharpening the conceptual link between the sign restriction and the structural shock it helps identify. This appendix re-estimates the SVAR with MU replacing FU as the third variable and verifies that the main results are robust to this alternative proxy for macroeconomic uncertainty.

D.2 Model Specification

The MU-augmented specification is identical to the baseline in every respect except the third VAR variable. Formally, $\mathbf{y}_t$ now contains: the cyclical component of industrial production, core CPI inflation, the macroeconomic uncertainty index (MU), policy path uncertainty (PPU), and the expected policy rate eight meetings ahead. The lag length remains $p = 8$ intermeeting periods, the sample covers May 1991 to December 2025, and the estimation follows the same two-stage Bayesian algorithm described in Section 3. The sign restrictions in Table 4 are adapted accordingly. Specifically, the MU shock is now required to raise the macroeconomic uncertainty index, rather than the financial uncertainty index, on impact and for the next four periods. All other sign restrictions are unchanged. All narrative restrictions are applied without modification. The sign restrictions constrain the signs of the structural shocks directly and are invariant to the choice of third variable.

The historical decomposition restrictions for the 1994 and 2022 episodes constrain the relative contributions of the shocks to PPU, which is unchanged across specifications. For the GFC and COVID episodes, the historical decomposition restrictions require ε^{MU} to be the dominant contributor to the third variable (now the macroeconomic uncertainty index rather than financial uncertainty), a condition that is if anything more natural here since a macroeconomic uncertainty shock should be the primary driver of a macroeconomic uncertainty index.

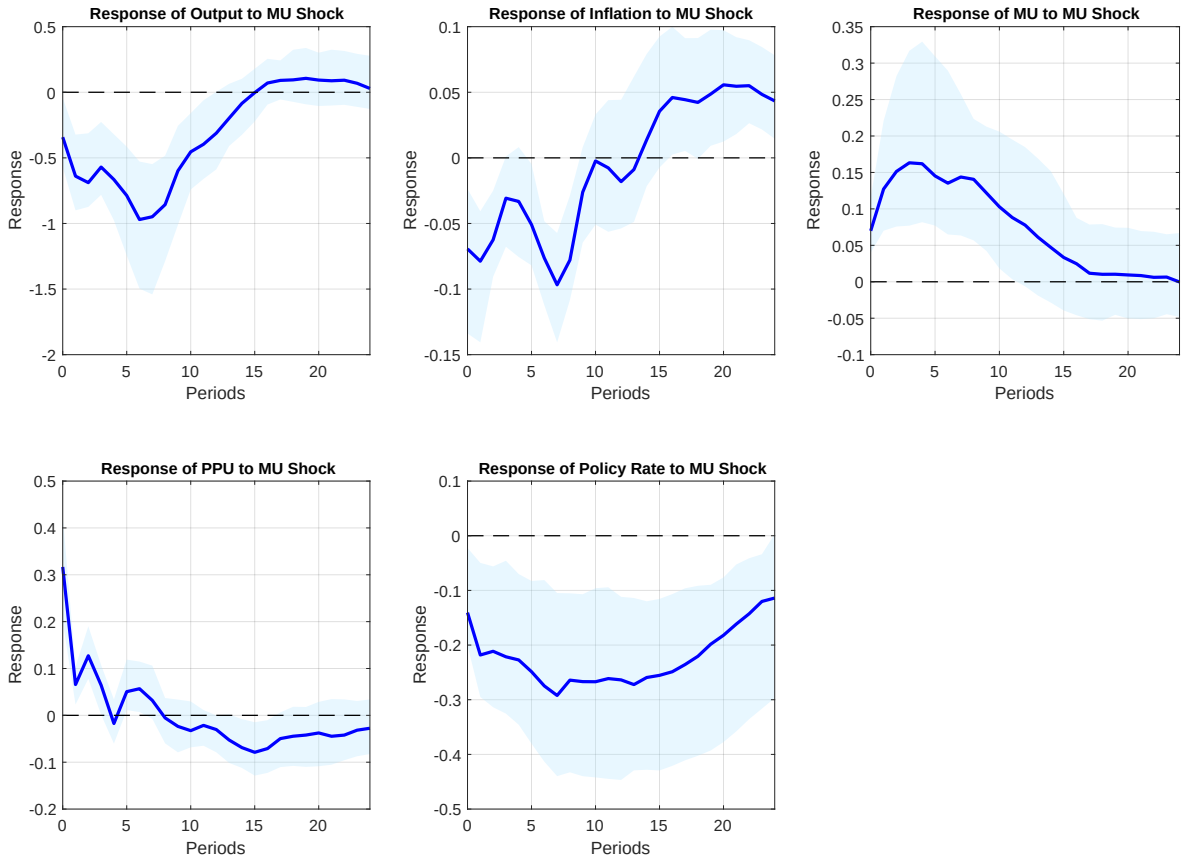
D.3 Impulse Responses

Figures 13 and 14 present the impulse responses to one-standard-deviation MU and MPRU shocks from the MU-augmented model. The qualitative character of both shocks is preserved.

A positive macroeconomic uncertainty shock (Figure 13) continues to generate a demand-like contraction. Industrial production falls on impact and remains depressed for approximately one year, core inflation declines, and the expected policy rate falls as the Federal Reserve eases to offset the contractionary effects of heightened uncertainty. The macroeconomic uncertainty index rises sharply and remains elevated, consistent with the sign restriction. Policy path uncertainty increases on impact before reverting toward baseline. These dynamics are qualitatively consistent with the baseline impulse responses in Figure 2. Thus, the disinflationary, demand-depressing character of the MU shock does not seem to be an artifact of using financial uncertainty as the control variable.

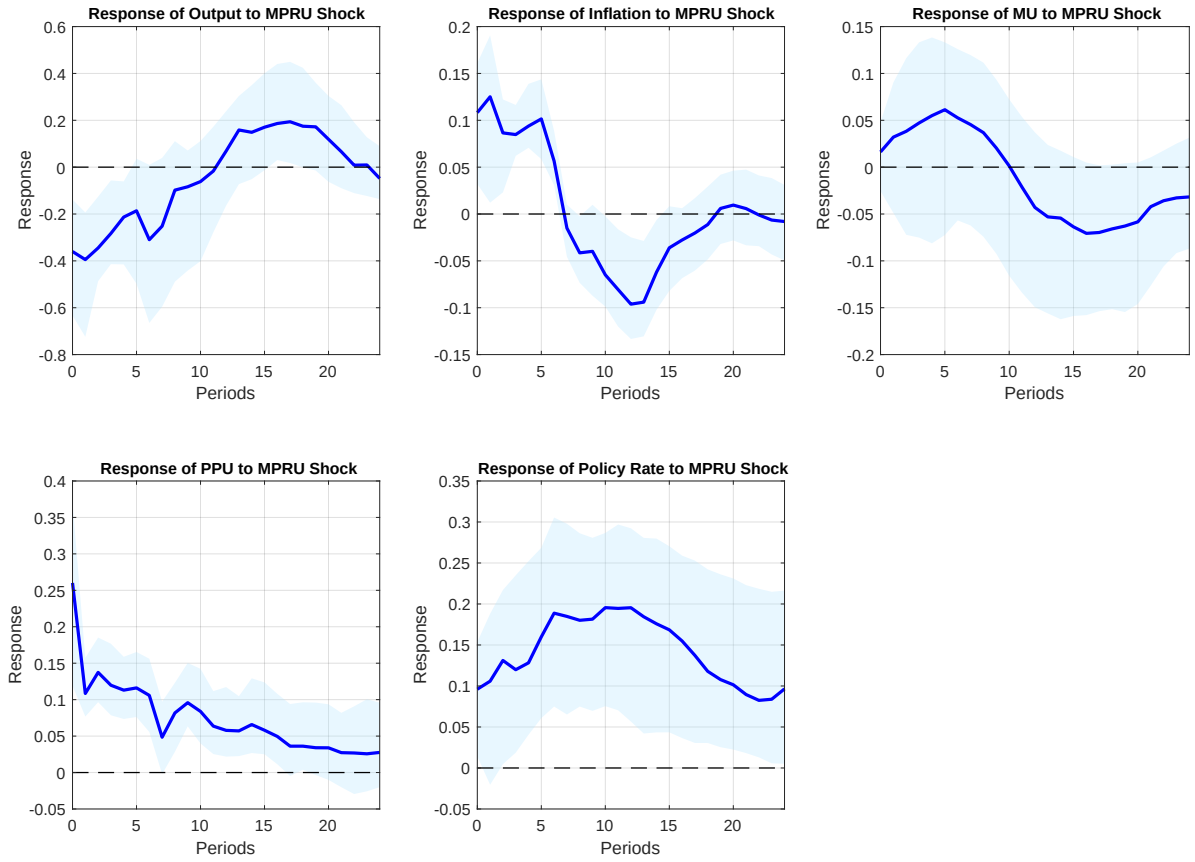
The impulse responses to a positive MPRU shock (Figure 14) are again similar to the baseline's central qualitative finding. Industrial production falls, while inflation rises, generating the stagflationary pattern that distinguishes MPRU from MU. Policy path uncertainty increases persistently and remains elevated for approximately two years. The macroeconomic uncertainty index responds only modestly to the MPRU shock, in sharp contrast to its large response to the MU shock. This finding is precisely the asymmetry one would expect if MPRU captures uncertainty about the Federal Reserve's reaction function rather than about macroeconomic fundamentals. The inflation response to MPRU is not imposed

Figure 13: **Responses to a Macroeconomic Uncertainty Shock: MU-Augmented Specification**



This figure plots the impulse responses to a one-standard-deviation macroeconomic uncertainty shock, ε^{MU}, from the MU augmented SVAR specification in which the macroeconomic uncertainty index of Jurado et al. (2015) and Ludvigson et al. (2021) replaces the financial uncertainty index as the third VAR variable. Variables shown: industrial production, core CPI inflation, the macroeconomic uncertainty index, policy path uncertainty (PPU), and the expected policy rate eight meetings ahead. Solid lines display the point-wise median responses and shaded areas represent 68 percent highest posterior density credible sets across 730 retained posterior draws.

Figure 14: **Responses to a Monetary Policy Response Uncertainty Shock: MU-Augmented Specification**



This figure plots the impulse responses to a one-standard-deviation monetary policy response uncertainty shock, ε^{MPRU}, from the MU-augmented SVAR specification in which macroeconomic uncertainty replaces financial uncertainty as the third VAR variable. Variables shown: industrial production, core CPI inflation, the macroeconomic uncertainty index, policy path uncertainty (PPU), and the expected policy rate eight meetings ahead. Solid lines display the point-wise median responses and shaded areas represent 68 percent highest posterior density credible sets across 730 retained posterior draws.

by the sign restrictions, so its persistence in the MU-augmented specification provides additional evidence that the stagflationary identification is not sensitive to whether financial or macroeconomic uncertainty enters the VAR.

D.4 Forecast Error Variance Decomposition

Table A.4 reports the forecast error variance decomposition from the MU-augmented model. The qualitative conclusions from the baseline (Table 5) are preserved across all variables, and the two central findings that (i) MPRU shocks are the dominant driver of inflation fluctuations and (ii) that both MU and MPRU shocks contribute meaningfully to PPU remain.

For policy path uncertainty (Panel D), MU shocks account for 28 percent of the forecast error variance on impact, declining to 22 percent at the 12-period horizon, while MPRU shocks account for 22 percent on impact, rising to 27 percent at the 12-period horizon. These patterns contrast with the baseline, where MU explains 19 percent declining to 16 percent and MPRU explains 23 percent rising to 37 percent. Two observations are worth noting. First, the total joint contribution of MU and MPRU shocks to PPU variance is 50 percent on impact and 49 percent at horizon 12 in the MU-augmented model, compared with 42 percent and 52 percent in the baseline, a relatively small difference. Second, the reallocation within this total (toward MU and away from a large MPRU growth trajectory at longer horizons) is economically interpretable. When macroeconomic uncertainty is directly present in the VAR as a state variable, the MU shock is estimated to have a larger direct channel to PPU, since the MU index more precisely captures the macroeconomic uncertainty mechanism through which policy path uncertainty responds to shifts in the economic outlook. Crucially, MPRU shocks remain a quantitatively significant and distinct source of PPU variation, explaining 22 to 27 percent of the forecast error variance across all horizons.

For inflation (Panel B), MPRU shocks explain 22 percent of the forecast error variance on impact and 29 percent at the 12-period horizon, compared with 35 and 40 percent in the baseline. MU shocks explain 9 percent on impact and 17 percent at horizon 12, compared with 12 to 13 percent in the baseline. The ratio of MPRU to MU contributions to inflation

is approximately 2.4 to 1 on impact and 1.7 to 1 at horizon 12 in the MU-augmented model, preserving the direction and rough magnitude of the asymmetry documented in the main text. Importantly, the dominant role of MPRU shocks in driving inflation fluctuations is robust to the choice of the uncertainty control variable.

For industrial production (Panel A), the MU-augmented model assigns a larger share of output variance to MU shocks at longer horizons: MU explains 38 percent of the forecast error variance at horizon 8, compared with 23 percent in the baseline. MPRU shocks explain 6 to 8 percent of output variance across most horizons, somewhat below the baseline's 8 to 12 percent. The qualitative finding that MU shocks are the dominant driver of output fluctuations at business cycle frequencies, while MPRU shocks play a secondary role, is preserved and, if anything, is strengthened. For the macroeconomic uncertainty index itself (Panel C), MU shocks explain approximately 30 percent of its variance on impact, declining toward 20 percent at longer horizons; MPRU shocks explain 4 to 6 percent across all horizons. This pattern closely mirrors the structure of the financial uncertainty decomposition in the baseline, where MU accounted for 29 to 21 percent and MPRU for 3 to 6 percent. The two uncertainty measures behave similarly in how they load on the structural shocks, lending further support to the view that our identification is capturing a genuine distinction between macroeconomic and monetary policy response uncertainty rather than an artifact of variable construction.

One notable quantitative difference from the baseline is the larger role of MU shocks in explaining policy rate variance (Panel E). In the MU-augmented model, MU shocks account for 32 to 36 percent of policy rate forecast error variance across horizons, compared with 11 to 15 percent in the baseline. This difference is interpretable. Specifically, when macroeconomic uncertainty is explicitly modeled as a state variable, the VAR more fully captures the Federal Reserve's endogenous response to shifts in the economic outlook, attributing more of the policy rate's unexpected variation to the macroeconomic uncertainty channel. MPRU shocks explain 12 to 15 percent of policy rate variance in the MU-augmented model, somewhat above the 5 to 12 percent range in the baseline. The direction and approximate magnitude of the MPRU contribution to the policy rate is little changed.

Table A.4: Forecast Error Variance Decomposition: MU-Augmented Specification

	Panel A: Output		Panel B: Inflation	
Horizon	ε^{MU}	ε^{MPRU}	ε^{MU}	ε^{MPRU}
0	0.078	0.085	0.091	0.218
1	0.150	0.085	0.086	0.221
4	0.303	0.073	0.112	0.301
8	0.375	0.061	0.194	0.286
12	0.360	0.062	0.167	0.291
	Panel C: Macroeconomic Uncertainty		Panel D: Policy Path Uncertainty	
Horizon	ε^{MU}	ε^{MPRU}	ε^{MU}	ε^{MPRU}
0	0.305	0.039	0.277	0.219
1	0.280	0.048	0.255	0.219
4	0.224	0.049	0.251	0.246
8	0.209	0.052	0.214	0.261
12	0.197	0.064	0.215	0.273
	Panel E: Policy Rate			
Horizon	ε^{MU}	ε^{MPRU}		
0	0.324	0.150		
1	0.307	0.119		
4	0.332	0.123		
8	0.363	0.127		
12	0.338	0.138		

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 macroeconomic 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, from a specification in which macroeconomic uncertainty replaces financial uncertainty as the third VAR variable. Entries report the median fraction of forecast error variance attributable to each shock across 730 retained posterior draws. The sample covers FOMC meetings from August 1991 to December 2025. Compare with Table 5 for the baseline specification.

Overall, replacing financial uncertainty with macroeconomic uncertainty as the control variable in the SVAR does not alter the paper's central findings. The MU shock generates a demand-like contraction in both specifications and the MPRU shock generates stagflationary dynamics in both. MPRU shocks remain a quantitatively significant driver of policy path uncertainty, explaining 22 to 27 percent of its forecast error variance, and continue to dominate MU shocks in explaining inflation fluctuations across all horizons. The episode-level narrative embedded in the historical decomposition is preserved, and the structural shock series are closely aligned across models. The primary quantitative differences, a larger role for MU shocks in driving output and policy rate variance, are economically interpretable consequences of including macroeconomic uncertainty directly in the system and do not alter the qualitative interpretation of the results. Therefore, the identification of MU and MPRU shocks, and the finding that they produce qualitatively distinct macroeconomic dynamics, is robust to the choice of uncertainty control variable.