

# Identifying the Macroeconomic Effects of Bank Lending Supply Shocks

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# Bank Lending and Economic Activity

- Little consensus about the role of the supply of bank loans in economic fluctuations.
- Banking sector can serve as a propagation mechanism for, or a source of, macroeconomic shocks:
  - ▶ “Bank lending channel”  
*Bermanke & Blinder (1988); Kashyap & Stein (1994,2000); Peek & Rosengren (2000)*
  - ▶ “Financial accelerator.”  
*Kiyotaki & Moore (1997); Bermanke, Gertler & Gilchrist (1999); Hall (2010)*
- Lack of consensus reflects difficult identification problems:
  - ▶ Shocks that affect the supply of bank loans likely have independent effects on the real economy, and
  - ▶ Even shocks that originate in the banking sector may reflect disturbances that have a separate effect on economic activity.

## Our Paper

- Uses **bank-level** data from the Senior Loan Officer Opinion Survey on Bank Lending Practices (SLOOS) to construct a measure of “loan supply shocks.”
- Loan supply shocks represent changes in credit standards that are orthogonal to:
  - ▶ Bank-specific changes in loan demand
  - ▶ Economic outlook and uncertainty regarding the outlook
  - ▶ Other bank-specific factors (e.g. profitability and asset quality).
- Examines the impact of loan supply shocks on the macroeconomy within the context of a standard VAR-X model.
- Most-related literature: Lown & Morgan (2006).

## Main Findings

- Pattern of loan supply shocks accords well with the narrative account of the credit conditions over the 1992–2010 period.
- Adverse shocks to bank loan supply have large real effects:
  - ▶ One standard deviation shock leads to a 4 percent decline in banks' core lending capacity after five years
  - ▶ And reduces level of real GDP by 1/2 percent over same period.
- Effects of lending shocks are asymmetric:
  - ▶ Tightenings in standards have larger effects than easings.
- Using loan supply shocks as instruments, estimate semi-elasticity of loan demand to be -1.4.

# Outline

- Data
- Identifying Loan Supply Shocks
- Macroeconomic Effects
- Extensions
- Conclusion

# Senior Loan Officer Opinion Survey (SLOOS)

- SLOOS queries banks about:
  - ▶ **Supply**: Changes in credit standards and loan terms
  - ▶ **Demand**: Changes in loan demand
  - ▶ Reasons for changes in loan demand and standards and terms
- Conducted quarterly with up to 60 banks participating:
  - ▶ **Qualitative** answers
  - ▶ Loan categories: C&I, CRE, RRE, HELOCs, CC, other consumer loans
  - ▶ Sample period: 1991:Q3–2010:Q3
  - ▶ In 2010:Q3 SLOOS respondents accounted for 70% of assets of the U.S. commercial banking sector

## Senior Loan Officer Opinion Survey (cont.)

- Prototypical question on changes in **credit standards**:

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

- ▶ **Answers:** 1=eased considerably; 2=eased somewhat; 3=unchanged; 4=tightened somewhat; 5=tightened considerably

- Prototypical question on changes in **loan demand**:

*Over the past three months, how has demand for loans of type  $j$  at your bank changed?*

- ▶ **Answers:** 1=increased considerably; 2=increased somewhat; 3=unchanged; 4=decreased somewhat; 5=decreased considerably



## Bank-Specific Diffusion Indexes

- Credit standards diffusion index:

$$\Delta S_{it}[j] = \begin{cases} -1 & \text{if bank } i \text{ eased standards on loan type } j \\ 0 & \text{if bank } i \text{ did not change standards on loan type } j \\ 1 & \text{if bank } i \text{ tightened standards on loan type } j \end{cases}$$

▶ **Diffusion index:**  $\Delta S_{it} = \sum_j w_{it}[j] \Delta S_{it}[j]$

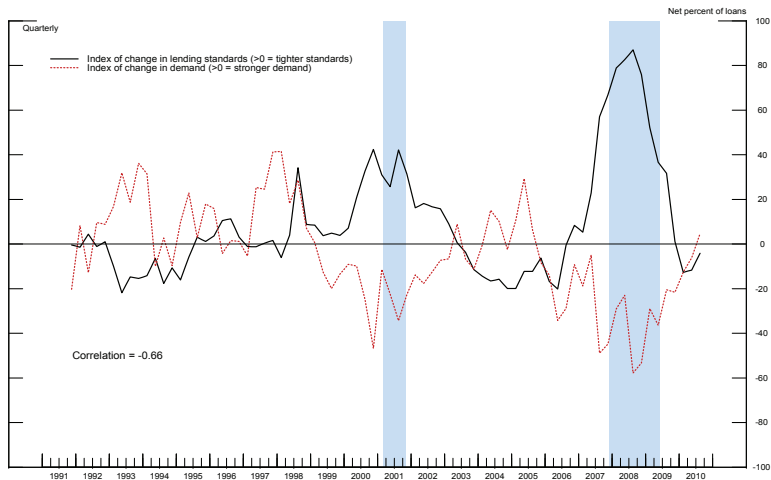
- Loan demand diffusion index:

$$\Delta D_{it}[j] = \begin{cases} -1 & \text{if bank } i \text{ had decreased demand for loan type } j \\ 0 & \text{if bank } i \text{ had no change in demand for loan type } j \\ 1 & \text{if bank } i \text{ had increased demand for loan type } j \end{cases}$$

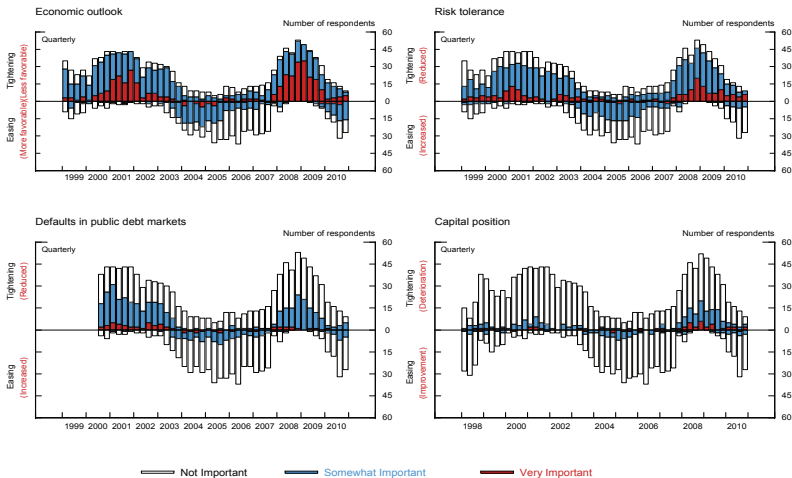
▶ **Diffusion index:**  $\Delta D_{it} = \sum_j w_{it}[j] \Delta D_{it}[j]$

# Aggregate Diffusion Indexes

(1991:Q3–2010:Q2)



# Why Do Banks Change Their Credit Standards?



# Empirical Framework

- Dynamic specification:

$$\Delta S_{it} = \alpha \Delta S_{it-1} + \beta \Delta D_{it} + \lambda' \mathbf{f}_t + \theta' \mathbf{z}_{it-1} + \eta_i + \epsilon_{it}$$

- ▶  $\mathbf{f}_t$  = vector of (observable) macroeconomic factors:
  - SPF expectations of year-ahead changes in short- and long-term interest rates and of real GDP growth
  - SPF and market-based measure of economic uncertainty
- ▶  $\mathbf{z}_{it}$  = vector of bank/BHC-specific factors:
  - bank-level indicators of profitability, asset quality, balance sheet composition
  - BHC-level indicators of trailing equity returns, volatility,  $q$ .

## Empirical Framework (cont.)

- Aggregate “loan supply shock” series:

$$\epsilon_t = \frac{1}{N_t} \sum_i \psi_{it} \hat{\epsilon}_{it}$$

- $\psi_{it}$  is ratio of bank  $i$ 's core loans to sample's at time  $t$ .

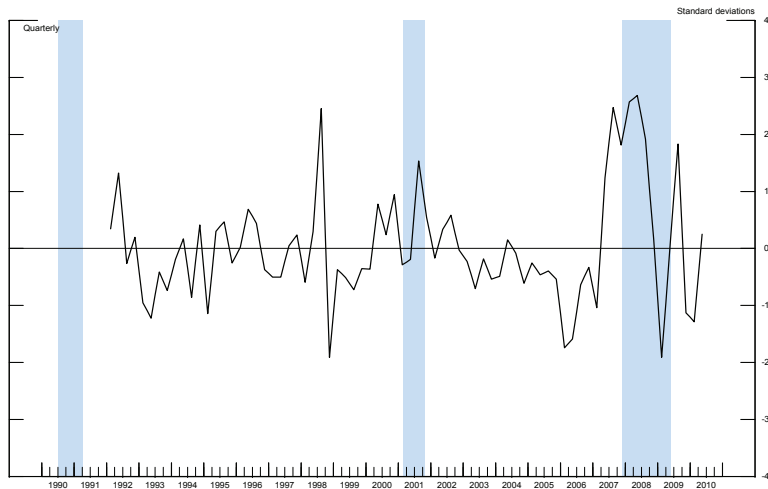
# Explaining Changes in Banks' Credit Standards

(1992:Q1–2010:Q2)

Variable	<i>Est.</i>	<i>S.E.</i>	<i>Est.</i>	<i>S.E.</i>	<i>Est.</i>	<i>S.E.</i>	<i>Est.</i>	<i>S.E.</i>
$\Delta S_{it-1}$	0.358	0.003	0.540	0.019	0.405	0.022	0.387	0.022
$\Delta D_{it}$	-0.054	0.001	-0.096	0.015	-0.075	0.013	-0.069	0.013
$E_t[r_{t+4}^{3m} - r_t^{3m}]$	-	-	-	-	-5.662	1.397	-4.237	1.594
$E_t[r_{t+4}^{10y} - r_t^{10y}]$	-	-	-	-	-6.597	3.192	-10.338	3.231
$E_t[y_{t+4} - y_t]$	-	-	-	-	-5.452	1.300	-4.369	1.319
CredSprd <sub><i>t</i></sub>	-	-	-	-	0.116	0.010	0.120	0.010
FrcstDisp <sub><i>t</i></sub>	-	-	-	-	-0.064	0.008	-0.047	0.009
NIM <sub><i>i,t-1</i></sub>	-	-	-	-	-	-	-8.638	3.406
DEL <sub><i>i,t-1</i></sub>	-	-	-	-	-	-	-1.064	0.524
$R_{E_{i,t-1}}$	-	-	-	-	-	-	-0.143	0.038
$\sigma_{E_{i,t-1}}$	-	-	-	-	-	-	-0.066	0.037
Tobin's $q_{i,t-1}$	-	-	-	-	-	-	0.070	0.094
CoreLoans <sub><i>i,t-1</i></sub>	-	-	-	-	-	-	0.291	0.099
CoreDep <sub><i>i,t-1</i></sub>	-	-	-	-	-	-	-0.138	0.072
Adj. $R^2$	0.140		0.389		0.439		0.449	
Bank Fixed Effects	-		Yes		Yes		Yes	

# Estimated Bank Loan Supply Shocks

(1992:Q1–2010:Q2)



## Macroeconomic Implications

- 5-variable VAR-X(2) specification:

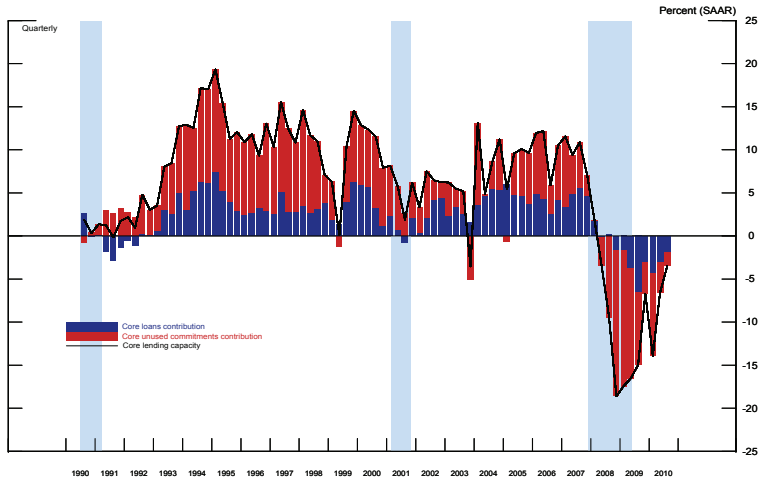
$$\mathbf{y}_t = \mathbf{c} + \mathbf{A}(L)\mathbf{y}_{t-1} + \beta\epsilon_t + \mathbf{u}_t$$

- Endogenous variables ( $\mathbf{y}_t$ ):
  - ▶ log-difference of real GDP
  - ▶ log-difference of the GDP deflator
  - ▶ log-difference of banks' **core lending capacity**  
(loans outstanding + unused commitments)
  - ▶ credit spread index  
(principal component of spreads on 11 corp. and hhd. loans)
  - ▶ target federal funds rate
- Estimation period: 1992:Q1–2010:Q3
- We cumulate responses of real GDP, core lending capacity



# Growth in Banks' Core Lending Capacity

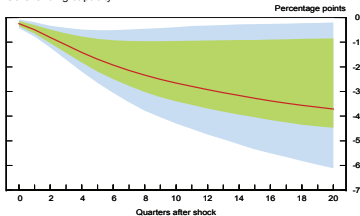
(1990:Q2–2010:Q3)



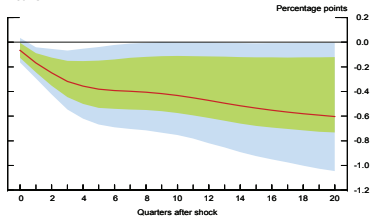
# Adverse Bank Loan Supply Shock

(1 standard deviation shock)

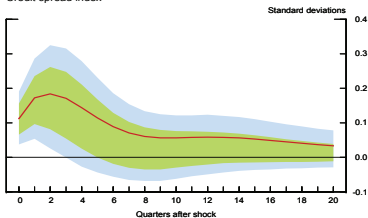
Core lending capacity



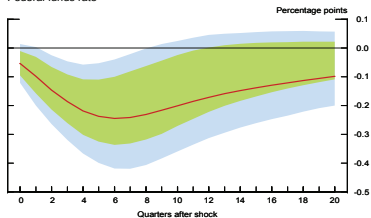
Real GDP



Credit spread index



Federal funds rate



## Comparison with SVAR

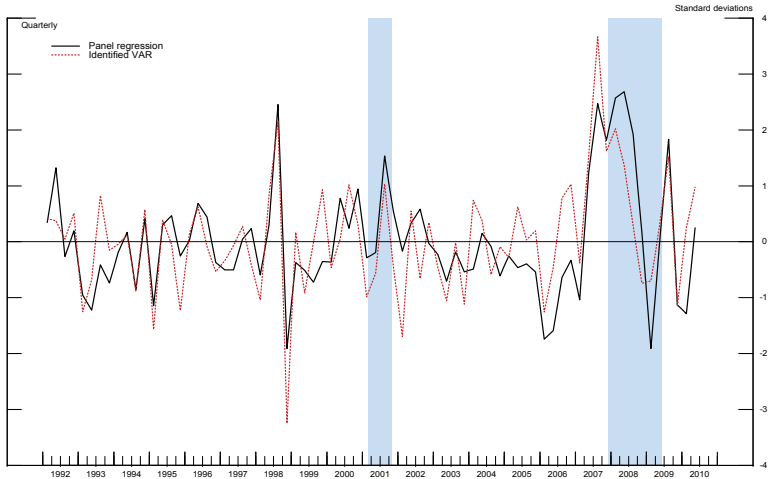
- 6-variable VAR(2) specification:

$$\mathbf{y}_t = \mathbf{c} + \mathbf{A}(L)\mathbf{y}_{t-1} + \mathbf{u}_t$$

- Order of endogenous variables ( $\mathbf{y}_t$ ):
  - ▶ log-difference of real GDP
  - ▶ log-difference of the GDP deflator
  - ▶ log-difference of banks' core lending capacity
  - ▶ credit spread index
  - ▶ target federal funds rate
  - ▶ change in aggregate credit standards diffusion index.
- Shocks to credit standards identified using the Choleski decomposition.

# Comparison of Bank Loan Supply Shocks

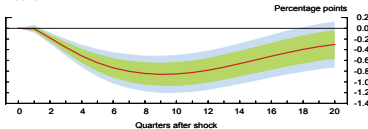
(1992:Q1–2010:Q2)



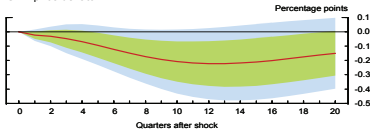
# IRFs: Recursive Ordering Identification

1 standard deviation shock

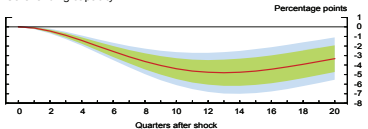
Real GDP



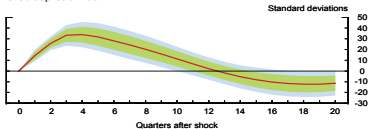
GDP price deflator



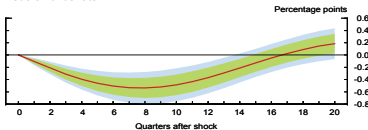
Core lending capacity



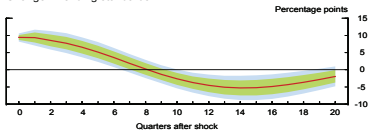
Credit spread index



Federal funds rate



Change in lending standards



# Asymmetric Shocks

- Asymmetric VAR-X(2) specification:

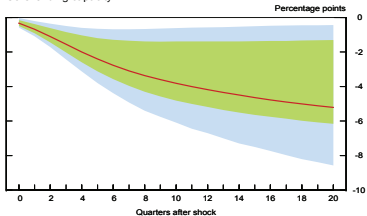
$$\mathbf{y}_t = \mathbf{c} + \mathbf{A}(L)\mathbf{y}_{t-1} + \beta^{(+)}\epsilon_t^{(+)} + \beta^{(-)}\epsilon_t^{(-)} + \mathbf{u}_t$$

- $\epsilon_t^{(+)}$  = **positive** loan supply shocks (i.e., “easing” shocks)
- $\epsilon_t^{(-)}$  = **negative** loan supply shocks (i.e., “tightening” shocks).

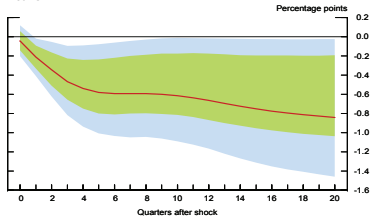
# Credit Tightening Shock

(1 standard deviation shock)

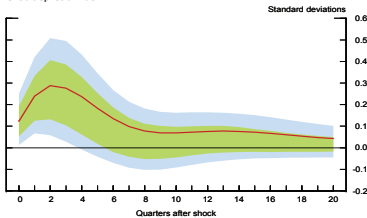
Core lending capacity



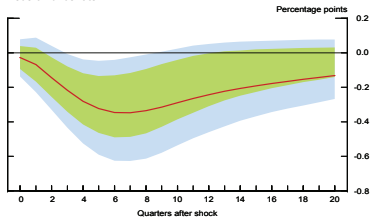
Real GDP



Credit spread index



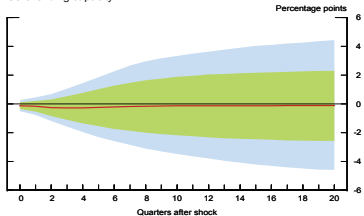
Federal funds rate



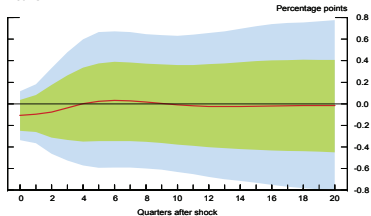
# Credit Easing Shock

(1 standard deviation shock)

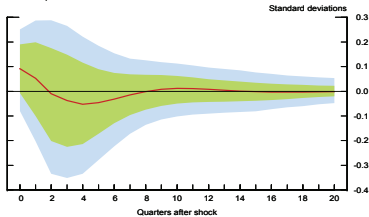
Core lending capacity



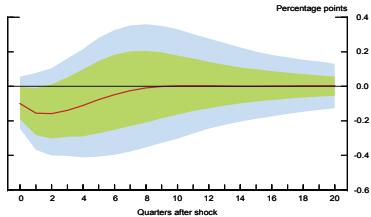
Real GDP



Credit spread index



Federal funds rate





## Estimating Slope of Loan Demand Curve

- If a good measure of loan supply shocks, series should also be a good instrument for estimating loan demand.
- We use the Federal Reserve's Survey of Terms of Business Lending to obtain business loan quantities and prices.
- Over 260,000 observations from 1997:Q2 to 2010:Q2.
- We restrict sample to unsecured loans to avoid dealing with collateral.
- We allow loans under commitment (credit lines) to have a different elasticity.
- We do both OLS, IV regressions of loan quantity on loan spread.

## Estimating Slope of Loan Demand Curve (cont.)

Dependent variable:  $Loansize_{ijt}$  (Log of loan size in thousands of dollars)

Explanatory Variable	(OLS)	(IV)
$Spread_{ijt}$	-0.61 (0.10)	-1.44 (0.45)
$Commit_{ij}$	-0.24 (0.56)	-0.75 (1.25)
$CommitSpread_{ijt}$	-0.07 (0.10)	0.11 (0.40)

## Concluding Remarks

- Recent financial crisis has highlighted the critical role that the financial system plays in economic fluctuations:
  - ▶ It may be a source of macroeconomic shocks,
  - ▶ Or a transmission mechanism for such shocks.
- Nevertheless, empirically quantifying the effects of financial shocks on the real economy remains difficult.
- Bank lending surveys offer a potentially a useful avenue through which to identify exogenous movements in bank loan supply.

## Concluding Remarks (cont.)

- We use one such survey—the SLOOS—to construct a measure of loan supply shocks.
- The shocks correspond well with narrative accounts.
- We estimate that adverse shocks to bank loan supply lead real GDP to decline by 1/2 percent, core lending capacity by 4 percent after five years.
- Adverse shocks have larger effects than beneficial ones.
- Using the shocks as instruments, we estimate the semi-elasticity of loan demand to be -1.4.