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”
  - “Financial accelerator.”
    - Kiyotaki & Moore (1997); Bernanke, 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.
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
  - 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

Quarterly

Index of change in lending standards (>0 = tighter standards)
Index of change in demand (>0 = stronger demand)

Correlation = -0.66

Net percent of loans
Why Do Banks Change Their Credit Standards?

- **Economic outlook**
  - Number of respondents: 60, 45, 30, 15, 0, 15, 30, 45, 60
  - Trends: Easing (More favorable), Tightening (Less favorable)

- **Risk tolerance**
  - Number of respondents: 60, 45, 30, 15, 0, 15, 30, 45, 60
  - Trends: Easing (Increased), Tightening (Reduced)

- **Defaults in public debt markets**
  - Number of respondents: 60, 45, 30, 15, 0, 15, 30, 45, 60
  - Trends: Easing (Improvement), Tightening (Deterioration)

- **Capital position**
  - Number of respondents: 60, 45, 30, 15, 0, 15, 30, 45, 60
  - Trends: Easing (Improvement), Tightening (Deterioration)

Legend:
- Not Important
- Somewhat Important
- Very Important
Empirical Framework

- Dynamic specification:

\[ \Delta S_{it} = \alpha \Delta S_{it-1} + \beta \Delta D_{it} + \lambda' f_t + \theta' z_{it-1} + \eta_i + \epsilon_{it} \]

- \( f_t \) = 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

- \( z_{it} \) = 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)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Est.</th>
<th>S.E.</th>
<th>Est.</th>
<th>S.E.</th>
<th>Est.</th>
<th>S.E.</th>
<th>Est.</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta S_{it-1}$</td>
<td>0.358</td>
<td>0.003</td>
<td>0.540</td>
<td>0.019</td>
<td>0.405</td>
<td>0.022</td>
<td>0.387</td>
<td>0.022</td>
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<tr>
<td>$\Delta D_{it}$</td>
<td>-0.054</td>
<td>0.001</td>
<td>-0.096</td>
<td>0.015</td>
<td>-0.075</td>
<td>0.013</td>
<td>-0.069</td>
<td>0.013</td>
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<tr>
<td>$E_t[r^3_{t+4} - r^3_{3m}]$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-5.662</td>
<td>1.397</td>
<td>-4.237</td>
<td>1.594</td>
</tr>
<tr>
<td>$E_t[r^{10y}_{t+4} - r^{10y}_t]$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-6.597</td>
<td>3.192</td>
<td>-10.338</td>
<td>3.231</td>
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<tr>
<td>$E_t[y_{t+4} - y_t]$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-5.452</td>
<td>1.300</td>
<td>-4.369</td>
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<td>CredSprd t</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.116</td>
<td>0.010</td>
<td>0.120</td>
<td>0.010</td>
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<tr>
<td>FrcstDisp t</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-0.064</td>
<td>0.008</td>
<td>-0.047</td>
<td>0.009</td>
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<td>NIM i,t-1</td>
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<td>-8.638</td>
<td>3.406</td>
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<td>DEL i,t-1</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-1.064</td>
<td>0.524</td>
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<tr>
<td>$R_{E_{i,t-1}}$</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-0.143</td>
<td>0.038</td>
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<tr>
<td>$\sigma_{E_{i,t-1}}$</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-0.066</td>
<td>0.037</td>
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<tr>
<td>Tobin’s $q_{i,t-1}$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.070</td>
<td>0.094</td>
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<tr>
<td>CoreLoans i,t-1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.291</td>
<td>0.099</td>
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<tr>
<td>CoreDep i,t-1</td>
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<td>-</td>
<td>-0.138</td>
<td>0.072</td>
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<tr>
<td>Adj. $R^2$</td>
<td>0.140</td>
<td>0.389</td>
<td>0.439</td>
<td>0.449</td>
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<td>Bank Fixed Effects</td>
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<td>Yes</td>
<td>Yes</td>
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</tr>
</tbody>
</table>
Estimated Bank Loan Supply Shocks
(1992:Q1–2010:Q2)
Macroeconomic Implications

• 5-variable VAR-X(2) specification:

\[ y_t = c + A(L) y_{t-1} + \beta \epsilon_t + u_t \]

• Endogenous variables \( y_t \):
  ▶ 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: 19920: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)
Comparison with SVAR

- 6-variable VAR(2) specification:
  \[ y_t = c + A(L)y_{t-1} + u_t \]

- Order of endogenous variables \((y_t)\):
  - 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
Asymmetric Shocks

- Asymmetric VAR-X(2) specification:
  \[ y_t = c + A(L)y_{t-1} + \beta^{(+)} \epsilon^{(+)}_t + \beta^{(-)} \epsilon^{(-)}_t + u_t \]

- \( \epsilon^{(+)}_t \) = 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)
Credit Easing Shock

(1 standard deviation shock)
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.)

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>(OLS)</th>
<th>(IV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Spread_{ijt}$</td>
<td>-0.61</td>
<td>-1.44</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.45)</td>
</tr>
<tr>
<td>$Commit_{ij}$</td>
<td>-0.24</td>
<td>-0.75</td>
</tr>
<tr>
<td></td>
<td>(0.56)</td>
<td>(1.25)</td>
</tr>
<tr>
<td>$CommitSpread_{ijt}$</td>
<td>-0.07</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.40)</td>
</tr>
</tbody>
</table>

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