The Impact of Uncertainty in Bank Lending Standards

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Introduction

- Different studies evaluate how financial markets can amplify the propagation of economic uncertainty (Gilchrist et al., 2014; Arellano et al., 2019).
- Other studies find that uncertainty shocks originated in financial markets are an important source of output fluctuations (Bollerslev et al., 2009; Ludvigson et al., 2021).

Main questions:

- What is the impact of credit uncertainty (volatility) on real activity?
- How important is credit uncertainty on households and businesses in explaining the level and variance of macroeconomic variables?

▸ Literature

Bank Lending Standards

- Standards refer to any of the various non-price lending terms specified in a typical bank loan or line of credit, such as collaterals, covenants, loan limits, etc.
- The Senior Loan Officer Opinion Survey on Bank Lending Practices (SLOOS) reports the net percentage of domestic banks tightening standards across loan categories.
  - This survey is conducted by the Fed on a quarterly basis with the purpose of monitoring lending conditions in the banking sector.
  - Up to 80 U.S. commercial banks participate in each survey.
- So, we can think this variable as a direct measure of *credit conditions*.

▸ more BLS ▸ data BLS

In this paper

- Employ an SVAR model with stochastic volatility:

$$Y_t = c + \sum_{j=1}^{P} \beta_j Y_{t-j} + \sum_{k=1}^{K} b_k \tilde{h}_{t-k} + \Omega_t^{1/2} e_t, \quad e_t \sim \mathbb{N}(0, I_n),$$
$$\tilde{h}_t = \alpha + \theta \tilde{h}_{t-1} + Q^{1/2} \eta_t, \quad \eta_t \sim \mathbb{N}(0, I_n), \quad \mathbb{E}(\varepsilon_t, \eta_t) = 0,$$

  where Y_t is a vector of endogenous variables and $\tilde{h}_t$ is a vector of log-stochastic volatilities. The time-varying covariance matrix of the VAR residuals is

$$\Omega_t = A^{-1} H_t A^{-1'}, \quad H_t = \text{diag}\left(\exp \tilde{h}_t\right).$$

- θ is not diagonal but the covariance matrix Q is assumed diagonal.

- A determines the interpretation of structural shocks and hence their volatility.

Model specification and identification

- Identification is applied to the contemporaneous relationships among the levels of the reduced form shocks.
- Use bank lending standards, that reports how banks' credit standards for approving loans have changed, as a direct measure of credit supply conditions (1991Q3 - 2023Q4).
- Other variables: Real GDP growth, lending growth to households and private non-financial corporations, 3-month Treasury Bill rate, composite lending rate.[1] ▸ More about data
- The identification strategy uses contemporaneous sign restrictions to identify a contractionary credit shock (Gertler and Karadi, 2011):
  - A rise in credit standards decreases the lending growth and increases the lending rate.

[1] Weighted average of 30-year mortgage rate, rate on loans for new autos, rate on credit cards, rate on personal loans, prime loan rate, commercial and industrial loan rate.

Model specification and identification

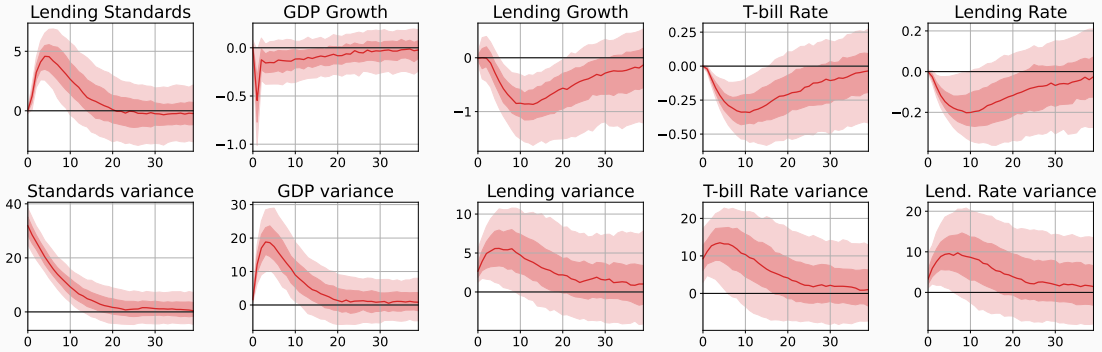
- The structure for A^{-1} is:

$$A^{-1} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31}^{(-)} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51}^{(+)} & a_{52} & a_{53} & a_{54} & 1 \end{pmatrix},$$

- The lag length in the VAR model is set to 3. Use 2 lags of the stochastic volatilities in the observation equation.

▸ More about the algorithm

IRs to an increase in the variance of credit standards shock



Notes: The solid line is the median. The light shaded area is the 84% error band while the dark shaded area is the 68% error band.

Volatility shocks contribution to the FEV

Level shocks

Variable	Horizon	Decomposition of level FEV		Decomposition of volatility FEV	
		All volat. shocks	Standards	All volat. shocks	Standards
Credit Standards	4 quarters	61.17	12.87	98.60	83.25
	20 quarters	82.05	16.50	88.55	49.56
	40 quarters	74.91	13.34	77.14	32.60
GDP growth	4 quarters	28.71	5.92	98.64	4.66
	20 quarters	46.64	9.44	90.00	10.25
	40 quarters	50.65	10.18	82.32	11.02
Lending growth	4 quarters	28.64	1.79	98.18	6.59
	20 quarters	67.69	14.76	85.40	12.79
	40 quarters	66.03	11.52	72.07	11.52
T-bill rate	4 quarters	51.38	12.69	98.58	8.73
	20 quarters	82.31	17.71	89.82	14.68
	40 quarters	70.55	11.84	80.47	13.19
Lending rate	4 quarters	37.82	12.36	98.70	4.23
	20 quarters	80.64	17.96	90.94	10.36
	40 quarters	69.71	11.57	82.89	10.39

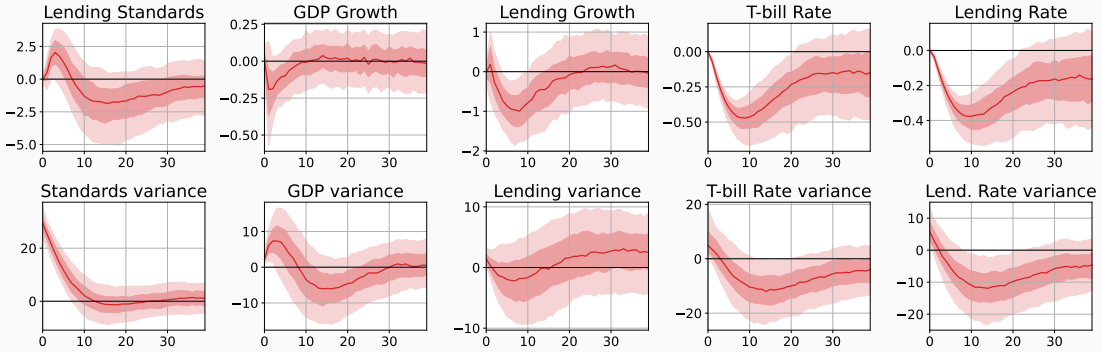
Hosueholds: IRs to an increase in the variance of credit standards shock

FEVD HH

Notes: The solid line is the median. The light shaded area is the 84% error band while the dark shaded area is the 68% error band.

Businesses: IRs to an increase in the variance of credit standards shock

FEVD Bus



Notes: The solid line is the median. The light shaded area is the 84% error band while the dark shaded area is the 68% error band.

Final Remarks

- The volatility of all endogenous variables rises in response to an increase in the variance of credit standards shock.
- The real GDP decreases, persistent decrease in credit growth, the T-bill rate, and lending rate.
- The credit standards volatility shocks explain more than 10% of the FEV of endogenous variables.
- Role of uncertainty shocks of credit standards on business loans to explain the decrease in output, interest rates and monetary policy response.
- Uncertainty shocks of credit standards on household loans do not have significant aggregate effects for variables in levels.

Appendix

Literature review

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- Literature emphasizes the role of economic uncertainty on macroeconomic fluctuations (Bloom, 2009; Jurado, Ludvigson, Ng, 2015; etc.).
- Alessandri and Mumtaz (2019) and Caldara et al. (2016). Credit markets are an important link in the propagation of macroeconomic uncertainty.
- Ludvigson, Ma and Ng (2021). Macroeconomic uncertainty is often an endogenous response to output shocks, while uncertainty about financial markets is a likely source of output fluctuations.
- Mian, Rao and Sufi (2013) and Guerrieri and Lorenzoni (2017). Contraction in households' borrowing capacity leads to a decline of consumer spending by adjusting their balance sheets.
- *How households and firms adjust from a regime of easy credit to one of tight credit is important*.

Bank Lending Standards

back

- Questions about changes in lending standards follow the general pattern of

  "Over the past three months, how have your bank's credit standards for approving loans of type X changed?"

$$I^S_{ikt} = \begin{cases} -1, & \text{if bank } i \text{ reported } \textit{easing} \text{ standards on loan category } k \text{ in quarter } t \\ 0, & \text{if bank } i \text{ reported no change in standards on loan category } k \text{ in quarter } t \\ 1, & \text{if bank } i \text{ reported } \textit{tightening} \text{ standards on loan category } k \text{ in quarter } t \end{cases}$$

- Then, the bank-level responses averaged over the N banks responding to that question in one specific quarter:

$$\Delta S_{kt} = 100 \left(\sum_{i=1}^{N} \omega_{i,k,t-1} \times I^S_{ikt} \right).$$

Bank Lending Standards

back

- Seven categories of core loans: (i) commercial and industrial, (ii) commercial real state, (iii) residential mortgages to purchase homes, (iii) home equity lines of credit, (iv) credit cards, (v) auto, and (vi) other consumer loans.

Bank lending standards

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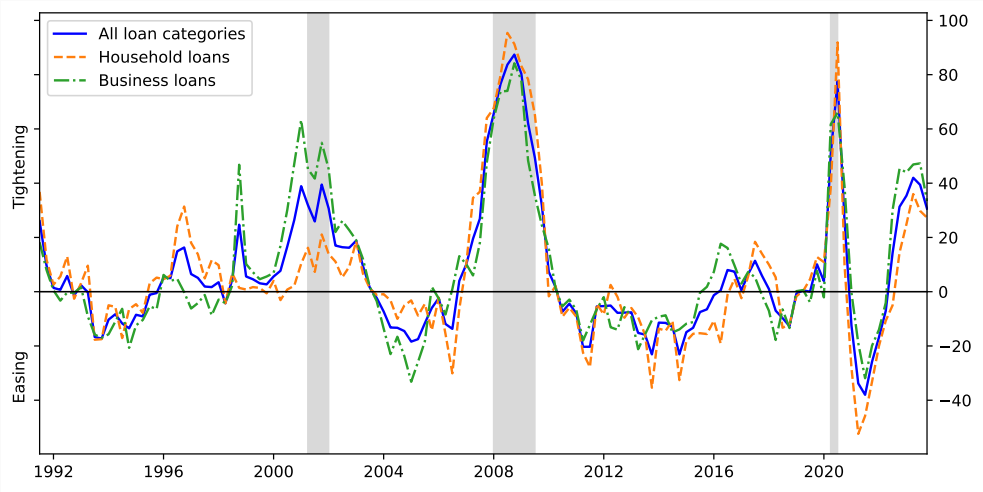

Data

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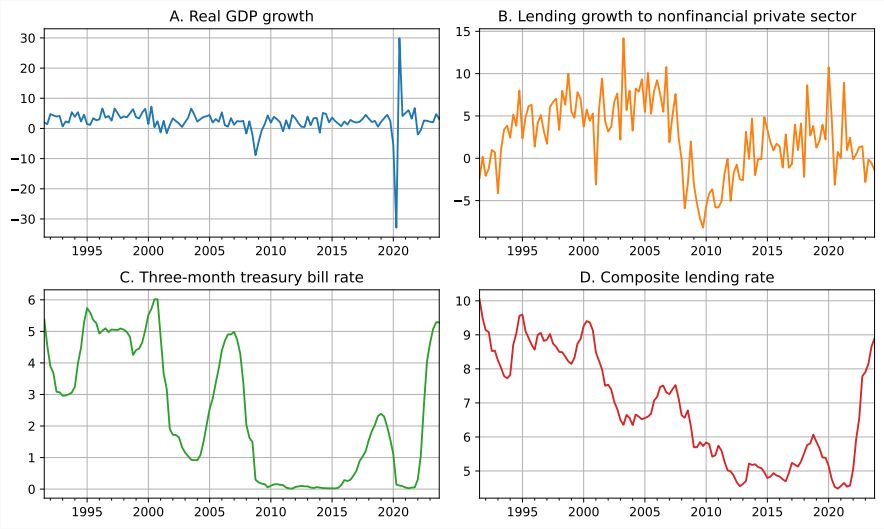
A. Real GDP growth
B. Lending growth to nonfinancial private sector
C. Three-month treasury bill rate
D. Composite lending rate
1995
2000
2005
2010
2015
2020

Composition of loans to non-financial private sector

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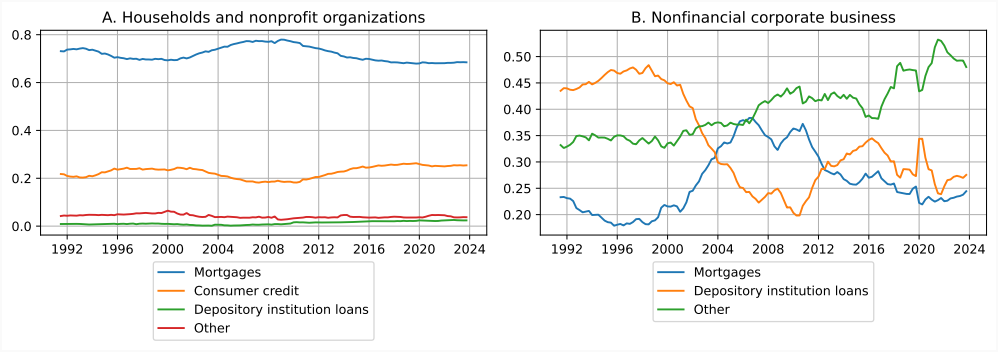

Dissagregated variables for households and businesses

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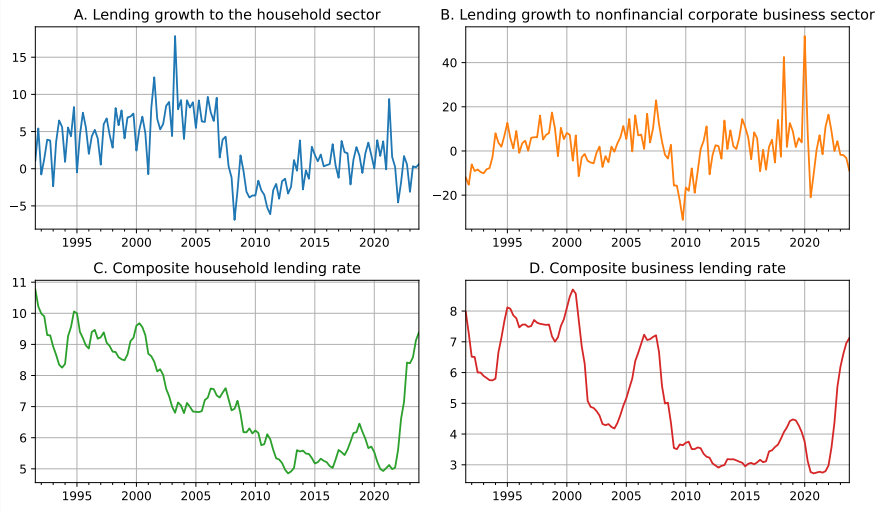

Algorithm and priors in the SV-SVAR model

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- The SV-SVAR is estimated with a Gibbs sampling algorithm discussed in Mumtaz and Theodoridis (2020).
- In summary, the algorithm proceeds in the following steps:
  1. The prior distributions for the VAR coefficients shrink the coefficient matrix towards an AR specification and are normal distributed with moments implemented via dummy observations. A training sample is used to compute the prior distributions for the matrices A and $H_{t=0}$.
  2. The observation equation is a VAR model with heteroskedastic disturbances, conditional on $\tilde{h}_t$ and A draws. The VAR representation is rewritten as a state-space model and a Kalman filter algorithm is used to draw from the conditional distribution of $\Gamma = vec([c; \beta_j; b_k])$.
  3. Given $\tilde{h}_t$ and Γ, the elements of the matrix A can be drawn using a series of linear regression models with a GLS transformation amongst the elements of the residual matrix $\Omega_t^{1/2} e_t$.

Algorithm and priors in the SV-SVAR model

back

4. Given the VAR coefficients and the parameters of the transition equation, the model has a multivariate non-linear state-space representation. A particle Gibbs with ancestor sampling is used to draw the posterior of $\tilde{h}_t$ following Lindsten et al. (2014) and Andrieu et al. (2010).
5. Conditional in the draw for $\tilde{h}_t$, the conditional posterior of the parameters in the transition equation $\Theta = vec([\alpha; \theta])$ is normal and can be drawn using standard results for linear regressions.

Level shocks contribution to the FEV

back

Variable	Horizon	Decomposition of level FEV		Decomposition of volatility FEV	
		All level shocks	Standards	All level shocks	Standards
Credit Standards	4 quarters	38.83	33.72	1.40	0.21
	20 quarters	17.95	8.10	11.45	1.89
	40 quarters	25.09	7.22	22.86	3.68
GDP growth	4 quarters	71.29	1.66	1.36	0.24
	20 quarters	53.36	4.28	10.00	1.88
	40 quarters	49.35	6.04	17.68	3.35
Lending growth	4 quarters	71.36	3.11	1.82	0.28
	20 quarters	32.31	2.87	14.60	2.39
	40 quarters	33.97	4.67	27.93	4.51
T-bill rate	4 quarters	48.62	2.16	1.42	0.23
	20 quarters	17.69	2.55	10.18	1.64
	40 quarters	29.45	5.04	19.53	3.33
Lending rate	4 quarters	62.18	0.69	1.30	0.21
	20 quarters	19.36	2.08	9.06	1.42
	40 quarters	30.29	4.42	17.11	2.82

Households: Contribution of volatility shocks to the FEV

back

Variable	Horizon	Decomposition of level FEV		Decomposition of volatility FEV	
		All level shocks	Standards	All level shocks	Standards
Credit Standards	4 quarters	20.25	3.52	98.49	42.46
	20 quarters	59.95	8.12	87.94	25.87
	40 quarters	66.01	9.33	77.54	20.02
GDP growth	4 quarters	17.76	1.60	98.75	2.57
	20 quarters	35.54	5.78	90.62	7.00
	40 quarters	42.72	7.54	82.59	8.00
Lending growth	4 quarters	27.81	1.43	97.79	18.10
	20 quarters	59.69	6.98	85.46	15.30
	40 quarters	65.15	8.22	73.18	13.39
T-bill	4 quarters	45.25	1.33	98.57	13.32
	20 quarters	81.36	6.06	90.06	16.66
	40 quarters	75.56	8.38	80.24	15.69
Lending rate	4 quarters	16.27	1.12	98.34	12.31
	20 quarters	72.32	5.63	89.60	15.69
	40 quarters	74.90	7.60	81.06	13.72

Businesses: Contribution of volatility shocks to the FEV

back

Variable	Horizon	Decomposition of level FEV		Decomposition of volatility FEV	
		All level shocks	Standards	All level shocks	Standards
Credit Standards	4 quarters	70.93	2.73	98.72	71.17
	20 quarters	84.01	7.69	90.60	27.80
	40 quarters	76.88	9.26	80.37	20.23
GDP growth	4 quarters	21.99	3.18	98.80	1.25
	20 quarters	39.94	6.41	91.31	5.11
	40 quarters	44.62	7.97	82.79	6.50
Lending growth	4 quarters	19.70	1.95	98.68	0.77
	20 quarters	53.33	7.43	90.73	4.32
	40 quarters	55.40	8.58	81.55	6.95
T-bill	4 quarters	60.24	45.12	98.60	1.69
	20 quarters	82.85	31.48	90.57	7.92
	40 quarters	72.51	14.72	81.57	9.39
Lending rate	4 quarters	43.19	28.20	98.46	1.93
	20 quarters	84.20	31.65	90.20	9.95
	40 quarters	75.55	14.70	81.68	10.67