When credit expansions become troublesome: the story of investor sentiments

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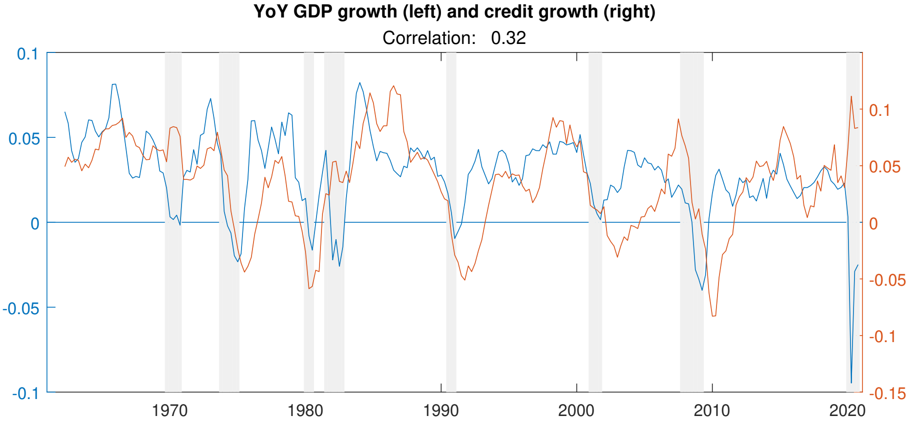
Credit growth and GDP growth are imperfectly correlated



Note: GDP is real GDP, credit is total credit to the non-financial business sector from the flow of funds, deflated with the GDP deflator. All data are for the United States. Sample period: 1960Q1 to 2020Q4.

Understanding the drivers of credit dynamics is important

Credit booms predict financial crises, which cause deep recessions (Jordà, Schularick, and Taylor (2011)).

But not all credit booms are alike (Gorton and Ordoñez (2020)):

- **Bad** credit booms are followed by a bust (e.g. Japan in the 1980s, US during the late 1990s)
- **Good** credit booms are not (e.g. US or Europe during the 1980s)

Popular narrative: expectations as drivers of credit cycles (e.g. Mishkin (2008))

- "Wrong" expectations → bad credit boom
- "Correct" expectations → good credit boom

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Can non-fundamental shocks cause credit cycles?

1. **Macroeconomic model of credit-demand driven boom-bust cycles**
Key elements:

- long-term debt & default risk
- noisy signals about future fundamentals

$\Rightarrow$ noise shocks cause leverage-driven booms, followed by debt overhang-driven bust.

2. **Empirical investigation of the effects of noise shocks**
In line with the model:

- News and noise shocks lead to leverage-driven credit booms
- Noise shocks lead to credit busts with slow deleveraging and persistently elevated default rates

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Outline

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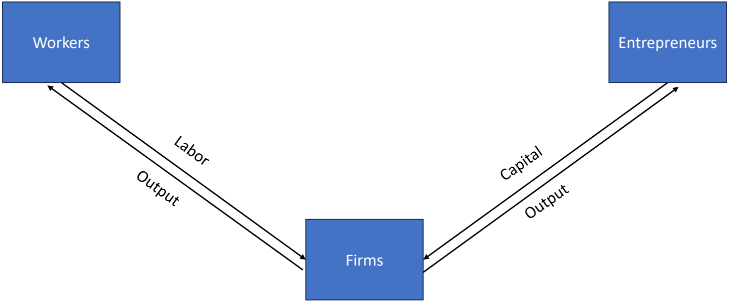
How can noise-driven asset price fluctuations affect credit? A simple model.

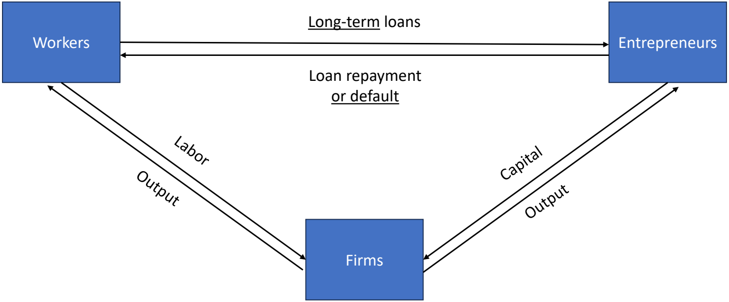
The economy:

- Three periods, $t = 1, 2, 3$.
- Three risk-neutral agents: workers, firms, and entrepreneurs.
- Worker and firm problems are standard Worker problem Firm problem
- Two assets: capital K and defaultable long-term debt B.
- Two sources of uncertainty: aggregate (news) shocks to productivity Z and idiosyncratic capital quality shocks A to entrepreneurs.

Flow of funds – agents



Flow of funds – financial frictions



Flow of funds – balance sheets

Assets	Liabilities
Long-term loans	Equity

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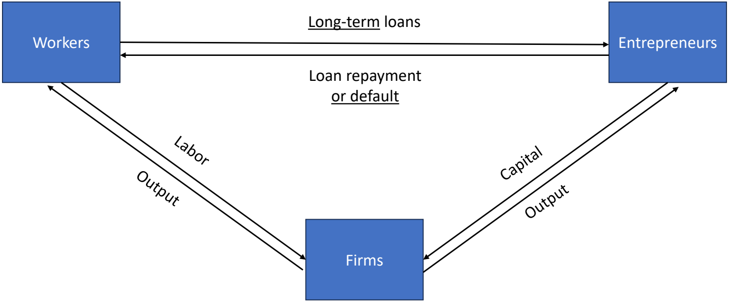
Capital	Long-term loans
	Equity



Flow of funds – shocks

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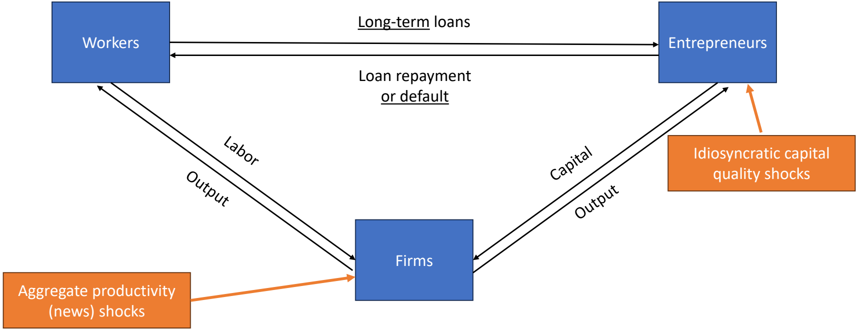
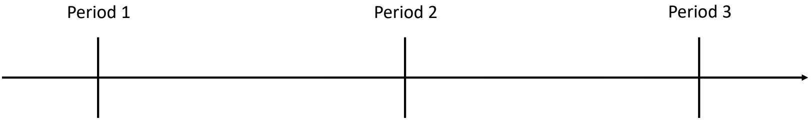


Timing of aggregate shocks



Period 1 productivity:
$Z_1 = 1$

Signal about period 2 productivity:
$S_1 = a_1 + e_1$

News shock:
$a_1 \sim N(0, \sigma_a^2)$

Noise shock:
$e_1 \sim N(0, \sigma_e^2)$

Period 2 productivity:
$Z_2 = Z_1 + a_1$

Period 3 productivity:
$Z_3 = Z_2$

Entrepreneur problem pt. 1

Investment: Entrepreneurs invest into capital k_{it}, which they rent to firms at rate $r^K(Z_t)$.

Capital quality shocks: At the beginning of the period, there is an idiosyncratic shock $A_{it} \sim U(\underline{A}, \overline{A})$ to the capital stock of entrepreneurs.

Long-term debt: Entrepreneurs borrow long-term b_{it} at a state-contingent price Q_{it}. They have outstanding long-term debt b_{it-1}, which is rolled over at the market price Q_{it}. All debt matures in $t = 3$.

Equity issuance: Entrepreneurs consume c_{it}^F. This can be negative, which we interpret as equity issuance.

Default: Entrepreneurs can default, in which case creditors receive nothing and their capital is lost. They optimally do so below a cut-off A_{it}^* for the idiosyncratic shock.

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Entrepreneur problem pt. 2

The problem of an entrepreneur in period 2 is

$$X_{i2}(k_{i1}, b_{i1}, A_{i2}; \mathcal{S}_2) = \max_{c^F_{i2}, k_{i2}, b_{i2}} c^F_{i2} + \beta^F E_2\Big[\underbrace{\max(X_{i3}(k_{i2}, b_{i2}, A_{i3}; \mathcal{S}_3), 0)}_{\text{Default option}} \Big],$$

subject to the budget constraint:

$$c^F_{i2} + k_{i2} = \underbrace{(r^K_2 + A_{i2} + 1)k_{i1} - \mu b_{i1}}_{\text{Net worth}} + \underbrace{Q_2(k_{i2}, b_{i2}; \mathcal{S}_{2+})\,(b_{i2} - (1-\mu)b_{i1})}_{\text{Debt issuance revenue}}.$$

Higher μ, shorter debt maturity.

The continuation value function is

$$X_{i3}(k_{i2}, b_{i2}, A_{i3}; \mathcal{S}_3) = c^F_{i3} = (r^K_3(Z_3) + A_{i3} + 1)k_{i2} - b_{i2}.$$

The period 1 problem looks similar, **adding the signal as an aggregate state**.

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Mutual fund

Workers own and invest in a safe claim D_t in a mutual fund, holding the portfolio of defaultable loans $\int_i b_{it} di$.

They earn a gross return $\int_i (1 - F(A^*_{it})) b_{it-1} di - D_{t-1}$.

They set state-contingent prices $Q_t(k_{it}, b_{it}; \mathcal{S}_{t+})$, such that they break even in expectation. $\mathcal{S}_{t+}$ is the end of period aggregate state vector.

It's straightforward to add a financial friction to the intermediary sector. We do this in the paper. Model extension with banks

Details on aggregation and equilibrium

Outline

Discussion of the assumptions

Long-term debt

- A large share of firms' debt is long-term, see e.g. Gomes et al. (2016).
- This fact matters both for leverage dynamics at the firm level and aggregate dynamics, see e.g. DeMarzo and He (2016), Kuehn and Schmid (2014), Gomes, Jermann, and Schmid (2016), Jungherr and Schott (2021).

Endogenous default

- Default risk is important for leverage dynamics and credit spreads, see e.g. H. Chen (2010) or L. Chen, Collin-Dufresne, and Goldstein (2009).

Risk-neutral agents and fixed labour supply

- Labour supply and household preferences matter for the propagation of news shocks, see e.g. Jaimovich and Rebelo (2009), Schmitt-Grohé and Uribe (2012), or Görtz, Gunn, et al. (2022).
- We shut these effects down to focus on the interaction between credit supply and credit demand frictions.

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Signal extraction problem

The noise representation has an alternative news representation with a news shock ν_1 and a surprise shock Δ_2 (Chahrour and Jurado (2018)).

The solution to the signal extraction problem yields

$$\nu_1 = E\left[Z_2 | S_1\right] = \underbrace{\frac{\sigma_a^2}{\sigma_a^2 + \sigma_e^2}}_{\text{Kalman gain}} S_1 = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_e^2}(a_1 + e_1). \tag{1}$$

Both news and noise shocks raise expected productivity.

The surprise shock in period 2 is

$$\Delta_2 = \frac{\sigma_e^2}{\sigma_a^2 + \sigma_e^2} a_1 - \frac{\sigma_a^2}{\sigma_a^2 + \sigma_e^2} e_1. \tag{2}$$

News shocks lead to a positive, noise shocks to a negative surprise.

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Entrepreneurs and the credit demand curve

In period 2, debt FOC:

$$\underbrace{Q_2(k_2, b_2; \mathcal{S}_{2+})}_{\text{Bond revenue}} + \underbrace{\frac{\partial Q_2(k_2, b_2; \mathcal{S}_{2+})}{\partial b_2} (b_2 - (1-\mu) b_1)}_{\text{Bond revenue change}} = \underbrace{\beta^F \left(1 - F(A_3^*)\right)}_{\text{Default-adjusted repayment}} \tag{3}$$

The default threshold in period 3, $A_3^*(k_2, b_2, Z_3)$, is

$$A_3^* = \frac{b_2}{k_2} - \left(r_3^K(Z_3) + 1\right) \tag{4}$$

Notice that the default threshold is linear in leverage b_2/k_2.

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Loan pricing and the credit supply curve

If no credit supply frictions, the bond price is a function of the default probability of the firm:

$$Q_2(k_2, b_2; \mathcal{S}_{2+}) = 1 - F(A_3^*) = \frac{\overline{A} - A_3^*}{\overline{A} - \underline{A}}.$$

This implies that the bond price derivatives are

$$\frac{\partial Q_2(k_2, b_2; \mathcal{S}_{2+})}{\partial k_2} = -f(A_3^*)\frac{\partial A_3^*}{\partial k_2} = \frac{1}{\overline{A} - \underline{A}}\frac{b_2}{k_2}\frac{1}{k_2} > 0 \quad (5)$$

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Analytical discussion of the key mechanism

Plugging credit demand and credit supply together and defining leverage $\omega_2 \equiv \frac{b_2}{k_2}$, we get for the optimal leverage policy:

$$\omega_2 = \underbrace{\frac{1-\beta^F}{2-\beta^F}\left(\bar{A} + 1 + r_3^K(Z_3)\right)}_{\text{Target leverage } \omega_2^*} + \underbrace{\frac{1-\beta^F}{2-\beta^F}\frac{k_1}{k_2}(1-\mu)\omega_1}_{\text{Downward leverage persistence}} \tag{7}$$

Thus,

- Leverage is increasing in (expected) future productivity Z_3
- Leverage is increasing in lagged leverage ω_1
- Leverage is declining in the investment rate $\frac{k_2}{k_1}$
- Longer debt maturity, more leverage persistence

As the default probability is linear in leverage, it has the same properties.

Analytical discussion of the key mechanism

Plugging credit demand and credit supply together and defining leverage $\omega_2 \equiv \frac{b_2}{k_2}$, we get for the optimal leverage policy:

$$\omega_2 = \underbrace{\frac{1-\beta^F}{2-\beta^F}\left(\bar{A} + 1 + r_3^K(Z_3)\right)}_{\text{Target leverage } \omega_2^*} + \underbrace{\frac{1-\beta^F}{2-\beta^F}\frac{k_1}{k_2}(1-\mu)\omega_1}_{\text{Downward leverage persistence}} \tag{7}$$

Thus,

- Leverage is increasing in (expected) future productivity Z_3
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Analytical discussion of the key mechanism

1. **Leverage-fuelled credit boom**
   - Both a noise and a news shock raise expected productivity growth.
   - As leverage is increasing in expected future productivity, both shocks raise leverage.

2. **Credit bust with slow deleveraging and elevated default rates**
   - A positive noise shock in period 1 leads to a negative surprise shock to productivity growth in period 2.
   - Target leverage falls.
   - Because of downward leverage persistence, entrepreneurs do not adjust leverage to the target level.
   - Leverage is higher, default rates are higher and investment (see the paper) is lower relative to the case without a noise shock.

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Outline

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Identification assumptions

Based on Forni, Gambetti, Lippi, and Sala (2017a) and Forni, Gambetti, Lippi, and Sala (2017b)

3 key identification assumptions

1. potential output is driven by a news shock
2. investors observe a noisy signal about the news shock
3. the noise does not affect potential output

The econometrician cannot infer news shock from data available at time of the shock

BUT:

The econometrician can infer news and noise shocks ex post, as noise shocks are unrelated to past, current and future potential output

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Recovering noise shocks from the data

We use quarterly data for the US, 1960Q1-2020Q4.

First, we estimate a VAR in log-levels with (in that order)

- potential output (from the BEA) per capita
- the 3-month treasury bill rate (to proxy for short rates)
- the Moody's AAA corporate bond yield (to proxy for risk premiums)
- stock prices (S&P 500)
- real GDP (to proxy for the business cycle) per capita

to recover reduced-form residuals.

Second, we apply a simple Cholesky scheme to recover **signal shocks** and **surprise shocks**.

Third, we identify **noise shocks** and **true news shocks** as a dynamic rotation of the **signal shocks** and the **surprise shocks**, with the identification assumptions as above.

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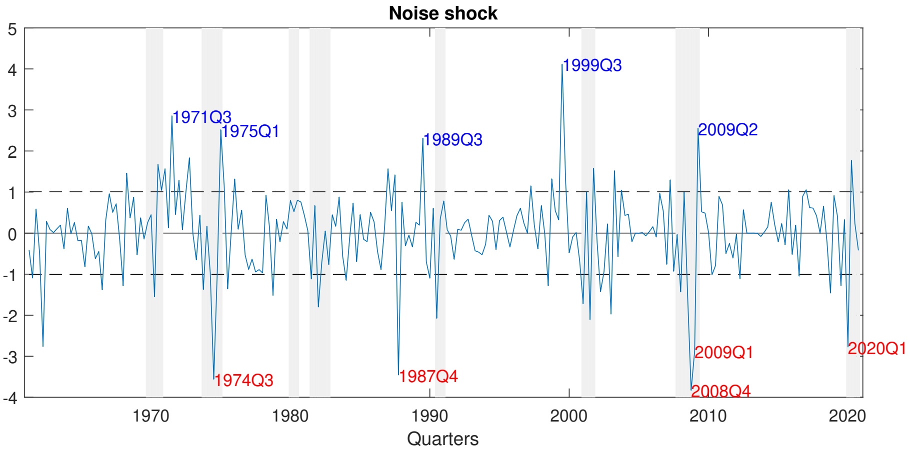
Resulting time series of noise shocks



Standardized units; dashed-line marks one standard deviation; grey areas mark NBER recessions. the blue text denotes the timing of the five largest positive noise shocks; the red text the timing of the five largest negative noise shocks.

Dividend shock | Narrative account | Historical decomposition | Summary statistics

Outline

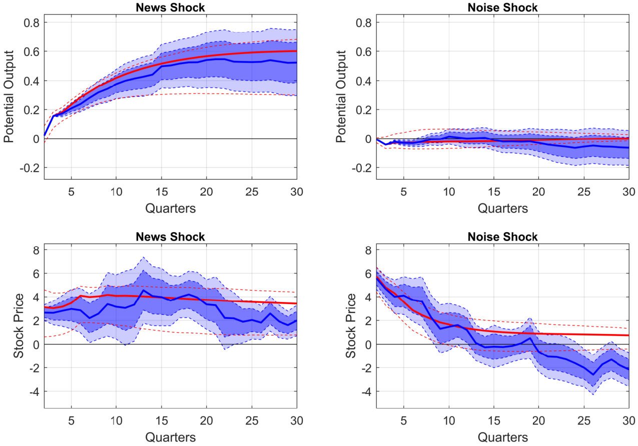
Validating noise shocks

Lag-augmented local projection (Jordà (2005), Stock and Watson (2018), Olea and Plagborg-Møller (2020), Plagborg-Møller and Wolf (2020)):

$$
\begin{aligned}
Y_{t+h} = \alpha^h &+ \sum_{s=1}^{S} \beta_s^h \hat{shock}_{t-s} + \sum_{s=1}^{S} \rho_s^h Y_{t-s} \\
&+ \sum_{s=0}^{S} \Gamma_s^{h,1} X_{t-s}^1 + \sum_{s=1}^{S} \Gamma_s^{h,2} X_{t-s}^2 + \theta^h t + \varepsilon_{t+h} \qquad (8)
\end{aligned}
$$

- $Y_{t+h}, h \in [0, H]$ is the outcome of interest h periods ahead
- $\hat{shock}_t$ is the shock of interest, estimated in the first stage
- X_{t-s} is a vector of control variables (same as in the VAR): 3-month Treasury rate and the Moody's AAA corporate bond yield (in X^1); dividends, stock prices, the other shock and real GDP (in X^2)

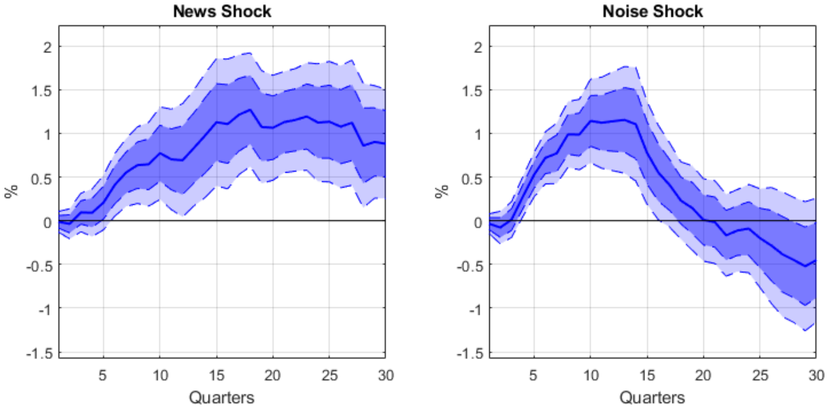
Effect of shocks on potential output & stock prices



LP IRF in blue, VAR IRF in red
Confidence levels: 90 percent (light shading) 68 percent (dark shading)
standard errors correct for autocorrelation of the residuals using a Newey-West estimator. All data are for the United States. Time period: 1960Q1-2020Q4. CAPE

Outline

Total credit

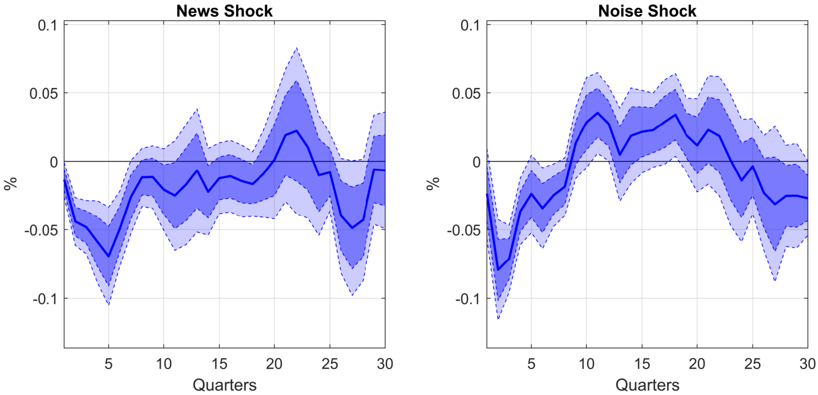


Note: Data: sum of loans to non-financial corporate business (FL104123005.Q) and debt securities to non-financial corporate business (FL104122005.Q) from the Financial Accounts of the United States. All data are for the United States. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 (bright shading) and 68 (dark shading) percent confidence intervals. Credit-to-GDP ratio Bonds Loans

Robustness

- Dividends as fundamental Link
- BAA yield as expectation Link
- Extending the sample to 1950Q1 Link
- Stopping the sample in 2006Q4 Link
- Adding credit to the VAR Link
- GDP ordered second in the VAR Link
- Adding Jurado et al. (2015)-uncertainty to the VAR Link

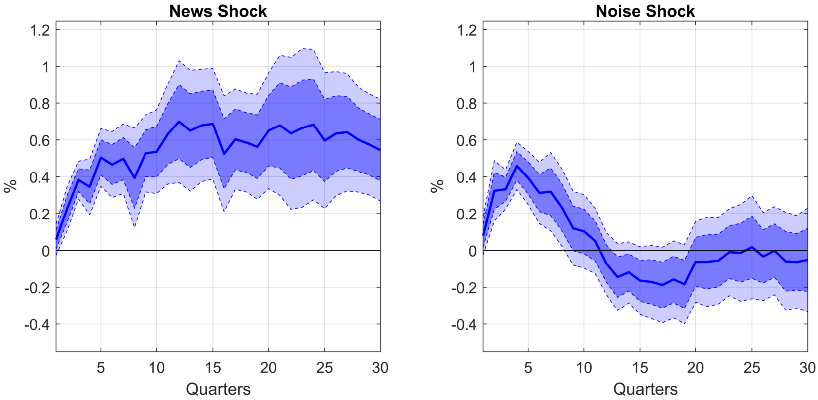
BAA-AAA corporate bond spread



Note: Data: difference between the Moody's BAA corporate bond spread (BAA) and the Moody's AAA corporate bond spread (AAA). Source: FRED. All data are for the United States. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 (bright shading) and 68 (dark shading) percent confidence intervals.

AAA-10Y treasury spread | 10Y-3M treasury spread | GZ spread | Excess bond premium | SLOOS, higher demand | SLOOS, banks tightening | Business delinquency rate

Real effects



Note: Data: real GDP (GDPC1) from FRED. All data are for the United States. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 (bright shading) and 68 (dark shading) percent confidence intervals. Consumption Investment Hours Inflation

Outline

Conclusion

We study the expectational noise shocks as a potential driver of credit cycles, in a model and in the data.

In the model, credit boom-bust cycles are due to credit demand frictions that arise because of defaultable long-term debt.

In the data, a noise shock that is unrelated to fundamentals leads to a boom-bust cycle in credit and default rates, consistent with the data.

Outline

Outline

5. Appendix
   - Extension: state-dependent transmission
   - More on the model
   - More on the identification of noise shocks
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   - Alternative leverage definitions
   - Additional variables

State-dependent transmission

Question:

What is the role of credit supply frictions in the transmission of noise shocks?

Theory:

- High risk premiums **amplify** the effects of credit supply frictions, as leverage is counter-cyclical (e.g. Akinci and Queralto (2022), Akinci, Benigno, et al. (2020)).
- High risk premiums **mute** the effects of credit demand frictions, as firms leverage less if credit is more costly.

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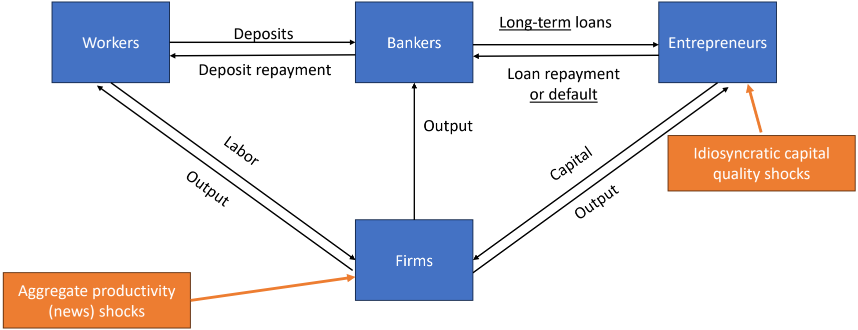
Model extension: adding a frictional banking sector

Assets	Liabilities
Deposits	Equity

Assets	Liabilities
Long-term loans	Deposits
	Equity

Assets	Liabilities
Capital	Long-term loans
	Equity



Loan pricing with credit supply frictions

With credit supply frictions, the bond price is a function of the default probability of the firm and an endogenous aggregate wedge that depends on the balance sheet constraint of the banking sector:

$$Q_2(k_2, b_2; \mathcal{S}_{2+}) = 1 - F(A_3^*) = \Psi_2 \frac{\overline{A} - A_3^*}{\overline{A} - \underline{A}}.$$

The wedge is

$$\Psi_2 = \beta^I \frac{1 + \mu^I}{\mu^I \psi + \beta^I (1 + \mu^I)},$$

which is decreasing in the multiplier μ^I on the banks' financial constraint.

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which is decreasing in the multiplier μ^I on the banks' financial constraint.

Optimal leverage with credit supply frictions

With credit supply frictions, the optimal choice of entrepreneurs' leverage is

$$\omega_2 = \frac{\Psi_2 - \beta^F}{2\Psi_2 - \beta^F}\left(\bar{A} + 1 + r_3^K(Z_3)\right)\omega_2^* + \frac{\Psi_2 - \beta^F}{2\Psi_2 - \beta^F}\frac{k_1}{k_2}(1-\mu)\omega_1 \qquad (9)$$

As $\frac{\Psi_2 - \beta^F}{2\Psi_2 - \beta^F}$ is increasing in Ψ_2 for the relevant range of values $\Psi_2 \in \left[\beta^F, 1\right]$, higher financial constraints (i.e. a lower Ψ_2) weaken the credit demand channel and the debt overhang channel.

Instead, because Ψ_2 is pro-cyclical, there is a novel credit supply channel.

State dependent transmission

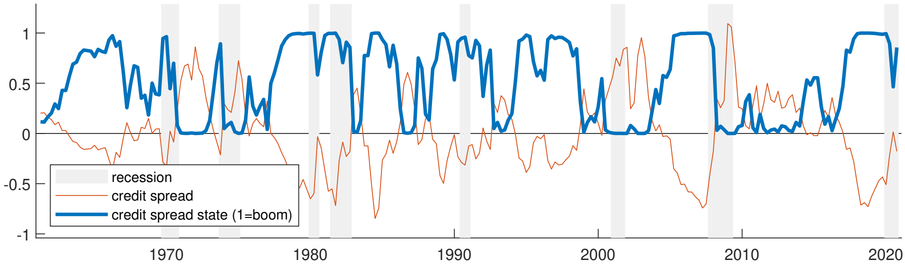
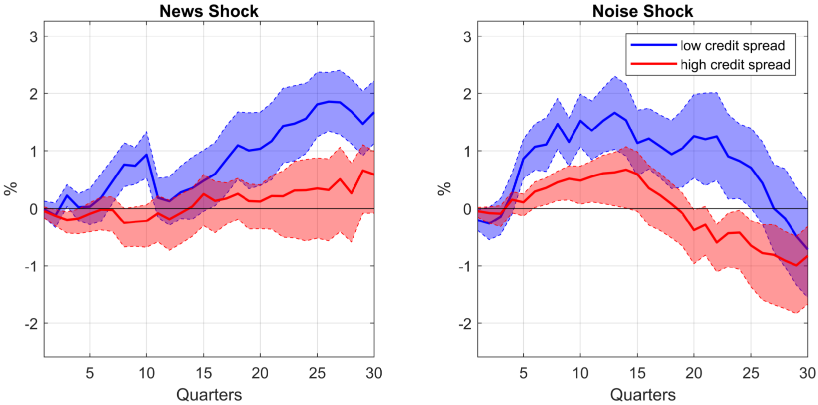


Figure: States of high and low credit spreads

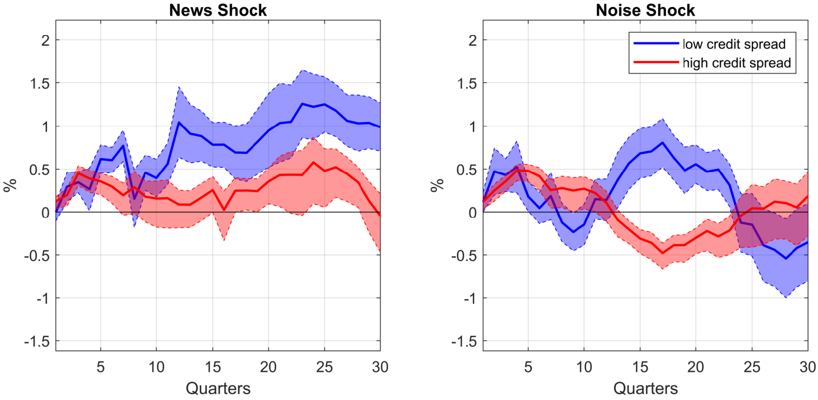
Note: Data: difference between the Moody's AAA credit spread (AAA) and the 10-year treasury constant maturity rate (DGS10). Data source: FRED. All data are for the United States. Time period: 1960Q1-2020Q4. The spread is detrended with a linear trend. The state is computed according to the smoothing function $\exp(-\gamma X)/(1+\exp(-\gamma X))$ with $\gamma = 10$.

Non-financial debt: more amplification during times of low risk premiums



Note: Data: sum of loans to non-financial corporate business (FL104123005.Q) and debt securities to non-financial corporate business (FL104122005.Q) from the Financial Accounts of the United States. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 percent confidence intervals.

Real effects are stronger during times of low credit spreads



Note: Data: real GDP (GDPC1) from FRED. All data are for the United States. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 percent confidence intervals.

Unobserved Component Model

We decompose credit into a trend, a drift (not shown) and a cycle:

$$credit_t = trend_t + cycle_t \tag{10}$$

The credit cycle is driven by exogenously identified stock price noise shocks $noise_t$ and other shocks $\epsilon_{cycle,t}$:

$$cycle_t = \phi(L)cycle_{t-1} + \alpha_t noise_t + \epsilon_{cycle,t} \tag{11}$$

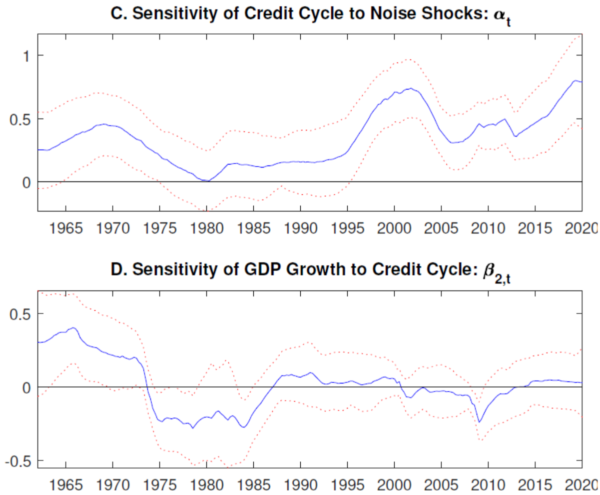
The impact of stock price noise shocks on the credit cycle is allowed to vary over time, according to

$$\alpha_t = \alpha_{t-1} + u_{\alpha,t} \tag{12}$$

The credit cycle feeds into GDP growth with a lag:

$$\Delta GDP_t = \beta_0 + \beta_1 \Delta GDP_{t-1} + \beta_{2,t} cycle_{t-1} + u_{GDP,t} \tag{13}$$

High sensitivity - noise-to-credit cycles-to-GDP growth



Note: Estimates from the unobserved component model. The confidence bands represent the 16th and 84th percentiles of the corresponding posterior densities. All data are for the United States. Time period: 1960Q1 to 2020Q4.

Outline

5 Appendix

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Worker problem

Workers supply labor L inelastically at wage W_t. They lend in the form of short-term debt D_t at a rate R_t^D. They consume C_t.

The problem of a worker in period 2 is

$$V_2 = \max_{C_2, D_2} C_2 + E_2 \left[V_3 \right],$$

subject to

$$\begin{aligned} C_2 + D_2 &= W_2 L + R_1^D D_1, \\ V_3 = C_3 &= W_3 L + R_2^D D_2. \end{aligned}$$

Back

Firm problem

Firms rent capital K_{t-1} from entrepreneurs at rate r_t^K and hire labor from workers at rate W_t.

They produce output with technology $Y_t = Z_t K_{t-1}^{\alpha} L_t^{1-\alpha}$.

The problem of a firm is

$$\max_{K_{t-1}, L_t} Z_t K_{t-1}^{\alpha} L_t^{1-\alpha} - W_t L_t - r_t^K K_{t-1}. \tag{14}$$

Back

Workers and firms

The solution to the worker problem yields $R_1^D = R_2^D = 1$.

Optimal choice of inputs yields a wage $W_t = (1-\alpha) Z_t K_{t-1}^{\alpha} L^{-\alpha}$ and a return on capital $r_t^K = \alpha Z_t K_{t-1}^{\alpha-1} L^{1-\alpha}$ for $t = 1, 2, 3$.

Aggregation

We set the model up in a way such that despite the presence of idiosyncratic shocks, there is no heterogeneity.

This implies that we can consider representative workers, firms, and entrepreneurs.

The aggregate resource constraint is

$$C_t + C_t^F + K_t = \left(Z_2((1 - F(A_t^*))K_{t-1})^{\alpha} L^{1-\alpha} + (1 - F(A_t^*))K_{t-1}\right).$$

Back

A credit boom in period 1

Combining credit supply and credit demand equations:

$$\underbrace{(1-\beta^F)E_1\left[Q_2(k_2,b_2;\mathcal{S}_{2+})\left(1-F(A_2^*)\right)\right]}_{\text{Valuation wedge}} = \underbrace{-\frac{\partial Q_1(k_1,b_1;\mathcal{S}_{1+})}{\partial b_1}(b_1-b_0)}_{\text{Marginal effect on default risk}},$$

where

$$\frac{\partial Q_1(k_1,b_1;\mathcal{S}_{1+})}{\partial b_1} = \underbrace{-\frac{1}{\overline{A}-\underline{A}}E_1\left[Q_2\frac{1}{k_1}\right]}_{\text{Direct effect}} + \underbrace{E_1\left[\frac{\overline{A}-A_2^*}{\overline{A}-\underline{A}}\left(\frac{\partial Q_2}{\partial k_2}\frac{\partial k_2}{\partial b_1}+\frac{\partial Q_2}{\partial b_2}\frac{\partial b_2}{\partial b_1}\right)\right]}_{\text{Indirect debt overhang effect}}. \tag{15}$$

Fall in expected default risk -> rise in wedge between valuation of cash flows -> firm takes on more default risk and leverage at the margin.

Effect stronger the smaller $b_1 - b_0$.

A credit bust in period 2

$$\underbrace{\left(1-\beta^F\right)\left(1-F(A_3^*)\right)}_{\text{Valuation wedge}} = \underbrace{-\frac{\partial Q_2(k_2, b_2; \mathcal{S}_{2+})}{\partial b_2}\left(b_2 - b_1\right)}_{\text{Marginal effect on default risk}}, \tag{16}$$

where

$$\frac{\partial Q_2(k_2, b_2; \mathcal{S}_{2+})}{\partial b_2} = -\frac{1}{\overline{A} - \underline{A}}\frac{1}{k_2} \tag{17}$$

Rise in expected default risk. Extreme case: $b_2 = b_1$. Firm does not internalize that investment and debt reduction reduces default risk at the margin.

Reduces default risk too little: underinvestment, excessive leverage and excessive default.

Issue more severe the higher b_1 (i.e. the stronger was the credit boom), because bond price more sensitive to default risk

Outline

5. Appendix
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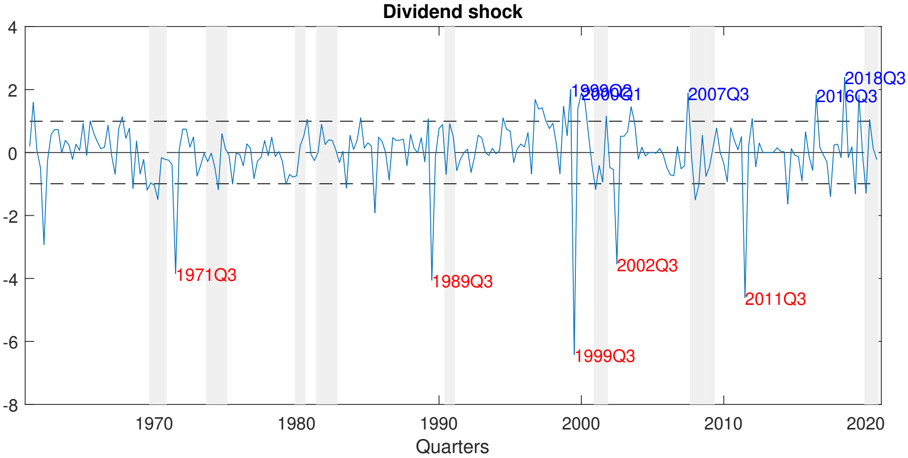
Resulting time series of dividend shocks



Standardized units back

News and noise shocks jointly

	Mean	St.dev.	Autocorr.
Noise (stocks)	0.00	1.01	-0.01
Fund. (stocks)	-0.00	0.99	-0.02

Table: Summary statistics

	Noise (stocks)	Fund. (stocks)
Noise (stocks)	1.00	-0.01
Fund. (stocks)	-0.01	1.00

Table: Correlation of shocks

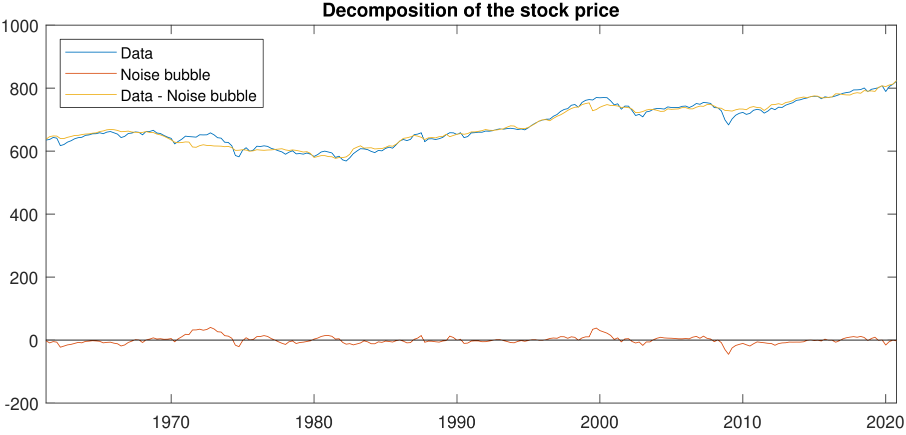
back

Events coinciding with noise shocks

Positive noise shocks	
1971Q3	Nixon rally (NY Times)
1980Q1	Inflation hedge (NY Times)
1987Q3	Run-up to 1987 stock market crash (WSJ)
1999Q3	Peak of the dot-com bubble
2009Q2	Great recession ends
Negative noise shocks	
1962Q2	Kennedy slide (WSJ)
1974Q3	Nixon resignation (WSJ)
1987Q4	1987 stock market crash (WSJ)
2008Q4	US financial market meltdown
2009Q1	US financial market meltdown

Table: Largest 5 positive and negative noise shocks and coinciding events back

Decomposition of stock price into components



Data: S&P500 (in blue). The red line is the noise bubble component, the yellow line the difference between the noise bubble component and the data. All data are for the United States. Time period: 1960Q1-2020Q4. back

Outline

5 Appendix

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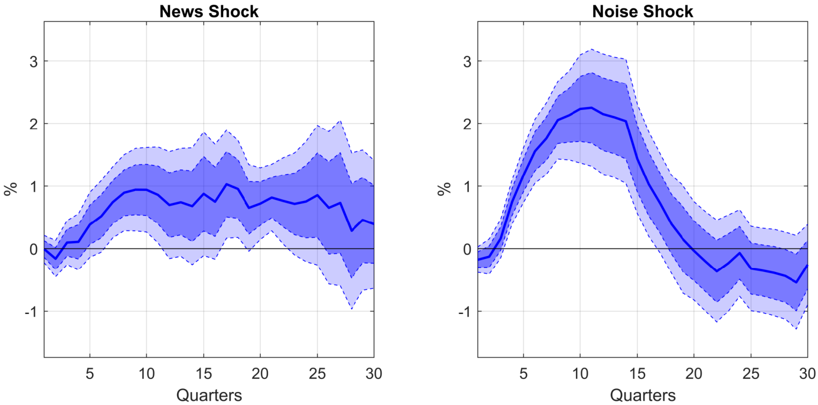
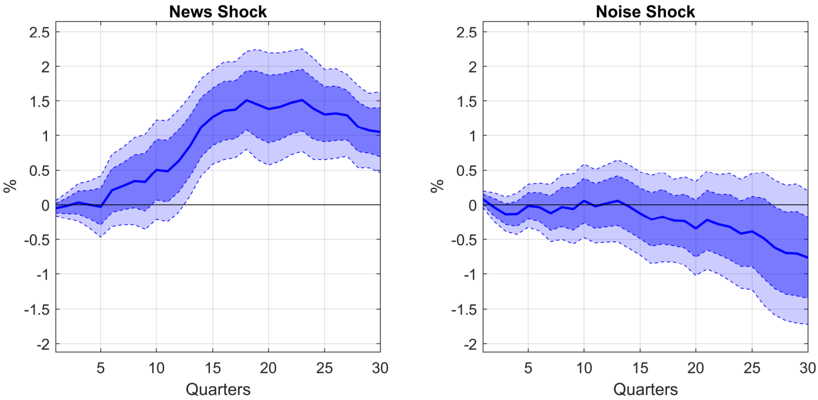
The bank lending channel



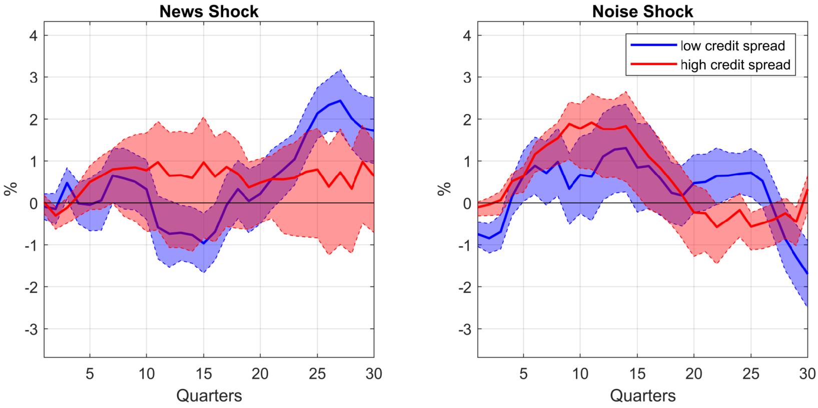
Note: loans to non-financial corporate business (FL104123005.Q) from the Financial Accounts of the United States. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 (bright shading) and 68 (dark shading) percent confidence intervals. back

The bond market channel



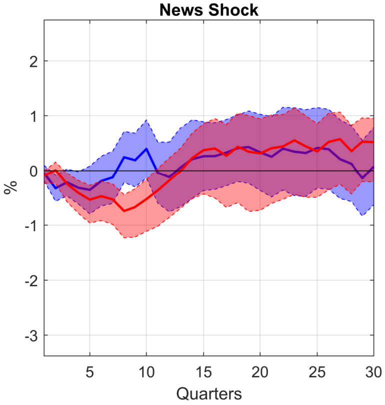
Note: Data: debt securities to non-financial corporate business (FL104122005.Q) from the Financial Accounts of the United States. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 (bright shading) and 68 (dark shading) percent confidence intervals. back

Non-financial loans: no differences in amplification



Note: Data: loans to non-financial corporate business (FL104123005.Q) from the Financial Accounts of the United States. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 percent confidence intervals.

Non-financial bonds: only amplification during times of low risk premiums



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Outline

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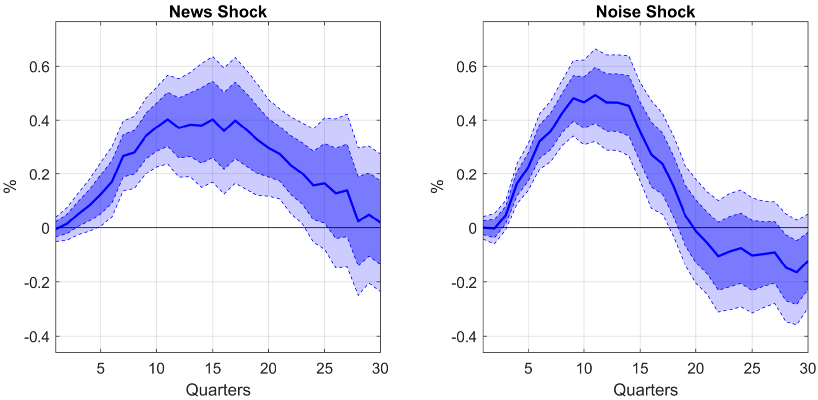
- Additional variables

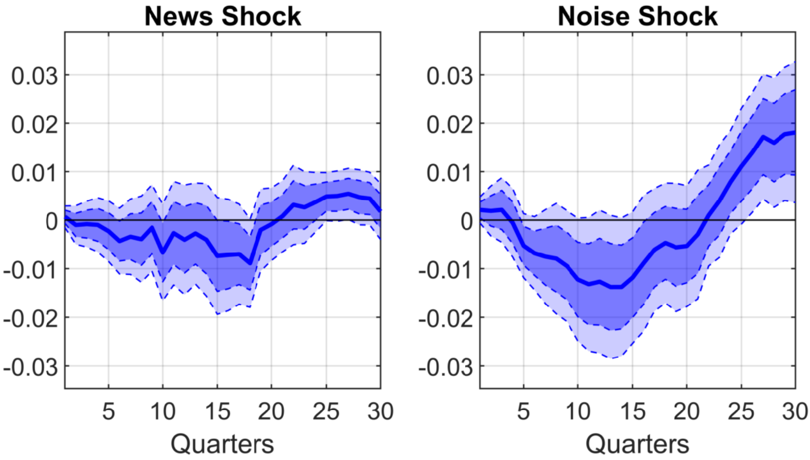
The bank lending channel: loans/commercial bank assets



Note: Data: loans to non-financial corporate business (FL104123005.Q) from the Financial Accounts of the United States, divided by total assets of commercial banks (FA763164103.Q) from the Financial Accounts of the United States. Series are cumulated. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 (bright shading) and 68 (dark shading) percent confidence intervals. Book leverage

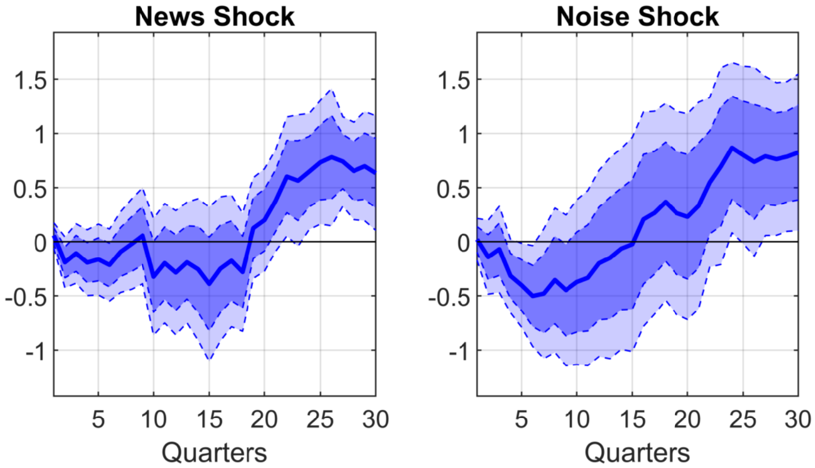
Book equity Book assets Book leverage, Compustat Market leverage, Compustat

The bank lending channel: bank leverage



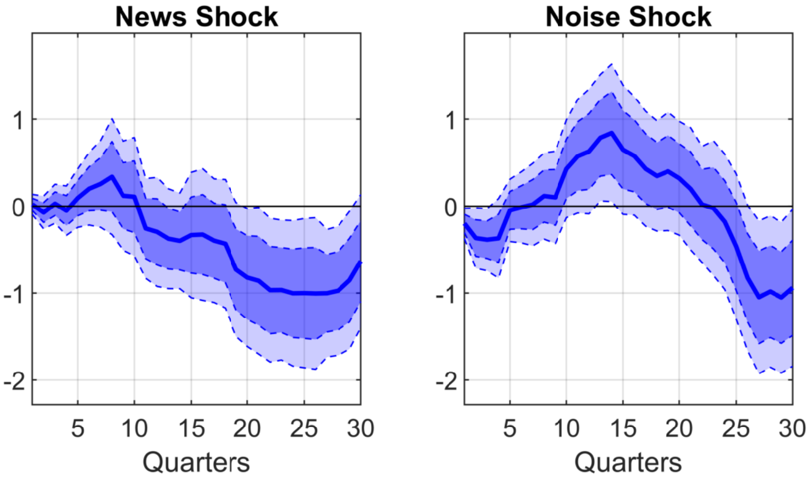
Note: Data: inverse ratio of total financial assets of broker-dealers (FA764068005.Q) to corporate equities as a liability of broker-dealers (FA763164103.Q) from the Financial Accounts of the United States. Series are cumulated. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 (bright shading) and 68 (dark shading) percent confidence intervals.

The bank lending channel: commercial bank equity



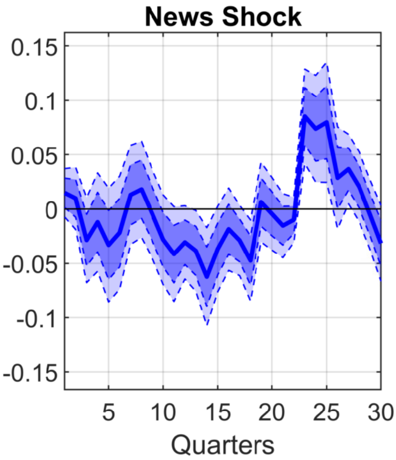
Note: Data: equity as a liability of commercial banks (FA763164103.Q) from the Financial Accounts of the United States. Series are cumulated. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 (bright shading) and 68 (dark shading) percent confidence intervals.

The bank lending channel: commercial bank assets

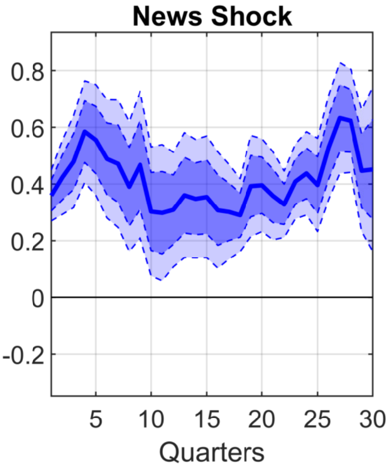


Note: Data: assets of commercial banks (FA763164103.Q) from the Financial Accounts of the United States. Series are cumulated. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 (bright shading) and 68 (dark shading) percent confidence intervals.

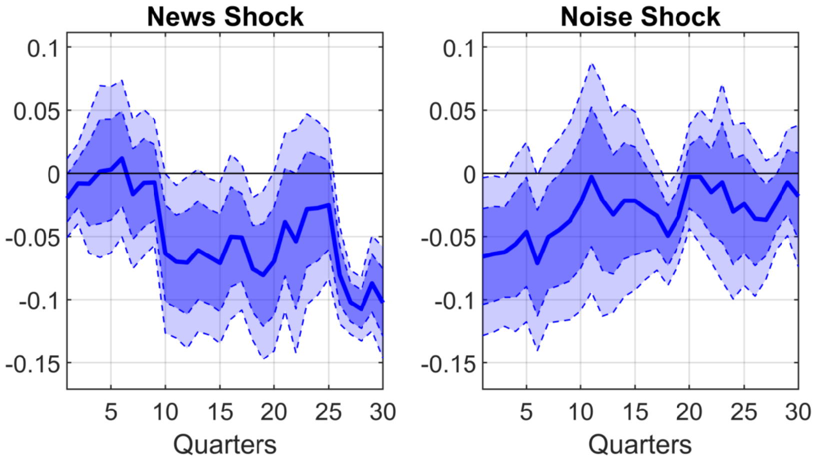
Commercial bank book leverage, Compustat



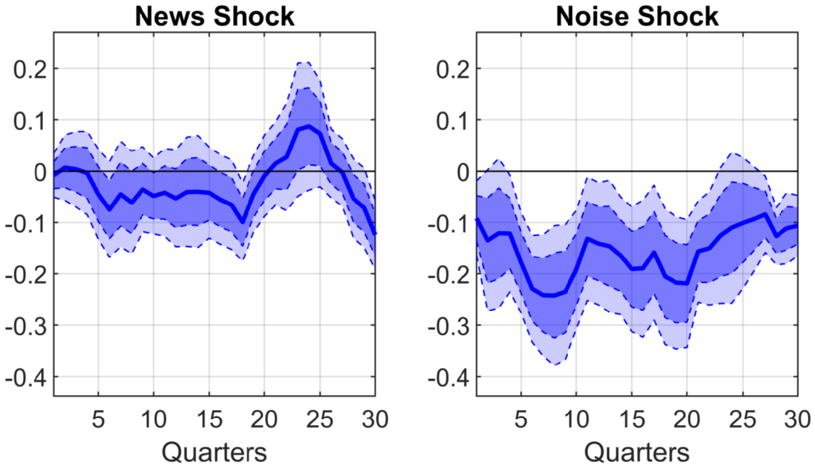
Commercial bank market leverage, Compustat



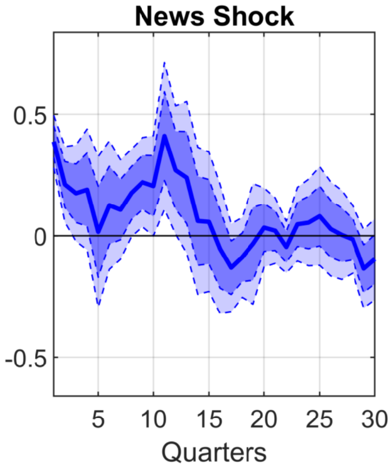
Broker-dealer book leverage, Flow of Funds



Broker-dealer book leverage, Compustat



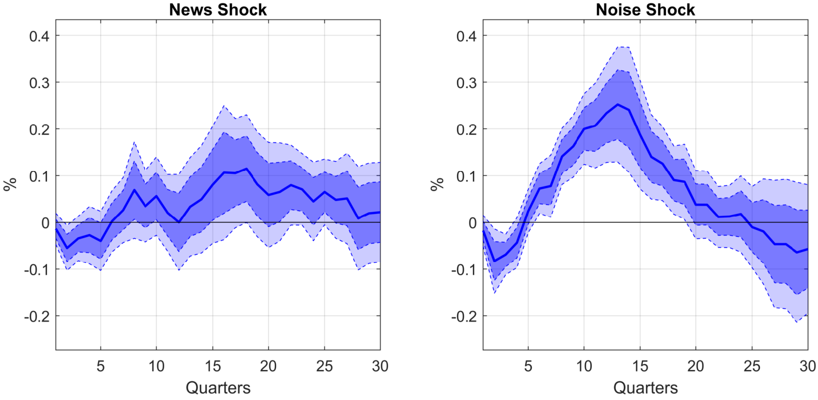
Broker-dealer market leverage, Compustat



Outline

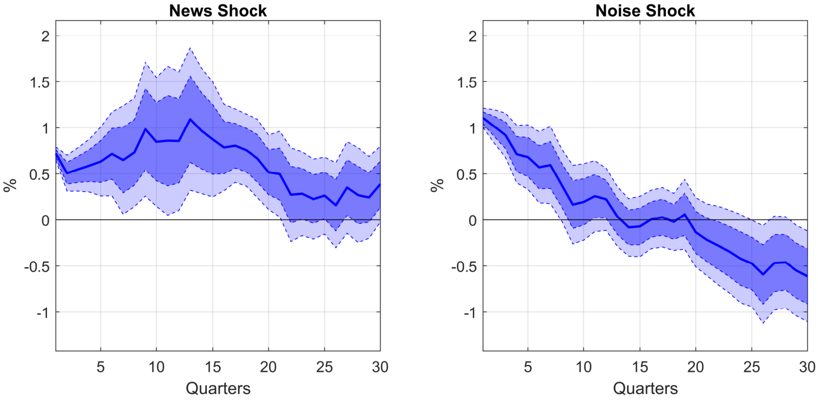
5. Appendix
   - Extension: state-dependent transmission
   - More on the model
   - More on the identification of noise shocks
   - Bonds vs Loans
   - Alternative leverage definitions
   - Additional variables

Credit-to-GDP ratio



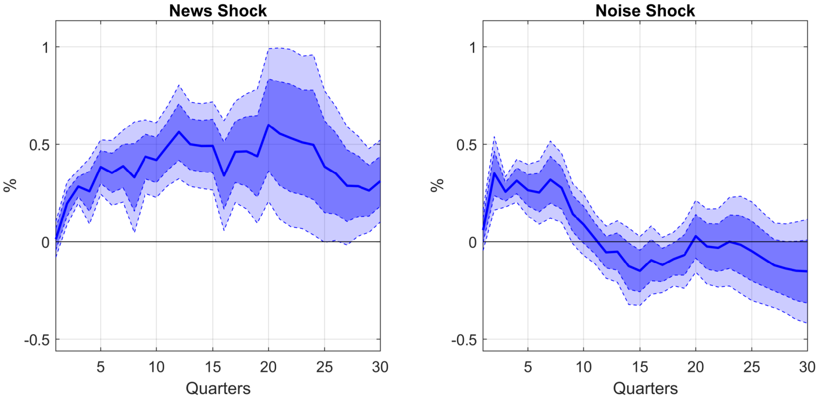
Note: Data: sum of loans to non-financial corporate business (FL104123005.Q) and debt securities to non-financial corporate business (FL104122005.Q) from the Financial Accounts of the United States. All data are for the United States. Time period: 1960Q1 to 2020Q4. The shaded areas correspond to the 90 (bright shading) and 68 (dark shading) percent confidence intervals. Back

Cyclically adjusted Price Earnings Ratio (CAPE)



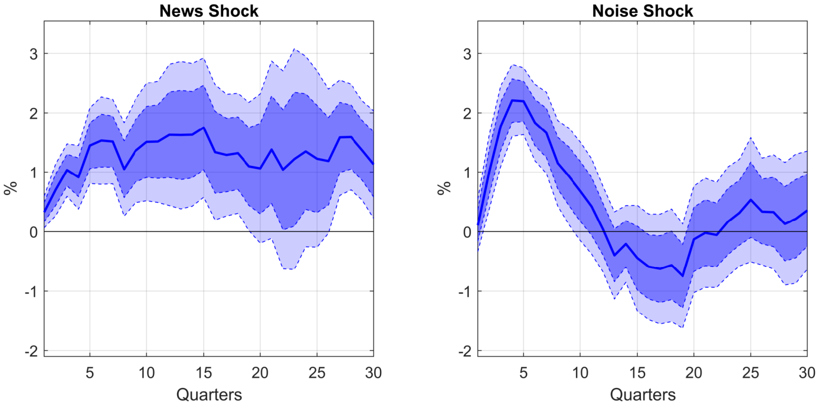
Back

Consumption



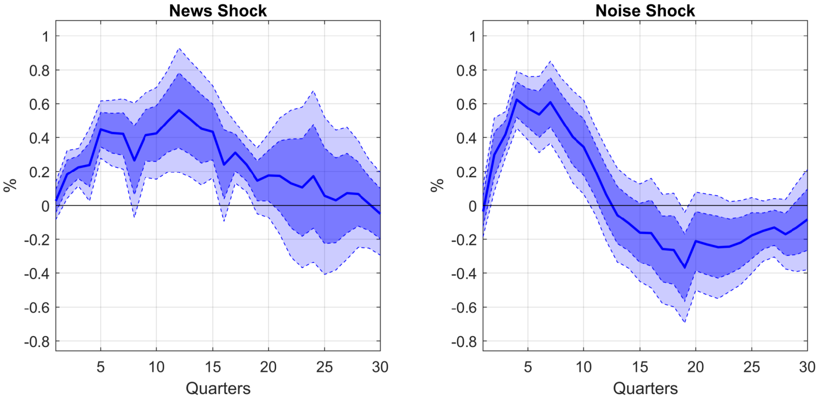
Back

Investment



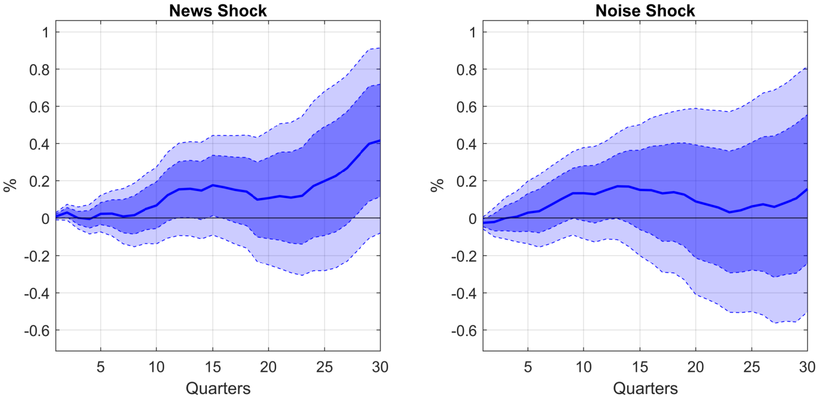
Back

Hours


News Shock
Noise Shock
%
Quarters
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
5
10
15
20
25
30

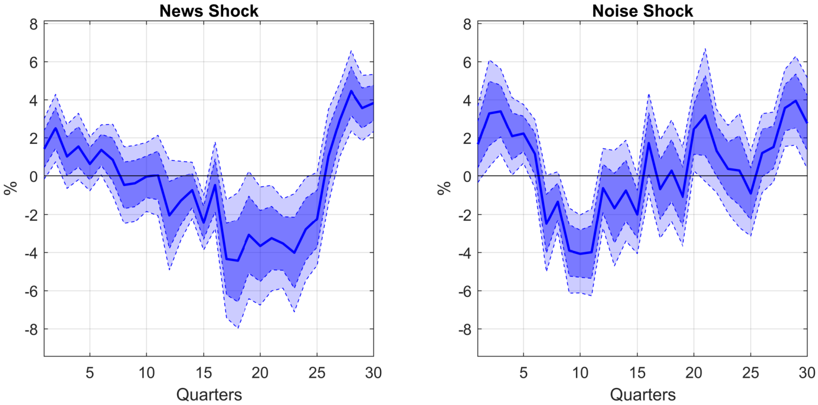
Back

Inflation



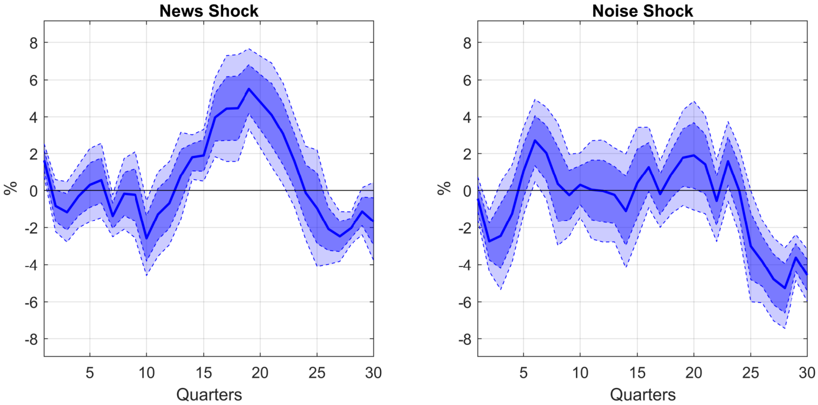
Back

SLOOS, higher demand



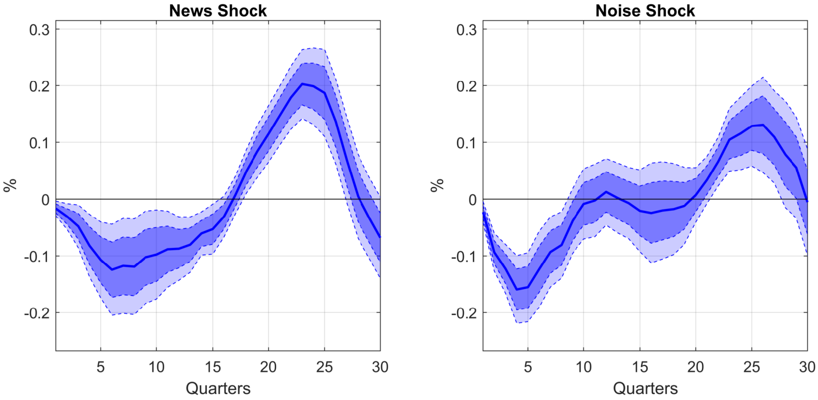
Back

SLOOS, banks tightening



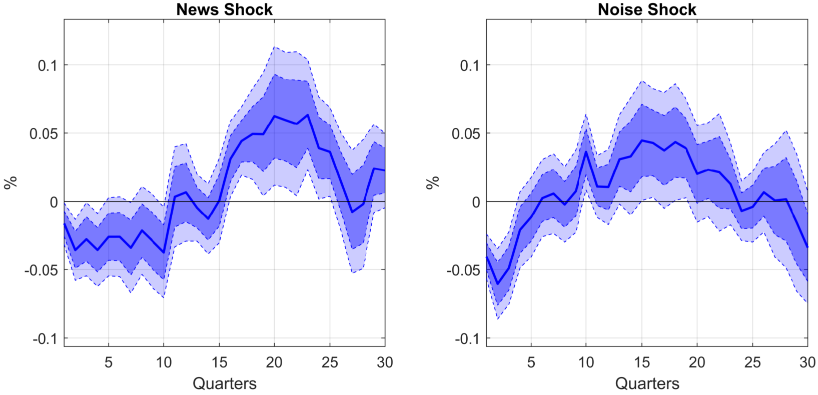
Back

Business loan delinquency rate



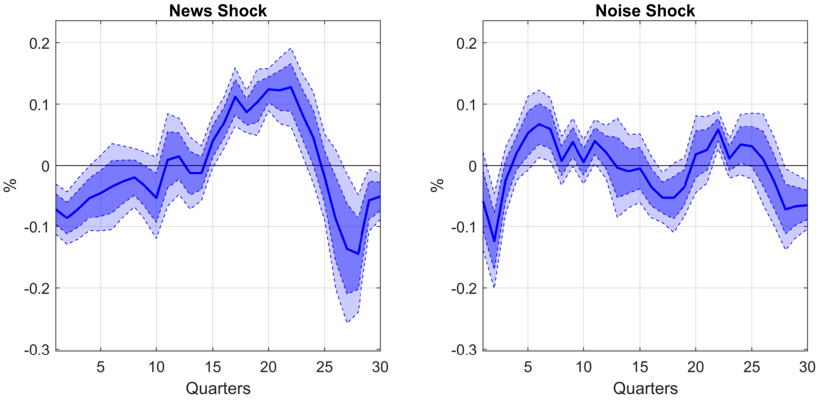
Back

AAA-10Y spread (liquidity premium)



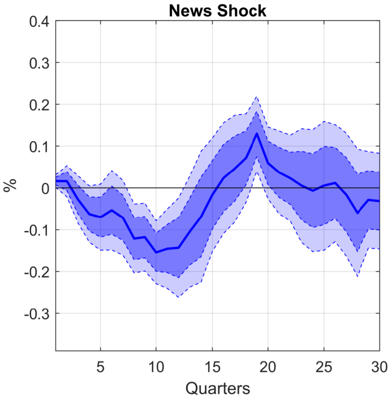
Back

Excess bond premium (risk premium)



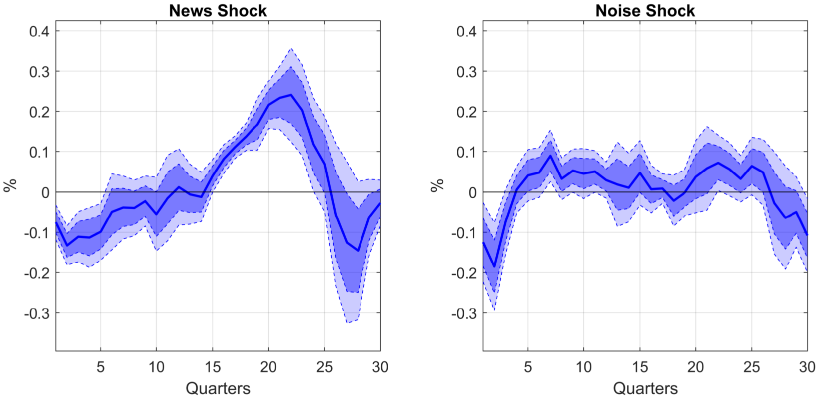
Back

10Y-3M treasury spread (term premium)



Back

GZ spread (risk premium)



Back