FEDERAL RESERVE BANK OF SAN FRANCISCO

WORKING PAPER SERIES

Monetary Tightening and Financial Stress during Supply– versus Demand–driven Inflation

Frederic Boissay
Bank for International Settlements

Fabrice Collard
Toulouse School of Economics (CNRS)

Cristina Manea
Bank for International Settlements

Adam Shapiro
Federal Reserve Bank of San Francisco

August 2024

Working Paper 2023-38

https://www.frbsf.org/economic-research/publications/working-papers/2023/38/

Suggested citation:

Boissay, Frederic, Fabrice Collard, Cristina Manea, and Adam Shapiro. 2024 "Monetary Tightening and Financial Stress during Supply– versus Demand–driven Inflation." Federal Reserve Bank of San Francisco Working Paper 2023-38. https://doi.org/10.24148/wp2023-38

This paper was previously circulated under the title "Monetary Tightening, Inflation Drivers and Financial Stress."

Monetary Tightening and Financial Stress during Supply– versus Demand–driven Inflation

F. Boissay* F. Collard† C. Manea‡ A. Shapiro§¶

August 12, 2024

Abstract

The paper explores the state–dependent effects of a monetary policy tightening on financial stress, focusing on a novel dimension: whether inflation is driven by supply factors *versus* demand factors at the time of the policy intervention. We use local projections to estimate the effect of high frequency identified monetary policy surprises on a variety of financial stress measures, differentiating the effects based on whether inflation is supply–driven or demand–driven. We find that financial stress flares up after a monetary tightening when inflation is supply–driven whereas it remains roughly unchanged or even declines when inflation is demand–driven. Our findings point to a potential trade–off between price and financial stability when inflation is high and driven by supply factors.

Keywords: supply– versus demand–driven inflation, monetary tightening, financial stress

JEL classification: E1, E3, E6, G01.

*Bank for International Settlements. Email: frederic.boissay@bis.org.

†Toulouse School of Economics (CNRS). Email: fabrice.collard@gmail.com.

‡Bank for International Settlements. Email: cristina.manea@bis.org.

§Federal Reserve Bank of San Francisco. Email: adam.shapiro@sf.frb.org.

¶The views expressed in this paper are our own and should not be interpreted as reflecting those of the Bank for International Settlements or the Federal Reserve Bank of San Francisco, the Board of Governors of the Federal Reserve System. We thank C. Zhao for excellent research assistance, N. Lemercier, B. Martinez and A. Maurin for excellent data support, K. Hubrich and R. Tetlow for sharing the latest update of the Fed Board's Staff Financial Stress Index, E. Goncalves and G.Koester for sharing the demand– and supply–driven inflation series computed for the euro area, G. Barnard and S.-H. Koh for sharing the demand– and supply–driven inflation series computed for the OECD countries, T. Park for facilitating the latter exchange, and finally to T. Duprey, D. Hauser, J. Kilman, M. Kremer, D. Rees, and R. Sekkel for help with financial stress indicators and monetary policy shocks for countries other than the US. We appreciate feedback received from participants in the BIS Research Seminar, in particular from J. Benchimol, A. Bilan, L. Chitu, S. Claessens, F. De Fiore, S. Eickmeier, N. Galo, M. Hoffmann, T. Holden, J.P. l'Huillier, D. Igan, M. Kaldorf, E. Kharroubi, G. Lombardo, J. Mankart, R. Moessner, B. Mojon, F. Ravenna, L. Riva, D. Sandri, E. Sette, I. Schüler, U. Szczerbowicz, B. Rudolf, C. Waller, H. Weber, University of St Gallen Macro Workshop, Bank of Israel VIMACRO Seminar, Deutsche Bundesbank Research Seminar, ECB Inaugural ChaMP Conference, Annual BIS-SNB Conference, IJCB Annual Conference hosted by Banca d'Italia, Hong–Kong Monetary Authority Research Seminar.

1 Introduction

Since the Great 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 tightening of monetary policy (*e.g.* Schularick, ter Steege, and Ward (2021), Jiménez, Kuvshinov, Peydró, and Richter (2022), Grimm, Jordà, Schularick, and Taylor (2023)). These findings suggests 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 of monetary policy in the first place. In particular, the analysis in Boissay, Collard, Galí, and Manea (2024) suggests that a key factor is whether inflation is due to adverse supply shocks or expansionary demand shocks.

The aim of this paper is to assess empirically how financial stress responds to a monetary tightening and whether the response varies if inflationary pressures are demand– or supply–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). We differentiate the effects based on whether inflation is supply–driven or demand–driven at the time of the policy intervention using Shapiro's (2022a; 2022b) inflation decomposition. The level and composition of inflation should be seen as proxies for the nature and strength of (possibly unobserved) business cycle shocks at the time of the monetary tightening, including supply–side drivers such as adverse productivity shocks, supply–chain disruptions, or oil price shocks, and demand–side drivers such as fiscal expansions or pent–up demand.

Our main findings are twofold. First, policy rate hikes *increase* financial stress in the presence of supply–driven inflation. Furthermore, the magnitude of the response increases in the level of supply–driven inflation, thus uncovering a potential policy trade–off between price 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-chain

[1]See for instance Stein (2012), Goldberg, Klee, Prescott, and Wood (2020), European Central Bank (2021).

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 policy rate hike 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 — the so–called "financial accelerator" (Bernanke, Gertler, and Gilchrist (1999), Bernanke and Gertler (1995), Gilchrist and Zakrajšek (2012), Gertler and Karadi (2015)). When default risk is too elevated, financial markets may freeze and a financial crisis may break out.

Our second main finding is that, in contrast to the case of supply–driven inflation, policy rate hikes do not affect or may even *reduce* financial stress in the presence of demand–driven inflation —especially if the latter is strong. This is because demand–driven inflation is a reflection of expansionary aggregate demand shocks buffeting the economy. When aggregate demand is growing, 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 strains. 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.[2]

Our empirical results are consistent with the dynamics of financial stress during the most recent monetary tightening episode in the US (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 with a fall in *supply*–driven inflation (right panel, red line) as supply constraints eased and energy shocks receded, as well as with a rise in *demand*–driven inflation (right panel, green line) due to post–pandemic pent–up demand supported by the ample fiscal package. In the light of our empirical findings, the lower sensitivity of financial stress to policy rate hikes in the later stage of the current monetary tightening episode could thus be due to the switch of the main inflation drivers from supply to demand factors.

[2] Boissay, Collard, Galí, and Manea (2024) provide theoretical underpinnings for this empirical result.

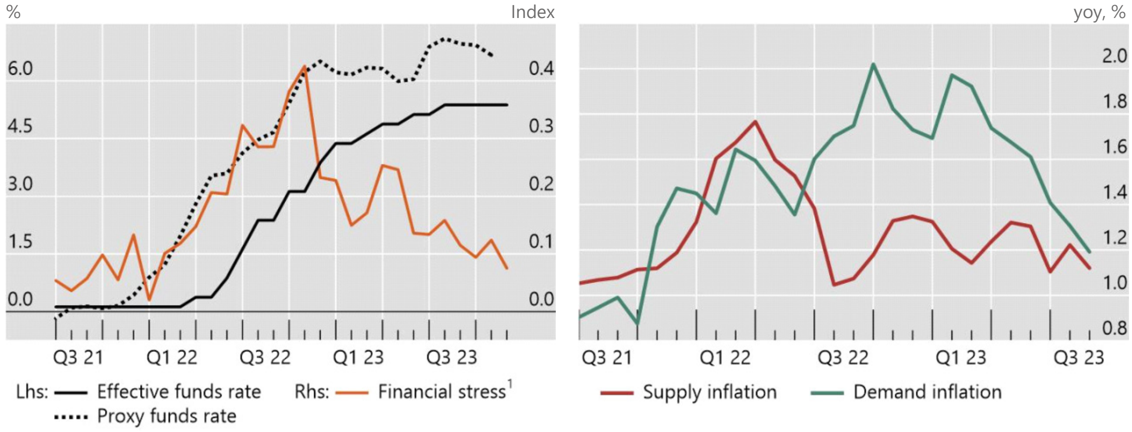

Figure 1: Financial stress and inflation drivers during the monetary tightening cycle in the US

Notes: Financial stress: composite index of systemic stress (CISS) from the ECB. Proxy funds rate: proxy rate adjusted for the effects of forward guidance from San Francisco Fed. Supply/demand inflation: supply and demand components of core PCE year-on-year inflation computed with the methodology in Shapiro (2022) net of the prepandemic 2015-2019 average.

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 drivers. 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,b)'s approach rests on sign restrictions too but it 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 US, which contributes 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, Petrella, Pfajfar, and Gaffeo (2014), Tenreyro and Thwaites (2016)) or monetary expansions *versus* contractions (*e.g.* Angrist, Jordà, and Kuersteiner (2018), Barnichon and Matthes (2018), Alessandri, Jorda, and Venditti (2023)). While conclusions of the first set of papers are mixed, those in the second set unanimously find that policy rate hikes have larger effects than policy rate cuts on real activity and credit spreads. Our paper focuses on the effect of policy rate hikes during inflationary episodes and explores a novel state-dependency dimension of the effects of a monetary tightening on financial stress: the nature of supply versus demand inflation 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 emphasise 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, Jordà, Schularick, and Taylor (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, Borio, Leonte, and Shim (2023)) or after a "low–rate–for–long" period (Jiménez, Kuvshinov, Peydró, and Richter (2022)). Our analysis qualifies the conclusions of the second set of papers, suggesting that the effects of a policy rate hike on financial stability may depend on the nature and magnitude of shocks in the economy at the time of the hike.

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 policy rate hike 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 not only responds to developments in the economy and also impacts them (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 the policy rate *per se*.[3]

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 $h = 1, 2, ..., 36$. In the construction of the dependent variable y_{t+h} is a measure of financial stress in month $t + h$ —we will consider several of them. Among the 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.[4] We also include six lags of both

[3]Monetary policy surprises are appealing in these applications because their focus on interest rate changes in a narrow window of time around FOMC announcements plausibly rules out reverse causality and other endogeneity problems. For other studies using monetary policy surprises, see for instance, Kuttner (2001); Bernanke and Kuttner (2005); Gürkaynak, Sack, and Swanson (2005); Hanson and Stein (2015); and Swanson (2021) use monetary policy surprises to estimate the effects of monetary policy on asset prices, while Cochrane and Piazzesi (2002); Faust and Rogers (2003); Faust, Swanson, and Wright (2004); Gertler and Karadi (2015); Ramey (2016b); and Stock and Watson (2018) use them to help estimate the effects of monetary policy on macroeconomic variables in a structural vector autoregression (SVAR) or Jordà (2005) local projections (LP) framework.

[4]Adding the Baker, Bloom, and Davis (2016) Economic Policy Uncertainty Index as a control variable or eliminating 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 changes in the federal funds rate or in the Wu-Xia "shadow rate". 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 analyses with monthly data (see for instance Bauer and Swanson (2023) or Ramey (2016a)).

the dependent variable and of the interaction variables in equation (1). Finally, since we use the "high precision" version of Shapiro (2022a,b)'s inflation decomposition, we also include interaction terms of the "ambiguous" contribution to PCE inflation (together with their lags) similar to those for supply– or demand–driven inflation.[5]

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

First, the β_h^T coefficients capture the responses (at horizon $h = 0, 1, 2, ..., 36$) 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 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 policy rate hike 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 independent 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.[6] The baseline analysis is

[5]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.

[6]The other variables, which are used as controls (*e.g.* industrial production, unemployment rate, the Baker, Bloom, and Davis (2016) Economic Policy Uncertainty Index, Gilchrist and Zakrajšek (2012) excess bond premium and corporate credit spreads), are standard and retrieved from HAVER and the Federal Reserve Bank of St.

conducted for the US 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,b), while the end of the sample corresponds to the end of the series of monetary policy surprises in Bauer and Swanson (2023).

Measures of Financial Stress. We consider a set of high–frequency financial stress indicators (FSIs) as dependent variables.[7] 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.

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

#	Description	Source	Stddev
1.	AA rate-Treasury spread, const. maturity	Merrill & Bloomberg	66.3
2.	BBB rate-Treasury spread, const. maturity	Merrill & Bloomberg	96.2
3.	Federal funds rate less 2-yr Treasury yield	FRB & Bloomberg	0.70
4.	10-year Treasury bond implied volatility	Bloomberg	1.40
5.	Private long-term bond implied volatility	Bloomberg	2.30
6.	10-Year Treasury on-the-run premium	Bloomberg	9.43
7.	2-year Treasury on-the-run premium	Bloomberg	3.60
8.	S&P 500 earnings/price less 10-year Treasury	I/B/E/S & FRB	2.01
9.	S&P 100 implied volatility (VIX)	Bloomberg	8.53

Notes: Baseline FSI for the US. 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.

Our baseline FSI for the US 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.[8] The index is a simple demeaned sum of nine spread and volatility components in key financial markets in the US (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

Louis' FRED Database.

[7] 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,b)'s supply– and demand–driven inflation series are available (1990–2019).

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

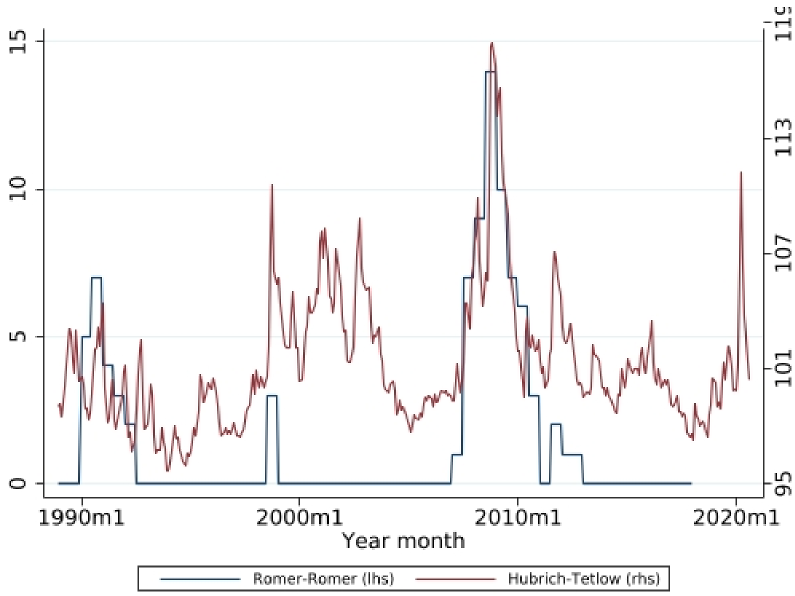

Figure 2: Baseline financial stress measure for the US

Notes: The figure plots for the United States our baseline FSI (Hubrich-Tetlow, red line) along with the Romer and Romer (2017) qualitative financial crisis indicator (blue line). Data is shown monthly from December 1988 to August 2020 for the FSI, and semiannual until 2017:2 for Romer and Romer.

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–know FSIs (Table A1) such as the Kansas City Fed FSI, Saint Louis Fed FSI, Bloomberg FSI, ECB's Composite Indicator of Systemic Stress (CISS), or the Gilchrist and Zakrajšek (2012) corporate spread and equity bond premium indices. We also complement our analysis with financial conditions indices (FCIs) such as the Chicago Fed National FCI and the Goldman Sachs FCI.

Measures of Exogenous Changes in the Policy Rate. We measure exogenous changes in monetary policy rate using the latest publicly available series of high frequency identified monetary policy surprises from Bauer and Swanson (2023).[9] We follow the literature and transform the monetary surprises to monthly frequency by summing up daily observations within each month. We normalise the series such that the estimated effects concern a 25 basis points monetray policy surprise.

[9]Monetary policy surprises are typically viewed as unpredictable with any publicly available information that predates the FOMC announcement. This view is supported by the standard argument that, otherwise, financial market participants would be able to trade profitably on that predictability and drive it away in the process. A few recent studies, however (*e.g.* Cieslak (2018), Miranda-Agrippino and Ricco (2021), and Bauer and Swanson (2023)) have documented substantial correlation of monetary policy surprises with publicly available macroeconomic or financial market data that predate the FOMC announcement, which undermines the standard assumption that monetary policy surprises represent exogenous changes. Bauer and Swanson (2023) address this issue by removing the component of the monetary policy surprises that is correlated with economic and financial data.

Measures of Supply– and Demand–driven Inflation. We use the supply– and demand–driven contributions to PCE inflation from Shapiro (2022a,b) — plotted in Figure A3. The series quantify the degree to which either demand or supply is driving inflation in a given month. The methodology exploits the sectoral decomposition of PCE inflation and classify 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, and the residuals are collected; 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 is labeled as demand (supply)–driven. For a detailed description of the methodology — see Shapiro (2022a,b).

3.3 Baseline Results

We first report results for the estimates of β_h^T—the impact of an unexpected monetary policy tightening independent of inflation. Figure 3 shows that the policy rate hike works to raise financial stress consistent with previous findings in the credit channel literature.[10] Nevertheless, in contrast to the swift average reaction estimated with linear SVAR models, we find that the unconditional effect materialises with a one year lag after the policy rate hike.

Further conditioning on the type of inflationary pressures reveals that the unconditional effect of a policy rate hike on financial stress can be either magnified or totally undone depending on the context of the monetary tightening. Indeed, the effect is very different when the hike takes place amid a strong demand–driven inflationary boom than when the economy experiences large adverse supply shocks.

We first consider the effects of a monetary tightening on financial stress when inflation is supply–driven and show that such a tightening induces a trade–off between price and financial stability. The *positive* interaction coefficients of the policy rate hike with supply–driven inflation (Figure 4, left panel) mean that the adverse supply shocks underlying inflation work to amplify the effect of the monetary tightening on financial stress. The stronger the adverse shocks reflected in higher supply–driven inflation, the stronger the amplification (Figure 5, right 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 that the unconditional one–year–lagged transmission shown in Figure 3. The additional effect also remains significant for eighteen

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

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.

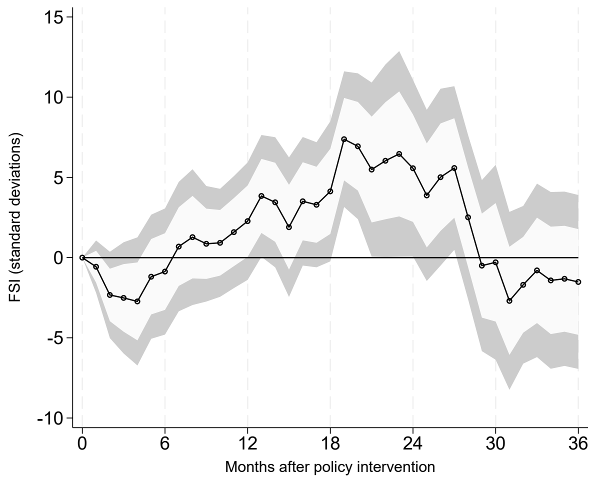

Figure 3: Unconditional effect of a monetary tightening on financial stress

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^T for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Fed Board Financial Stress Index and 6 lags. 90% confidence bands, Newey-West standard errors. US monthly data from January 1990 to December 2019. Findings robust to specifications including the optimal lag order according to the AIC and BIC criteria equal to three and four, respectively.

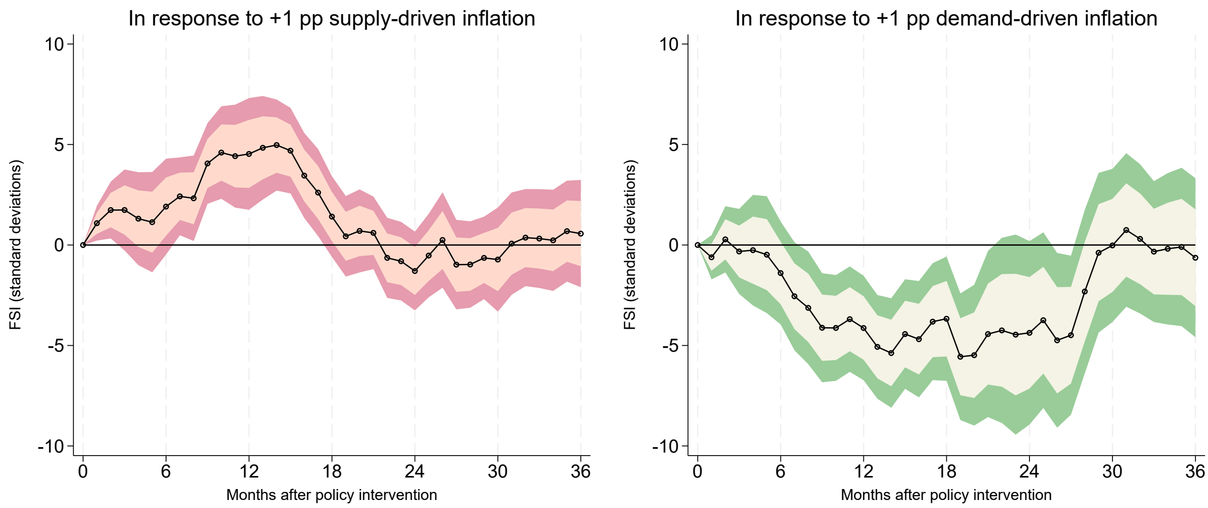

Figure 4: Additional state–dependent effect of a monetary tightening on financial stress

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Fed Board Financial Stress Index and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019. Findings robust to specifications including the optimal lag order according to the AIC and BIC criteria equal to three and four, respectively.

When inflation is demand–driven, in contrast, a monetary tightening does not involve a price *versus* financial stability trade–off. Figure 4 (right panel) indeed shows that the interaction coefficients of the rate hike 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 5, left 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, the net effect on financial stress of a monetary tightening remains positive throughout the full horizon. In the other scenario, positive demand shocks and resulting inflation are relatively high, *i.e.* associated with a 2 percentage point demand–driven inflation rate. In that case, the stabilising effect on the financial system of a rate hike more than offsets its destabilising unconditional one (*i.e.* is negative throughout the horizon). On balance, the rate hike thus works to lower financial stress in the medium–term (dark green line).

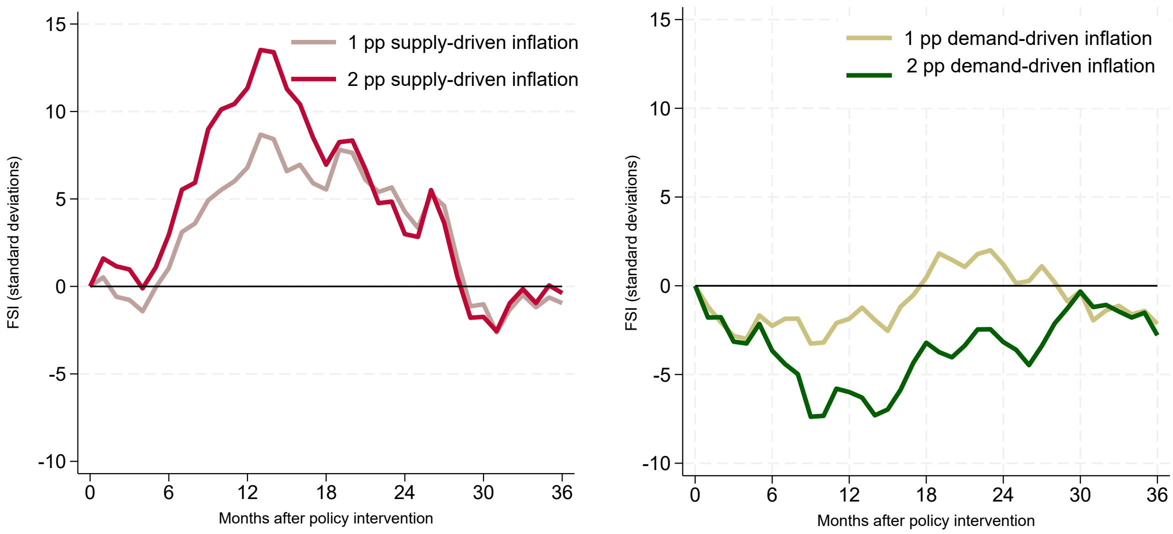

Figure 5: State–dependent effect of a monetary tightening on financial stress

Notes: Dynamic responses to a 25 basis points 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 $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Fed Board Financial Stress Index and 6 lags. US monthly data from January 1990 to December 2019.

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 A4). The effects are amplified in the presence of supply–driven inflation and dampened or reversed in the presence of demand–driven inflation (Figure A5). By and large, these effects mirror those in the case of a monetary tightening, even though their magnitude is smaller than that of the effects of a tightening —consistent with findings in the literature (compare Figures 4 and A5).

In sum, we find that financial stress increases by more (less) in response to a policy rate hike when inflation is supply (demand)–driven inflation 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.

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 dis–inflation or considers varied measures of financial stress. The figures displaying the estimated effects in all these additional exercises are deferred to the Appendix.

Varied Samples. Our findings are robust to excluding observations during the 2007-2008 GFC and the 2010–15 ZLB periods (see Section 6.2.2 in the Appendix). Similar patterns broadly obtain when considering other countries, such as Canada, United Kingdom (UK), 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 compared to the US 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 (as opposed to monthly frequency in the case of the US). Since we use daily monetary policy surprises as a measure of exogenous variation in the policy rate, the availability of 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 (Table C1) are usually shorter and their exogeneity has been less scrutinised than in the case of US series. Third, fewer financial stress measures are available for these countries compared to the US. 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 (Table C2).

Despite these caveats, we obtain similar patterns as for the US (Section 6.3.2 in the Appendix), including when comparing the estimates with those for the US obtained with quarterly (instead of monthly) data (Figure C25).

Inflation *versus* Dis–inflation. To remain parsimonious, our baseline specification does not distinguish between inflationary ($\pi_t^{s/d} > 0$) *versus* dis–inflationary ($\pi_t^{s/d} < 0$) 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 3 and C1). The exercise is described in Section 6.2.1 in the Appendix.

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 sub–components, credit spreads, equity finance premium or indices of financial conditions.[11]

Other Financial Stress Indices. We show that our results are robust to using other well–know FSIs (Table A1) such as the Kansas City Fed FSI, Saint Louis Fed FSI, Bloomberg FSI, or ECB's Composite Indicator of Systemic Stress (CISS) (see Section 6.2.3 in the Appendix).

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 sub–indices of financial stress in the bond market, the equity market (non–financial/financial firms), and the foreign exchange market (see Section 6.2.4 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. Next, we consider measures of financing conditions (FCI) such as Goldman Sachs FCIs, Chicago Fed National FCI and its credit, risk, and leverage sub–indices, as dependent variables. In contrast to FSIs, which are computed based on credit spreads and volatilities, FCIs are geared towards 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 to FSIs (*e.g.* Figures C15 and C17 in the Appendix).

By and large, the analysis with FCIs delivers similar results as that with FSIs, although these results are not always as salient (see Section 6.2.5 in the Appendix). In particular, we find that financing conditions deteriorate by more following a rate hike when inflation is supply–driven but the effect is somewhat weaker, in the sense that it is statistically significant at lower significance levels in the case of the Chicago Fed NFCI and the Goldman Sachs FCI (Figures C14 and C16,

[11] For the complete list of financial stress variables considered, see Table A1 in the Appendix.

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.

Limits of the Analysis. The generality and external validity of our findings are admittedly constrained by the relative short estimation sample period.[12] 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 analyse the effects of *expected* (systematic) monetary policy actions to which the US Federal Reserve may implicitly (be thought to) commit.[13]

4 Understanding the Results

Why does financial stress rise after a policy rate hike when inflation is supply–driven, whereas it remains roughly unchanged or even subsides when inflation is demand–driven? In this 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 on 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, 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 C18, Sections 6.5 and 6.2.4 in the Appendix).

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

[13] The model–based analysis in Boissay, Collard, Galí, and Manea (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.

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, Gertler, and Gilchrist (1999), Bernanke and Gertler (1995), 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, Kuvshinov, Peydró, and Richter (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 cope with higher borrowing costs —in effect providing them with a "natural hedge" against policy rate hikes. 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; see Figure 4, right panel; Figure C18; and Sections 6.5 and 6.2.4 in the Appendix.

In the medium–term, policy rate hikes may also help prevent that the positive demand shocks that fuel inflation also fuel a credit/asset price boom and attendant vulnerabilities. But even when they take place on the back of an already strong credit boom, rate hikes may prompt borrowers to deleverage, thus lowering their exposure to adverse shocks and default risk down the road. Such de–risking 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 5).

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 rationalised and reproduced within a simple New Keynesian (NK) model with endogenous financial crises like Boissay, Collard, Galí, and Manea (2024)'s.

Model Mechanism. Boissay, Collard, Galí, and Manea (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 returns on investments are low. In those instances, agents 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 behaviour 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 agents to "search for yield", making the credit market more fragile.

In such environment, monetary policy may affect the probability of a financial crisis in several ways. Under a standard Taylor rule, for example, crises occur as 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 amounts contributes to lowering capital returns even more —moving the economy closer to its "financial fragility region". These dynamics are captured in Figure D3 which illustrates the median dynamics around crises for a model specification with supply shocks only.

The model also predicts that, if left unaddressed, persistent inflationary (positive) demand shocks can lead to a potentially unsustainable credit/investment boom, and usher the economy in the financial fragility region (Figure D4). The central bank can nonetheless prevent that the economy enters 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.

In line with our empirical findings, 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 build–up of financial imbalances and eases financial stress in the medium–term when inflation is demand–driven.

Estimates Based on Model Simulations. One direct way to compare the predictions of Boissay, Collard, Galí, and Manea (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, Collard, Galí, and Manea (2024), the model is parameterised on quarterly data under a standard Taylor rule, the non–financial parameters (including the persistence and standard deviation of the shocks) are set at their standard values (see *e.g.* Galí (2015)) and the financial ones are set so that, in the simulated stochastic steady state, the economy spends 10% of the time in a financial crisis and aggregate productivity falls by 1.8% 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.[14] As measure of financial stress, we use the model probability that a crisis breaks out next quarter. Each set of simulations contains one million quarterly observations.

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

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

for $h=1,2,...,36$. 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 β_h^{TS} (supply–driven inflation) and β_h^{TD} (demand–driven inflation), reported in Figure

[14] 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 non–linear model solved with a global solution method (as is the case in Boissay, Collard, Galí, and Manea (2024)), it is not possible to disentangle the supply– from the demand–side drivers of inflation.

7, and their comparison with those obtained from the data, as reported in Figure 4.

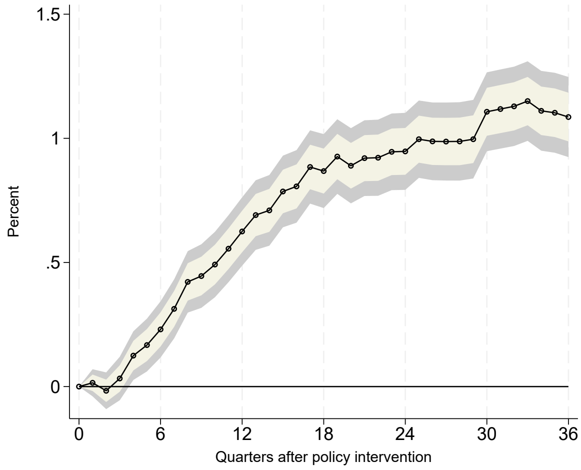

Figure 6: Unconditional effect of a monetary tightening on financial stress

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Regression coefficients β_h^T for $h = 0, ..., 36$ in (2). Based on simulated time series from the model in Boissay, Collard, Galí, and Manea (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 6 lags similar to our baseline empirical specification for the US. 90% confidence bands.

Figure 7: Additional state–dependent effect of a monetary tightening on the one-period-ahead probability of a crisis

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Left panel: regression coefficients β_h^{TS} for $h = 0, ..., 36$ in (2). Right panel: regression coefficients β_h^{TD} for $h = 0, ..., 36$ in (2). Based on simulated time series from the model in Boissay, Collard, Galí, and Manea (2024) with supply shocks and monetary policy surprises (left panel), and with demand shocks and monetary policy surprises (right panel). Specification with 6 lags similar to our baseline empirical specification for the US. 90% confidence bands.

The two sets of estimates are by and large 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 6), the effect is amplified when the hike takes place on the back of adverse supply shocks and supply–driven inflation (Figure 7, 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 7, right panel), illustrating the dampening effect of the hike on the credit/investment boom and attendant risks to financial stability.

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 build–up 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 Figures 7 (right panel) and D5 in the Appendix)).

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 financial stress, pointing to the existence of a potential policy trade–off between price 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.* Figures A3 or C19 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 manoeuvre to fight supply–driven inflationary pressures (a version of the so–called "financial dominance"). In that case, other tools (such as macro–prudential ones) may be necessary to alleviate risks to financial stability throughout the monetary tightening (Boissay, Borio, Leonte, and Shim (2023)).

Our analysis is only a first pass on this topic and sets the stage for further research. As next steps, we are considering to expand our dataset along both time and country dimensions; to use alternative methodologies to measure supply– versus demand–driven inflation; and to use 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)). These extensions would allow us not only to consolidate (or qualify) our findings but also to study how they vary with the state of the financial cycle (*e.g.* credit/asset price boom).

References

ALESSANDRI, P., O. JORDA, AND F. VENDITTI (2023): "Decomposing the Monetary Policy Multiplier," *Federal Reserve Bank of San Francisco Working Paper*, 2023-14.

ANGRIST, J. D., Ò. JORDÀ, AND G. M. KUERSTEINER (2018): "Semiparametric estimates of monetary policy effects: string theory revisited," *Journal of Business & Economic Statistics*, 36(3), 371–387.

ARRIGONI, S., A. BOBASU, AND F. VENDITTI (2020): "The simpler the better: measuring financial conditions for monetary policy and financial stability," *ECB Working Paper*.

BAKER, S. R., N. BLOOM, AND S. J. DAVIS (2016): "Measuring economic policy uncertainty," *The quarterly journal of economics*, 131(4), 1593–1636.

BARNICHON, R., AND C. MATTHES (2018): "Functional approximation of impulse responses," *Journal of Monetary Economics*, 99, 41–55.

BAUER, M. D., AND E. T. SWANSON (2023): "An Alternative Explanation for the "Fed Information Effect"," *American Economic Review*, 113(3), 664–700.

BERNANKE, B., M. GERTLER, AND S. GILCHRIST (1999): *The financial accelerator in a quantitative business cycle framework*, vol. 1. Handbook of Macroeconomics.

BERNANKE, B. S., AND M. GERTLER (1995): "Inside the Black Box: The Credit Channel of Monetary Policy Transmission," *The Journal of Economic Perspectives*, 9(4), 27–48.

BERNANKE, B. S., AND K. N. KUTTNER (2005): "What explains the stock market's reaction to Federal Reserve policy?," *The Journal of finance*, 60(3), 1221–1257.

BISHOP, J., AND P. TULIP (2017): *Anticipatory Monetary Policy and the" Price Puzzle"*. Federal Reserve Bank of Australia.

BOISSAY, F., C. BORIO, C. LEONTE, AND I. SHIM (2023): "Prudential policy and financial dominance: exploring the link," *BIS Quarterly Review*.

BOISSAY, F., F. COLLARD, J. GALÍ, AND C. MANEA (2024): "Monetary Policy and Endogenous Financial Crises," *BIS Working Paper no. 991*.

BORIO, C. E., AND P. W. LOWE (2002): "Asset prices, financial and monetary stability: exploring the nexus," *BIS Working Paper no.114*.

Brave, S. A., and R. A. Butters (2011): "Monitoring financial stability: A financial conditions index approach," *Economic Perspectives*, 35(1), 22.

Caldara, D., and E. Herbst (2019): "Monetary policy, real activity, and credit spreads: Evidence from Bayesian proxy SVARs," *American Economic Journal: Macroeconomics*, 11(1), 157–192.

Champagne, J., and R. Sekkel (2018): "Changes in monetary regimes and the identification of monetary policy shocks: Narrative evidence from Canada," *Journal of Monetary Economics*, 99, 72–87.

Chavleishvili, S., and M. Kremer (2023): "Measuring systemic financial stress and its risks for growth," *ECB Working Paper No. 2842*.

Cieslak, A. (2018): "Short-rate expectations and unexpected returns in treasury bonds," *The Review of Financial Studies*, 31(9), 3265–3306.

Cochrane, J. H., and M. Piazzesi (2002): "The fed and interest rates—a high-frequency identification," *American economic review*, 92(2), 90–95.

Duprey, T. (2020): "Canadian financial stress and macroeconomic condition," *Canadian Public Policy*, 46(S3), S236–S260.

Duprey, T., B. Klaus, and T. Peltonen (2017): "Dating systemic financial stress episodes in the EU countries," *Journal of Financial Stability*, 32, 30–56.

Eickmeier, S., and B. Hofmann (2022): "What drives inflation? Disentangling demand and supply factors," BIS Working Papers 1047, Bank for International Settlements.

European Central Bank (2021): "The role of financial stability considerations in monetary policy and the interaction with macroprudential policy in the euro area," Occasional Paper Series # 272.

Faust, J., and J. H. Rogers (2003): "Monetary policy's role in exchange rate behavior," *Journal of Monetary Economics*, 50(7), 1403–1424.

Faust, J., E. T. Swanson, and J. H. Wright (2004): "Identifying VARs based on high frequency futures data," *Journal of Monetary Economics*, 51(6), 1107–1131.

Galí, J. (2015): *Monetary policy, inflation, and the business cycle: an introduction to the New Keynesian framework and its applications*. Princeton University Press.

Gerko, E., and H. Rey (2017): "Monetary policy in the capitals of capital," *Journal of the European Economic Association*, 15(4), 721–745.

Gertler, M., and P. Karadi (2011): "A model of unconventional monetary policy," *Journal of Monetary Economics*, 58(1), 17–34.

Gertler, M., and P. Karadi (2015): "Monetary Policy Surprises, Credit Costs, and Economic Activity," *American Economic Journal: Macroeconomics*, 7(1), 44–76.

Gilchrist, S., and E. Zakrajšek (2012): "Credit Spreads and Business Cycle Fluctuations," *American Economic Review*, 102(4), 1692–1720.

Goldberg, J., E. Klee, E. Prescott, and P. Wood (2020): "Monetary policy strategies and tools: financial stability considerations," Federal Reserve Board Finance and Economics Discussion Series # 2020-074.

Gorton, G., and G. Ordoñez (2019): "Good booms, bad booms," *Journal of the European Economic Association*, 18(2), 618–665.

Grimm, M., O. Jordà, M. Schularick, and A. Taylor (2023): "Loose Monetary Policy and Financial Instability," NBER Working Paper No 30958.

Gürkaynak, R. S., B. Sack, and E. Swanson (2005): "The sensitivity of long-term interest rates to economic news: Evidence and implications for macroeconomic models," *American economic review*, 95(1), 425–436.

Hakkio, C. S., W. R. Keeton, et al. (2009): "Financial stress: What is it, how can it be measured, and why does it matter," *Economic Review*, 94(2), 5–50.

Hanson, S. G., and J. C. Stein (2015): "Monetary policy and long-term real rates," *Journal of Financial Economics*, 115(3), 429–448.

Hartigan, L., and M. Wright (2021): "Financial conditions and downside risk to economic activity in Australia," .

Hatzius, J., and S. J. Stehn (2018): "The case for a financial conditions index," *Goldman Sachs Economic Research*, 16.

HUBRICH, K., AND R. J. TETLOW (2015): "Financial stress and economic dynamics: The transmission of crises," *Journal of Monetary Economics*, 70, 100–115.

JAROCIŃSKI, M., AND P. KARADI (2020): "Deconstructing Monetary Policy Surprises—The Role of Information Shocks," *American Economic Journal: Macroeconomics*, 12(2), 1–43.

JIMÉNEZ, G., E. KUVSHINOV, J.-P. PEYDRÓ, AND B. RICHTER (2022): "Monetary Policy, Inflation, and Crises: new Evidence from History and Administrative Data," CEPR Discussion Paper No 17761.

JIMÉNEZ, G., D. KUVSHINOV, J.-L. PEYDRÓ, AND B. RICHTER (2022): "Monetary policy, inflation, and crises: New evidence from history and administrative data," CEPR Discussion Papers 17761, C.E.P.R. Discussion Papers.

JORDÀ, Ò. (2005): "Estimation and inference of impulse responses by local projections," *American economic review*, 95(1), 161–182.

JORDÀ, Ò., M. SCHULARICK, AND A. M. TAYLOR (2020): "The effects of quasi-random monetary experiments," *Journal of Monetary Economics*, 112, 22–40.

KILMAN, J., ET AL. (2022): *Monetary Policy Shocks for Sweden*. Department of Economics, School of Economics and Management, Lund University.

KLIESEN, K. L., D. C. SMITH, ET AL. (2010): "Measuring financial market stress," *economic synopses*.

KUTTNER, K. N. (2001): "Monetary policy surprises and interest rates: Evidence from the Fed funds futures market," *Journal of monetary economics*, 47(3), 523–544.

LAEVEN, M. L., AND M. F. VALENCIA (2018): *Systemic banking crises revisited*. International Monetary Fund.

LO, M. C., AND J. PIGER (2005): "Is the response of output to monetary policy asymmetric? Evidence from a regime-switching coefficients model," *Journal of Money, credit and Banking*, pp. 865–886.

MARTINEZ-MIERA, D., AND R. REPULLO (2017): "Search for yield," *Econometrica*, 85(2), 351–378.

Miranda-Agrippino, S., and G. Ricco (2021): "The transmission of monetary policy shocks," *American Economic Journal: Macroeconomics*, 13(3), 74–107.

Nakamura, E., and J. Steinsson (2018): "Identification in Macroeconomics," *Journal of Economic Perspectives*, 32(3), 59–86.

Nelson, W. R., and R. Perli (2007): "Selected indicators of financial stability," *Risk Measurement and Systemic Risk*, 4, 343–372.

Park, C.-Y., and R. V. Mercado Jr (2014): "Determinants of financial stress in emerging market economies," *Journal of Banking & Finance*, 45, 199–224.

Paul, P. (2023): "Historical patterns of inequality and productivity around financial crises," *Journal of Money, Credit and Banking*, 55(7), 1641–1665.

Ramey, V. (2016a): "Chapter 2 - Macroeconomic Shocks and Their Propagation," vol. 2 of *Handbook of Macroeconomics*, pp. 71–162. Elsevier.

Ramey, V. A. (2016b): "Macroeconomic shocks and their propagation," *Handbook of macroeconomics*, 2, 71–162.

Romer, C. D., and D. H. Romer (2017): "New Evidence on the Aftermath of Financial Crises in Advanced Countries," *American Economic Review*, 107(10), 3072–3118.

Rosenberg, M. (2009): "Financial conditions watch," *Bloomberg, December*, 3.

Sandström, M. (2018): "The impact of monetary policy on household borrowing-a high-frequency IV identification," *Riksbank Research Paper Series*, (174).

Santoro, E., I. Petrella, D. Pfajfar, and E. Gaffeo (2014): "Loss aversion and the asymmetric transmission of monetary policy," *Journal of Monetary Economics*, 68, 19–36.

Schularick, M., L. ter Steege, and F. Ward (2021): "Leaning against the Wind and Crisis Risk," *American Economic Review: Insights*, 3(2), 199–214.

Shapiro, A. H. (2022a): "Decomposing supply and demand driven inflation," *Journal of Money, Credit, and Banking, forthcoming.*

——— (2022b): "How Much Do Supply and Demand Drive Inflation?," *FRBSF Economic Letter*, 2022(15), 1–06.

STEIN, J. C. (2012): "Monetary policy as financial stability regulation," *The Quarterly Journal of Economics*, 127(1), 57–95.

STOCK, J. H., AND M. W. WATSON (2018): "Identification and Estimation of Dynamic Causal Effects in Macroeconomics Using External Instruments," *The Economic Journal*, 128(610), 917–948.

SWANSON, E. T. (2021): "Measuring the effects of federal reserve forward guidance and asset purchases on financial markets," *Journal of Monetary Economics*, 118, 32–53.

TAYLOR, J. (2011): "Macroeconomic lessons from the Great Deviation," in *NBER Macroeconomics Annual*, ed. by D. Acemoglu, and M. Woodford, vol. 25, p. 387–95. University of Chicago Press.

TENREYRO, S., AND G. THWAITES (2016): "Pushing on a string: US monetary policy is less powerful in recessions," *American Economic Journal: Macroeconomics*, 8(4), 43–74.

6 Appendix

6.1 Baseline specification

6.1.1 Data

Table A1: Overview Financial Stress Indices for the US

#	Index	Source (description)	Type
1.	Fed Staff's Board FSI	Hubrich and Tetlow (2015)	stress
2.	Bloomberg FCI	Rosenberg (2009)	stress
3.	NEW CISS	Chavleishvili and Kremer (2023)	systemic stress
4.	Kansas City FED FSI	Hakkio, Keeton, et al. (2009)	stress
5.	VIX	Chicago Board Options Exchange	stress
6.	Saint Louis Fed FSI	Kliesen, Smith, et al. (2010)	stress & conditions
7.	Chicago Fed National FCI	Brave and Butters (2011)	stress & conditions
8.	Goldman Sachs FCI	Hatzius and Stehn (2018)	stress & conditions
9.	GZ corporate spreads index	Gilchrist and Zakrajšek (2012)	stress
10.	GZ equity premium index	Gilchrist and Zakrajšek (2012)	stress
11.	Loan delinquency rates	Fed Board Statistics	stress
12.	Firm bankruptcies	United States Courts	stress

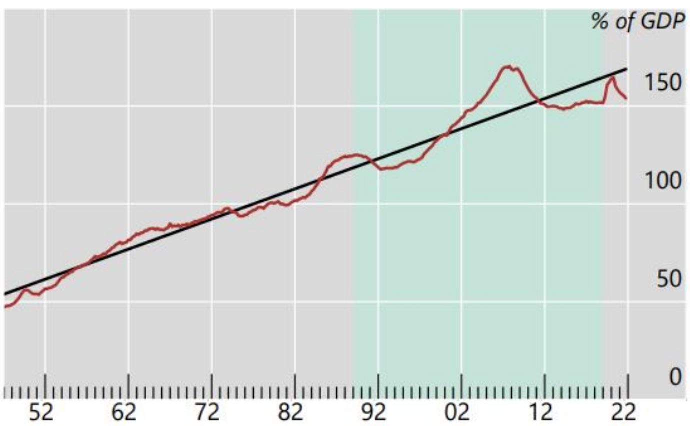

Figure A1: Private credit to gdp ratio during the estimation period in the US

Notes: Shaded area: estimation period. Source: National Data, BIS.

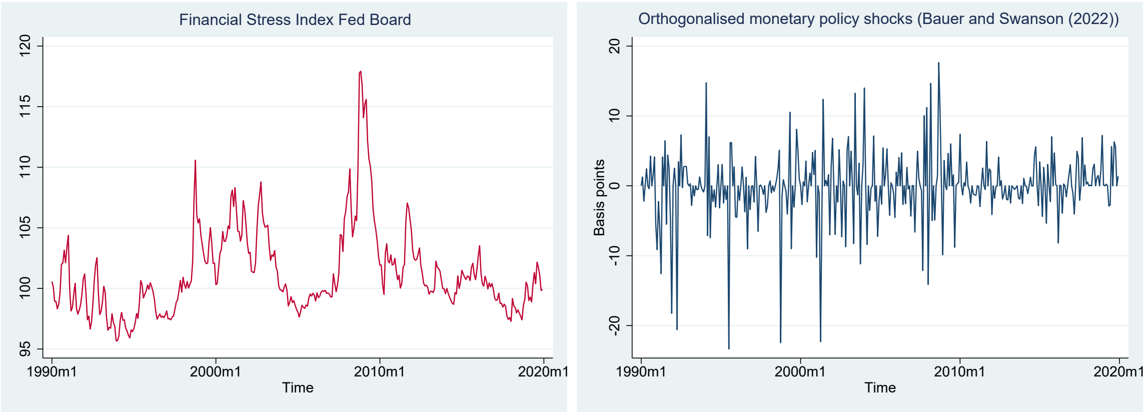

Figure A2: Data baseline specification

Notes: Data is stationary at 5% level (ADF tests)

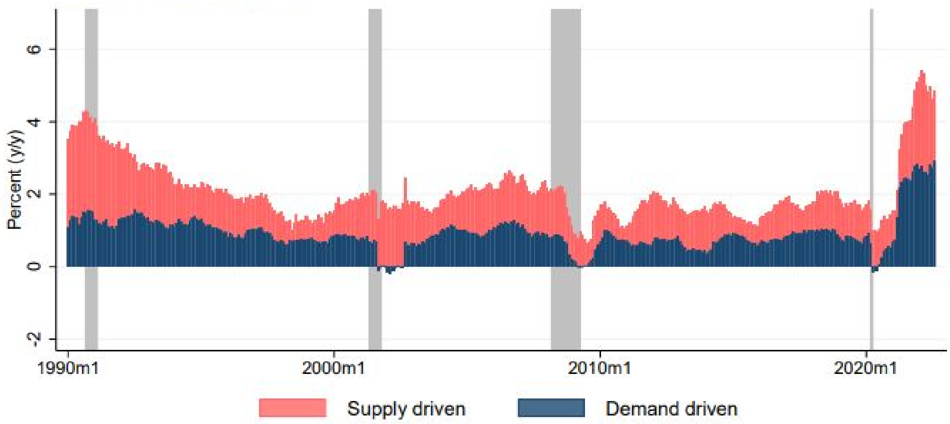

Figure A3: Inflation decomposition into demand and supply factors for the US (Core PCE)

Source: Shapiro (2022a,b)

6.1.2 Disentangling the Role of Inflation level and Composition

The estimated effect of a 100 basis points monetary tightening on financial stress conditional on a 100 basis points supply-driven inflation π_t^s at horizon h equals:

$$\frac{\partial y_{t+h} - y_{t-1}}{\partial \mathbb{1}\{mps_t > 0\} mps_t}\Big|_{\pi_t^s \neq 0,\ \pi_t^d = 0} = \hat{\beta}_h^T + \hat{\beta}_h^{TS} \pi_t^s \tag{3}$$

Both $\hat{\beta}_h^T$ (Figure 3) and $\hat{\beta}_h^{TS}$ (Figure 4, left panel) are positive, indicating that policy rate hikes during supply–driven inflationary episodes unambiguously rise 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 5, right panel).

The estimated effect of a 100 basis points monetary tightening on financial stress conditional on demand–driven inflation π_t^d is given by:

$$\frac{\partial y_{t+h} - y_{t-1}}{\partial \mathbb{1}\{mps_t > 0\} mps_t}_{|\pi_t^s \neq 0,\ \pi_t^d = 0} = \hat{\beta}_h^T + \hat{\beta}_h^{TD} \pi_t^d$$

The estimated interaction coefficients $\hat{\beta}_h^{TD}$ are negative (Figure 4, 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 see* $\hat{\beta}_h^T > 0$, and in those instances the policy rate hike will work to reduce financial stress.

Finally, to sum up, the total estimated effect of a 100 basis points monetary tightening on financial stress at horizon h is given by:

$$\frac{\partial y_{t+h} - y_{t-1}}{\partial \mathbb{1}\{mps_t > 0\} mps_t}_{|\pi_t^s \neq 0,\ \pi_t^d \neq 0} = \hat{\beta}_h^T + \hat{\beta}_h^{TS} \pi_t^s + \hat{\beta}_h^{TD} \pi_t^d \tag{4}$$

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

6.1.3 State–dependent Effects of a Monetary Loosening

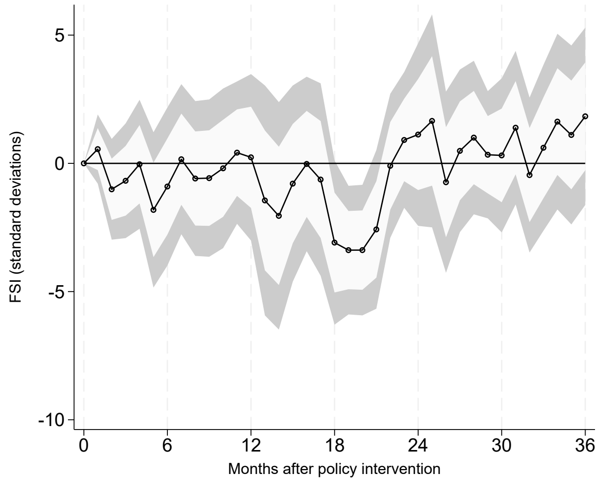

Figure A4: Unconditional effect of a monetary loosening on financial stress

Notes: Dynamic responses to a 25 basis points negative monetary policy surprise. Shown are regression coefficients β_h^L for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Fed Board Financial Stress Index and 6 lags. 90% confidence bands, Newey-West standard errors. US monthly data from January 1990 to December 2019. Findings robust to specifications including the optimal lag order according to the AIC and BIC criteria equal to three and four, respectively.

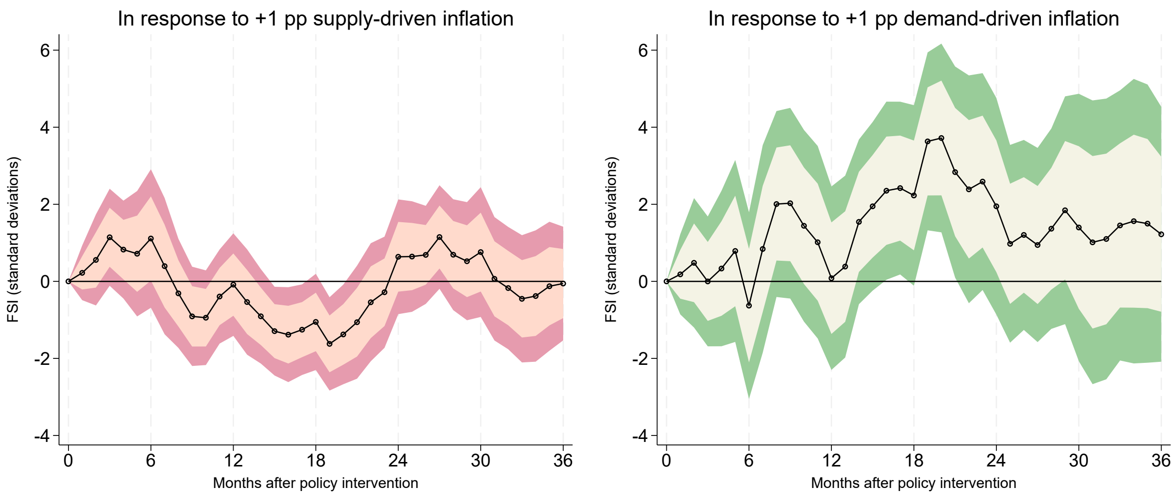

Figure A5: Additional state–dependent effect of a monetary loosening on financial stress

Notes: Dynamic responses to a 25 basis points negative monetary policy surprise. Shown are regression coefficients β_h^{LS} (left) and β_h^{LD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Fed Board Financial Stress Index and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US 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 A6).

Figure A6: Additional state–dependent effect of a monetary loosening on financial stress

Notes: Dynamic responses to a 25 basis points negative monetary policy surprise. Shown are regression coefficients β_h^{LS} (left) and β_h^{LD} (right) for $h = 0, ..., 36$. 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, Fed Board Financial Stress Index and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019.

6.2 Robustness checks: US specification

6.2.1 Distinguishing Between Inflation and Disinflation

Compared to 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:

$$
\begin{aligned}
y_{t+h} - y_{t-1} = & \alpha_h + \beta_h^T \mathbb{1}\{mps_t > 0\} mps_t \\
& + \beta_{\mathbf{h}}^{\mathbf{TSi}} \mathbb{1}\{mps_t > 0\} \mathbb{1}\{\pi_t^s > 0\} mps_t \pi_t^s + \beta_{\mathbf{h}}^{\mathbf{TDi}} \mathbb{1}\{mps_t > 0\} \mathbb{1}\{\pi_t^d > 0\} mps_t \pi_t^d \\
& + \beta_h^{TSd} \mathbb{1}\{mps_t > 0\} \mathbb{1}\{\pi_t^s < 0\} mps_t \pi_t^s + \beta_h^{TDd} \mathbb{1}\{mps_t > 0\} \mathbb{1}\{\pi_t^d < 0\} mps_t \pi_t^d \\
& + \beta_h^L \mathbb{1}\{mps_t < 0\} mps_t \\
& + \beta_h^{LSi} \mathbb{1}\{mps_t < 0\} \mathbb{1}\{\pi_t^s > 0\} mps_t \pi_t^s + \beta_h^{LDi} \mathbb{1}\{mps_t < 0\} \mathbb{1}\{\pi_t^d > 0\} mps_t \pi_t^d \\
& + \beta_h^{LSd} \mathbb{1}\{mps_t < 0\} \mathbb{1}\{\pi_t^s < 0\} mps_t \pi_t^s + \beta_h^{LDd} \mathbb{1}\{mps_t < 0\} \mathbb{1}\{\pi_t^d < 0\} mps_t \pi_t^d \\
& + A_h \sum_{\tau=1}^{L} \mathscr{C}_{t-\tau} + e_{t+h},
\end{aligned} \tag{5}
$$

We obtain that the unconditional effects of the tightening and its additionally state dependent effects (Figure C1) remain literary unchanged compared to those obtained based on the baseline specification (Figure 4).

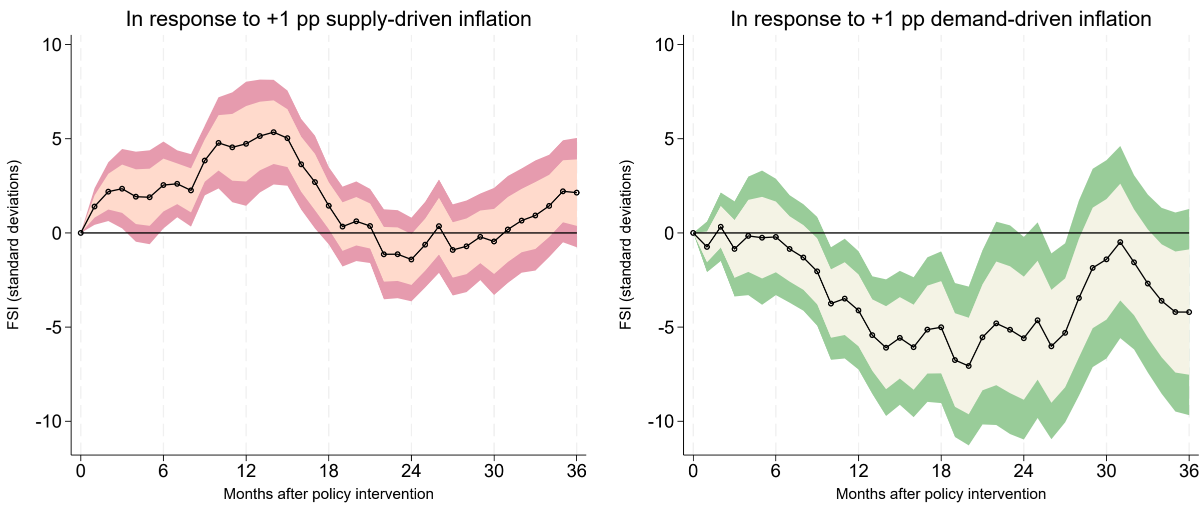

Figure C1: Additional state–dependent effect of a monetary tightening on financial stress

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TSi} (left) and β_h^{TDi} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Fed Board Financial Stress Index and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019. Findings robust to specifications including the optimal lag order according to the AIC and BIC criteria equal to three and four, respectively.

6.2.2 Subsamples

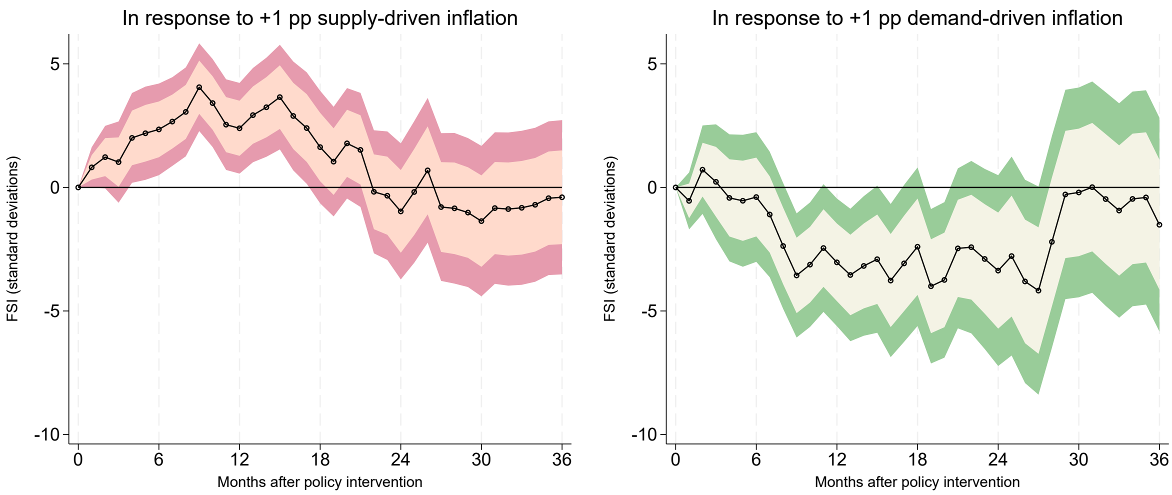

Figure C2: Additional state–dependent effect of a tightening on financial stress - no GFC

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Fed Board Financial Stress Index and 6 lags. 90% confidence bands. US monthly data from January 1990 to December 2019 excluding the 2007-2008 GFC period.

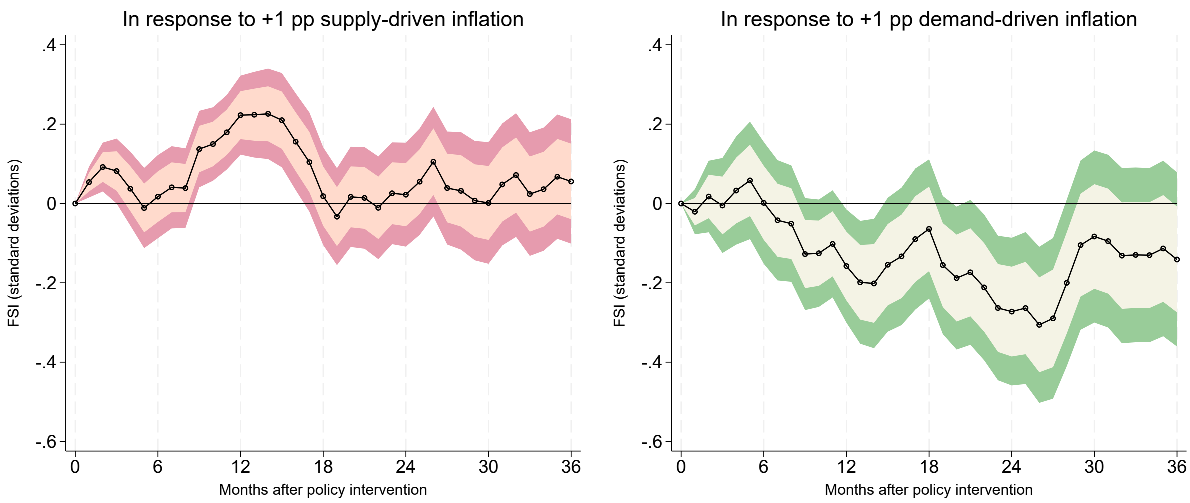

Figure C3: Additional state–dependent effect of a tightening on financial stress - no ZLB

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Fed Board Financial Stress Index and 6 lags. 90% confidence bands. US monthly data from January 1990 to December 2019, excluding the ZLB period between 2010 and 2015.

6.2.3 Other Financial Stress Indices

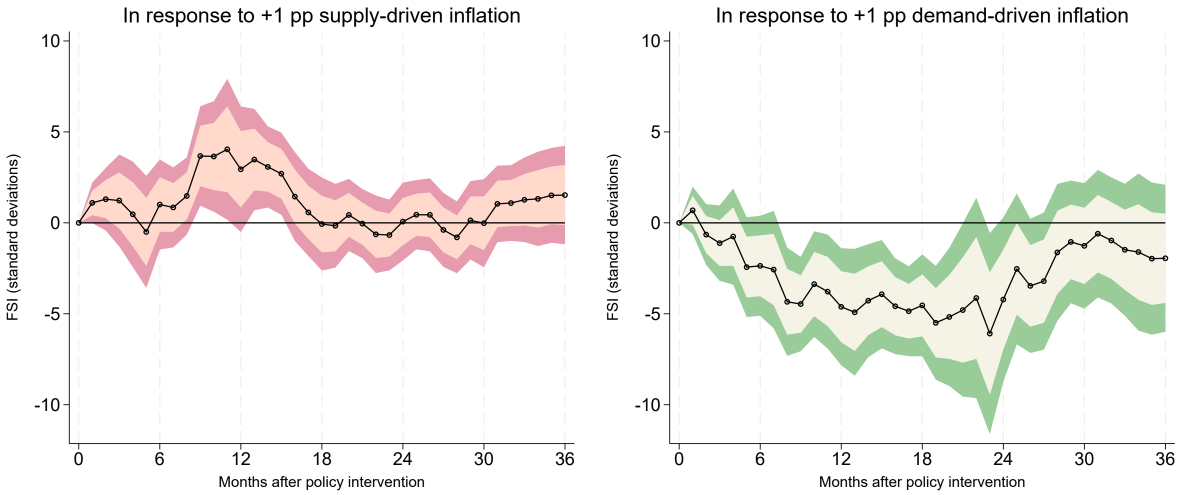

Figure C4: Additional effect of a monetary tightening on financial stress: Bloomberg FCI

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Bloomberg FCI and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US 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 US Ted spread, the Libor/OIS spread, the commercial paper/T-bills spread, the US High Yield /10Y Treasury spread, the US Muni/10Y Treasury spread, the Swaption Volatility index, S&P500 and the VIX.

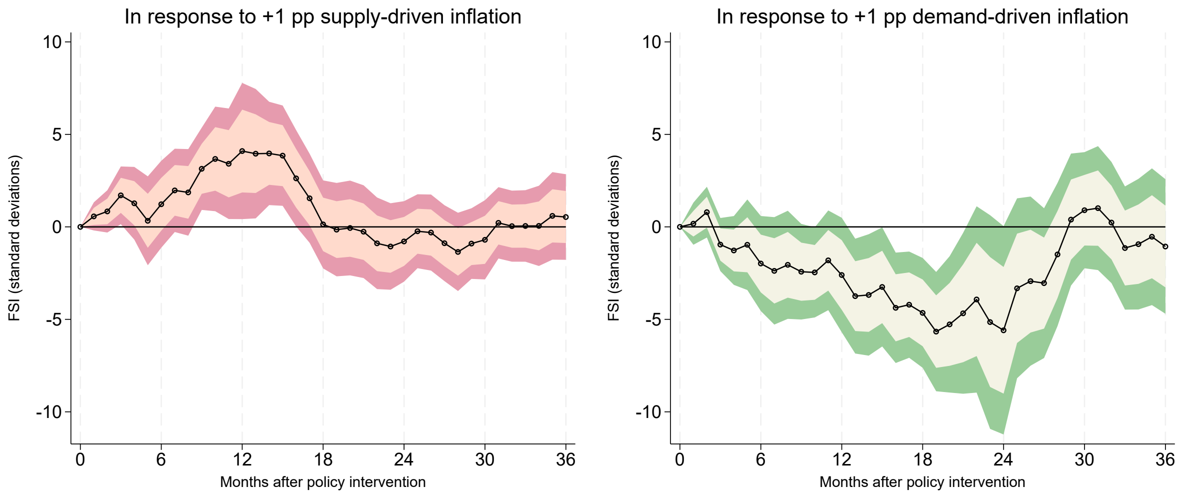

Figure C5: Additional effect of a monetary tightening on financial stress: KC Fed FSI

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Kansas City Fed FSI and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019. The KC Fed FSI is a pure FSI index with eleven components represented by spreads, volatility, "flight to quality" and "asymmetric information" proxies in main segments of financial markets. Its precise components are: 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, Keeton, et al. (2009)).

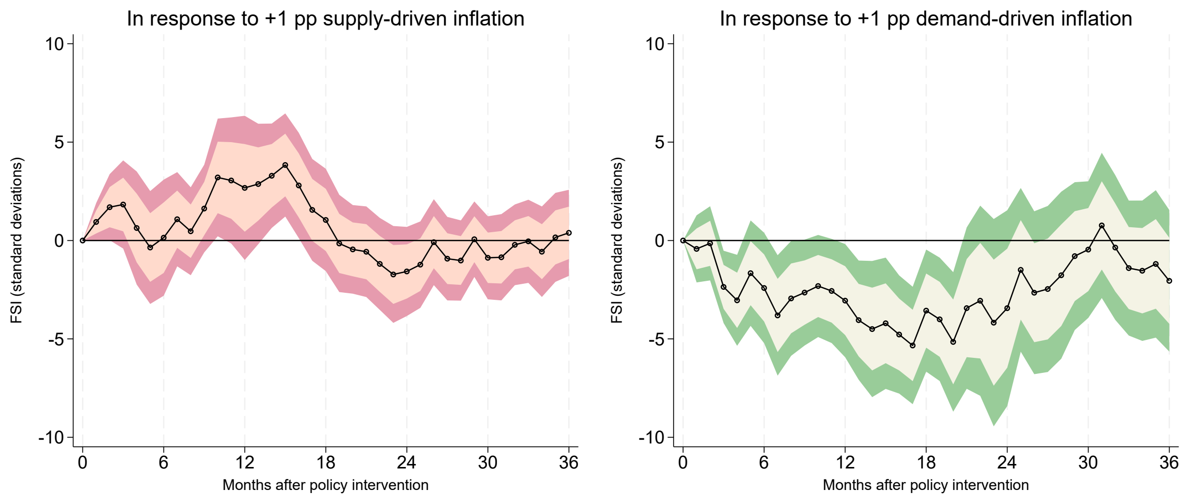

Figure C6: Additional state–dependent effect of a monetary tightening on financial stress: CISS

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the CISS and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019. The CISS is an index of systemic financial stress which aggregate 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 Chavleishvili and Kremer (2023), Figure 1 (panel B).

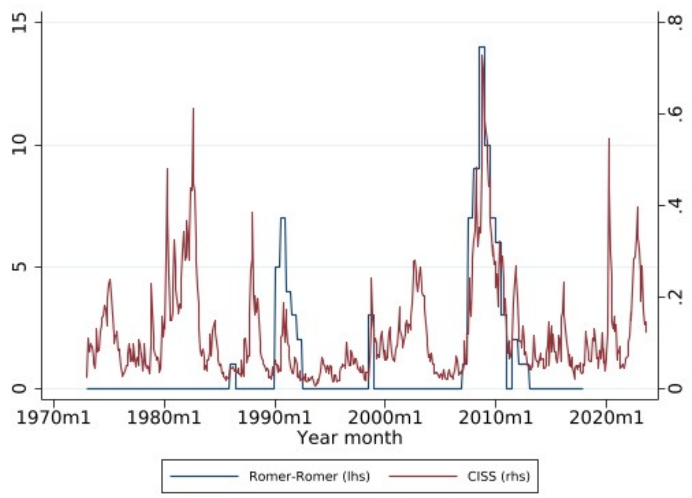

Figure C7: Alternative (composite) financial stress index for the US: CISS

Notes: The figure plots for the United States the CISS systemic financial stress index (red line) along with the Romer and Romer (2017) qualitative financial crisis indicator (blue line). Data is shown monthly from January 1973 to August 2023 for the CISS, and semiannual until 2017:2 for Romer and Romer.

6.2.4 Financial Stress Components

Figure C8: Additional effect of a monetary tightening on the GZ corporate credit spreads

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Gilchrist and Zakrajšek (2012) (GZ) corporate credit spreads and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019.

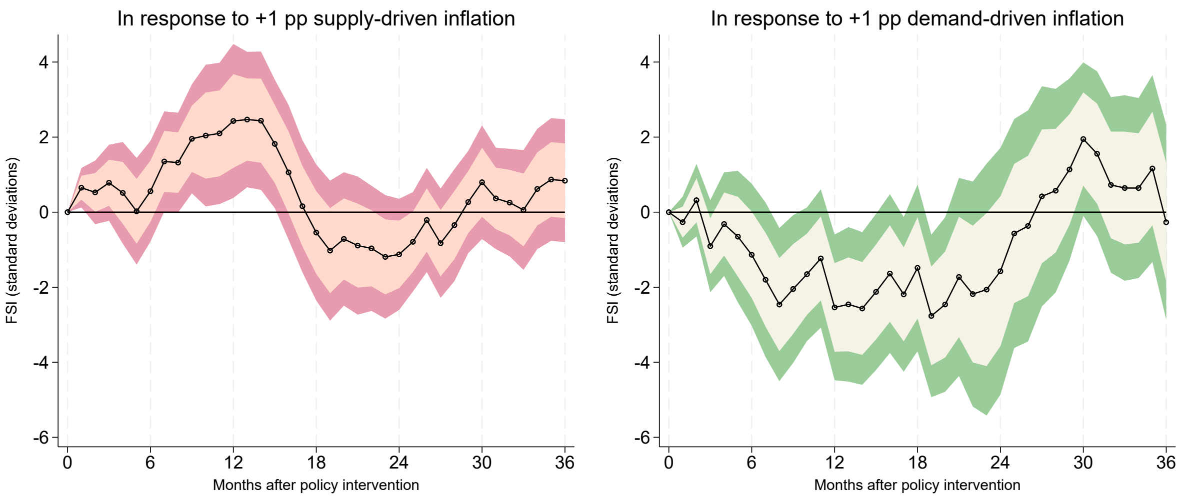

Figure C9: Additional effect of a monetary tightening on the GZ equity finance premium

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Gilchrist and Zakrajšek (2012) (GZ) Equity Finance Premium and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019.

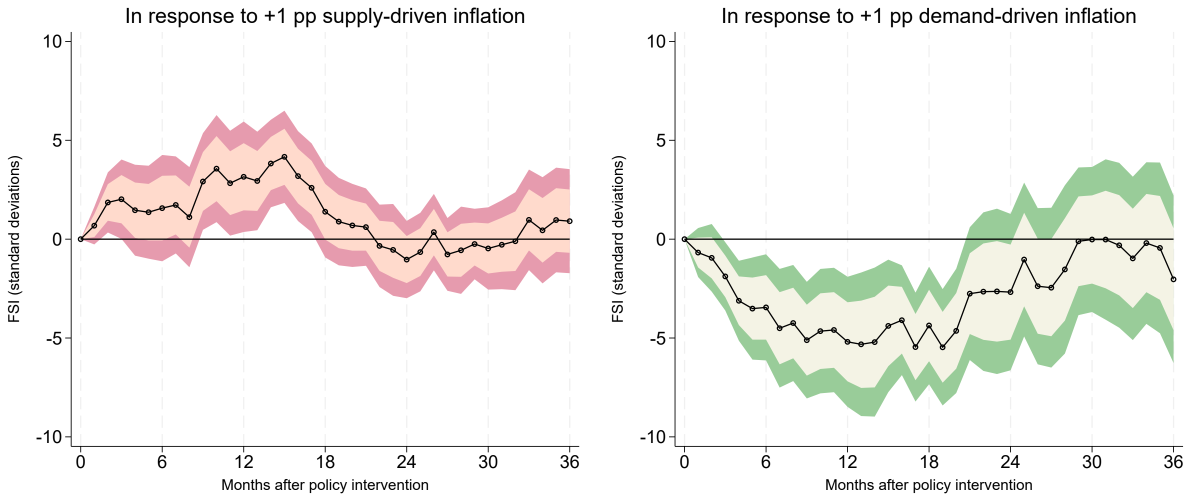

Figure C10: Additional effect of a monetary tightening on financial stress: Bond Market CISS

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Bond Market CISS subindex and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019. The CISS is an index of systemic financial stress which aggregate 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 Chavleishvili and Kremer (2023), Figure 1 (panel B).

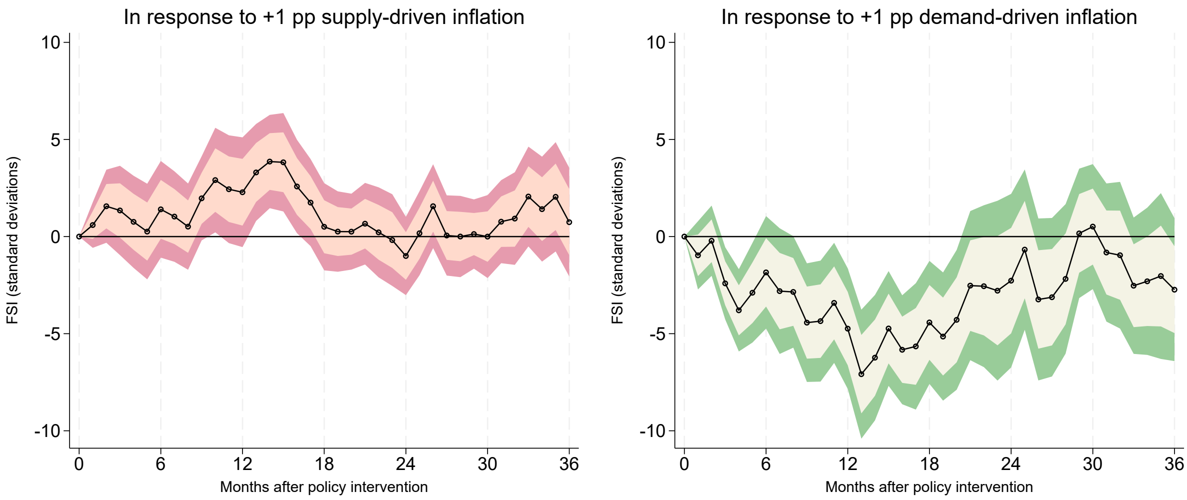

Figure C11: Additional effect of a monetary tightening on financial stress: NFC CISS

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Non-financial corporations Equity Market CISS subindex and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019. The CISS is an index of systemic financial stress which aggregate 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 Chavleishvili and Kremer (2023), Figure 1 (panel B).

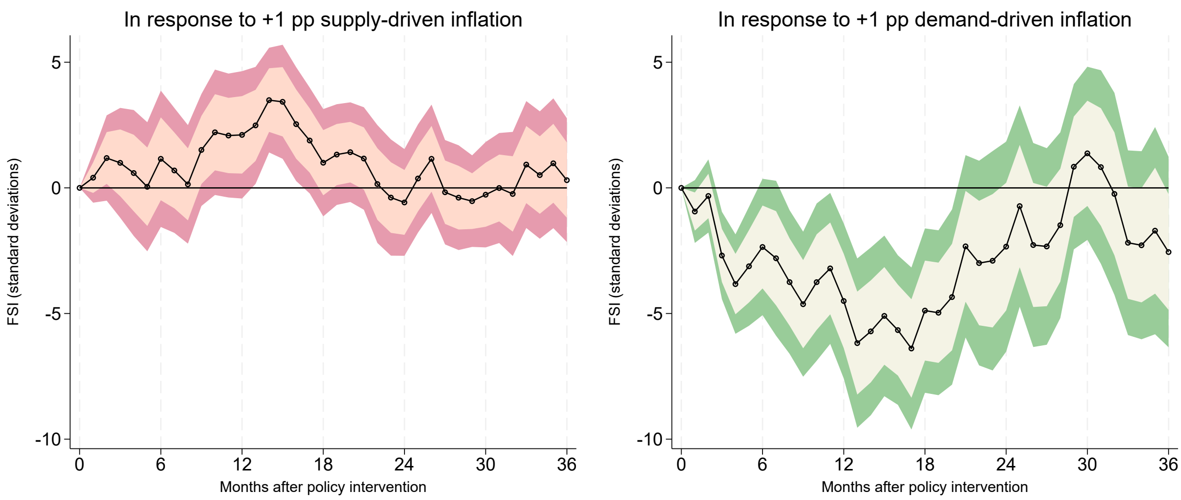

Figure C12: Additional effect of a monetary tightening on financial stress: Financial CISS

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Financial Corporations Equity Market CISS subindex and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019. The CISS is an index of systemic financial stress which aggregate 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 Chavleishvili and Kremer (2023), Figure 1 (panel B).

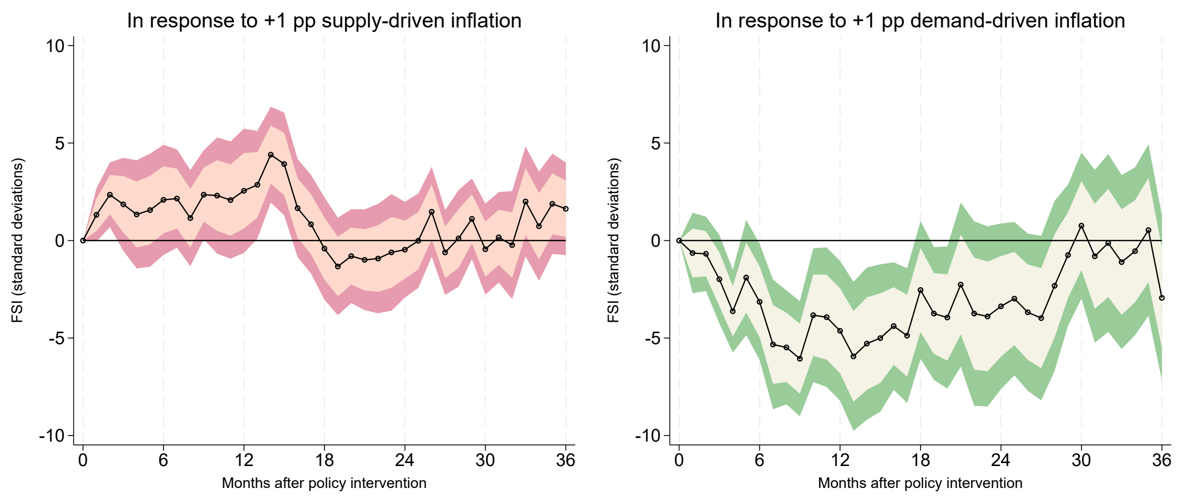

Figure C13: Additional state–dependent effect of a tightening on financial stress: FX CISS

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Foreign Exchnage Market CISS subindex and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019. The CISS is an index of systemic financial stress which aggregate 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 Chavleishvili and Kremer (2023), Figure 1 (panel B).

6.2.5 Financial Conditions Indices

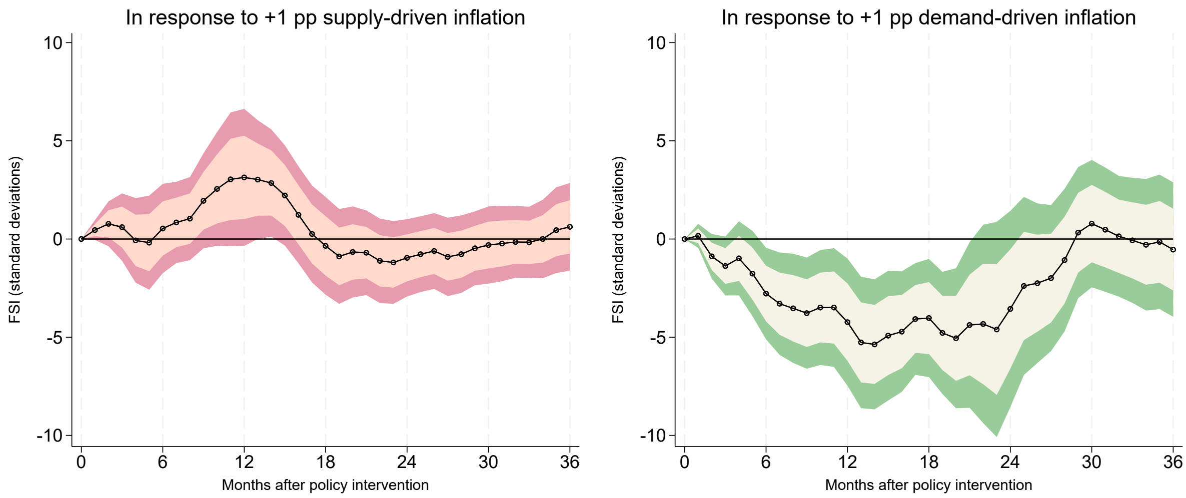

Figure C14: Additional effect of a tightening on financial conditions: Chicago Fed NFCI

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Chicago FED NFCI and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019, baseline specification. The Chicago Fed National FCI 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)).

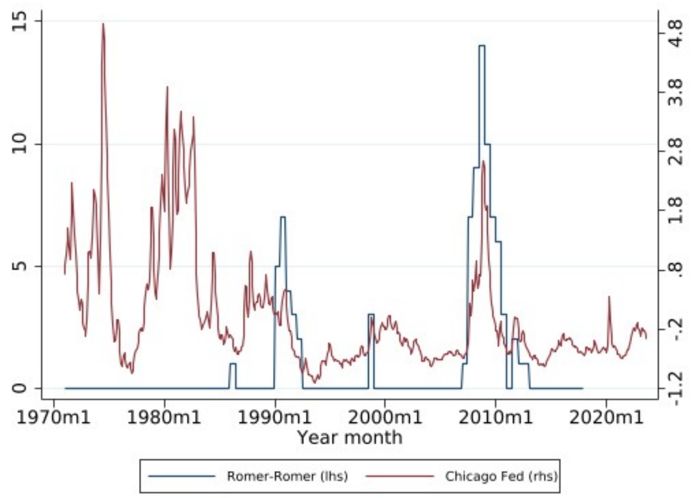

Figure C15: A financial conditions index for the US: the Chicago Fed NFCI

Notes: The figure plots for the United States the Chicago Fed NFCI (red line) along with the Romer and Romer (2017) qualitative financial crisis indicator (blue line). Data is shown monthly from January 1971 to August 2023 for the Chicago Fed NFCI, and semiannual until 2017:2 for Romer and Romer.

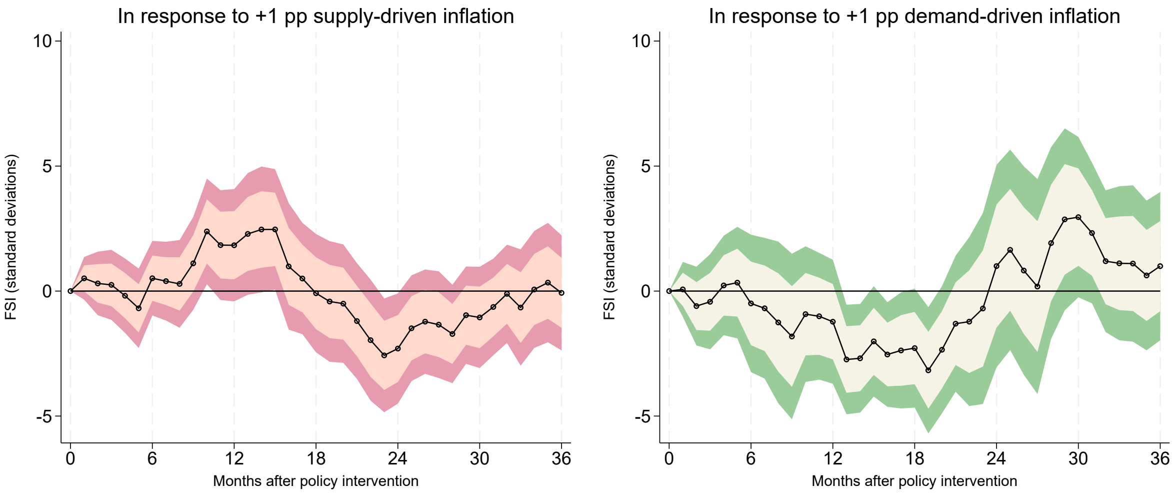

Figure C16: Additional effect of a tightening on financial conditions: Goldman Sachs FCI

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Goldman Sachs FCI and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US 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% (see Table B3 in Hatzius and Stehn (2018)).

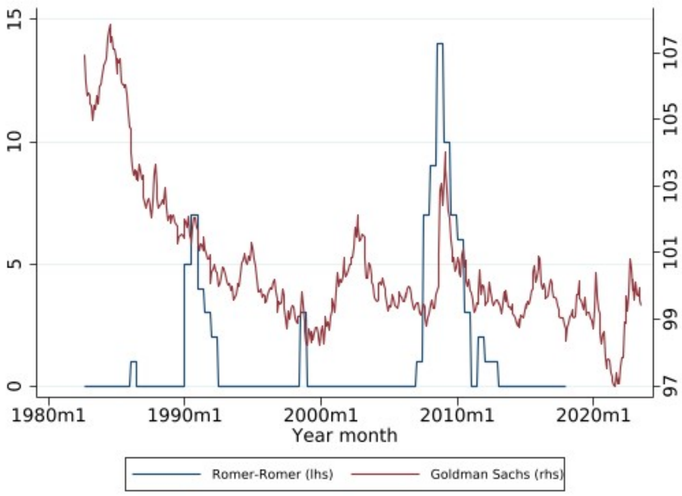

Figure C17: A financial conditions index for the US: the Goldman Sachs FCI

Notes: The figure plots for the United States the Goldman sachs FCI (red line) along with the Romer and Romer (2017) qualitative financial crisis indicator (blue line). Data is shown monthly from September 1982 to August 2023 for the Chicago Fed NFCI, and semiannual until 2017:2 for Romer and Romer.

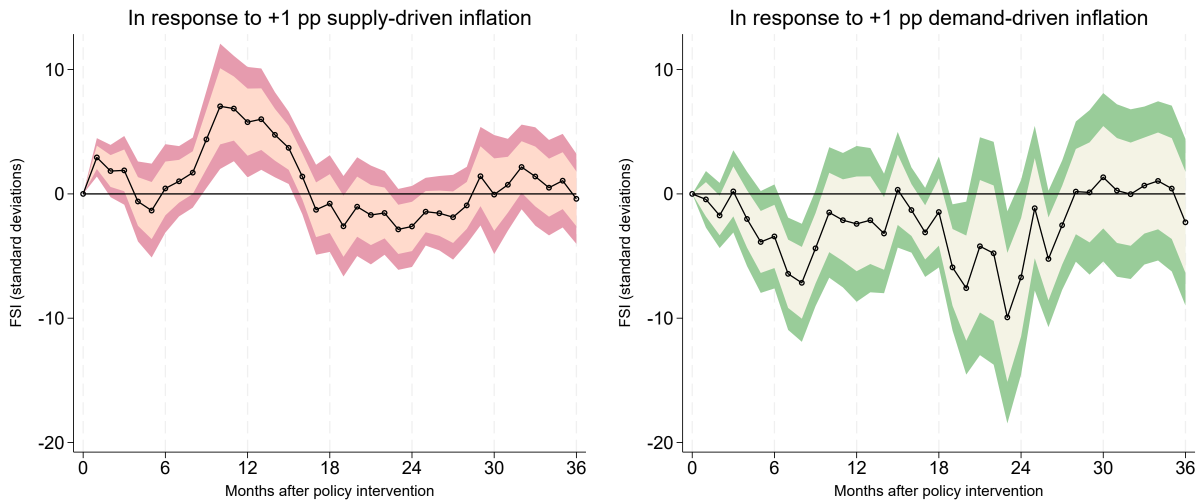

Figure C18: Additional effect of a tightening on financial conditions/stress: Saint Louis Fed FSI

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, the Saint Louis Fed FSI and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019. The Saint 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 one, as opposed to a pure financial stress index.

6.3 Robustness Checks: Other Countries

6.3.1 Data

Table C1: Overview Monetary Policy surprises by Country

#	Reference	Type	Remarks
	Canada		
	Champagne and Sekkel (2018)	Narrative	Romer & Romer type
	United Kingdom		
	Gerko and Rey (2017)	High-frequency	(sign)-correction
	France		
	Jarociński and Karadi (2020)	High-frequency	(sign)-correction
	Sweden		
	Kilman et al. (2022), Sandström (2018)	High-frequency	
	Australia		
	Bishop and Tulip (2017)	Narrative	

Table C2: Overview Financial Stress Indices by Country

#	Index	Source (description)	Type
	Canada		
1.	Canadian FSI	Duprey (2020)	systemic stress
	United Kingdom		
1.	NEW CISS	Chavleishvili and Kremer (2023)	systemic stress
2.	Bloomberg FCI	Rosenberg (2009)	stress
3.	CLIFS	Duprey, Klaus, and Peltonen (2017)	systemic stress
4.	Goldman Sachs FCI	Hatzius and Stehn (2018)	stress & conditions
	France		
1.	NEW CISS	Chavleishvili and Kremer (2023)	systemic stress
2.	CLIFS	Duprey, Klaus, and Peltonen (2017)	systemic stress
3.	Goldman Sachs FCI	Hatzius and Stehn (2018)	stress & conditions
	Sweden		
1.	CLIFS	Duprey, Klaus, and Peltonen (2017)	systemic stress
	Australia		
1.	ADB FSI	Park and Mercado Jr (2014), ADB Database	stress
2.	Corporate Credit Spreads	Investment Grade Index BofA Merrill Lynch	stress
3.	RBA FCI	Hartigan and Wright (2021)	stress & conditions

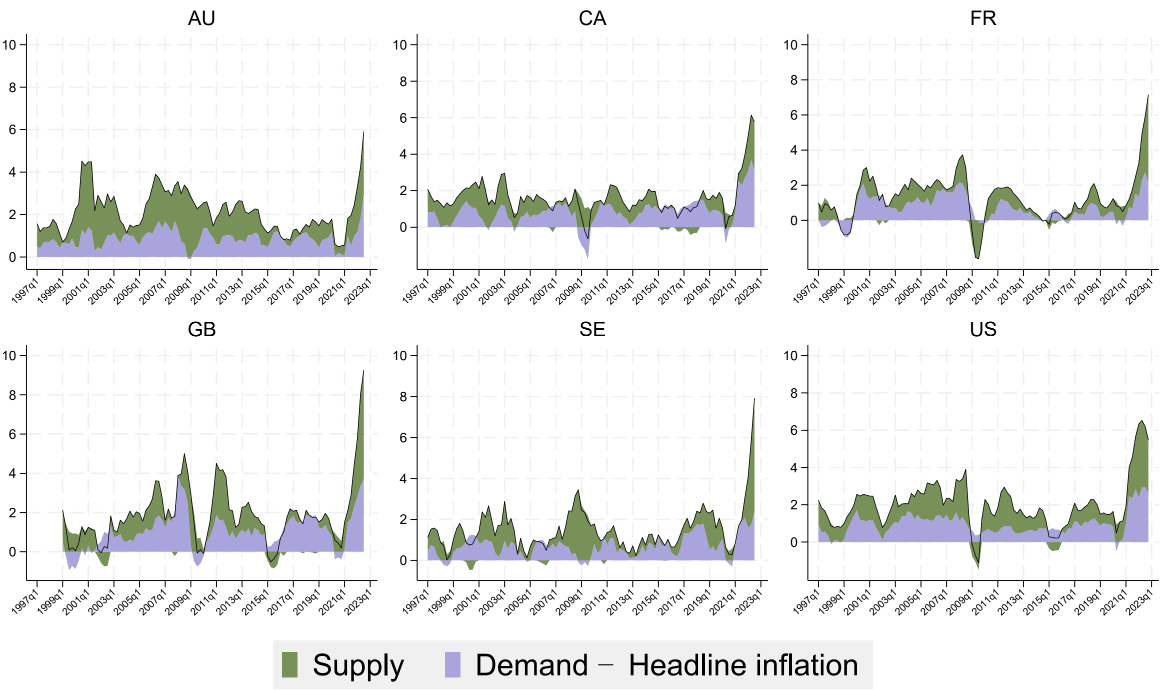

Figure C19: Inflation decomposition into demand and supply factors

Notes: Headline inflation, quarterly frequency, year-on-year. Y–axis: percent. Source: OECD

6.3.2 Findings

Figure C20: Additional state–dependent effect of a tightening on financial stress in Canada

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 12$. Baseline specification described by (1) with Champagne and Sekkel (2018) (narrative) monetary policy surprises, core year-on-year inflation, and CFSI (Duprey (2020)) financial stress index. Quarterly data from 1984Q1 to 2015Q3. The sample is dictated by the availability of demand/supply inflation series which starts in 1984Q1 and of the series of monetary policy surprises which ends in 2015Q3. Specification with 4 lags (optimal lag order according to the AIC criterion). Findings robust with a specification with 2 lags (optimal lag order according to the BIC criterion). 90% confidence bands.

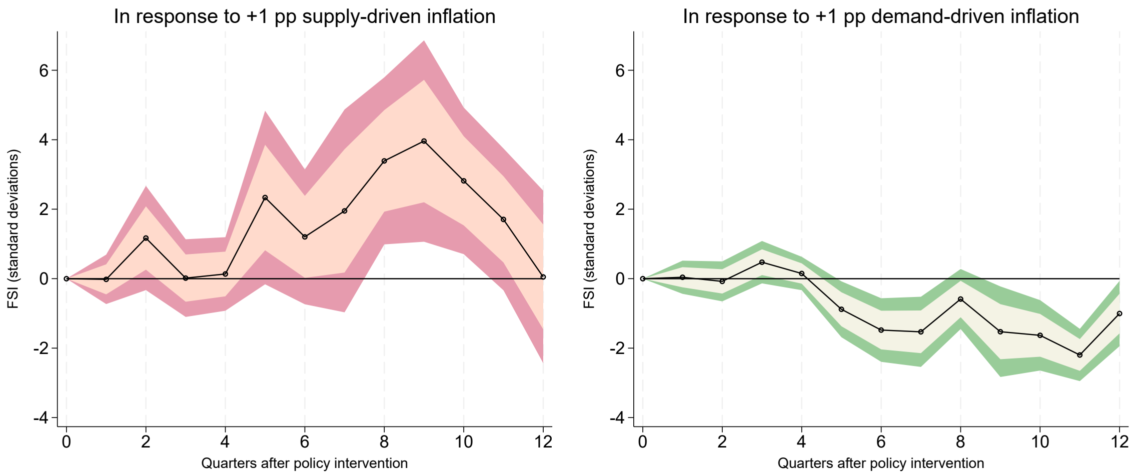

Figure C21: Additional state–dependent effect of a tightening on financial stress in the UK

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 12$. 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 1999Q1 to 2014Q4. The sample is dictated by the availability of demand/supply inflation series which starts in 1999Q1 and of the series of monetary policy surprises which ends in 2014Q4. Headline inflation only available for the UK. 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 4 lags (optimal lag order according to the AIC and BIC lag selection criterion). 90% confidence bands.

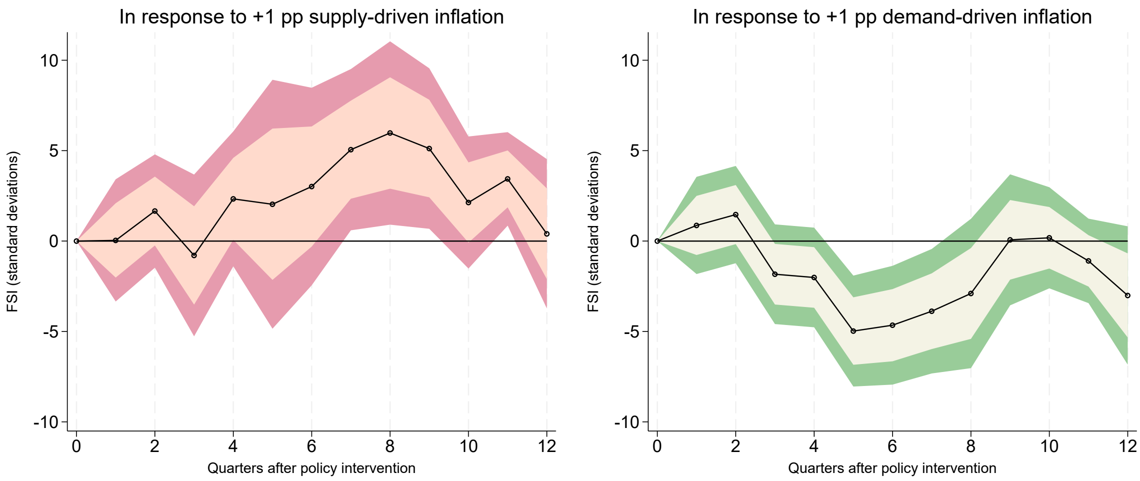

Figure C22: Additional state–dependent effect of a tightening on financial stress in France

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 12$. 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 1999Q1 to 2014Q4. The sample is dictated by the availability of demand/supply inflation series which starts in 1999Q1 and of the series of monetary policy surprises which ends in 2019Q2. Headline inflation only available for France. Similar results for CLIFS, with the effect of supply-driven inflation frontloaded. Similar patterns for the GS FCI index, but with less salient effect for the supply interaction. Specification with 4 lags (the optimal lag order according the AIC and BIC lag selection criteria). 90% confidence bands.

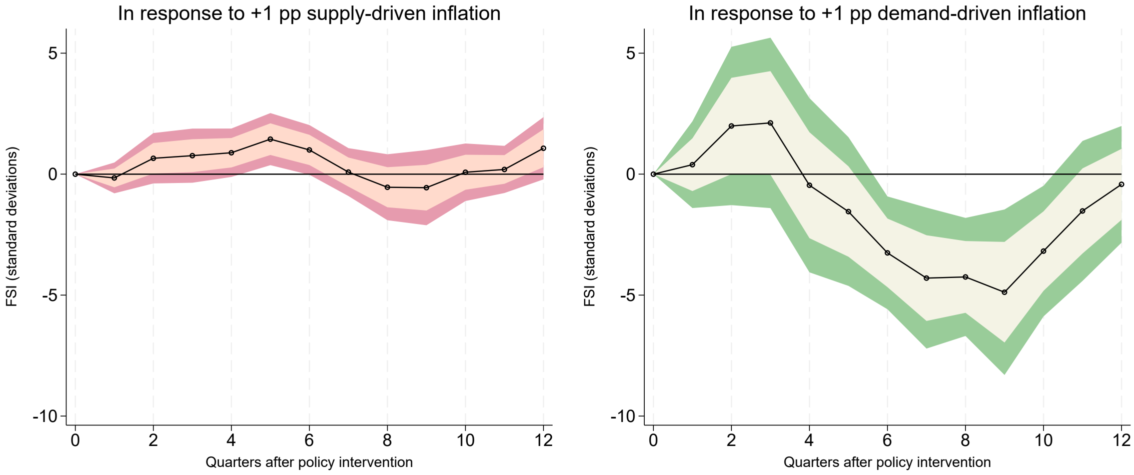

Figure C23: Additional state–dependent effect of a tightening on financial stress in Australia

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 12$. Baseline specification with Bishop and Tulip (2017) narrative monetary policy surprises, headline year-on-year inflation, and the ADB financial stress index. Specification with 4 lags (optimal lag order according to the AIC lag selection criterion). Quarterly data from 1997Q1 to 2019Q4. 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 4 major financial markets: the banking sector, the foreign exchange market, the equity market, and the debt market. The index is tailored to Open Economies/EMEs (see Park and Mercado Jr (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.

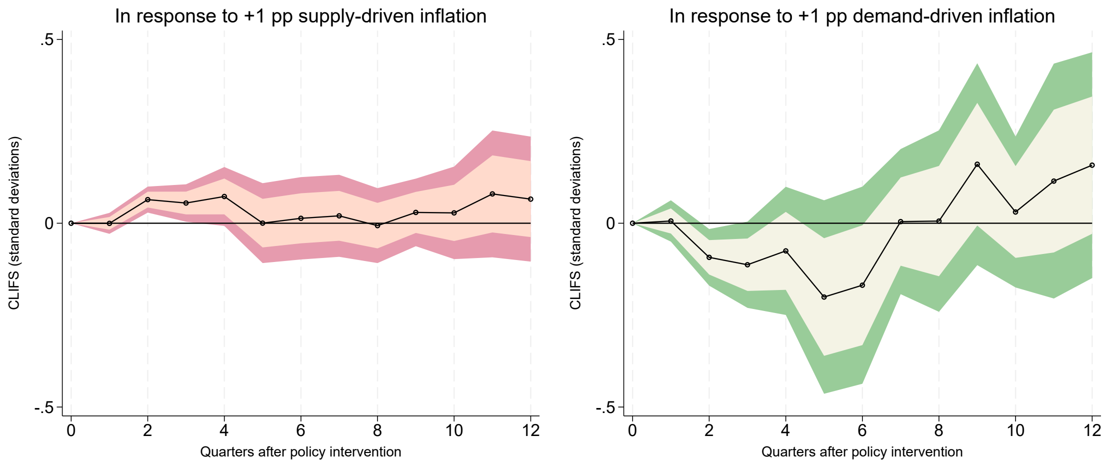

Figure C24: Additional state–dependent effect of a tightening on financial stress in Sweden

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 12$. Baseline specification described by (1) with Kilman et al. (2022) monetary policy surprises, headline year-on-year inflation, and the CLIFS financial stress index. Quarterly data from 2002Q1 to 2021Q2. The sample is dictated by the availability of high-frequency monetary policy surprises. Headline inflation only available for Sweden. Specification with 2 lags due to limited data availability of high frequency monetary policy surprises. 90% confidence bands.

6.4 US: Quarterly Version

Figure C25: Additional effect of a monetary tightening on financial stress (baseline, quarterly)

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, Fed Board Financial Stress Index and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019. Findings robust to specifications including the optimal lag order according to the AIC and BIC criteria equal to three and four, respectively.

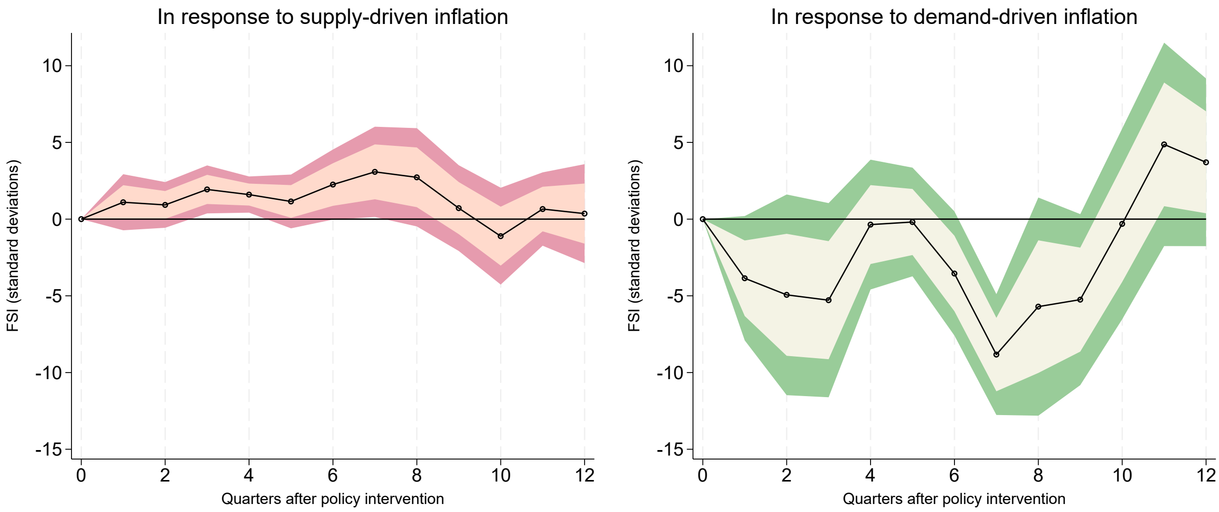

Figure C26: Additional effect of a monetary tightening on financial stress (headline, quarterly)

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, headline inflation, Fed Board Financial Stress Index and 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019. Findings robust to specifications including the optimal lag order according to the AIC and BIC criteria equal to three and four, respectively.

6.5 Underlying Mechanisms

Figure D1: Additional state–dependent effect of a monetary tightening on firm bankruptcies

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, total of businesses bankruptcies filling (quarterly), 4 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019.

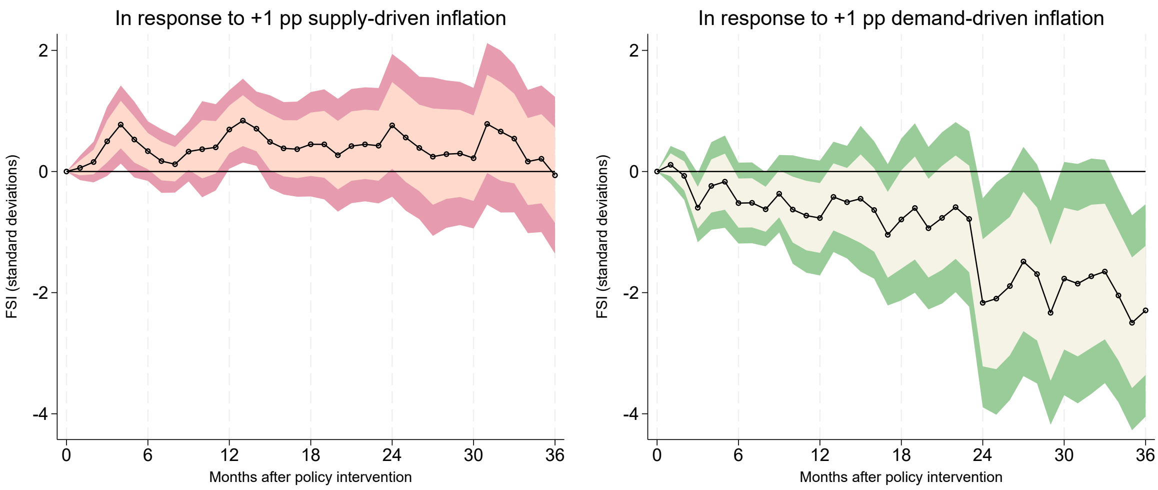

Figure D2: Additional state–dependent effect of a tightening on loan delinquency rate

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Shown are regression coefficients β_h^{TS} (left) and β_h^{TD} (right) for $h = 0, ..., 36$. Baseline specification described by (1) with Bauer and Swanson (2023) monetary policy surprises, core inflation, loan delinquency rate (quarterly) for total loans and leases, 6 lags. 90% confidence bands, Newey-West standard errors (statistically significant differences). US monthly data from January 1990 to December 2019. Delinquency Rates on Loans and Leases at Commercial Banks are taken from Fed Board's website.

6.6 Financial crises dynamics in Boissay, Collard, Galí, and Manea (2024)

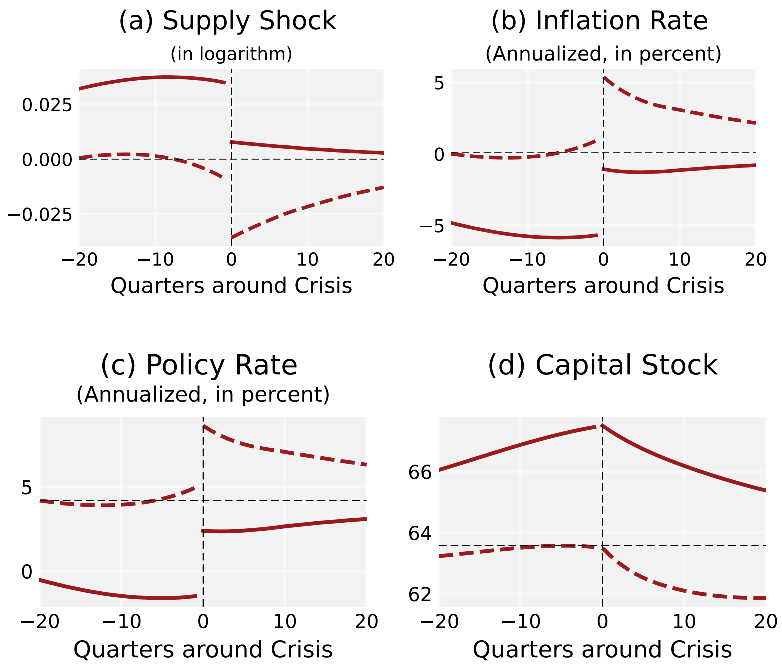

Figure D3: Dynamics around financial crises in an economy with supply shocks only

Notes: Simulations of the model in Boissay, Collard, Galí, and Manea (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 realised. Crisis in the bottom 10% are labeled "unpredictable", while crises in the top 10% are labeled "predictable".

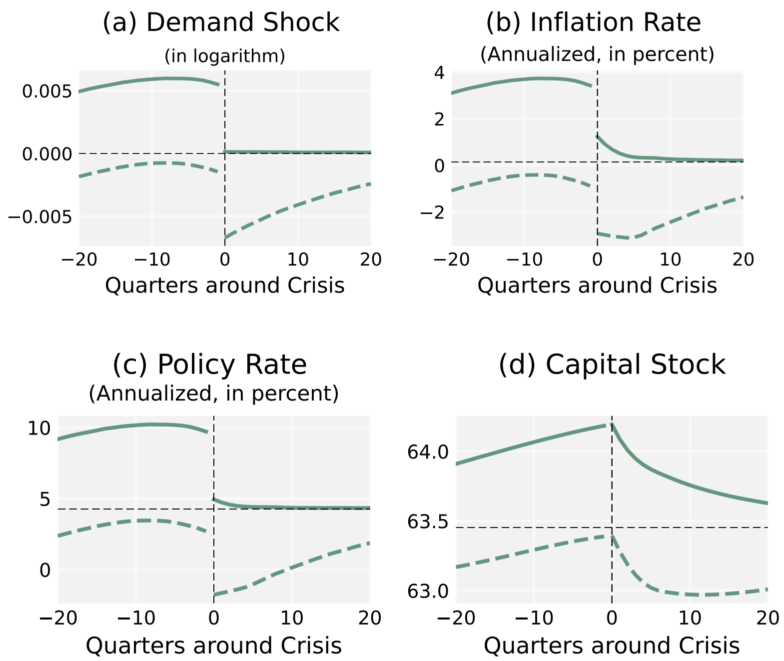

Figure D4: Dynamics around financial crises in an economy with demand shocks only

Notes: Simulations of the model in Boissay, Collard, Galí, and Manea (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 realised. Crisis in the bottom 10% are labeled "unpredictable", while crises in the top 10% are labeled "predictable".

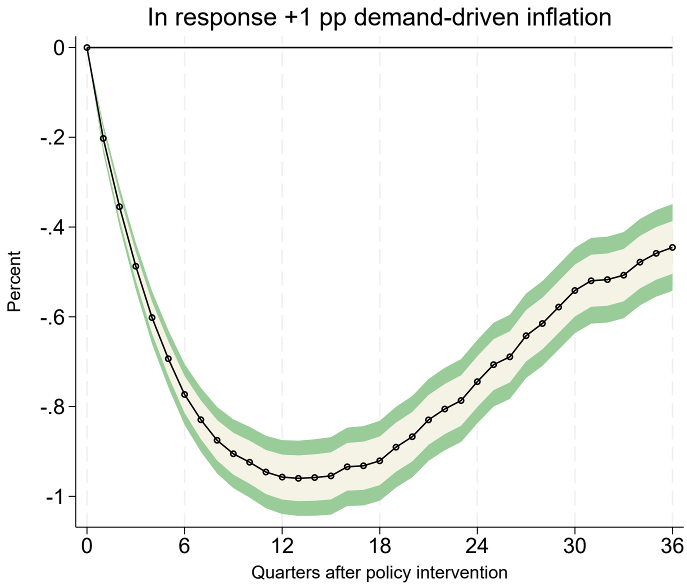

Figure D5: Additional effect of a policy rate hike on one-period-ahead probability of a crisis for each percentage point of year-on-year demand–driven inflation in early stages of credit booms

Notes: Dynamic responses to a 25 basis points positive monetary policy surprise. Regression coefficients β_h^{TD} for $h = 0, ..., 36$ interacted with a dummy that credit/capital stock is in the bottom quantile based on simulated time series from the model in Boissay, Collard, Galí, and Manea (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.