Monetary Tightening and Financial Stress During Supply- versus Demand-Driven Inflation*

F. Boissay,[a] F. Collard,[b] C. Manea,[a] and A. Shapiro[c]
[a]Bank for International Settlements
[b]Toulouse School of Economics (CNRS)
[c]Federal Reserve Bank of San Francisco

This paper explores the state-dependent effects of a monetary tightening on financial stress, focusing on a novel dimension: whether inflation is driven by supply versus demand factors at the time of the policy intervention. These underlying factors likely affect the economy's financial resilience to a monetary tightening. We estimate the effects of high-frequency

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identified monetary surprises on financial stress, differentiating the effects based on whether inflation is supply- or demand-driven. We find that financial stress increases after a tightening when inflation is supply-driven, whereas it remains roughly unchanged or even declines when inflation is demand-driven.

JEL Codes: E1, E3, E6, G01.

1. Introduction

Since the Global Financial Crisis (GFC), financial stability risks have become a central consideration in central banks' decision-making process.[1] One reason is that financial instability may prevent central banks from achieving their primary objectives. Another is that monetary policy may *on its own* inadvertently usher in stress in the financial system. Recent empirical studies show that financial crises tend to follow a protracted loosening and/or a sharp tightening of monetary policy (e.g., Schularick, ter Steege, and Ward 2021; Jiménez et al. 2022; Grimm et al. 2023). These findings suggest that tightening monetary policy to address inflationary pressures may cause potential financial vulnerabilities to surface and lead to financial instability.

In theory, a key determinant of whether and how far a central bank can raise its policy rate without creating financial stress is the *nature* of inflationary pressures that prompted the tightening in the first place. In particular, the analysis in Boissay et al. (2024) suggests that a key factor is whether inflation is due to adverse supply shocks or expansionary demand shocks. The type of inflation can be seen as a symptom of very different underlying macroeconomic conditions. While supply-driven inflation tends to be associated with economic contractions (e.g., due to supply chain disruptions and adverse productivity or oil price shocks), demand-driven inflation instead tends to occur during expansions (e.g., due to fiscal stimulus, private demand preference shocks, or pent-up demand).

The aim of this paper is to assess empirically how financial stress responds to a monetary tightening and whether the response varies

[1] See for instance Stein (2012), Goldberg et al. (2020), and European Central Bank (2021).

if inflationary pressures are supply- or demand-driven. To answer this question, we estimate the dynamic effects of high-frequency identified monetary policy surprises on a variety of financial stress measures using local projections à la Jordà (2005). To differentiate the effects based on whether inflation is driven by supply or demand factors at the time of the policy intervention, we use Shapiro (2022a, 2022b)'s inflation decomposition.[2]

Our baseline analysis is conducted for the U.S. at the monthly frequency over the period January 1990 to December 2019, and essentially combines two sets of data in addition to Shapiro's inflation decomposition: varied measures of financial stress (e.g., the Federal Reserve Board Financial Stress Index), and Bauer and Swanson (2023)'s exogenous monetary policy shocks.[3]

Our main findings are twofold. First, a surprise monetary tightening *increases* financial stress in the presence of supply-driven inflation. Furthermore, the magnitude of the response increases in the level of supply-driven inflation, thus revealing a potential policy trade-off between price stability and financial stability when inflation is high and supply-driven. There are several explanations for this finding. When a central bank raises its policy rate in response to supply-driven inflation, the economy is usually also experiencing negative pressures on output. Adverse supply shocks (e.g., supply

[2]To be sure, we focus on supply-driven and demand-driven inflation as symptoms and useful summary statistics of the (possibly many different) supply and demand shocks that hit the economy and whose size and effects are not directly measurable. More particularly, supply-driven inflation typically flares up in the face of adverse supply shocks, i.e., when the productive capacity of the economy is struggling to meet the demand. Such summary statistics are especially relevant and useful for studying the effects of monetary policy tightening by inflation-targeting central banks, to the extent that such central banks are more likely to increase their policy rates during periods of inflation.

[3]Other types of high-frequency identified monetary policy surprises are publicly available (e.g., Gertler and Karadi 2015). We use Bauer and Swanson (2023)'s because their orthogonalized monetary policy surprises have been shown (i) to be purged of endogenous Federal Reserve responses to economic data and (ii) to produce estimates of monetary policy's effects that are more plausible than those obtained with other monetary policy surprises in the sense that the effects are larger and do not suffer from the usual price and activity puzzles. In Section A.3 of the appendix, we expand the analysis to countries for which both high-frequency identified monetary policy surprises and the supply versus demand inflation decomposition are publicly available (Australia, Canada, France, Sweden, United Kingdom).

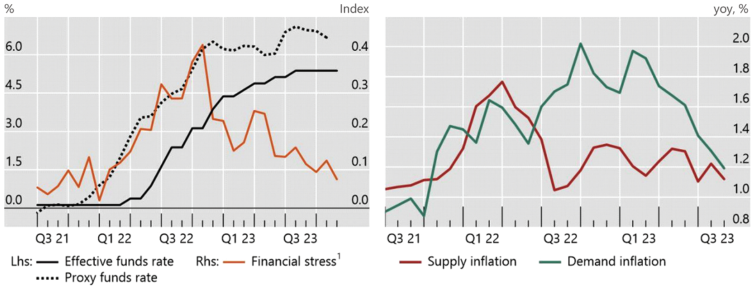
chain disruptions, high energy prices) not only spur inflation but also weigh on borrowers' cash flows, undermining their usual role as "natural buffers." By contracting aggregate demand, a surprise monetary tightening may further reduce borrowers' cash flows and increase their credit default risk. When credit markets are subject to financial frictions (e.g., moral hazard, asymmetric information, costly state verification), borrowers can be excessively sensitive to rate hikes. Their higher default risk may induce lenders to require additional guarantees in the form of yet higher credit spreads and external finance premia, thereby further increasing credit default risk and financial stress—the so-called financial accelerator (Bernanke and Gertler 1995; Bernanke, Gertler, and Gilchrist 1999; Gilchrist and Zakrajšek 2012; Gertler and Karadi 2015).

Our second main finding is that, in contrast to the case of supply-driven inflation, a surprise monetary tightening does not affect or may even *reduce* financial stress in the presence of demand-driven inflation—especially if the latter is high. One possible explanation is that demand-driven inflation is a reflection of expansionary aggregate demand shocks. When aggregate demand increases, borrowers' cash flows tend to increase as well. Strong cash flows act as natural buffers against rate hikes, allowing borrowers to deleverage through the tightening cycle without experiencing severe financial strains. In the medium term, tighter monetary policy may also help prevent positive demand shocks from feeding a credit/asset price boom and attendant financial vulnerabilities. When the central bank raises its policy rate to tame strong demand-driven inflationary pressures, the risk of experiencing financial stress may thus dissipate—rather than increase.[4]

Our empirical results are consistent with the dynamics of financial stress during the post–COVID-19 monetary tightening episode in the U.S. (Figure 1). When the Federal Reserve began to raise its policy rate in early 2022 (left panel, black lines), financial stress flared up (left panel, orange line) and moved in sync with the monetary policy contraction. In the fall of 2022, however, financial stress (left panel, orange line) subsided despite the further tightening of monetary policy. The diminution of financial stress broadly coincided

[4] Boissay et al. (2024) provide theoretical underpinnings for this empirical result.

Figure 1. Financial Stress and Inflation Drivers during the Monetary Tightening Cycle in the U.S.



Note: Financial stress: ECB Composite Index of Systemic Stress (CISS). Proxy funds rate: proxy rate adjusted for the effects of forward guidance from the Federal Reserve Bank of San Francisco. Supply/demand inflation: supply and demand components of core PCE year-on-year inflation computed with the methodology in Shapiro (2022a) net of the pre-pandemic 2015–19 average.

with a fall in *supply*-driven inflation (right panel, red line) and a rise in *demand*-driven inflation (right panel, green line) due to post-pandemic pent-up demand and an ample fiscal package. In light of our empirical findings, the lower sensitivity of financial stress to policy rate hikes in the later stage of the monetary tightening episode could thus have been due to the switch of the main inflation drivers from supply to demand factors.

The paper is structured as follows. Section 2 reviews the related literature. Section 3 presents the empirical strategy, data, and empirical findings. Section 4 discusses possible explanations for the findings and the implications for the conduct of monetary policy. Section 5 concludes.

2. Related Literature

Our work is related to four main strands of literature.

The first strand is on the methodology to decompose inflation into demand and supply factors. Eickmeier and Hofmann (2022) propose a decomposition based on a quarterly structural factor model with sign restrictions using a large number of inflation and real activity measures. Shapiro (2022a, 2022b)'s approach also rests on sign restrictions but is based on the sectoral decomposition of the monthly personal consumption expenditure (PCE) index. In the present paper, we use the latter methodology because it allows us to compute the supply- and demand-driven inflation series at a higher (monthly) frequency for our baseline specification for the U.S., thus contributing to our identification strategy—and accuracy thereof.

The second strand of related papers examines the state-dependent effects of monetary policy. Papers in this literature have so far essentially focused on the asymmetric effects of monetary policy across booms versus recessions (e.g., Lo and Piger 2005; Santoro et al. 2014; Tenreyo and Thwaites 2016) or monetary expansions versus contractions (e.g., Barnichon, Matthes, and Sablik 2017; Angrist, Jordà, and Kuersteiner 2018; Barnichon and Matthes 2018; Alessandri, Jordà, and Venditti 2023; Kurt 2024). While the first set of papers yield mixed conclusions, the second set unanimously find that a surprise monetary tightening has larger effects on real activity and credit spreads than a surprise loosening. Our paper focuses on how tightening monetary policy affects financial stress during inflationary episodes and explores a novel state-dependency dimension: the nature of inflation drivers at the time of the policy intervention.

Our paper is also related to the literature on the credit channel of monetary policy. Previous papers conclude that modest movements in short-term rates can lead to large movements in the equity finance premium and credit spreads, consistent with the existence of a credit channel of monetary policy (e.g., Gertler and Karadi 2015; Caldara and Herbst 2019). While our results confirm the existence of this channel, they also emphasize that it does not operate in a linear fashion and is particularly strong when the central bank raises its policy rate to fight high levels of supply-driven inflation.

Finally, our analysis speaks to the empirical literature on the effects of monetary policy on financial stability. Some of the previous papers in this literature argue that expansionary monetary policy ("low rate for long") can fuel financial imbalances and lead to boom-bust scenarios (e.g., Borio and Lowe 2002; Taylor 2011; Grimm et al. 2023). Other studies conclude that raising policy rates can trigger a financial crisis, with the odds of such an event being particularly high when the hikes take place on the back of a credit/asset boom (e.g., Schularick, ter Steege, and Ward 2021; Boissay et al. 2023) or after a "low-rate-for-long" period (Jiménez et al. 2022). Our analysis qualifies and refines the conclusions of these studies.

3. Empirical Analysis

This section describes our empirical strategy. We start by laying out our baseline econometric specification and then move on to describing the data. Finally, we report our estimation results and discuss their robustness.

3.1 Econometric Specification and Identification Strategy

To trace out the effect of a surprise monetary tightening on financial stress, we estimate impulse response functions through local projections (Jordà 2005). The approach consists in estimating a sequence of linear regressions to assess how an exogenous rise in the policy rate affects financial stress over a 36-month horizon. This empirical analysis is subject to the usual endogeneity problem: monetary policy both affects and responds to developments in the economy (Nakamura and Steinsson 2018). To address this problem, we use high-frequency identified monetary policy surprises as a measure of exogenous variations in interest rates—instead of changes in the policy rate per se.[5]

Our baseline econometric specification is the following:

$$\begin{aligned} y_{t+h} - y_{t-1} = \alpha_h &+ \beta_h^T \mathbb{1}\{mps_t > 0\} mps_t + \beta_h^{TS} \mathbb{1}\{mps_t > 0\} mps_t \pi_t^s \\ &+ \beta_h^{TD} \mathbb{1}\{mps_t > 0\} mps_t \pi_t^d + \beta_h^L \mathbb{1}\{mps_t < 0\} mps_t \\ &+ \beta_h^{LS} \mathbb{1}\{mps_t < 0\} mps_t \pi_t^s + \beta_h^{LD} \mathbb{1}\{mps_t < 0\} mps_t \pi_t^d \\ &+ A_h \sum_{\tau=1}^{L} \mathscr{C}_{t-\tau} + e_{t+h}, \qquad (1) \end{aligned}$$

for $h = 1, 2, \ldots, 36$. In the construction of the dependent variable y_{t+h} is a measure of financial stress in month $t + h$. Among the

[5]Monetary policy surprises are appealing because their focus on interest rate changes in a narrow window of time around Federal Open Market Committee (FOMC) announcements plausibly rules out reverse causality and other endogeneity problems. For other studies using monetary policy surprises, see for instance Kuttner (2001); Cochrane and Piazzesi (2002); Faust and Rogers (2003); Faust, Swanson, and Wright (2004); Bernanke and Kuttner (2005); Gürkaynack, Sack, and Swanson (2005b); Gertler and Karadi (2015); Hanson and Stein (2015); Ramey (2016); Stock and Watson (2018); and Swanson (2021).

independent variables, mps_t is a monetary policy surprise in month t, $\mathbb{1}\{mps_t > 0\}$ is an indicator variable for a tightening, $\mathbb{1}\{mps_t < 0\}$ is an indicator variable for a loosening, $\pi_t^{s/d}$ is supply- or demand-driven PCE inflation (year-on-year), and $\mathscr{C}_t$ is a vector of additional control variables.

A rich set of control variables aims at addressing potential confounding factors and ensuring that our results are not driven by factors other than monetary policy. These control variables include contemporaneous values and six lags of the following macroeconomic variables: the demand-driven as well as the supply-driven contributions to PCE inflation (year-on-year), the log of industrial production, the unemployment rate, and the Gilchrist and Zakrajšek (2012) series of excess bond premium and corporate credit spreads.[6] We also include six lags of both the dependent variable and of the interaction variables in Equation (1). Since we use the “high-precision” version of Shapiro (2022a, 2022b)’s inflation decomposition, we also include interactions with the “ambiguous” contribution to PCE inflation (together with their lags) similar to those to supply- or demand-driven inflation.[7]

To facilitate the interpretation of our empirical findings later on, several comments on the coefficients of interest are in order.

First, the β_h^T coefficients capture the responses (at horizon $h = 0, 1, 2, \ldots, 36$) of financial stress to an unexpected rise in the policy rate regardless of the level of inflation, relative to no surprise change in the policy rate. The inclusion of negative monetary surprises (term

[6]Adding the Baker, Bloom, and Davis (2016) economic policy uncertainty index as a control variable or dropping the Gilchrist and Zakrajšek (2012) series of excess bond premium and corporate credit spreads from the list of control variables in our baseline specification leaves our findings literally unchanged. Results are also robust to adding the log of commodity prices, and the federal funds rate (or the Wu–Xia “shadow rate”) as in Ramey (2016). Note that we include the time t realizations of all core independent and dependent variables. We thus take a conservative stance with respect to the contemporaneous response of the dependent variable to monetary policy, effectively attributing as much as possible of that response to contemporaneous variation in the independent variables and controls and not to the unexpected monetary intervention. These controls are conventionally used in LPs with monthly data (see for instance Ramey 2016 or Bauer and Swanson 2023).

[7]In Shapiro (2022a), the ambiguous contribution to PCE inflation corresponds to the part of inflation stemming from categories of goods whose price change in a given month could not be identified as either supply or demand driven.

after β_h^L) ensures that the omitted category is a case where there is no surprise change in the policy rate. Altogether, the estimates of the β_h^T coefficients should be interpreted as the *unconditional dynamic* effect of a monetary tightening.

Second, the interaction coefficients β_h^{TS} and β_h^{TD} capture the *additional* effects of a surprise monetary tightening on financial stress at horizon h for every additional percentage point of supply- and demand-driven inflation prevailing at the time of the monetary tightening. Note that our specification allows us to study how both the *level* and *composition* of inflation, and implicitly the nature and strength of underlying inflation drivers, shape the response of financial stress to a monetary tightening. The level effects are captured by the statistical significance of the two interaction coefficients: if neither β_h^{TS} nor β_h^{TD} is statistically significant, this will mean that the policy rate has the same effect on financial stress independently of the level of inflation and, hence, of the strength of underlying factors driving it. Composition effects are further captured by the difference between the two inflation interaction coefficients: if the difference between β_h^{TS} and β_h^{TD} is not statistically significant, this will mean that (for a given inflation level) a rise in the policy rate has the same effect regardless of whether inflation is driven by supply or demand factors.

3.2 Data

Our analysis essentially rests on three sets of variables: measures of financial stress, exogenous monetary policy changes, and supply- and demand-driven inflation.[8] The baseline analysis is conducted for the U.S. at monthly frequency over the period January 1990 to December 2019. The beginning of our sample is dictated by the availability of the supply- and demand-driven inflation series in Shapiro (2022a, 2022b), while the end of the sample corresponds to the end of the series of monetary policy surprises in Bauer and Swanson (2023).

[8]The other variables, which are used as controls (e.g., industrial production; unemployment rate; the Baker, Bloom, and Davis 2016 economic policy uncertainty index; the Gilchrist and Zakrajšek (2012) excess bond premium and corporate credit spreads), are standard and retrieved from Haver Analytics and the Federal Reserve Economic Data (FRED) database of the Federal Reserve Bank of St. Louis.

Measures of Financial Stress. We consider a set of high-frequency financial stress indicators (FSIs) as dependent variables.[9] Such indices quantify the aggregate level of stress in financial markets by compressing several individual stress indicators into a single statistic and are available at high frequency over the time span of our key independent variables. We thus choose one such index as our baseline proxy for financial stress.

Our baseline FSI for the U.S. is an updated version of the index used by Hubrich and Tetlow (2015) which was developed by the staff of the Federal Reserve Board to assess in real time the degree of financial markets' dysfunction during the GFC.[10] The index is a simple demeaned sum of nine spread and volatility components in key financial markets in the U.S. (Table 1) and follows closely the Romer and Romer (2017) granular index of financial crises (Figure 2). We choose this FSI as baseline for both transparency reasons and in view of recent findings by Arrigoni, Bobasu, and Venditti (2020) that simple averages of market-specific financial stress indices tend to perform better ex post in gauging financial stress than indices based on more elaborate statistical techniques. To facilitate the comparison across financial stress indices, all indices are standardized.

We will check the robustness of our results with other well-known FSIs such as the Federal Reserve Bank of Kansas City (Kansas City Fed) FSI, the Federal Reserve Bank of St. Louis (St. Louis Fed) FSI, the Bloomberg FSI, the European Central Bank (ECB) Composite Indicator of Systemic Stress (CISS), or the Gilchrist and Zakrajšek (2012) corporate spread and equity bond premium indices.[11] We also complement our analysis with financial conditions indices (FCIs) such as the Federal Reserve Bank of Chicago (Chicago Fed) National FCI (NFCI) and the Goldman Sachs FCI.

[9]One (perhaps more direct) alternative would have been to use financial *crisis* dummies or indicators as dependent variables. However, such variables are only available at an annual (e.g., Laeven and Valencia 2018) or semiannual (e.g., Romer and Romer 2017) frequency, and there are too few crisis episodes to make statistical inference over the common sample period for which Bauer and Swanson (2023)'s monetary policy surprises and Shapiro (2022a, 2022b)'s supply- and demand-driven inflation series are available (1990–2019).

[10]This index was built based on the methodology proposed by Nelson and Perli (2007).

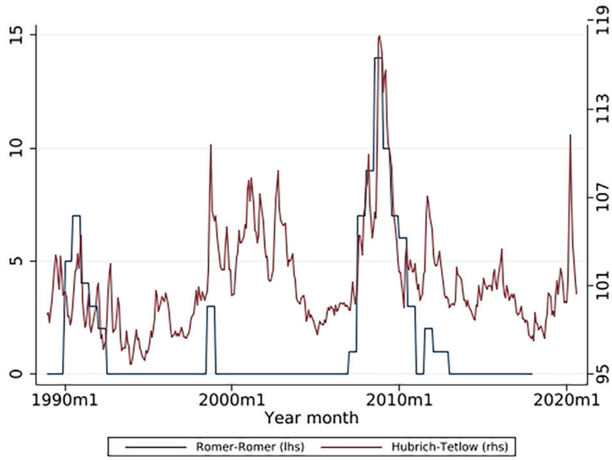
[11]See Table A.1 in the appendix.

Table 1. Components of the Federal Reserve Board Staff's Financial Stress Index

Description	Source	Std. Dev.
AA Rate–Treasury Spread, Const. Maturity	Merrill and Bloomberg	66.3
BBB Rate–Treasury Spread, Const. Maturity	Merrill and Bloomberg	96.2
Federal Funds Rate Less 2-Year Treasury Yield	Federal Reserve Board and Bloomberg	0.70
10-Year Treasury Bond Implied Volatility	Bloomberg	1.40
Private Long-Term Bond Implied Volatility	Bloomberg	2.30
10-Year Treasury On-the-Run Premium	Bloomberg	9.43
2-Year Treasury On-the-Run Premium	Bloomberg	3.60
S&P 500 Earnings/Price Less 10-Year Treasury	I/B/E/S and Federal Reserve Board	2.01
S&P 100 Implied Volatility (VIX)	Bloomberg	8.53

Note: Baseline FSI for the U.S. The index is computed as a simple demeaned sum of the nine components shown, weighted as a function of the inverse of their sample standard deviations.

Figure 2. Baseline Financial Stress Measure for the U.S.

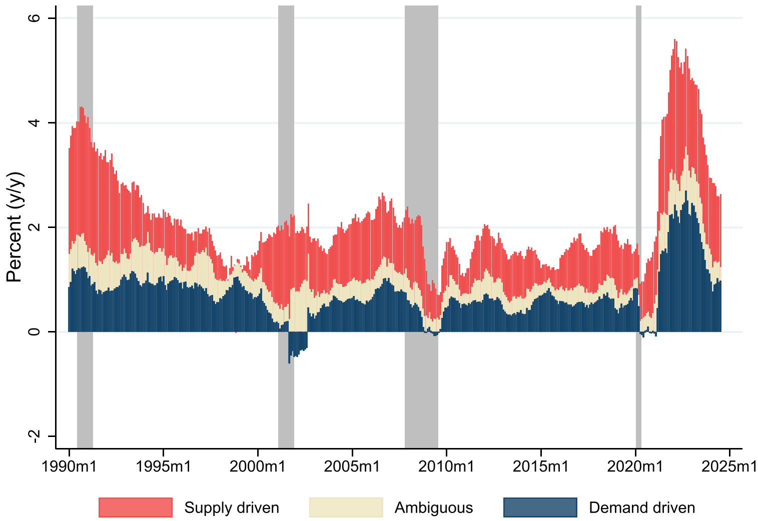


Note: The figure plots for the U.S. our baseline FSI (Hubrich-Tetlow, red line) along with the Romer and Romer (2017) qualitative financial crisis indicator (blue line). Data are shown monthly from December 1988 to August 2020 for the FSI, and semiannually until 2017:H2 for Romer and Romer.

Measures of Exogenous Changes in the Policy Rate. We measure exogenous changes in the monetary policy rate using the latest publicly available series of high-frequency identified monetary policy surprises from Bauer and Swanson (2023).[12] We follow the literature and transform the monetary surprises to monthly frequency

[12] A commonly held view is that high-frequency identified monetary policy surprises are exogenous and unpredictable—otherwise, financial market participants would be able to trade profitably on that predictability and drive it away in the process. A few recent studies (e.g., Cieslak 2018; Miranda-Agrippino and Ricco 2021; and Bauer and Swanson 2023) have, however, challenged this view by documenting a substantial correlation of monetary policy surprises with publicly available macroeconomic or financial market data that predate the FOMC announcement. Bauer and Swanson (2023) have addressed this issue by removing the component of the monetary policy surprises that is correlated with economic and financial data. For this reason, our preferred monetary surprises are Bauer and Swanson's. To check the robustness of our results, though, we also used Jarociński and Karadi (2020)'s publicly available high-frequency identified monetary policy surprises, and obtained broadly similar results. Notably, our findings apply as well to the effect of *unconventional* monetary policy surprises from Jarociński (2024) (see Section A.2.4 in the appendix).

Figure 3. Inflation Decomposition into Demand, Supply, and Ambiguous Factors for the U.S.



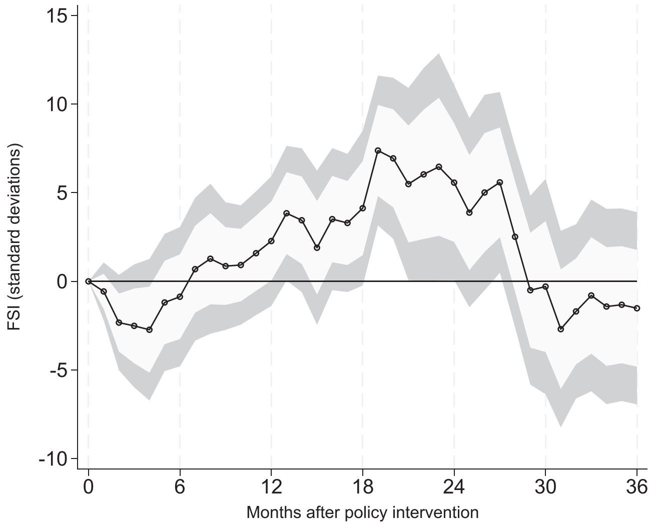
Source: Shapiro (2022a, 2022b).
Note: Core PCE inflation.

by summing up daily observations within each month. We normalize the series such that the estimated effects apply to a 25 basis point (bp) monetary policy surprise.

Measures of Supply- and Demand-Driven Inflation. We use the supply- and demand-driven contributions to PCE inflation from Shapiro (2022a, 2022b)—plotted in Figure 3.

The series measure the extent to which either demand or supply forces are driving inflation in a given month. The methodology exploits the sectoral decomposition of PCE inflation and classifies inflation in each sector as being (mainly) driven by supply or demand factors. The identification is based on sign restrictions at the sectoral level: separate price and quantity regressions are run on each of the more than 100 goods and services categories that make up the PCE price index; the categories are then labeled as supply driven or demand driven based on the signs of residuals in the price and quantity reduced-form regressions; if prices and quantities in a given sector are hit by shocks of the same (different) sign, inflation

Figure 4. Unconditional Effect of a Monetary Tightening on Financial Stress



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^T for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands, Newey-West standard errors. U.S. monthly data from January 1990 to December 2019. Findings robust to specifications including the optimal lag order according to the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) equal to three and four, respectively.

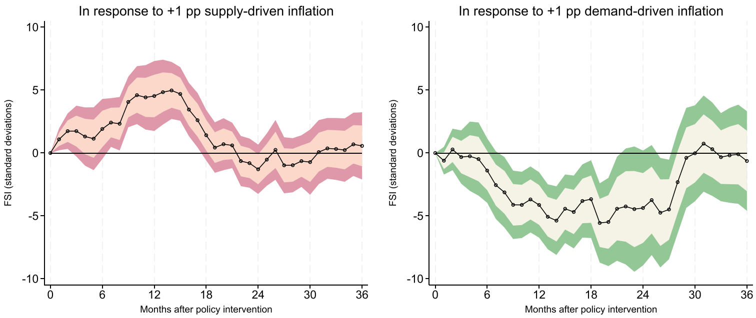
is labeled as demand- (supply-) driven. For a detailed description of the methodology, see Shapiro (2022a, 2022b).

3.3 Baseline Results

We first report results for the estimates of β_h^T—the impact of an unexpected monetary policy tightening independently of inflation. Figure 4 shows that the policy rate hike works to raise financial stress, broadly in line with previous findings in the credit channel literature.[13]

[13] See Gertler and Karadi (2011) for the effects of a monetary policy surprise on credit spreads.

Figure 5. Additional State-Dependent Effect of a Monetary Tightening on Financial Stress

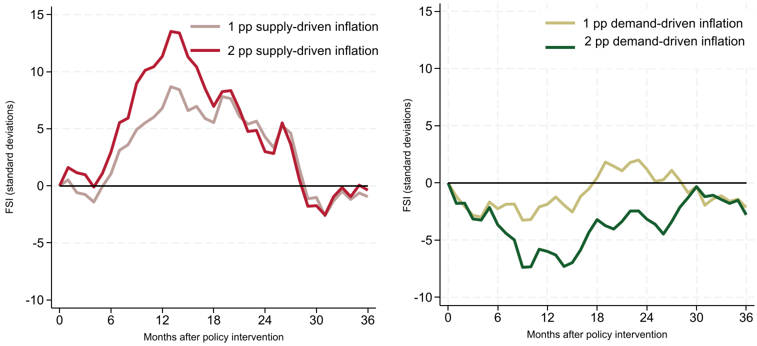


Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. Findings robust to specifications including the optimal lag order according to the AIC and BIC equal to three and four, respectively.

Next, conditioning on the type of inflationary pressures reveals that the above unconditional effect of a surprise monetary tightening on financial stress can be either magnified or totally undone depending on the context of the monetary tightening.

We first consider the effects of a monetary tightening on financial stress when inflation is supply-driven and find *positive* interaction coefficients (Figure 5, left panel). In other terms, the adverse supply shocks underlying inflation work to amplify the effect of monetary policy on financial stress. The stronger the adverse shocks reflected in higher supply-driven inflation, the stronger the amplification (Figure 6, left panel). The additional effect also kicks in relatively fast, already in the first month following the rate hike. This quasi-instantaneous transmission is much faster than the unconditional one-year-lagged transmission shown in Figure 4. The additional effect also remains significant for 18 months. Our results thus suggest that the adverse supply shocks work not only to amplify but also to expedite the effect of the monetary tightening on financial stress.

Figure 6. State-Dependent Effect of a Monetary Tightening on Financial Stress



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are the combination of regression coefficients $\beta_h^T + \beta_h^{TD}\pi^d$ (left) and $\beta_h^T + \beta_h^{TS}\pi^s$ (right), where $\pi^d = \{1, 2\}$ and $\pi^s = \{1, 2\}$, for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. U.S. monthly data from January 1990 to December 2019.

When inflation is demand-driven, in contrast, a monetary tightening does not induce a price stability versus financial stability trade-off. Figure 5 (right panel) indeed shows that the interaction coefficients of the surprise monetary tightening with demand-driven inflation are *negative* for almost the entire horizon of interest. In other terms, expansionary demand shocks work to offset the unconditional effect of a rate hike on financial stress, thus *dampening* the overall increase in financial stress.

Moreover, the magnitude of the dampening increases in the level of demand inflation (Figure 6, right panel). Depending on the inflation level, one can distinguish two scenarios. In one scenario, positive demand shocks and resulting inflation are relatively low (light green line). In that case, a monetary tightening has essentially no effect on financial stress throughout the full horizon (the net effect hovers around zero). In the second scenario, positive demand shocks and resulting inflation are relatively high, i.e., associated with a 2 percentage point (pp) demand-driven inflation. In that case, the stabilizing effect on the financial system of a rate hike more than offsets its destabilizing unconditional one (i.e., it is negative throughout the horizon). On balance, the rate hike thus works to lower financial stress in the medium term (dark green line).

Last, we consider the effects of a monetary *loosening* on financial stress as reflected by the β^L, β^{LS}, and β^{LD} coefficients. Unconditionally, a loosening works to ease financial stress (Figure A.3). The effects are amplified in the presence of supply-driven inflation and dampened or reversed in the presence of demand-driven inflation (Figure A.4). These effects are smaller than but similar to those found in the case of a monetary tightening, consistent with findings in the literature (compare Figures 5 and A.4; see also Barnichon, Matthes, and Sablik 2017; Kurt 2024).

Our results also suggest that the speed, time profile, and strength of monetary policy transmission through financial markets are state dependent. For instance, tightening monetary policy during supply-driven inflation episodes is expected to affect very swiftly and strongly financial markets, but for a relatively short period of time. By contrast, the transmission of a monetary tightening during moderate demand-driven inflation episodes is expected to take longer and be weaker.

In sum, we find that financial stress increases by more (less) in response to a surprise monetary tightening when inflation is supply- (demand-) driven than in the absence of inflation. Moreover, provided that demand-driven inflation is high enough, financial stress can decrease in the medium term in response to a monetary tightening. When both inflation drivers are active, the ultimate effect of a policy rate hike on financial stress will depend on both the level and supply-versus-demand composition of inflation.[14]

3.4 Robustness Checks

Our findings are robust to a battery of checks and remain unchanged when one varies the sample, controls for periods of disinflation, or considers varied measures of financial stress. The figures of the estimated effects throughout these robustness checks are deferred to the appendix.

[14]In Section A.1.4 of the appendix, we derive the overall effect of a surprise rate hike on financial stress and identify five periods within the estimation sample when monetary tightening was or would have been conducive to financial stress.

3.4.1 Varied Samples

Our findings are robust to excluding observations during the 2007–08 GFC and the 2010–15 zero lower bound (ZLB) periods.[15] Similar patterns broadly obtain when considering other countries, such as Canada, the United Kingdom, France, Australia, and Sweden.

The above countries are chosen based on the joint availability of demand- and supply-driven inflation series and monetary policy surprises. The identification strategy is less precise for these countries than for the U.S. because of several constraints imposed by the data. First, given the frequency of statistical releases, the demand- and supply-driven inflation series can only be computed at quarterly frequency (as opposed to monthly frequency in the case of the U.S.). Since we use daily monetary policy surprises as a measure of exogenous variation in the policy rate, using demand- and supply-driven inflation series at quarterly frequency reduces the precision of our identification strategy relative to our baseline analysis. Second, the series of monetary policy surprises for these other countries are usually shorter, and their exogeneity has been less scrutinized than in the case of U.S. series. Third, fewer financial stress measures are available for these countries. Whenever possible, we use a systemic financial stress index such as the CISS as our baseline dependent variable and then check the robustness of our findings with measures of market-specific financial stress such as credit spreads and financial market volatility. These caveats notwithstanding, we obtain similar patterns as for the U.S., including when comparing the estimates with those for the U.S. obtained with quarterly (instead of monthly) data (Figure A.35).[16]

3.4.2 Average Impact

To have a broader overview of the relationship between monetary policy surprises and financial stress, we run regression (1) without distinguishing whether the monetary policy surprises are positive (tightening) or negative (loosening). Results are reported in Section A.2.2 in the appendix. We obtain that the unconditional effects of the tightening (not reported) and its additionally state-dependent

[15] See Section A.2.3 in the appendix.

[16] See Tables A.2 and A.3 as well as Section A.3.2 in the appendix.

effects (Figure A.8) look broadly similar to those obtained based on the baseline specification (Figure 5), albeit smaller. This is consistent with the estimated effects of surprise policy cuts being smaller than those of surprise hikes (compare Figure A.4 and Figure 5).

3.4.3 Inflation versus Disinflation

To remain parsimonious, our baseline specification does not distinguish between inflationary ($\pi_t^{s/d} > 0$) versus disinflationary ($\pi_t^{s/d} < 0$) pressures. When making this distinction, we find slightly stronger results, in the sense that the dampening effect of demand-driven inflation is marginally larger (compare the right panels of Figures 4 and A.7). The exercise is described in Section A.2.1 in the appendix.

3.4.4 Varied Measures of Stress

Our findings are also robust to using a wide range of measures of stress as dependent variables, including other financial stress indices and their individual subcomponents, credit spreads, equity finance premium, or indices of financial conditions.[17]

Other Financial Stress Indices. We show that our results are robust to using other well-known FSIs such as the Kansas City Fed FSI, St. Louis Fed FSI, Bloomberg FSI, or ECB Composite Indicator of Systemic Stress (CISS).

Financial Stress Components. Our findings are unchanged when one uses components of financial stress indicators, such as Gilchrist and Zakrajšek (2012) corporate credit spreads, excess bond premium indices, or the CISS subindices of financial stress in the bond market, the equity market (nonfinancial/financial firms), and the foreign exchange market (see Section A.2.6 in the appendix). The broad-based nature of results points to a systemic state-dependent effect of rate hikes on financial stress in supply- versus demand-driven inflationary environments.

Financial Conditions. We also consider measures of financial conditions such as the Goldman Sachs FCI and the Chicago Fed

[17] For the complete list of financial stress variables considered, see Table A.1 in the appendix.

National FCI and its credit, risk, and leverage subindices, as dependent variables. In contrast to FSIs, which are computed based on credit spreads and volatilities, FCIs are geared toward capturing the actual cost of financing for economic agents and ascribe a predominant role to the level of interest rates as well as to equity valuations. For this reason, FCIs tend to be less correlated with the Romer and Romer (2017) granular measure of financial crises compared with FSIs (e.g., Figures A.25 and A.27 in the appendix).

By and large, the analysis with FCIs delivers the same—albeit not always as salient—results as the analysis with FSIs (see Section A.2.7 in the appendix). In particular, we find that financing conditions deteriorate by more following a surprise monetary tightening when inflation is supply driven but the effect is somewhat weaker. For example, the significance levels are lower in the case of the Chicago Fed NFCI and the Goldman Sachs FCI (Figures A.24 and A.26, left panels). This weaker result could indicate that the state-dependent effects identified in our analysis apply above all to financial stress and less to financial conditions more broadly.

3.4.5 Limits of the Analysis

The generality and external validity of our findings are admittedly constrained by the relative short estimation sample period.[18] For the purpose of identifying causal effects, we also had to focus on the effects of *unexpected* movements in the policy rate (i.e., monetary policy surprises), and could not analyze the effects of *expected* (systematic) monetary policy actions to which the U.S. Federal Reserve may implicitly (be thought to) commit.[19]

4. Understanding the Results

Why does financial stress rise after a surprise monetary tightening when inflation is supply-driven, whereas it remains roughly unchanged or even subsides when inflation is demand-driven? In this

[18]For instance, the estimation sample for our baseline specification for the U.S. spans from January 1990 to December 2019.

[19]The model-based analysis in Boissay et al. (2024) suggests that the state-dependent effects of a rate hike uncovered in the present paper survive when the rate hike is driven by a systematic response of monetary policy.

section, we first argue that the nature of the shocks driving inflation lies at the core of this state dependency. We then show that our empirical results can be explained (and reproduced) within a simple theoretical monetary model featuring endogenous financial stress.

4.1 The Nature of the Shocks Matters

Supply- and demand-driven inflationary pressures have distinct causes that influence borrowers' ability to weather increases in the policy rate and the attendant deterioration of financing conditions.

Adverse supply shocks such as supply chain disruptions, unexpected rises in energy prices, or productivity losses not only spur inflation but also tend to simultaneously weigh on economic activity and on borrowers' cash flows and their ability to repay their debts. When inflation is driven by such shocks, policy rate hikes induce yet another contraction in real activity through aggregate demand, which may amplify credit default risk. Consistent with the transmission of policy rate hikes through credit default risk, we find that credit spreads, the equity finance premium, loan delinquencies, and corporate bankruptcies all rise by more following a policy rate hike when the hike takes place in a context of supply-driven inflation (Figure A.28 and Sections A.5 and A.2.6 in the appendix).

In addition, when credit markets are subject to frictions (e.g., moral hazard, asymmetric information, costly state verification), higher default risk induces lenders to require additional guarantees in the form of yet higher credit spreads and external finance premia, thereby further increasing borrowers' default risk (Bernanke and Gertler 1995; Bernanke, Gertler, and Gilchrist 1999; Gilchrist and Zakrajšek 2012; Gertler and Karadi 2015). In some cases, default risk may become so elevated that prospective lenders panic and credit markets freeze. Several historical studies indeed document that financial crises tend to be preceded by a fall in aggregate productivity (Gorton and Ordoñez 2019; Paul 2023)—and hence by a supply-induced contraction of the economy—together with a steep rise in policy rates (Jiménez et al. 2022).

By contrast, demand-driven inflation is typically due to expansionary demand shocks and often occurs on the back of strong economic growth. In such an environment, corporate profits and real wages tend to increase, which may help firms and households weather higher borrowing costs—in effect providing them with a "natural hedge" against the tightening of monetary policy. All else equal, monetary tightening is therefore less likely to generate financial stress when inflation is driven by a boom of aggregate demand (rather than by a fall in supply). This contention would be consistent with our finding that a rate hike has a muted effect on financial stress (notably, on credit spreads, equity finance premium, loan delinquencies) in the short term in that case (see Figure 5, right panel; Figure A.28; and Sections A.5 and A.2.6).

In the medium term, policy rate hikes may also help prevent the positive demand shocks from also feeding a credit/asset price boom and attendant financial vulnerabilities. But even when they take place on the back of a full-fledged credit boom, rate hikes may still prompt borrowers to deleverage, reducing their exposure to adverse shocks and default risk down the road. Such derisking process could be one explanation for our empirical finding that a rate hike reduces financial stress in the medium term when it takes place against relative strong demand-driven inflationary pressures (Figure 6).

4.2 Theoretical Underpinnings

The aim of this section is to show that the state-dependent effects of monetary policy on financial stress can be rationalized and reproduced within a simple New Keynesian (NK) model with endogenous financial crises like Boissay et al. (2024)'s.

Model Mechanism. Boissay et al. (2024)'s model is a textbook NK model that features an endogenous credit market breakdown due to an adverse selection/moral hazard problem. In this model, the credit market breaks down when capital returns are low. In those instances, borrowers have more incentive to invest in alternative ("below-the-radar") projects that are privately beneficial but raise the probability of credit default to the detriment of lenders—a behavior sometimes dubbed "search for yield" (Martinez-Miera and Repullo 2017). The consequent rise in counterparty risk may then induce prospective lenders to panic and refuse to lend, triggering a sudden collapse of credit markets and a financial crisis.

In turn, low capital returns may have varied causes, such as a large adverse supply shock or a protracted investment boom driven by positive and persistent demand shocks. In the latter case, the longer the sequence of positive demand shocks, the longer the boom is likely to last and the bigger the capital stock in the economy. Because of decreasing returns, capital accumulation exhausts profitable investment opportunities over time, prompting borrowers to search for yield and making the credit market more fragile.

In such an environment, monetary policy may affect the probability of a financial crisis in several ways. Under a standard Taylor rule, for example, crises tend to occur after the central bank hikes its policy rate in response to supply-driven inflation. In that case, adverse supply shocks lower firms' real returns on capital, and raising the policy rate to depress aggregate demand and rein in inflation contributes to lowering capital returns even more—moving the economy closer to its "financial fragility region." These dynamics are captured in Figure A.39, which illustrates the median dynamics around crises for a model specification with supply shocks only.

The model also predicts that persistent inflationary (positive) demand shocks can, if left unaddressed, lead to a potentially unsustainable credit/investment boom, and usher the economy into the financial fragility region (Figure A.40). The central bank may nonetheless prevent the economy from entering this region by, for example, unexpectedly raising the monetary policy rate in order to offset the positive demand shocks or by systematically committing to raise its policy rate whenever inflation is above some target.

All in all, the model thus predicts that raising the policy rate leads to financial stress in the short term when inflation is supply-driven but prevents the buildup of financial imbalances and eases financial stress in the medium term when inflation is demand-driven. To the extent that financial crises break out in periods of heightened financial stress (see Figure 2), Boissay et al. (2024)'s model sheds a spotlight on the possible transmission channels that underpin our empirical findings.[20]

[20]In our robustness checks (Section A.5 in the appendix), we show that our results carry through when we use corporate bankruptcies and loan delinquency rates as endogenous variables instead of market-based measures of financial stress.

Estimates Based on Model Simulations. One direct way to compare the predictions of Boissay et al. (2024)'s model with our empirical findings is to simulate the model and, based on the simulations, estimate the effects of monetary policy surprises on a measure of financial stress using the same econometric approach as that described in Section 3.1.

In Boissay et al. (2024), the model is parameterized on quarterly data under a standard Taylor rule. The nonfinancial parameters (including the persistence and standard deviation of the shocks) are set at their standard values (see e.g., Galí 2015), and the financial parameters are set so that, in the simulated stochastic steady state, the economy spends 10 percent of the time in a financial crisis and aggregate productivity falls by 1.8 percent due to financial frictions in a crisis—as observed in OECD countries.

For the purpose of cleanly separating supply- and demand-driven inflation, we consider two distinct sets of model simulations: one with supply shocks only and another with demand shocks only—in addition to the monetary policy surprises.[21] As a measure of financial stress, we use the model probability that a crisis breaks out next quarter. Each set of simulations contains 1 million quarterly observations.

We then use these simulated time series to run local projections similar to those in our empirical exercise (1), namely

$$\begin{aligned}\text{Prob}_{t+h} - \text{Prob}_{t-1} = \alpha_h &+ \beta_h^T \mathbb{1}\{mps_t > 0\} mps_t \\ &+ \beta_h^{TS/D} \mathbb{1}\{mps_t > 0\} mps_t \pi_t^{s/d} \\ &+ \beta_h^L \mathbb{1}\{mps_t < 0\} mps_t \\ &+ \beta_h^{LS/D} \mathbb{1}\{mps_t < 0\} mps_t \pi_t^{s/d} \\ &+ A_h \sum_{\tau=1}^{L} \mathscr{C}_{t-\tau} + e_{t+h}, \end{aligned} \tag{2}$$

[21] Ideally, one would have liked to consider a full version of the model with both supply and demand shocks—in addition to the monetary policy surprises. Unfortunately, in a nonlinear model solved with a global solution method (as is the case in Boissay et al. 2024), it is not possible to disentangle the supply- from the demand-side drivers of inflation.

for $h = 1, 2, \ldots, 36$. On the left-hand side, Prob_{t+h} is the probability of a financial crisis in $t + h + 1$, as computed in $t + h$ by the agents in the model. On the right-hand side, mps_t is the monetary policy surprise; $\mathbb{1}\{mps_t > 0\}$ is an indicator variable for a tightening; $\mathbb{1}\{mps_t < 0\}$ is an indicator variable for a loosening; $\pi_t^{s/d}$ is year-on-year supply/demand-driven inflation; and $\mathscr{C}_t$ is the vector of control variables including the contemporaneous values and six lags of year-on-year supply/demand-driven inflation and the log of output, as well as six lags of both the dependent variable and the interaction variables in Equation (2).

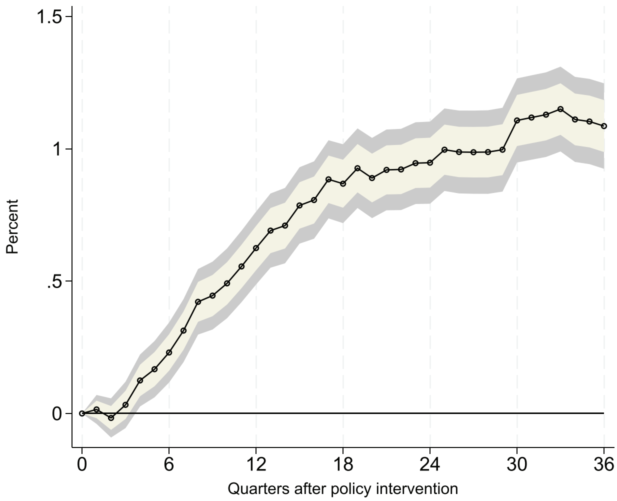
We are interested in the model-based estimates of the dynamic effects of a monetary tightening during supply-driven inflation (β_h^{TS}) and during demand-driven inflation (β_h^{TD}) and their comparison with those obtained from the data, as reported in Figure 5.

The two sets of estimates are largely consistent: their signs and dynamic profiles are the same—even though the model-based effects are more persistent than the empirical ones. While an unexpected policy rate hike increases the overall probability of a financial crisis (Figure 7), the effect is amplified when the hike takes place on the back of adverse supply shocks and supply-driven inflation (Figure 8, left panel). By contrast, the increase in the crisis probability is more muted when the hike takes place on the back of demand-driven shocks and demand-driven inflation (Figure 8, right panel), illustrating the dampening effect of the hike on the credit/investment boom and attendant risks to financial stability.[22]

Depending on when the hike occurs during the boom, the monetary tightening may even reduce the probability of crisis. To see this, we further condition our estimates on whether the hike takes place in the early stages of a demand-driven credit/investment boom, i.e., before any potential buildup of financial imbalances. We find that the negative effect of rate hikes on financial stress is much larger in that case and even more than offsets the unconditional effect of the hike (compare Figure 8, right panel, and Figure A.42).

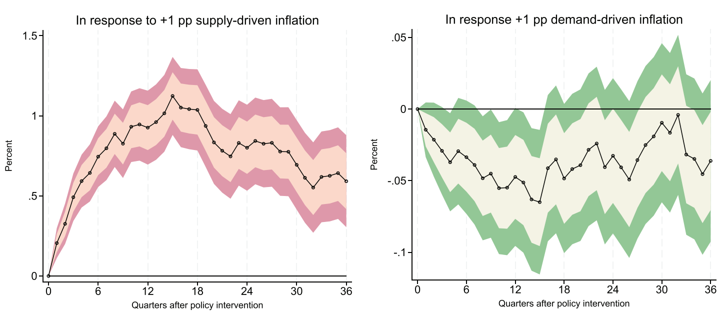
[22] Akin to our baseline empirical specification (1), we do not distinguish between inflation and disinflation in our baseline theoretical specification. When we do so, the dampening effects of a monetary tightening in the presence of demand-driven inflation are even more salient (see Figure A.41, right panel, in the appendix).

Figure 7. Unconditional Effect of a Monetary Tightening on Financial Stress



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Regression coefficients β_h^T for $h = 0, \ldots, 36$ in (2). Based on simulated time series from the model in Boissay et al. (2024) with demand shocks and monetary policy surprises. Similar results obtain based on the alternative specification with supply shocks and monetary policy surprises. Specification with six lags similar to our baseline empirical specification for the U.S. 90% confidence bands.

Figure 8. Additional State-Dependent Effect of a Monetary Tightening on the One-Period-Ahead Probability of a Crisis



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Left panel: regression coefficients β_h^{TS} for $h = 0, \ldots, 36$ in (2). Right panel: regression coefficients β_h^{TD} for $h = 0, \ldots, 36$ in (2). Based on simulated time series from the model in Boissay et al. (2024) with supply shocks and monetary policy surprises (left panel), and with demand shocks and monetary policy surprises (right panel). Specification with six lags similar to our baseline empirical specification for the U.S. 90% confidence bands.

5. Conclusion

We uncover novel state-dependent effects of a monetary tightening on financial stress, focusing on the drivers of inflation. When inflation is high and *supply-driven*, a rate hike induces a rise in financial stress, pointing to the existence of a potential policy trade-off between the price stability and financial stability objectives. By contrast, when inflation is high but *demand-driven*, a policy rate hike lowers financial stress and there is no such trade-off.

These findings have several important implications for the conduct of monetary policy. First, they emphasize that both the level and the drivers (i.e., whether it is supply- or demand-driven) of inflation are relevant for adequate policy calibration. In this context, the decomposition of inflation in demand and supply factors (e.g., Figure 3 or Figure A.29 in the appendix) may be a useful tool to gauge the odds of a "hard" financial landing during monetary tightening episodes. Second, our findings also highlight that existing financial vulnerabilities can limit a central bank's room for maneuver to fight supply-driven inflationary pressures (a version of the so-called financial dominance). In that case, other tools (such as macroprudential ones) may be necessary to alleviate risks to financial stability throughout the monetary tightening (Boissay et al. 2023).

Our analysis is only a first step that sets the stage for further research. As next steps, we are considering expanding our data set along both time and country dimensions; using alternative methodologies to measure supply- versus demand-driven inflation; and using other identification schemes for exogenous monetary policy such as the "local projections–instrumental variables" approach (Stock and Watson 2018; Jordà, Schularick, and Taylor 2020; Schularick, ter Steege, and Ward 2021).

Appendix

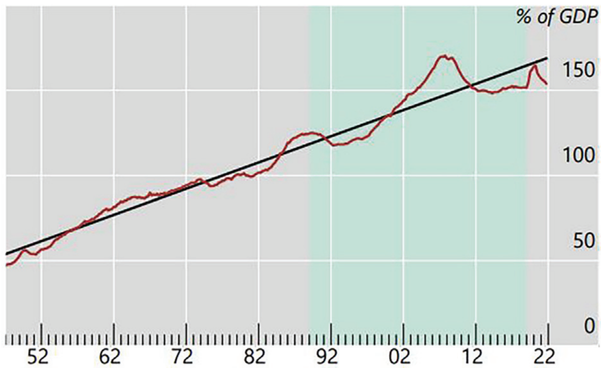
A.1 Baseline Specification

A.1.1 Data

Table A.1. Overview: Financial Stress Indices for the U.S.

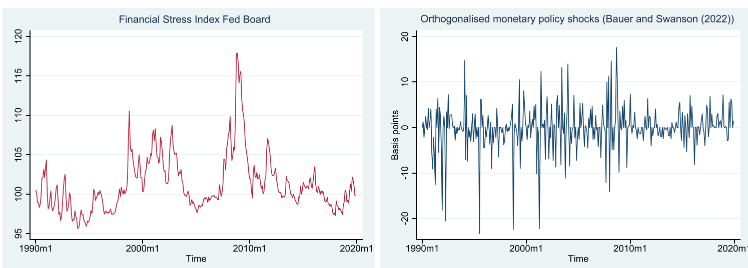
Index	**Source (Description)**	**Type**
Federal Reserve Board Staff's FSI	Hubrich and Tetlow (2015)	Stress
Bloomberg FCI	Rosenberg (2009)	Stress
New CISS	Chavleishvili and Kremer (2023)	Systemic Stress
Kansas City Fed FSI	Hakkio and Keeton (2009)	Stress
VIX	Chicago Board Options Exchange	Stress
St. Louis Fed FSI	Kliesen and Smith (2010)	Stress and Conditions
Chicago Fed National FCI	Brave and Butters (2011)	Stress and Conditions
Goldman Sachs FCI	Hatzius and Stehn (2018)	Stress and Conditions
GZ Corporate Spreads Index	Gilchrist and Zakrajšek (2012)	Stress
GZ Equity Premium Index	Gilchrist and Zakrajšek (2012)	Stress
Loan Delinquency Rates	Federal Reserve Board Statistics	Stress
Firm Bankruptcies	U.S. Courts	Stress

Figure A.1. Ratio of Private Credit to GDP during the Estimation Period in the U.S.



Source: National Data, Bank for International Settlements.
Note: Shaded area: estimation period.

Figure A.2. Data Baseline Specification



Note: Data are stationary at 5 percent level (augmented Dickey-Fuller tests). As noted by Jarociński (2024), monetary policy shocks are (unsurprisingly) lower during the ZLB (right panel).

A.1.2 Disentangling the Role of Inflation Level and Composition

The estimated effect of a surprise 25 bp monetary tightening on financial stress conditional on a 1 pp supply-driven inflation π_t^s at horizon h equals

$$\left.\frac{\partial y_{t+h} - y_{t-1}}{\partial mps_t}\right|_{mps_t>0;\pi_t^d=\pi_t^a=0} = \hat{\beta}_h^T + \hat{\beta}_h^{TS}\pi_t^s.$$

Both $\hat{\beta}_h^T$ (Figure 4) and $\hat{\beta}_h^{TS}$ (Figure 5, left panel) are positive, indicating that policy rate hikes during supply-driven inflationary episodes unambiguously raise financial stress. Furthermore, the positive coefficient of the interaction term $\hat{\beta}_h^{TS}$ implies that a higher level of supply-driven inflation π_t^s is associated with a stronger marginal effect of the tightening on financial stress (Figure 6, right panel).

The estimated effect of a 25 bp monetary tightening on financial stress conditional on demand-driven inflation π_t^d is given by

$$\left.\frac{\partial y_{t+h} - y_{t-1}}{\partial mps_t}\right|_{mps_t>0;\pi_t^s=\pi_t^a=0} = \hat{\beta}_h^T + \hat{\beta}_h^{TD}\pi_t^d.$$

The estimated interaction coefficients $\hat{\beta}_h^{TD}$ are negative (Figure 5, right panel), suggesting that the effect of policy rate hikes on financial stress is dampened during demand-driven inflationary episodes and may even turn negative when the demand-driven inflationary boom is strong enough. Specifically, when demand-driven inflation π_t^d is relatively mild, the positive effect due to $\hat{\beta}_h^T > 0$ prevails over the small negative effect due to $\hat{\beta}_h^{TD}\pi_t^d < 0$ and the rate hike leads overall to a rise in financial stress. By contrast, in the presence of a high level of demand inflation π_t^d, the negative effect due to $\pi_t^d\hat{\beta}_h^{TD} < 0$ will more than offset the positive effect due to the tightening per se $\hat{\beta}_h^T > 0$, and in those instances the policy rate hike will work to reduce financial stress.

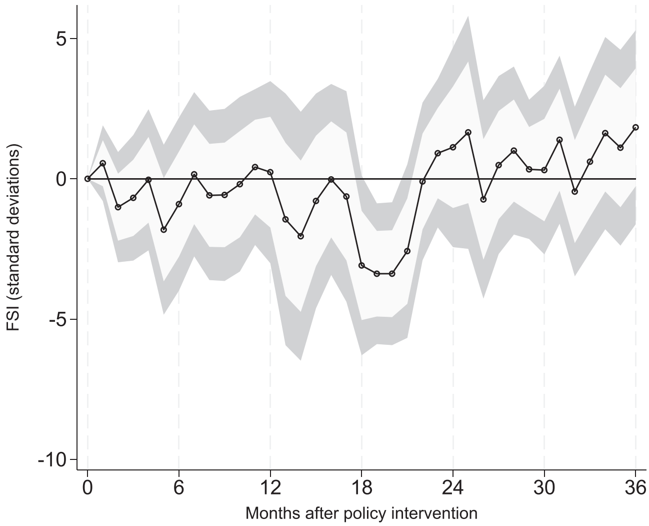
Finally, to sum up, the total estimated effect of a 25 bp monetary tightening on financial stress at horizon h is given by

$$\left.\frac{\partial y_{t+h} - y_{t-1}}{\partial mps_t}\right|_{mps_t>0} = \hat{\beta}_h^T + \hat{\beta}_h^{TS}\pi_t^s + \hat{\beta}_h^{TD}\pi_t^d + \hat{\beta}_{12}^{TA}\pi_t^a$$

and will depend on the levels of supply-driven inflation π_t^s, demand-driven inflation π_t^d, and ambiguous inflation π_t^a prevailing at the time of the tightening. At one extreme, in periods with high inflation driven mainly by supply factors, a rate hike will raise financial stress. At the other extreme, in periods with high inflation driven mainly by demand factors, a rate hike will reduce financial stress.

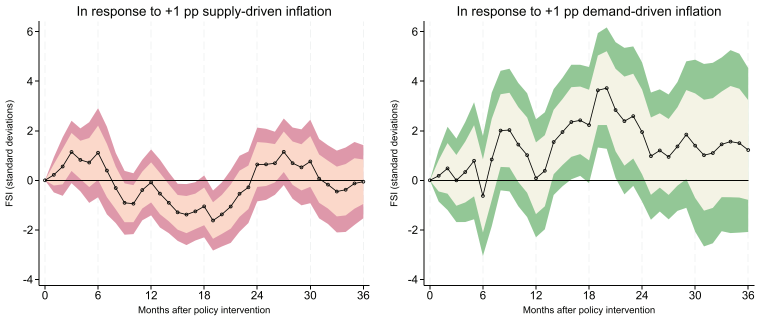
A.1.3 State-Dependent Effects of a Monetary Loosening

Figure A.3. Unconditional Effect of a Monetary Loosening on Financial Stress



Note: Dynamic responses to a 25 bp negative monetary policy surprise. Shown are regression coefficients β_h^L for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands, Newey-West standard errors. U.S. monthly data from January 1990 to December 2019. Findings robust to specifications including the optimal lag order according to the AIC and BIC equal to three and four, respectively.

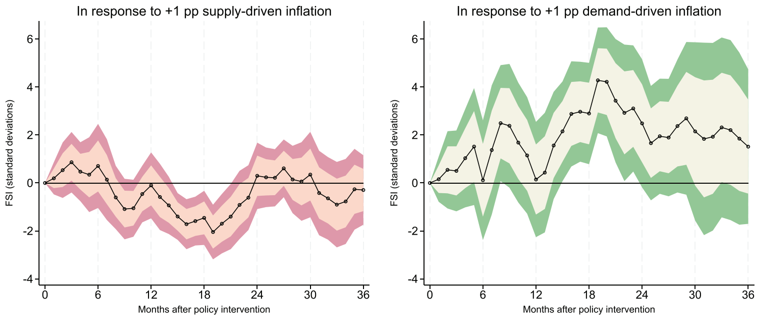
Figure A.4. Additional State-Dependent Effect of a Monetary Loosening on Financial Stress



Note: Dynamic responses to a 25 bp negative monetary policy surprise. Shown are regression coefficients β_h^{LS} (left) and β_h^{LD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019.

Alternative Specification. Adding as a control variable in our baseline specification the Baker, Bloom, and Davis (2016) economic policy uncertainty index renders the estimated state-dependent effects of a monetary loosening even more salient (Figure A.5).

Figure A.5. Additional State-Dependent Effect of a Monetary Loosening on Financial Stress



Note: Dynamic responses to a 25 bp negative monetary policy surprise. Shown are regression coefficients β_h^{LS} (left) and β_h^{LD} (right) for $h = 0, \ldots, 36$. Alternative specification where we add as an additional control the Baker, Bloom, and Davis (2016) economic policy uncertainty index in our baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019.

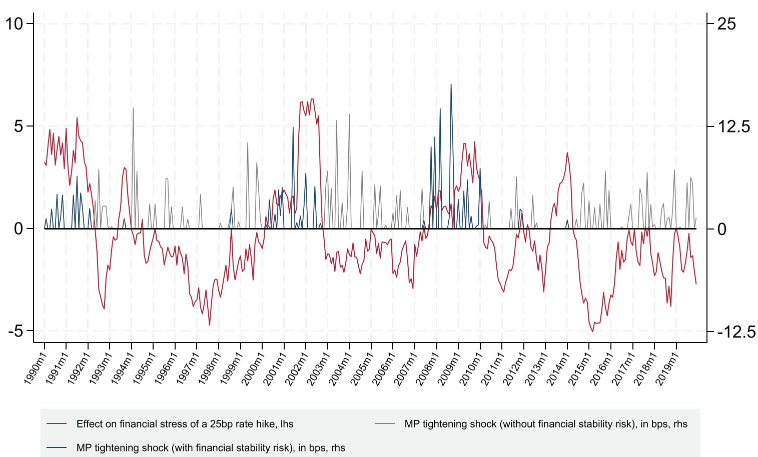
A.1.4 Overall Effect on Financial Stress of a Monetary Tightening: Evolution over Time

When both inflation drivers are active, the *overall* effect of a surprise policy rate hike on financial stress depends on both the level of inflation and its decomposition into supply, demand, and ambiguous inflation (Shapiro 2022a).

In the context of our analysis, this effect can be measured by the sum of the direct and interacted effects of positive monetary policy surprises at a 12-month horizon, i.e., $\hat{\beta}^{T}_{12} + \hat{\beta}^{TS}_{12}\pi^s_t + \hat{\beta}^{TD}_{12}\pi^d_t + \hat{\beta}^{TA}_{12}\pi^a_t$, where $\hat{\beta}^{TA}_{12}$ is the estimated effect of a 25 bp surprise monetary tightening when the latter takes place on the back of a 1 pp increase in ambiguous PCE inflation (as identified in Shapiro 2022a) as obtained from our baseline model in (1) and π^a_t is the level of ambiguous PCE inflation (in pp).

Figure A.6 shows the evolution of the estimated overall effect of a monetary policy tightening surprise (red line) along with that of

Figure A.6. Evolution of the Short-Term Effect of a 25 bp Surprise Rate Hike on Financial Stress



Note: Overall (state-dependent) effect of a surprise 25 bp rate hike on financial stress at a 12-month horizon measured as $\hat{\beta}^{T}_{12} + \hat{\beta}^{TS}_{12}\pi^s_t + \hat{\beta}^{TD}_{12}\pi^d_t + \hat{\beta}^{TA}_{12}\pi^a_t$, where π^a_t is the level of ambiguous PCE inflation (in pp) and $\hat{\beta}^{TA}_{12}$ is the estimated effect of a 25 bp rate hike when the hike takes place on the back of a 1 pp increase in ambiguous PCE inflation (see Shapiro 2022a) as obtained from the estimation of our baseline model in (1). Monetary tightening surprises: positive values of the Bauer and Swanson (2023) monetary surprises (see Figure A.2, right panel).

the Bauer and Swanson (2023) shocks (gray/blue line, positive values only). A positive overall effect indicates a situation where hiking the policy rate was or would have been conducive to financial stress in the short term. In retrospect, such a situation has occurred in five instances since 1990 (red line above zero): in 1990–91, 1993, 2001–02, 2008–10, and 2013–14. In effect, about one-third of the positive monetary policy surprises took place during those times (blue line).

A.2 Robustness Checks: U.S. Specification

A.2.1 Distinguishing Between Inflation and Disinflation

Compared with the baseline econometric specification described by (1), we run also the more detailed regression below where we additionally condition the effects of a monetary tightening on whether inflation is positive or negative at the time of the policy intervention:

$$
\begin{aligned}
y_{t+h} - y_{t-1} = \alpha_h &+ \beta_h^T \mathbb{1}\{mps_t > 0\} mps_t \\
&+ \beta_{\mathbf{h}}^{\mathbf{TSi}} \mathbb{1}\{mps_t > 0\} \mathbb{1}\{\pi_t^s > 0\} mps_t \pi_t^s \\
&+ \beta_{\mathbf{h}}^{\mathbf{TDi}} \mathbb{1}\{mps_t > 0\} \mathbb{1}\{\pi_t^d > 0\} mps_t \pi_t^d \\
&+ \beta_h^{TSd} \mathbb{1}\{mps_t > 0\} \mathbb{1}\{\pi_t^s < 0\} mps_t \pi_t^s \\
&+ \beta_h^{TDd} \mathbb{1}\{mps_t > 0\} \mathbb{1}\{\pi_t^d < 0\} mps_t \pi_t^d \\
&+ \beta_h^L \mathbb{1}\{mps_t < 0\} mps_t \\
&+ \beta_h^{LSi} \mathbb{1}\{mps_t < 0\} \mathbb{1}\{\pi_t^s > 0\} mps_t \pi_t^s \\
&+ \beta_h^{LDi} \mathbb{1}\{mps_t < 0\} \mathbb{1}\{\pi_t^d > 0\} mps_t \pi_t^d \\
&+ \beta_h^{LSd} \mathbb{1}\{mps_t < 0\} \mathbb{1}\{\pi_t^s < 0\} mps_t \pi_t^s \\
&+ \beta_h^{LDd} \mathbb{1}\{mps_t < 0\} \mathbb{1}\{\pi_t^d < 0\} mps_t \pi_t^d \\
&+ A_h \sum_{\tau=1}^{L} \mathscr{C}_{t-\tau} + e_{t+h}. \qquad \text{(A.1)}
\end{aligned}
$$

We obtain that the unconditional effects of the tightening (not reported) and its additionally state-dependent effects (Figure A.7) remain literary unchanged compared with those obtained based on the baseline specification (Figure 5).

Figure A.7. Additional State-Dependent Effect of a Monetary Tightening on Financial Stress

Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TSi} (left) and β_h^{TDi} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. Findings robust to specifications including the optimal lag order according to the AIC and BIC equal to three and four, respectively.

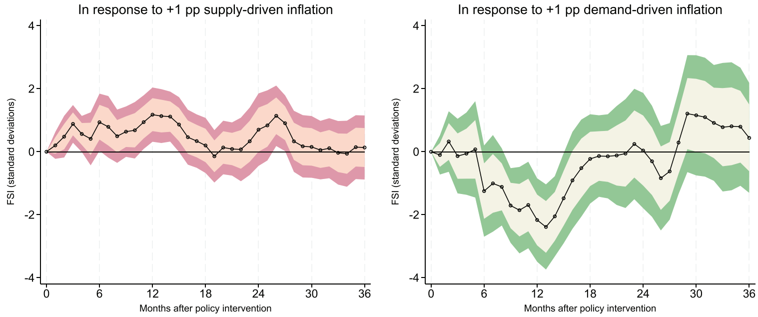
A.2.2 Not Distinguishing Positive from Negative Monetary Policy Surprises

To have a broader overview of the relationship between monetary policy surprises and financial stress, we run the regression below without distinguishing whether the monetary policy surprises are positive (tightening) or negative (loosening):

$$y_{t+h} - y_{t-1} = \alpha_h + \beta_h mps_t + \beta_h^S mps_t \pi_t^s + \beta_h^D mps_t \pi_t^d + A_h \sum_{\tau=1}^{L} \mathscr{C}_{t-\tau} + e_{t+h}. \tag{A.2}$$

We obtain that the unconditional effects of the tightening (not reported) and its additional state-dependent effects (Figure A.8) look broadly similar to those obtained based on the baseline specification (Figure 5), albeit smaller. This is consistent with the estimated effects of surprise policy cuts being smaller than those of surprise policy hikes (compare Figure A.4 and Figure 5).

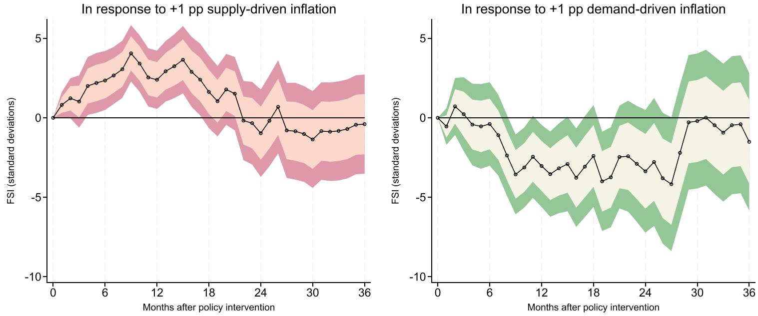
Figure A.8. Additional State-Dependent Effect of a Monetary Surprise on Financial Stress



Note: Dynamic responses to a 25 bp monetary policy surprise. Shown are regression coefficients β_h^S (left) and β_h^D (right) for $h = 0, \ldots, 36$. Specification described by (A.2) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019.

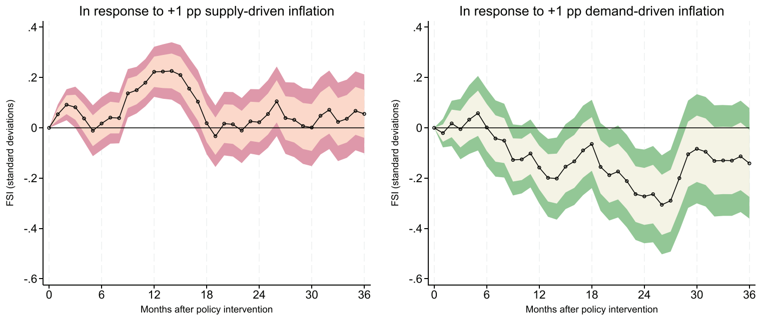
A.2.3 Subsamples

Figure A.9. Additional State-Dependent Effect of a Tightening on Financial Stress—No GFC



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands. U.S. monthly data from January 1990 to December 2019, excluding the 2007–08 GFC period.

Figure A.10. Additional State-Dependent Effect of a Tightening on Financial Stress—No ZLB



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands. U.S. monthly data from January 1990 to December 2019, excluding the ZLB period between 2010 and 2015.

A.2.4 Unconventional Monetary Policy Shocks

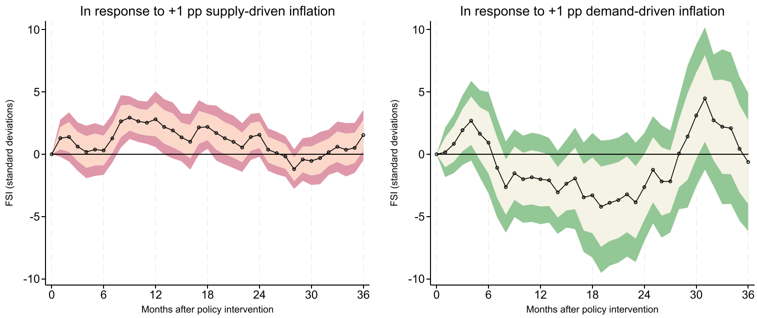
The aim of this section is to determine whether *unconventional* monetary policy surprises also have an effect on financial stress and whether this effect is similar to that of a surprise change in the policy rate.

Unconventional monetary policies can be defined in a broad sense as policies other than changes in the policy rate, and include central bank communication and statements about the future path of policy rates (i.e., forward guidance) as well as interventions such as large-scale asset purchases—and announcements thereof.

One important transmission channel of these policies is through changes in agents' expectations and view of future policy actions, which in turn affect the slope of the yield curve and medium-to-longer-term funding conditions. Indeed, Gürkaynack, Sack, and Swanson (2005a) have found that central bank statements have a much greater impact on longer-term Treasury yields than changes in the monetary policy rate.[23] In effect, unconventional monetary

[23] Note that such policies are not new, i.e., have been used well before the GFC and outside of zero lower bound periods. Gürkaynak, Sack, and Swanson (2005a),

Figure A.11. Additional State-Dependent Effect of an Unconventional Monetary Policy Tightening on Financial Stress



Note: Dynamic responses to a 25 bp *unconventional* monetary policy tightening. Shown are regression coefficients β_h^S (left) and β_h^D (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with the sum of Jarociński (2024)'s "u2" (Odyssean) and "u4" (Delphic) unconventional monetary policy shocks as policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019.

policy surprises have distinct effects and complement conventional ones by shifting the *slope* of the yield curve—as opposed to its *level*.

The recent literature has further identified that unconventional monetary policy announcements send two types of signals (Andrade and Ferroni 2021; Jarociński 2024): news about the central bank's future stance ("Odyssean" shocks); and news about the future state of the economy ("Delphic" shocks). Both types of news may affect medium-to-longer-term funding conditions and, possibly, financial stress.

To analyze these effects, we consider Odyssean and Delphic shocks as identified by Jarociński (2024), first together and then separately, and run the same regression as in the baseline specification in (1) using these shocks.[24] The results are reported in Figures A.11

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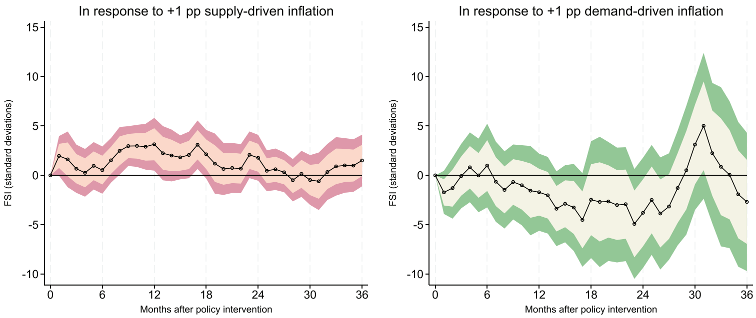
for example, list a few monetary policy announcements by the Federal Reserve between 1998 and 2004 that had particularly large effects on Treasury yields (see their Table 4, "Ten Largest Observations of the Path Factor").

[24] Jarociński (2024) provides a detailed description of these unconventional monetary policy shocks and links them to specific interventions and announcements of the Federal Reserve.

Figure A.12. Additional State-Dependent Effect of an Odyssean Unconventional Monetary Policy Tightening on Financial Stress



Note: Dynamic responses to a 25 bp *unconventional* monetary policy tightening. Shown are regression coefficients β_h^S (left) and β_h^D (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Jarociński (2024)'s "u2" (Odyssean) monetary policy shocks as policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019.

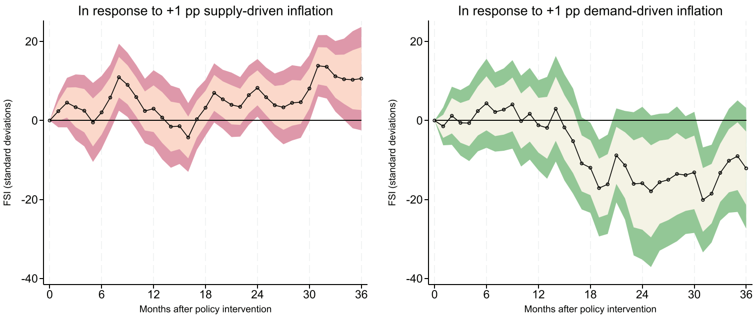
(sum of the two types of shocks), A.12 (Odyssean shocks only), and A.13 (Delphic shocks only).

The effects on financial stress of an unconventional monetary policy tightening are similar (albeit smaller) to those of a conventional tightening (compare Figures 5 and A.11).[25] The tightening increases (reduces) the risk of financial stress in the short (medium) term when it takes place on the back of supply-driven (demand-driven) inflationary pressures.

The effects do not depend on the transmission channel of the policy, i.e., whether they are transmitted through news about the future state of the economy (Figure A.13) or through news about the central bank's future monetary policy stance (Figure A.12).

[25] One possible reason for the smaller effect on financial stress is that unconventional monetary policy affects longer-term rates and takes time to percolate through borrowing costs, net cash flows, and default risk. In contrast, a rise in the policy rate (and expectation thereof) implies an upward shift of the whole yield curve and an immediate financial assets price correction and fall in net worth, possibly setting in motion adverse liquidity spirals.

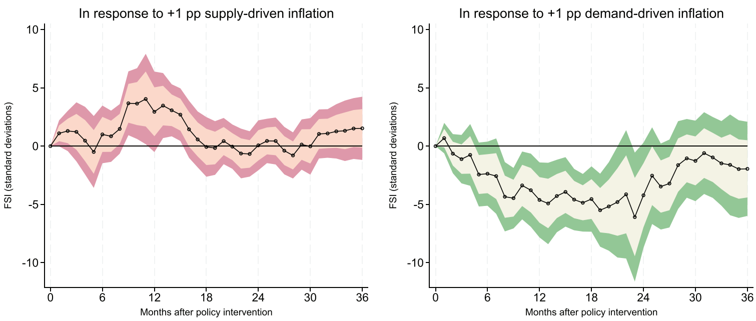
Figure A.13. Additional State-Dependent Effect of a Delphic Unconventional Monetary Policy Tightening on Financial Stress



Note: Dynamic responses to a 25 bp *unconventional* monetary policy tightening. Shown are regression coefficients β_h^S (left) and β_h^D (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Jarociński (2024)'s "u4" (Delphic) monetary policy shocks as policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019.

A.2.5 Other Financial Stress Indices

Figure A.14. Additional Effect of a Monetary Tightening on Financial Stress: Bloomberg FCI

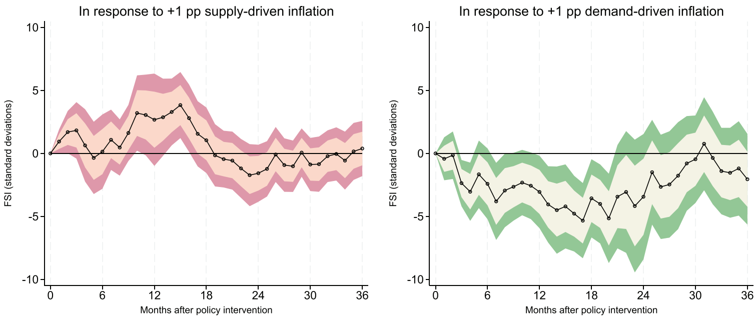


Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Bloomberg FCI, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. We take the negative value of the Bloomberg FCI because for this index a positive value indicates accommodative financial conditions, while a negative value indicates tighter financial conditions. This index can be classified as a stress index because it is computed mainly based on spreads and volatilities. Specifically, its components are the U.S. TED spread, the LIBOR/OIS spread, the commercial paper/T-bills spread, the U.S. high yield/10Y Treasury spread, the U.S. muni/10Y Treasury spread, the swaption volatility index, the S&P 500, and the VIX.

Figure A.15. Additional Effect of a Monetary Tightening on Financial Stress: Kansas City Fed FSI

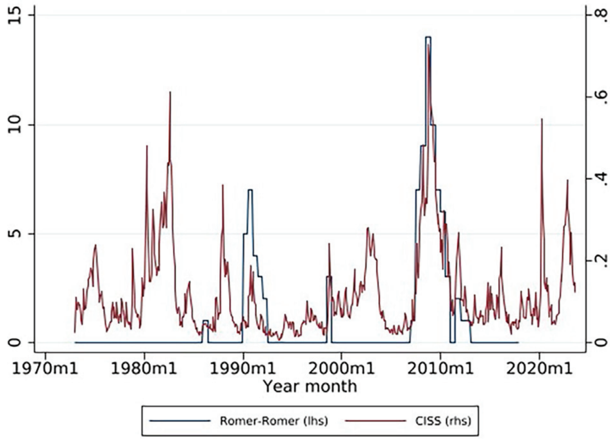
Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Kansas City Fed FSI, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. The Kansas City Fed FSI is a pure FSI index with 11 components represented by spreads, volatility, "flight to quality," and "asymmetric information" proxies in main segments of financial markets. Its precise components are the TED spread, swap spread, off-the-run/on-the-run spread, Aaa/Treasury spread, Baa/Aaa spread, high-yield/Baa spread/ consumer ABS/Treasury spread, stock-bond correlation, stock market volatility (VIX), IVOL-banking industry, CSD-banks (see Table 1 in Hakkio and Keeton 2009).

Figure A.16. Additional State-Dependent Effect of a Monetary Tightening on Financial Stress: CISS



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the CISS, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. The CISS is an index of systemic financial stress which aggregates 15 components capturing stress symptoms in money, bond, equity, and foreign exchange markets. It incorporates mainly volatility and spreads and is similar to a continuous version of Romer and Romer (2017) (see Figure 1, panel B in Chavleishvili and Kremer 2023).

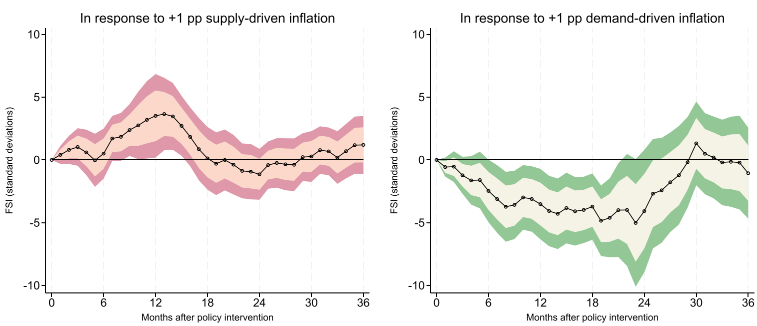
Figure A.17. Alternative (composite) Financial Stress Index for the U.S.: CISS



Note: The figure plots for the U.S. the CISS systemic financial stress index (red line) along with the Romer and Romer (2017) qualitative financial crisis indicator (blue line). Data are shown monthly from January 1973 to August 2023 for the CISS, and semiannually until 2017:H2 for Romer and Romer.

A.2.6 Financial Stress Components

Figure A.18. Additional Effect of a Monetary Tightening on the GZ Corporate Credit Spreads

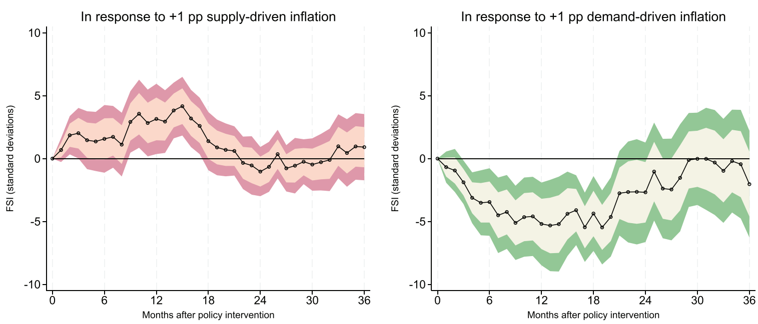


Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Gilchrist and Zakrajšek (2012) (GZ) corporate credit spreads, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019.

Figure A.19. Additional Effect of a Monetary Tightening on the GZ Equity Finance Premium

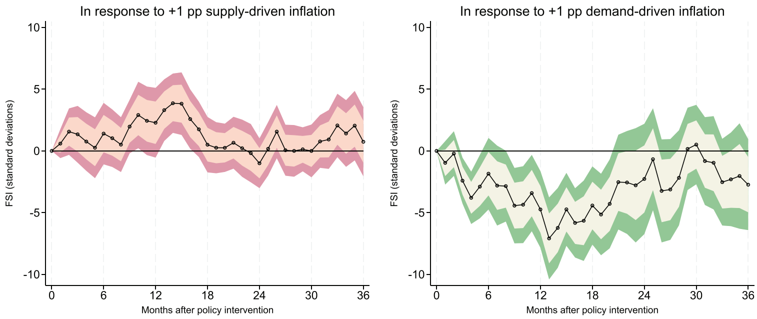
Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Gilchrist and Zakrajšek (2012) (GZ) equity finance premium, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019.

Figure A.20. Additional Effect of a Monetary Tightening on Financial Stress: Bond Market CISS



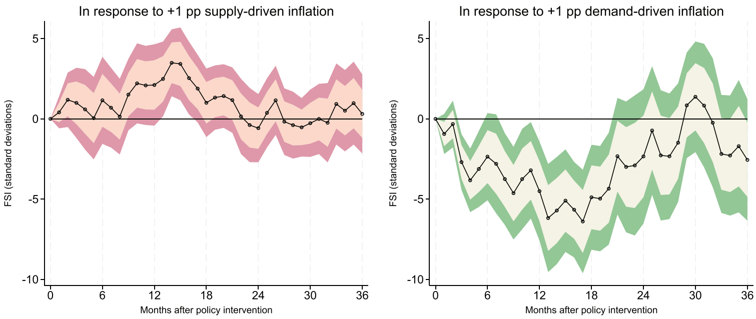
Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Bond Market CISS subindex, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. The CISS is an index of systemic financial stress which aggregates 15 components capturing stress symptoms in money, bond, equity, and foreign exchange markets. It incorporates mainly volatility and spreads and is similar to a continuous version of Romer and Romer (2017) (see Figure 1, panel B in Chavleishvili and Kremer 2023).

Figure A.21. Additional Effect of a Monetary Tightening on Financial Stress: NFC CISS



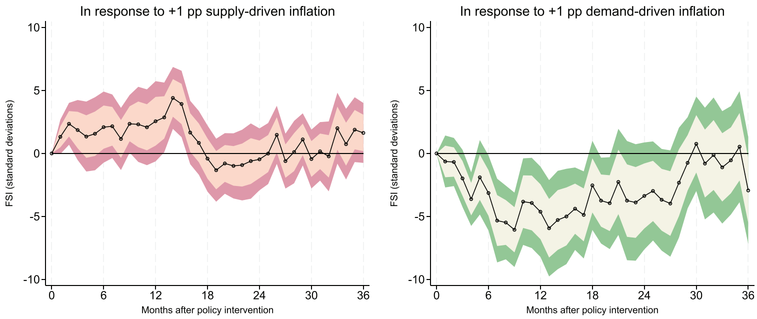
Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Non-financial Corporations Equity Market CISS subindex, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. The CISS is an index of systemic financial stress which aggregates 15 components capturing stress symptoms in money, bond, equity, and foreign exchange markets. It incorporates mainly volatility and spreads and is similar to a continuous version of Romer and Romer (2017) (see Figure 1, panel B in Chavleishvili and Kremer 2023).

Figure A.22. Additional Effect of a Monetary Tightening on Financial Stress: Financial CISS



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Financial Corporations Equity Market CISS subindex, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. The CISS is an index of systemic financial stress which aggregates 15 components capturing stress symptoms in money, bond, equity, and foreign exchange markets. It incorporates mainly volatility and spreads and is similar to a continuous version of Romer and Romer (2017) (see Figure 1, panel B in Chavleishvili and Kremer 2023).

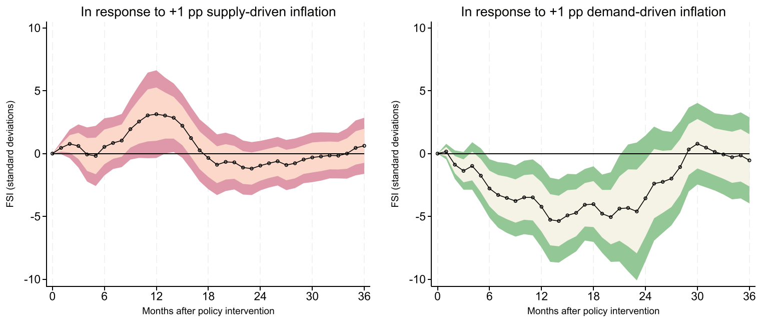
Figure A.23. Additional State-Dependent Effect of a Tightening on Financial Stress: FX CISS



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Foreign Exchange Market CISS subindex, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. The CISS is an index of systemic financial stress which aggregates 15 components capturing stress symptoms in money, bond, equity, and foreign exchange markets. It incorporates mainly volatility and spreads and is similar to a continuous version of Romer and Romer (2017) (see Figure 1, panel B in Chavleishvili and Kremer 2023).

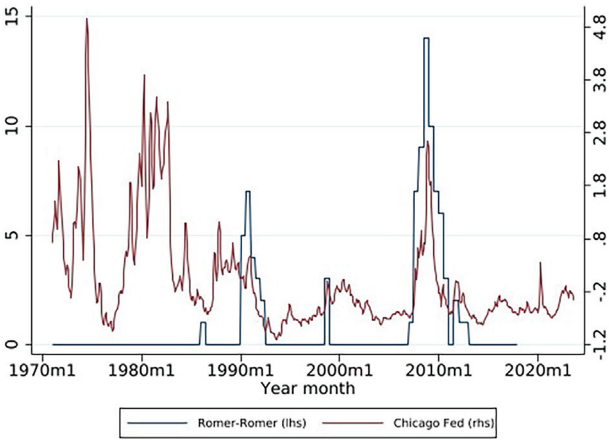
A.2.7 Financial Conditions Indices

Figure A.24. Additional Effect of a Tightening on Financial Conditions: Chicago Fed NFCI



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Chicago Fed NFCI, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019, baseline specification. The Chicago Fed NFCI is computed using 109 financial market variables including both spread/volatility measures (with substantial weights) as well as interest rate levels and asset prices, and provides a comprehensive index of financial conditions in money markets, debt and equity markets, and the traditional and "shadow" banking systems (see Table A1 in Brave and Butters 2011).

Figure A.25. A Financial Conditions Index for the U.S.: Chicago Fed NFCI

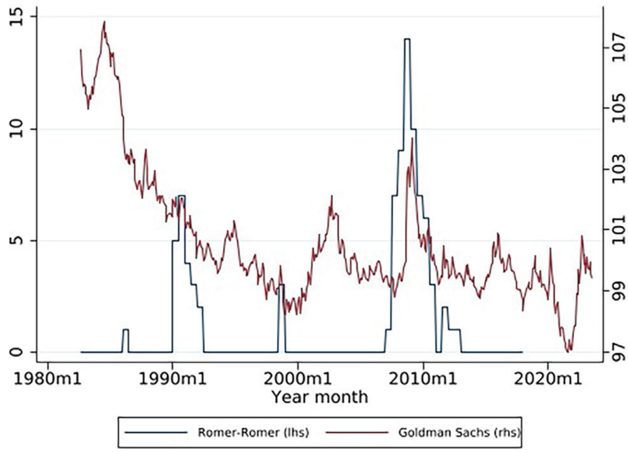


Note: The figure plots for the U.S. the Chicago Fed NFCI (red line) along with the Romer and Romer (2017) qualitative financial crisis indicator (blue line). Data are shown monthly from January 1971 to August 2023 for the Chicago Fed NFCI, and semiannually until 2017:H2 for Romer and Romer.

Figure A.26. Additional Effect of a Tightening on Financial Conditions: Goldman Sachs FCI

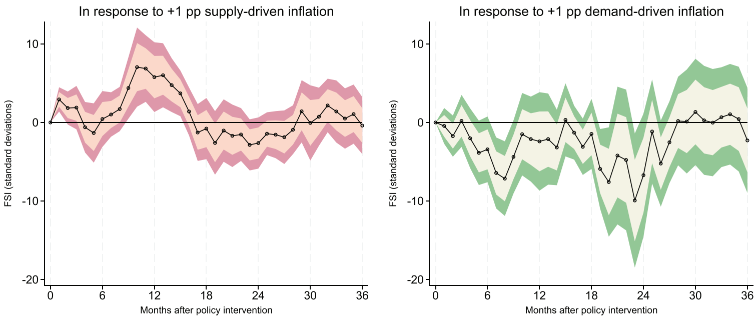
Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Goldman Sachs FCI, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. The Goldman Sachs FCI is constructed as a weighted average of short-term interest rates, long-term interest rates, the trade-weighted dollar, an index of credit spreads, and the ratio of equity prices to the 10-year average of earnings per share. The weights are set using the estimated impact of surprises to each variable on real GDP growth over the following four quarters using a stylized macro model. The weight on corporate credit spreads equals 39.6 percent (see Table B3 in Hatzius and Stehn 2018).

Figure A.27. A Financial Conditions Index for the U.S.: Goldman Sachs FCI



Note: The figure plots for the U.S. the Goldman Sachs FCI (red line) along with the Romer and Romer (2017) qualitative financial crisis indicator (blue line). Data are shown monthly from September 1982 to August 2023 for the Goldman Sachs FCI, and semiannually until 2017:H2 for Romer and Romer.

Figure A.28. Additional Effect of a Tightening on Financial Conditions/Stress: St. Louis Fed FSI



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the St. Louis Fed FSI, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. The St. Louis Fed FSI is constructed from 18 weekly data series: seven interest rate series, six yield spreads, and five other indicators. Since the index includes a fair number of interest rate series, one can classify it as a financial conditions index, as opposed to a pure financial stress index.

A.3 Robustness Checks: Other Countries

A.3.1 Data

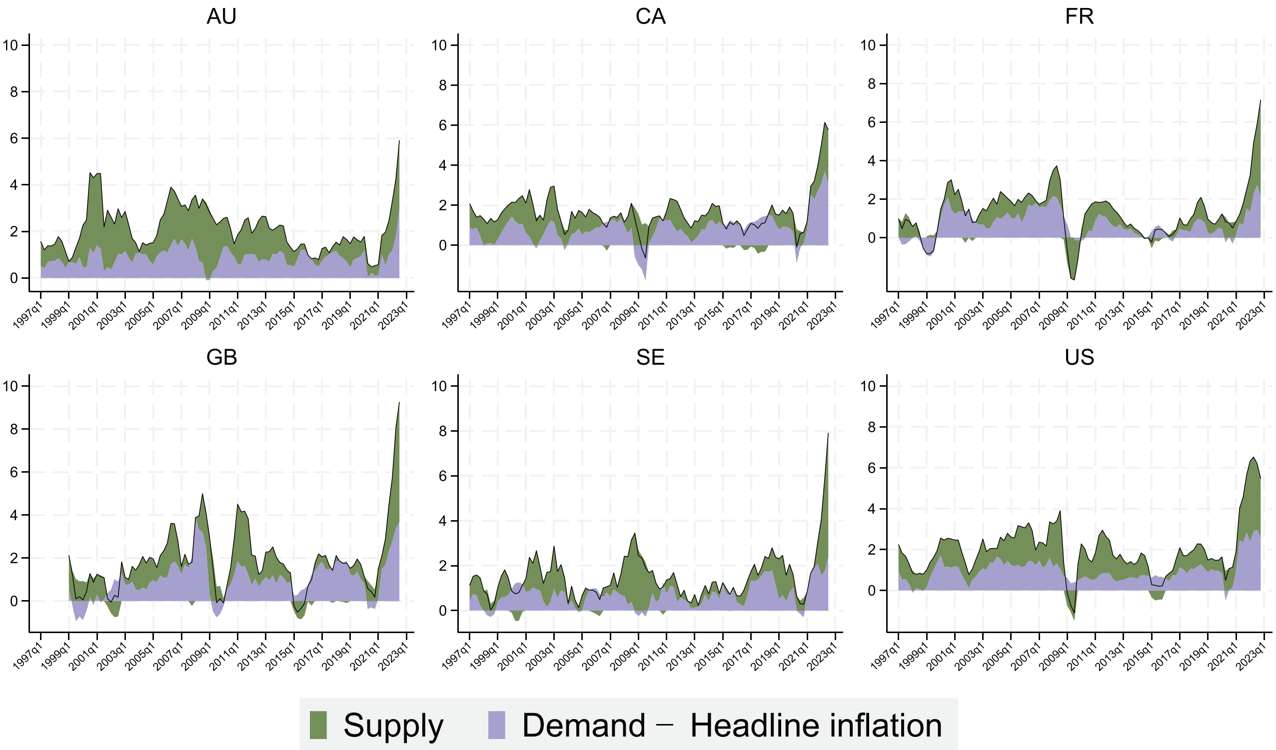
Table A.2. Overview: Monetary Policy Surprises by Country

Reference	Type	Remarks
Canada		
Champagne and Sekkel (2018)	Narrative	Romer and Romer Type
United Kingdom		
Gerko and Rey (2017)	High Frequency	(Sign) Correction
France		
Jarociński and Karadi (2020)	High Frequency	(Sign) Correction
Sweden		
Kilman (2022); Sandström (2018)	High Frequency	
Australia		
Bishop and Tulip (2017)	Narrative	

Table A.3. Overview: Financial Stress Indices by Country

Index	Source (Description)	Type
Canada		
Canadian FSI	Duprey (2020)	Systemic Stress
United Kingdom		
New CISS	Chavleishvili and Kremer (2023)	Systemic Stress
Bloomberg FCI	Rosenberg (2009)	Stress
Country-Level Index of Financial Stress (CLIFS)	Duprey, Klaus, and Peltonen (2017)	Systemic Stress
Goldman Sachs FCI	Hatzius and Stehn (2018)	Stress and Conditions
France		
New CISS	Chavleishvili and Kremer (2023)	Systemic Stress
CLIFS	Duprey, Klaus, and Peltonen (2017)	Systemic Stress
Goldman Sachs FCI	Hatzius and Stehn (2018)	Stress and Conditions
Sweden		
CLIFS	Duprey, Klaus and Peltonen (2017)	Systemic Stress
Australia		
Asian Development Bank (ADB) FSI	Park and Mercado (2014), ADB Database	Stress
Corporate Credit Spreads	Investment-Grade Index Bank of America (BofA) Merrill Lynch	Stress
Reserve Bank of Australia (RBA) FCI	Hartigan and Wright (2021)	Stress and Conditions

Figure A.29. Inflation Decomposition into Demand and Supply Factors



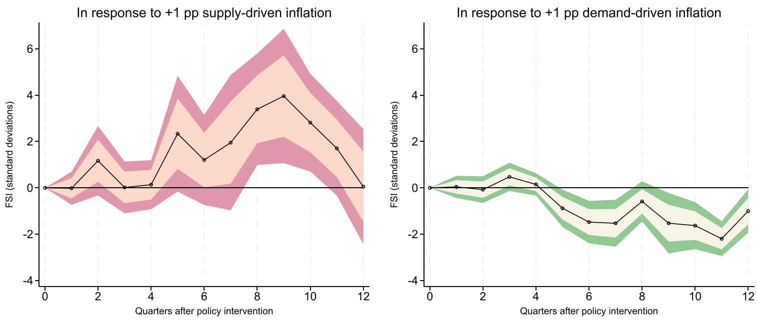
Source: OECD.
Note: Headline inflation, quarterly frequency, year-on-year. Y-axis: percent. To our knowledge, France was the only euro-area country for which the inflation decomposition was publicly available at the time of the analysis.

A.3.2 Findings

Figure A.30. Additional State-Dependent Effect of a Tightening on Financial Stress in Canada

Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 12$. Baseline specification described by (1) with Champagne and Sekkel (2018) (narrative) monetary policy surprises, core year-on-year inflation, and the Cleveland Financial Stress Index (CFSI) (Duprey 2020). Quarterly data from 1984:Q1 to 2015:Q3. The sample is dictated by the availability of the demand/supply inflation series which starts in 1984:Q1 and of the series of monetary policy surprises which ends in 2015:Q3. Specification with four lags (optimal lag order according to the AIC). Findings robust with a specification with two lags (optimal lag order according to the BIC). 90% confidence bands.

Figure A.31. Additional State-Dependent Effect of a Tightening on Financial Stress in the U.K.



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 12$. Baseline specification described by (1) with Gerko and Rey (2017) monetary policy surprises, headline year-on-year inflation, and the CISS financial stress index. Quarterly data from 1999:Q1 to 2014:Q4. The sample is dictated by the availability of the demand/supply inflation series which starts in 1999:Q1 and of the series of monetary policy surprises which ends in 2014:Q4. Headline inflation only available for the U.K. Results very salient when using the Bloomberg financial stress index (Rosenberg 2009), and hold also for CLIFS, the Goldman Sachs financial condition index, and the Goldman Sachs Corporate Spreads FCI. Specification with four lags (optimal lag order according to the AIC and BIC). 90% confidence bands.

Figure A.32. Additional State-Dependent Effect of a Tightening on Financial Stress in France

Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 12$. Baseline specification described by (1) with Jarociński and Karadi (2020) monetary policy surprises, headline year-on-year inflation, and the CISS financial stress index. Quarterly data from 1999:Q1 to 2014:Q4. The sample is dictated by the availability of demand/supply inflation series which starts in 1999:Q1 and of the series of monetary policy surprises which ends in 2019:Q2. Headline inflation only available for France. Similar results for CLIFS, with the effect of supply-driven inflation frontloaded. Similar patterns for the Goldman Sachs FCI index, but with less salient effect for the supply interaction. Specification with four lags (the optimal lag order according to the AIC and BIC). 90% confidence bands.

Figure A.33. Additional State-Dependent Effect of a Tightening on Financial Stress in Australia

Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 12$. Baseline specification with Bishop and Tulip (2017) narrative monetary policy surprises, headline year-on-year inflation, and the ADB financial stress index. Specification with four lags (optimal lag order according to the AIC). Quarterly data from 1997:Q1 to 2019:Q4. The sample is dictated by the availability of monetary policy surprises. Headline inflation only available for Australia. 90% confidence bands. The ADB FSI is a composite index that measures the degree of financial stress covering the four major financial markets: the banking sector, the foreign exchange market, the equity market, and the debt market. The index is tailored to open economies/emerging market economies (see Park and Mercado 2014 and ADB Database). Similar patterns for corporate credit spreads (e.g., investment-grade BofA Merrill Lynch), with the negative reaction of the demand interaction term being particularly salient in that case. Similar patterns with the RBA FCI (Hartigan and Wright 2021), but with a less salient positive interaction term associated to supply-driven inflation.

Figure A.34. Additional State-Dependent Effect of a Tightening on Financial Stress in Sweden

Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 12$. Baseline specification described by (1) with Kilman (2022) monetary policy surprises, headline year-on-year inflation, and the CLIFS financial stress index. Quarterly data from 2002:Q1 to 2021:Q2. The sample is dictated by the availability of high-frequency monetary policy surprises. Headline inflation only available for Sweden. Specification with two lags due to limited data availability of high-frequency monetary policy surprises. 90% confidence bands.

A.4 U.S.: Quarterly Version

Figure A.35. Additional Effect of a Monetary Tightening on Financial Stress (baseline, quarterly)

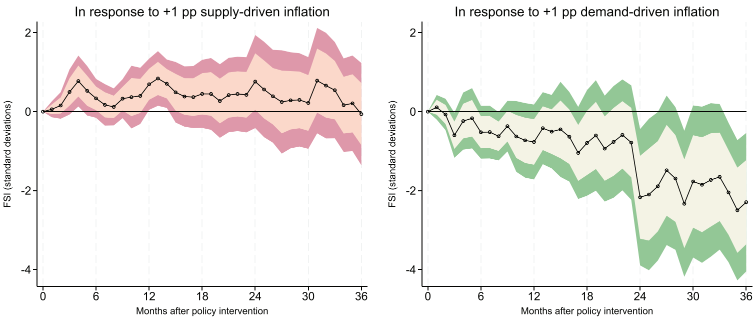
Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. Findings robust to specifications including the optimal lag order according to the AIC and BIC equal to three and four, respectively.

Figure A.36. Additional Effect of a Monetary Tightening on Financial Stress (headline, quarterly)

Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, headline inflation, Federal Reserve Board Financial Stress Index, and six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. Findings robust to specifications including the optimal lag order according to the AIC and BIC equal to three and four, respectively.

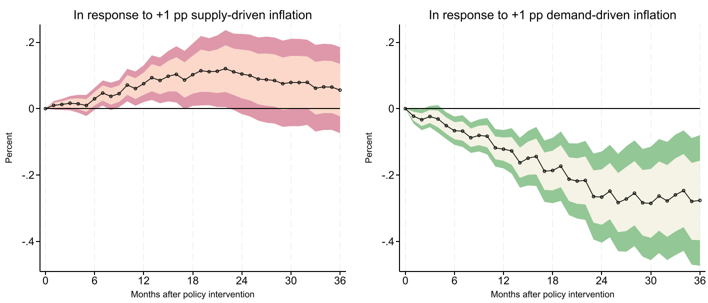
A.5 Underlying Mechanisms

Figure A.37. Additional State-Dependent Effect of a Monetary Tightening on Firm Bankruptcies



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, total of businesses bankruptcies filing (quarterly), four lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019.

Figure A.38. Additional State-Dependent Effect of a Tightening on Loan Delinquency Rate

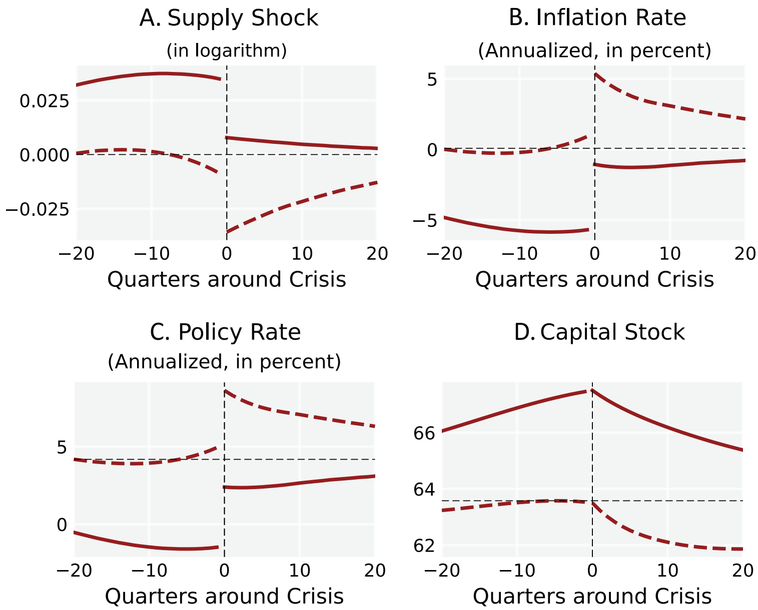


Note: Dynamic responses to a 25 bp positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, \ldots, 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, loan delinquency rate (quarterly) for total loans and leases, six lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). U.S. monthly data from January 1990 to December 2019. Delinquency rates on loans and leases at commercial banks are taken from Federal Reserve Board's website.

A.6 Simulations Based on Boissay et al. (2024)

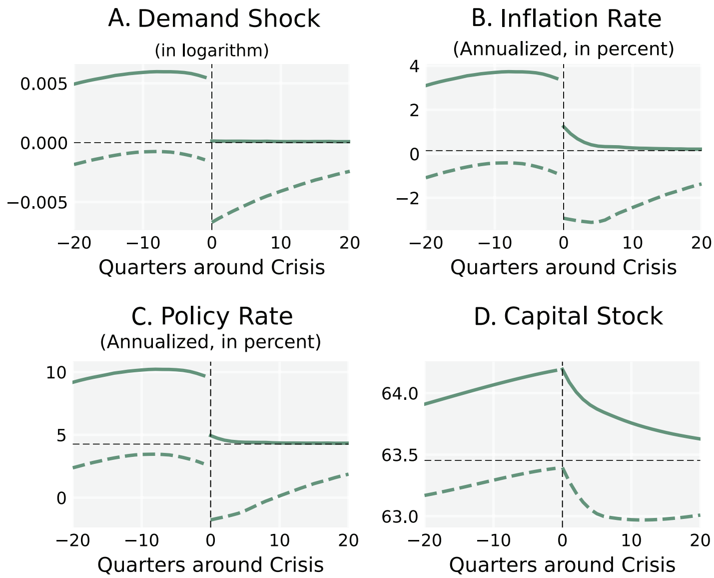
A.6.1 Anatomy of Financial Crises

Figure A.39. Dynamics around Financial Crises in an Economy with Supply Shocks Only



Note: Simulations of the model in Boissay et al. (2024) with supply shocks only. Solid lines: predictable crises. Dotted lines: unpredictable crises. Predictable and unpredictable crises are distinguished based on the distribution of the one-step-ahead probability of a crisis before a crisis is realized. Crises in the bottom 10 percent are labeled "unpredictable," while crises in the top 10 percent are labeled "predictable."

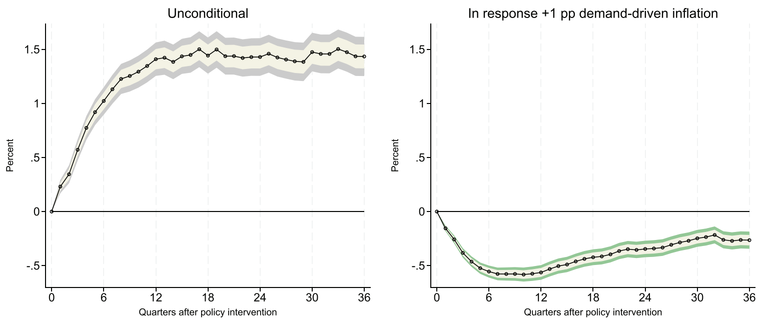
Figure A.40. Dynamics around Financial Crises in an Economy with Demand Shocks Only



Note: Simulations of the model in Boissay et al. (2024) with demand shocks only. Solid lines: predictable crises. Dotted lines: unpredictable crises. Predictable and unpredictable crises are distinguished based on the distribution of the one-step-ahead probability of a crisis before a crisis is realized. Crises in the bottom 10 percent are labeled "unpredictable," while crises in the top 10 percent are labeled "predictable."

A.6.2 Dynamic Effects Conditional on Inflation

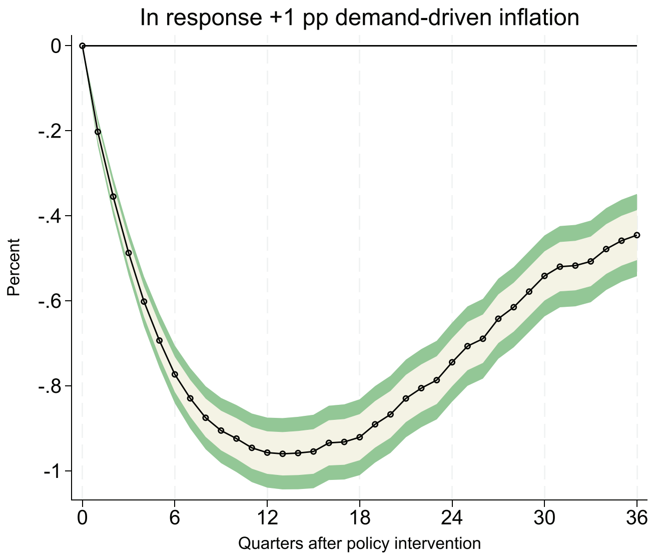
Figure A.41. Dynamic Effect of a Monetary Tightening on the One-Period-Ahead Crisis Probability



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Regression coefficients β_h^{TD} for $h = 0, \ldots, 36$ interacted with a dummy that inflation is positive based on simulated time series from the model in Boissay et al. (2024) with demand shocks and monetary policy surprises. Specification described by Equation (2), where the additional effects captured by the interaction of the policy rate with demand inflation for the monetary tightening (β_h^{TD}) and loosening (β_h^{LD}) are further split using a dummy variable between the sign of year-on-year inflation (i.e., inflation versus disinflation), and otherwise. 90% confidence bands.

A.6.3 Dynamic Effects Conditional on the Stage of the Financial Cycle

Figure A.42. Additional Effect of a Policy Rate Hike on One-Period-Ahead Crisis Probability for Each Percentage Point of Year-on-Year Demand-Driven Inflation in Early Stages of Credit Booms



Note: Dynamic responses to a 25 bp positive monetary policy surprise. Regression coefficients β_h^{TD} for $h = 0, \ldots, 36$ interacted with a dummy that credit/capital stock is in the bottom quantile based on simulated time series from the model in Boissay et al. (2024) with demand shocks and monetary policy surprises. Specification described by Equation (2), where the additional effects captured by the interaction of the policy rate with demand inflation for the monetary tightening (β_h^{TD}) and loosening (β_h^{LD}) are further split using a dummy variable between effects in the early stages of booms (i.e., when credit/capital stock is in the bottom quantile), and otherwise. 90% confidence bands.

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