Risk Overhang and Loan Portfolio Decisions: The Supply of Small Business Loans Before and During the Financial Crisis

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Introduction

- **Facts:** Banks hold small business loans in-portfolio.
  - Loans are illiquid assets due to information asymmetries.
  - Covariances across loans matter.
- **Theory:** Illiquidity and information asymmetry cause risk overhang that makes banks reject some NPV>0 loans:
  - Overhanging illiquid loans lock-up capital, and external capital funding for new loans is expensive.
  - New loan opportunities may have large positive covariances with overhanging loans.
- **Empirics:** We test whether loan overhang affects the supply of small business credit at commercial banks.

Introduction

- We estimate the business loan supply function for small U.S. banks between 1990 and 2010.
- The data are consistent with theory model:
  - Loan overhang effects exist throughout the sample period.
  - Overhang effects become stronger during the crisis (when illiquidity was arguably greater).
- We derive our regression specification directly from a model of loan supply with capital market imperfections (Froot, Scharfstein and Stein 1993, Froot and Stein 1998).
  - Bank lends in multiple sectors.
  - All loans are illiquid and have stochastic returns.
  - Loan returns covary across sectors.
  - Portfolio expansion requires costly external funding.
  - Banks set loan supply to maximize profits.

Loan Supply with Market Imperfections

$$NL_{ti}^{S} = -\sum_{j\neq i} NL_{tj}^{S}\frac{\sigma_{ij}}{\sigma_{ii}} - L_{t-1i} - \sum_{j\neq i} L_{t-1\,j}\frac{\sigma_{ij}}{\sigma_{ii}} + \left(-\frac{P''(W)}{P'(W)}\right)^{-1}\left(\frac{p_{ti}-\mu_{ti}}{\sigma_{ii}}\right)$$

	Hypothesis Name	Prediction	Variable Name
$\left(\frac{p_{ti}-\mu_{ti}}{\sigma_{ii}}\right)$	➔ risk-adjusted expected returns.	(+)	**RAR**
$\left(-\frac{P''(W)}{P'(W)}\right)^{-1}$	➔ risk tolerance.	(+)	**EQ**
$L_{t-1,i}$	➔ same-sector loan overhang.	(-)	**BUS**
$L_{t-1,j}$	➔ cross-sector loan overhang.	(-) if $\sigma_{ij} > 0$ (+) if $\sigma_{ij} < 0$	**RE, CON**
$NL_{t-1,j}$	➔ cross-sector new lending.	(-) if $\sigma_{ij} > 0$ (+) if $\sigma_{ij} < 0$	**NLC_RE, NLC_CON**

Data and Variables

- We estimate business loan supply for small U.S. banks.
  - Urban banks with assets < $2 billion (2010 $).
  - Quarterly data, 1990 – 2010.
  - Exclude "specialist" lenders.
  - 77,779 bank-quarter observations of 3,515 different banks.
- Small banks match the assumptions of the theory model:
  - Loans are relatively illiquid, especially business loans.
  - Do not have access to public capital markets.
  - Originate-and-hold, manage risk on-balance sheet, so cross-sector covariances matter.

Expected profit covariances (Table 3)

% of covariances that are negative		
	Pre-crisis 1990:Q1 - 2007:Q3	Crisis 2007:Q4 – 2010:Q4
Cov(BUS,RE)	60%***	
Cov(BUS,CON)	56%***	
Cov(RE, CON)		

***, ** and * indicate statistical difference from 50%.

Expected profit covariances (Table 3)

% of covariances that are negative		
	Pre-crisis 1990:Q1 - 2007:Q3	Crisis 2007:Q4 – 2010:Q4
Cov(BUS,RE)	60%***	
Cov(BUS,CON)	56%***	
Cov(RE, CON)	43%***	

***, ** and * indicate statistical difference from 50%.

Expected profit covariances (Table 3)

% of covariances that are negative		
	Pre-crisis 1990:Q1 - 2007:Q3	Crisis 2007:Q4 – 2010:Q4
Cov(BUS,RE)	60%***	42%**
Cov(BUS,CON)	56%***	53%*
Cov(RE, CON)	43%***	38%***

***, ** and * indicate statistical difference from 50%.

Estimating business loan supply equation

$$
\begin{aligned}
NLC_{t,BUS} \;=\; & \phi_{RE} NLC_{t,RE} + \phi_{CON} NLC_{t,CON} \\
& + \beta_{BUS} L_{t-1,\,BUS} + \gamma_{RE} L_{t-1,\,RE} + \gamma_{CON} L_{t-1,\,CON} \\
& + \lambda\; EQ_t \;+ \delta\; RAR_t + \Omega MACRO + error_{t,BUS}
\end{aligned}
$$

- We normalize loans by bank assets.
- Note: We cannot directly observe loan supply $NL^S{}_t$. Our proxy is "net lending change" = NLC_t = $L_t - L_{t-1}$.
- Note: Loans are not perfectly illiquid. Degree of illiquity will be reflected in the same-sector overhang coefficient β.
- Note: The effects of the loan covariances σ_{ij} are absorbed into the estimated cross-sector coefficients (ϕ, γ).

Estimating business loan supply equation

$$NLC_{t,BUS} = \phi_{RE} NLC_{t,RE} + \phi_{CON} NLC_{t,CON} + \beta_{BUS} L_{t-1,\,BUS} + \gamma_{RE} L_{t-1,\,RE} + \gamma_{CON} L_{t-1,\,CON} + \lambda\, EQ_t + \delta\, RAR_t + \Omega MACRO + error_{t,BUS}$$

- <u>Note</u>: NLC_{RE} and NLC_{CON} are clearly endogenous.
  - We employ 2SLS with instrumental variables.
  - Instruments include demand shifters (e.g., income growth, unemployment, home prices) that vary across states and across quarters.
- We include bank fixed effects, seasonal dummies, and state-level macro-economic conditions.

Pre-crisis Period(Table 4)

	Pre-Crisis Period	
	banks = 3,495	
Dependent variable:	NLC_BUS	
NLC_RE	0.3059*** (0.0615)	**Cross-sector new loans**
NLC_CON	0.8713*** (0.1600)	**Cross-sector new loans**
RE	0.0084*** (0.0013)	**Cross-sector overhang**
BUS	-0.0401*** (0.0022)	**Same-sector overhang**
CON	0.0109*** (0.0022)	**Cross-sector overhang**
RAR_BUS	0.0009** (0.0003)	**Risk-adjusted returns**
EQ	0.0235*** (0.0047)	**Risk tolerance**

Full sample, with Crisis dummies (Table 5)

Dependent Variable:	NLC_BUS
Sample:	**All banks**
NLC_RE	0.2817***
NLC_CON	0.8906***
RE	0.0083***
BUS	-0.0393***
CON	0.0101***
RAR	0.0008**
RAR*CRS	-0.0037*
∂NLC/∂RAR(CRS=1)	*-0.0029*
EQ	0.0235***
EQ*CRS	0.0061
∂NLC/∂EQ(CRS=1)	*0.0296****
CRS	-0.0003
∂NLC/∂CRS	*-0.0014***

Full sample, with Crisis dummies (Table 5)

Dependent Variable:	NLC_BUS	NLC_BUS	NLC_BUS
Sample:	**All banks**	**Low-equity banks**	**High-equity banks**
NLC_RE	0.2817***	0.3678***	0.2710***
NLC_CON	0.8906***	0.8223***	0.6242***
RE	0.0083***	0.0144***	0.0059***
BUS	-0.0393***	-0.0544***	-0.0438***
CON	0.0101***	0.0151***	0.0099***
RAR	0.0008**	0.0023***	0.0006*
RAR*CRS	-0.0037*	-0.0199***	-0.0022
∂NLC/∂RAR(CRS=1)	*-0.0029*	*-0.0175***	*-0.0015*
EQ	0.0235***	0.0640***	0.0204***
EQ*CRS	0.0061	-0.0947	0.0233**
∂NLC/∂EQ(CRS=1)	*0.0296****	*-0.0307*	*0.0437****
CRS	-0.0003	0.0121	-0.0031**
∂NLC/∂CRS	*-0.0014***	*-0.0037***	*-0.0016****

Three-loan model (Table 6)

Dependent Variable:	NLC_BUS	NLC_RE	NLC_CON
Sample:	**All banks**	**All banks**	**All banks**
NLC_BUS		1.8724***	2.7632***
NLC_RE	0.2817***		-1.1966***
NLC_CON	0.8906***	-0.6805***	
BUS	-0.0393***	0.0902***	0.1246***
RE	0.0083***	-0.0097***	-0.0136***
CON	0.0101***	-0.0122***	-0.0182***
RAR	0.0008**	-0.0000	0.0004
RAR*CRS	-0.0037*	0.0007*	0.0015*
∂NLC/∂RAR(CRS=1)	-0.0029	0.0007*	0.0019*
EQ	0.0235***	-0.0368***	-0.0543***
EQ*CRS	0.0061	-0.0062	-0.0160
∂NLC/∂EQ(CRS=1)	0.0296***	-0.0430**	-0.0704*
CRS	-0.0472***	0.0605***	0.0017
∂NLC/∂CRS	-0.0014**	0.0016**	0.0019*

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Conclusions

- Small banks manage their loan portfolios in a way that is consistent with modern portfolio theory.
  - Loan overhang reduces loan supply, both within and across lending sectors.
  - Low equity (reduced risk tolerance) and loan illiquidity exacerbate loan overhang effects.
- Bank lending behavior changed during the financial crisis:
  - Banks became less tolerant of risk.
  - Supply of credit to small business was rationed.

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Loan Supply with Market Imperfections

- The theory model yields the following loan supply function, which we attempt to estimate structurally:

$$NL_{ti}^{S} = -\sum_{j\neq i} NL_{tj}^{S}\frac{\sigma_{ij}}{\sigma_{ii}} - L_{t-1i} - \sum_{j\neq i} L_{t-1j}\frac{\sigma_{ij}}{\sigma_{ii}} + \left(-\frac{P''(W)}{P'(W)}\right)^{-1}\left(\frac{p_{ti}-\mu_{ti}}{\sigma_{ii}}\right)$$

$NL^{S}_{t,i}$	= new business loans.
$NL^{S}_{t,j}$	= new loans in other sectors (consumer, real estate).
σ_{ij}	= loan loss covariance between business and other sectors.
$L_{t\text{-}1,i}$	= existing (overhanging) business loans.
$L_{t\text{-}1,j}$	= existing (overhanging) loans in other sectors.
$P(W)$	= bank profits; W is “capital”; $P'(W)>0$, $P''(W)<0$.
$p_i-\mu_i$	= expected return on business loans, net of loan losses.
σ_{ii}	= variance of loan losses for business loans.