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An Old Debate

• Do financial frictions operate through demand for credit?
  – Shocks to borrower net worth, NPV of project, collateral value of assets
  – Bernanke and Gertler (1989), Kiyotaki and Moore (1997)

• Or, do financial frictions operate through supply of credit?
  – Bank lending channel
  – Kashyap, Stein and Wilcox (1993)
This Paper

- Examine evidence for 2007-9 crisis, pointing to:
  - **Inelastic demand for credit** by firms
  - Sharp contraction in **supply of intermediated credit**
  - Shortfall made up by sharp increase in **demand for direct credit**
This Paper

• Examine evidence for 2007-9 crisis, pointing to:
  – **Inelastic demand for credit** by firms
  – Sharp contraction in **supply of intermediated credit**
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• **Question:** why is one dollar of credit through the banking system so different from one dollar of credit that flows directly?
  – Focus on behavior of banks
  – Checklist of stylized facts
This Paper

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- **Question**: why is one dollar of credit through the banking system so different from one dollar of credit that flows directly?
  - Focus on behavior of banks
  - Checklist of stylized facts

- Model of direct and intermediated credit from checklist
Figure 1. Credit to US non-financial corporate sector (US Flow of Funds, table L102)
Figure 2. Changes in outstanding corporate bonds and loans to US non-financial corporate sector. Loans are defined as sum of mortgages, bank loans not elsewhere classified (n.e.c.) and other loans (US Flow of Funds, table F102)
Figure 3. Credit to US non-corporate business sector (US Flow of Funds, table L103)
Figure 4. Risk premium versus expected default probability (Source: Egon Zakrajsek, based on Gilchrist and Zakrajsek (2012))
Figure 5. Bank and bond credit supply before crisis
Figure 6. Bank and bond credit supply following deleveraging by banking sector
Figure 7. Bank and bond credit supply following deleveraging by banking sector
Figure 8. **Evidence from UK:** Cumulative gross issuance of bonds by UK private non-financial corporations (Source: Bank of England Asset Purchase Facility Quarterly Report, 2012 Q3)
Corporate Finance of Banking

\[
\begin{array}{c|c|c}
A & L \\
\hline
\text{Assets} & \text{Equity} \\
\text{} & \text{Debt} \\
\end{array}
\]
Figure 9. Scatter chart of \{ (\Delta A_t, \Delta E_t) \} and \{ (\Delta A_t, \Delta D_t) \} for changes in assets, equity and debt of US investment bank sector consisting of Bear Stearns, Goldman Sachs, Lehman Brothers, Merrill Lynch and Morgan Stanley between 1994Q1 and 2011Q2 (Source: SEC 10Q filings)
Figure 10. Scatter chart of \( \{(\Delta A_t, \Delta E_t)\} \) and \( \{(\Delta A_t, \Delta D_t)\} \) for changes in assets, equity and debt of US commercial bank sector between 1984Q1 and 2010Q2 (Source: FDIC call reports).
Figure 11. BNP Paribas: annual change in assets, equity and debt (1999-2010) (Source: Bankscope)
Societe Generale: annual changes in assets, equity and debt (1999 - 2010)

\[ y = 0.996x - 3.15 \]
\[ R^2 = 0.9985 \]

Figure 12. Société Générale: annual change in assets, equity and debt (1999-2010) (Source: Bankscope)
Figure 13. Barclays: 2 year change in assets, equity and debt (1992-2010) (Source: Bankscope)
Figure 14. Société Générale: 2 year change in assets, equity and debt (1999-2010) (Source: Bankscope)
Book Equity or Market Cap?

• **Book equity**

  \[ \text{Value of bank's portfolio of claims} - \text{value of liabilities} \]

  Example: repo haircut

• **Market capitalization**

  \[ \text{Discounted value of free cash flows} \neq \text{Marked-to-market value of book equity} \]

We are interested in bank’s **portfolio decision** (lending and other claims). Hence, **book equity** is the appropriate concept.
Two Hypotheses

Hypothesis 1. *Net worth* (of the borrower or bank) is sufficient statistic for risk premium

Hypothesis 2. As well as net worth, *leverage of the intermediaries* determines risk premium
Figure 15. Leverage of US Securities broker dealer sector (Source: Federal Reserve Flow of Funds)
Checklist for the Banking Sector

• Bank lending changes dollar-for-dollar through change in debt, with equity “sticky”

• Equivalently, bank chooses leverage given pre-determined equity

• Implication: banking sector leverage is procyclical
Micro Evidence

- Sample: U.S. public firms 1998-2010

- Intersection between
  - Compustat
  - Loan Pricing Corporation (LPC) Dealscan database
  - Securities Data Corporation (SDC) New Bond Issuances database

- 3,896 firms with new financing between 1998 and 2010 (out of 11,538 in Compustat sample)
From Q2:2007 to Q2:2009: total amount 1/2, spread 4x
Split between Loans and Bonds

From Q2:2007 to Q2:2009: loans 1/4, bonds 2x
From Q2:2007 to Q2:2009: loans 4x, bonds 3x
Firms with Access to Both Loans and Bonds


Firms with access to both types of credit can be used to identify demand and supply shocks

To qualify: obtained credit during crisis, positive assets before crisis, non-missing firm characteristics

Sorting (rating and firm characteristics) based on Q2:2005
## One Dimensional Sorts

### Panel A: Amount

<table>
<thead>
<tr>
<th>Relative to median</th>
<th>Size</th>
<th>Tobin’s Q</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Loan</td>
</tr>
<tr>
<td></td>
<td>Before</td>
<td>Crisis</td>
</tr>
<tr>
<td>Below</td>
<td>0.313</td>
<td>0.383</td>
</tr>
<tr>
<td>Above</td>
<td>1.791</td>
<td>1.709</td>
</tr>
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</table>

*(more...)*
## Panel B: Cost

<table>
<thead>
<tr>
<th>Relative to median</th>
<th>Total</th>
<th>Loan</th>
<th>Bond</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
<td>t-stat</td>
</tr>
<tr>
<td>Size</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below</td>
<td>129.26</td>
<td>262.11</td>
<td>8.185***</td>
</tr>
<tr>
<td>Above</td>
<td>73.55</td>
<td>263.02</td>
<td>11.855***</td>
</tr>
<tr>
<td>Tobin's Q</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below</td>
<td>106.80</td>
<td>269.23</td>
<td>9.027***</td>
</tr>
<tr>
<td>Above</td>
<td>84.87</td>
<td>244.24</td>
<td>10.670***</td>
</tr>
<tr>
<td>Tangibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below</td>
<td>89.87</td>
<td>250.18</td>
<td>10.536***</td>
</tr>
<tr>
<td>Above</td>
<td>103.32</td>
<td>277.55</td>
<td>10.125***</td>
</tr>
<tr>
<td>Rating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below</td>
<td>132.94</td>
<td>302.43</td>
<td>10.949***</td>
</tr>
<tr>
<td>Above</td>
<td>42.54</td>
<td>190.99</td>
<td>10.868***</td>
</tr>
</tbody>
</table>

*(more...)*
Figure 16. New loans to large firms (upper tercile) before and after the crisis
Figure 17. Bond issuance by large firms (upper tercile) before and after the crisis in billions of dollars.
One Dimensional Sorts: Main findings

- Flow of new credit: **no change overall** (!)
  - New loans: sharp reduction;
  - New bonds: sharp increase.

- Spreads: sharp increase.
Logit Analysis for Bond Issuance

- Determinants of new loans and bonds in regression framework (Denis and Mihov 2003, and Becker and Ivashina 2011).

- Details:
  - Sample: new issuers, rated the quarter prior to issuance
  - Dependent variable: \( Bond \text{ Issuance}_{i,q} = 1 \) if bond issued during quarter \( q \), and \( = 0 \) if loan (robust to exclusion of simultaneous issuers, 191 obs.)
  - Independent variables: firm characteristics (as before)
  - Specification: logit model
### Panel A: logit regressions (dependent variable: bond issuance)

<table>
<thead>
<tr>
<th></th>
<th>Crisis</th>
<th>BD</th>
<th>EBP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
<td>0.337***</td>
<td>0.366***</td>
<td>0.354***</td>
</tr>
<tr>
<td></td>
<td>(0.042)</td>
<td>(0.042)</td>
<td>(0.042)</td>
</tr>
<tr>
<td><strong>Tobin’s Q</strong></td>
<td>0.061</td>
<td>0.119</td>
<td>0.087</td>
</tr>
<tr>
<td></td>
<td>(0.075)</td>
<td>(0.076)</td>
<td>(0.075)</td>
</tr>
<tr>
<td><strong>Tangibility</strong></td>
<td>-0.285</td>
<td>-0.236</td>
<td>-0.244</td>
</tr>
<tr>
<td></td>
<td>(0.203)</td>
<td>(0.206)</td>
<td>(0.211)</td>
</tr>
<tr>
<td><strong>Rating</strong></td>
<td>0.052***</td>
<td>0.045**</td>
<td>0.039*</td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.019)</td>
<td>(0.020)</td>
</tr>
<tr>
<td><strong>Profitability</strong></td>
<td>11.286***</td>
<td>11.733***</td>
<td>12.622***</td>
</tr>
<tr>
<td></td>
<td>(2.506)</td>
<td>(2.503)</td>
<td>(2.538)</td>
</tr>
<tr>
<td><strong>Leverage</strong></td>
<td>1.007***</td>
<td>0.798***</td>
<td>0.796***</td>
</tr>
<tr>
<td></td>
<td>(0.255)</td>
<td>(0.263)</td>
<td>(0.259)</td>
</tr>
<tr>
<td><strong>Loan supply proxy</strong></td>
<td>0.621***</td>
<td>-0.009***</td>
<td>0.591***</td>
</tr>
<tr>
<td></td>
<td>(0.087)</td>
<td>(0.001)</td>
<td>(0.046)</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>4,276</td>
<td>4,276</td>
<td>4,153</td>
</tr>
<tr>
<td><strong>Pseudo R-squared</strong></td>
<td>0.075</td>
<td>0.079</td>
<td>0.095</td>
</tr>
</tbody>
</table>

### Panel B: changes in implied probabilities

| **Loan supply proxy** | 0.140   | -0.179  | 0.238    |
Model Checklist

1. Direct and intermediated credit

2. In downturn, new loans contract but bond issuance increases

3. Spreads increase on both loans and bonds

4. Bank lending increases or decreases dollar for dollar with an increase or decrease in debt, with equity being sticky

5. Bank leverage is procyclical
Model of Direct and Intermediated Finance

- Banking sector

- Mean-variance investors who hold portfolio of (i) cash (ii) bank liabilities (iii) risky loans
Bank Credit Supply

Notation for balance sheet of bank

Bank

\[
\begin{array}{c}
C \\
E \\
L
\end{array}
\]

\[1 + r\quad \text{and} \quad 1 + f\]
Credit Risk


Project $j$ succeeds when $Z_j > 0$, where

$$Z_j = -\Phi^{-1}(\varepsilon) + \sqrt{\rho} Y + \sqrt{1 - \rho} X_j$$

$\Phi(\cdot)$ c.d.f. of standard normal, $Y$ and $\{X_j\}$ independent standard normals

$$\Pr(Z_j < 0) = \Pr \left( \sqrt{\rho} Y + \sqrt{1 - \rho} X_j < \Phi^{-1}(\varepsilon) \right)$$

$$= \Phi \left( \Phi^{-1}(\varepsilon) \right) = \varepsilon$$
Bank diversifies away idiosyncractic risk

Conditional on $Y$, defaults are independent.

Keep $C$ fixed but diversify: increase number of borrowers, reduce face value of individual loans

In the limit, realized value of assets is function of $Y$ only

$$w(Y) \equiv (1 + r) C \cdot \Pr(Z_j \geq 0|Y)$$

$$= (1 + r) C \cdot \Pr\left(\sqrt{\rho}Y + \sqrt{1 - \rho}X_j \geq \Phi^{-1}(\varepsilon) |Y\right)$$

$$= (1 + r) C \cdot \Phi\left(\frac{Y\sqrt{\rho} - \Phi^{-1}(\varepsilon)}{\sqrt{1 - \rho}}\right)$$

(*
Figure 18. The two charts plot the densities over realized assets when $C (1 + r) = 1$. The left hand charts plots the density over asset realizations of the bank when $\rho = 0.1$ and $\epsilon$ is varied from 0.1 to 0.3. The right hand chart plots the asset realization density when $\epsilon = 0.2$ and $\rho$ varies from 0.01 to 0.3.
**Turning Credit Risk Model on Its Head**

- Turn credit risk model on its head and think of it as credit supply model
  - Fix $E$. Determine credit supply $C_S$

  $$C_S = \frac{E}{1 - \frac{1+r}{1+r}\varphi (\rho, \alpha, \varepsilon)}, \quad \varphi \in (0, 1)$$

$\varphi$ is ratio of **notional liabilities** to **notional assets** to be derived below.
From (*), the c.d.f. of $w$ is

$$F(z) = \Pr(w \leq z)$$
$$= \Pr(Y \leq w^{-1}(z))$$
$$= \Phi(w^{-1}(z))$$
$$= \Phi\left(\frac{1}{\sqrt{\rho}} \left(\Phi^{-1}(\varepsilon) + \sqrt{1 - \rho} \Phi^{-1}\left(\frac{z}{(1 + r)C}\right)\right)\right)$$

Common risk factor $\rho$ determines shape of the density, with larger $\rho$ implying fatter tail.

**Value-at-Risk (VaR) rule:** keep enough equity to limit insolvency probability to $\alpha > 0$
Bank credit supply $C$ determined from

$$\Pr (w < (1 + f) L) = \Phi \left( \frac{\Phi^{-1}(\varepsilon) + \sqrt{1 - \rho} \Phi^{-1}\left(\frac{(1 + f)L}{(1 + r)C}\right)}{\sqrt{\rho}} \right) = \alpha$$

$$\frac{\text{Notional liabilities}}{\text{Notional assets}} = \frac{(1 + f) L}{(1 + r) C} = \Phi \left( \frac{\sqrt{\rho} \Phi^{-1}(\alpha) - \Phi^{-1}(\varepsilon)}{\sqrt{1 - \rho}} \right)$$

(1)

where

$$\varphi (\alpha, \varepsilon, \rho) \equiv \Phi \left( \frac{\sqrt{\rho} \Phi^{-1}(\alpha) - \Phi^{-1}(\varepsilon)}{\sqrt{1 - \rho}} \right)$$
Supply of Credit by Bank

Credit supply $C$ and demand for funding $L$ is obtained from (1) and balance sheet identity $C = E + L$

\[
C = \frac{E}{1 - \frac{1+r}{1+f} \cdot \varphi}, \quad L = \frac{E}{\frac{1+f}{1+r} \cdot \frac{1}{\varphi} - 1}
\]

Aggregation holds due to proportionality

\[
\text{Leverage} = \frac{1}{1 - \frac{1+r}{1+f} \cdot \varphi}
\]

Risk premium is well-defined

\[
\text{Risk premium} = (1 - \varepsilon) (1 + r) - 1
\]
$$1 + \frac{f}{\varphi} - 1$$

$$\frac{\epsilon/(1-\epsilon)}{\frac{E}{1-\varphi(1+f)}}$$

Credit Supply

Supply of credit

$C(r)$
Mean-Variance Investors

Loans are packaged into bonds that diversify away idiosyncratic risk.

Demand for bonds (supply of credit) by mean-variance investor with risk tolerance $\tau$

$$
\tau \frac{[(1 - \varepsilon) (1 + r) - 1]}{\sigma^2 (1 + r)^2}
$$

where $\sigma^2$ is variance of $w(Y)$. There are $N$ mean-variance investors, and $T = \tau N$. Aggregate supply of credit from mean-variance sector is

$$
C_H = \frac{T [(1 - \varepsilon) (1 + r) - 1]}{\sigma^2 (1 + r)^2}
$$

We need to work out $\sigma^2$. 
Figure 19. Left hand panel plots the normalized leverage ratio \( \varphi \) as a function of \( \varepsilon \). The right hand panel plots the variance \( \sigma^2 \) as a function of epsilon for two values of \( \rho \).
Market Clearing

\(\pi\) is risk premium, given by \((1 - \varepsilon)(1 + r) - 1\)

Credit market clears when **total demand** for credit is met by **direct** and **intermediated** credit.

\[
\frac{E}{1 - \frac{1 + \pi}{1 - \varepsilon} \phi} + T \frac{(1 - \varepsilon)^2 \pi}{\sigma^2 (1 + \pi)^2} = K(\pi)
\]
Bank Iso-Lending Curves

Points in \((\varepsilon, \pi)\)-space with \(C_B\) constant

\[
\pi (\varepsilon) = \left(1 - \frac{E}{C_B}\right) \frac{1 - \varepsilon}{\varphi (\varepsilon)} - 1 \tag{2}
\]

Slope of the iso-lending curve tends to \(+\infty\) as \(\varepsilon \to 0\)

\[
\pi' (\varepsilon) = - \left(1 - \frac{E}{C_B}\right) \left[ \frac{1 - \varepsilon}{\varphi^2 \varphi' (\varepsilon)} + \frac{1}{\varphi} \right] \tag{3}
\]

since \(\varphi' (\varepsilon) \to -\infty\) as \(\varepsilon \to 0\)
Figure 20. Iso-lending curves in $(\varepsilon, \pi)$-space for banks (left panel) and bond investors (right panel). Parameter values are as indicated in the boxes.
Two Main Results

**Proposition.** Under mild regularity conditions, risk premium $\pi$ is increasing in $\varepsilon$.

*Excess bond premium goes up in recessions*

**Proposition.** For demand for credit not too elastic, an increase in $\varepsilon$ is associated with a contraction of banking sector assets, both in absolute terms and as a proportion of the total credit received by borrowers.

*In recessions, bank lending contracts but bond lending expands.*
Figure 21. Crossing point for the iso-lending curves of banks and households.
Back to Our Main Question

Why is one dollar of credit through the banking system so different from one dollar of credit that flows directly?

Answer: Size of banking sector proxies for banking sector risk-taking. Procyclical behavior of banking sector drives the risk premium over the cycle.

• Economic activity (esp. investment) sensitive to risk premium.

• Spike in excess spreads is followed by decline in economic activity (Gilchrist, Yankov and Zakrajsek (2009), Gilchrist and Zakrajsek (2011))
Checklist for Macro Models

- Reconcile procyclical leverage with standard dynamic portfolio choice

- Incorporate explanatory power of balance sheet variables for asset pricing (Adrian, Moench and Shin (2012))

- Explore quantitative impact of shifting composition of credit

- ...
But How Does Leverage Affect Real Economy?

• Kahle and Stulz (2012)\textsuperscript{1} for 2007-9 crisis
  
  – Firms with no debt cut capital expenditure as much (sometimes more) as firms with debt

• We have shown that during crisis there was:
  
  – Sharp contraction in \textit{supply of intermediated credit}
  – Shortfall made up by increase in \textit{direct credit}
  – Cost of both types of financing rise sharply

\textsuperscript{1}Kahle and Stulz (2012) “Access to Capital, Investment and the Financial Crisis”
How Does Leverage Affect Real Economy?

- Total quantity of credit (bank and bond) may not be good indicator of financial conditions

- *Composition* of credit matters - i.e. relative size of banking sector to bond market
  - Bank deleveraging leads to spike in lending rates in both bank loans and bonds
  - Spike in spreads is followed by economic downturn (Gilchrist and Zakrajsek (2012))
Core and Non-Core Bank Liabilities

• **Core:** Liabilities to domestic household and non-financial claim holders

• **Non-Core:** Liabilities to financial intermediaries and foreign creditors

Ratio of non-core to core liabilities is:

• Procyclical

• Mirrors lowering of credit standards
New Borrowers

Borrowers

Banking Sector

Foreign Creditors

Domestic Depositors
Figure 22. **Spain**: banking sector total domestic credit (Source: Bank of Spain)
Figure 23. **Spain**: Core liabilities of banking sector (Source: Bank of Spain)
Figure 24. **Spain**: funding gap of Spanish banks (Source: Bank of Spain)
Figure 25. **Spain**: funding gap of Spanish banks (Source: Bank of Spain)
Insights on Current Conjuncture

- Bond markets have thawed

- But credit conditions faced by SME borrowers in Europe are still tight

- Conjunction of the two explained by peculiarity of banks

- Opening channel from bond market to bank credit (e.g. covered bonds) may improve credit conditions