Financial Intermediation with Heterogeneous Projects:

An Application to the Japanese Credit Crunch

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Background

Stagnation in Japan during the 1990s:

- average growth rate of 1%
- lots of bad loans
- poor investment performance
- credit crunch, esp. small firms

Banks reject credit-worthy applicants despite their willingness to pay higher interest rate or post more collateral.

The Basle Accord

1988 international bank-capital agreement among the G-10 countries

- goals:
  - minimize the risk of the international banking system
  - minimize competitive inequality arising from differences among national bank-capital regulations
- minimum capital requirement: different risk-weighting scheme
  - 8% capital backing for loans
  - 0-1.6% capital backing for government securities
- implementation:
  - phase in from the end of 1990
  - takes full effect in 1992

Empirical Works on Credit Crunches

Hypotheses

- risk-based capital requirement (Basle Accord)
- higher regulatory scrutiny (bank regulators)
- voluntary risk reduction (bank managers)

Results

- U.S.: All (Sharpe, 1995; Peek and Rosengren, 1995; Wagster, 1999)
- Canada: Basle and regulators (Wagster, 1999)
- U.K.: regulators (Wagster, 1999)
- Japan: 1997 crunch (Woo, 1999, Motonishi and Yoshikawa, 1999)
  - near-zero nominal interest rate
  - injection of capital
  - relaxing capital adequacy requirement by accounting changes

Question

In the presence of a credit crunch, what policies can help? May some even hurt?

The crunch may be caused by regulatory requirements or internal risk management practice.

Credit Channels of Monetary Policy

Channels discussed in the literature

- the lending channel (Bernanke and Blinder, 1988)
- the balance sheet channel (Bernanke and Gertler, 1995)

Quantitative Models of Credit Channels

Fuerst (1995), Fisher (1996), Bernanke, Gertler and Gilchrist (1997), Cooley and Quadrini (1998)

The question still remains.

Tasks of This Paper

- To build a heterogeneous agent model of financial intermediation
  - be more precise about the credit decision of the bank
  - its concerns: return on loan, bad loans
  - failure happens, model it
  - heterogeneity of firms/investment projects
  - endogeneity of household, firm and bank decisions
- To generate a credit crunch by conservative bank lending
- To examine the effectiveness of monetary policy

Model Components

- A household
  - endowed with projects
  - external financing necessary
  - bank screening by net worth
  - idiosyncratic shock for unemployment
- A bank
  - collects deposits
  - allocate assets to loans and government bonds
  - risk management lending policy which potentially causes conservative lending in periods of reduced profitability and financial distress.
- A central bank that determines safe return

Households / Firms

$m*$ minimum net worth eligible for external financing

- Employed workers ($m < m^*$)
- Unemployed workers ($m < m^*$) prob u
- Entrepreneurs ($m \geq m^*$)
- Retirees prob τ
- Death prob δ

Momentary utility function:

$$U^{oc}(c) = \frac{(\xi^{oc} c^{1-\sigma})^{1-\rho} - 1}{1-\rho}$$

$oc \in \{W, U, E, R\}$

Workers

For a worker, $V^W(m) =$

$$\begin{aligned}
\max_{\{c^W, m'\}} \quad & \{U^W(c^W) + \beta[(1-\tau)[(1-u)V^W(m') + \\
& uV^U(m') + E_{r'}V^E(m', r')] + \tau V^R(m')]\} \\
\text{S.T.} \quad & c^W + m' = (1+R^d)m + y, \\
& V^W(m) = 0 \text{ if } m \geq m^*.
\end{aligned}$$

For an unemployed worker, $V^U(m) =$,

$$\begin{aligned}
\max_{\{c^U, m'\}} \quad & \{U^U(c^U) + \beta[(1-\tau)[(1-u)V^W(m') + \\
& uV^U(m') + E_{r'}V^E(m', r')] + \tau V^R(m')]\} \\
\text{S.T.} \quad & c^U + m' = (1+R^d)m + \theta y, \\
& V^U(m) = 0 \text{ if } m \geq m^*.
\end{aligned}$$

Entrepreneur

Being an entrepreneur

- n projects, r^{ij} of project x^{ij}, $x^i = \sum_j x^{ij}$
- external financing, $x_t^i = \phi m_t^i$ $(\phi > 1)$
- returns are risky
- bankruptcy of a project is possible
- personal bankruptcy also

$V^E(m, r)=$

$$\max_{\{c,m'\}} \quad \{U^E(c) + \beta[(1-\tau)[(1-u)V^W(m') + uV^U(m') + E_{r'}V^E(m', r')] + \tau V^R(m')]\},$$

$$\text{S.T.} \quad c = \max \begin{cases} c^{min}, & m + y - m' + \\ + \sum_{j=1}^{n} (1 + r^j)x^j - R^l(i - m) \end{cases}$$

$$\sum_{j=1}^{n} x^j = \phi m,$$

$$V^E(m, r) = 0 \text{ if } m < m^*.$$

The Bank

- collects deposits
- provides loans
- invests in Treasury bonds
- instruments: minimum collateral $m*$, lending rate R^l
- constraint 1: interest paid $=$ interest received - losses - costs
- constraint 2: losses/deposit ratio (α)
- constraint 3: banks cannot lend more than deposits accepted

Losses

- it is costly to liquidate
- if all projects of a household go bankrupt, the household gets minimal consumption

The Central Bank

Decides on Treasury bond interest rate (and deposit rate)

The central bank's impact

- can affect lending conditions: lending rate and minimum collateral
- side effects: savings decisions of workers also affected
- general equilibrium

Computation

- calibration to average characteristics of Japan 1982–1989
- assume initial values for some unknown parameters
- compute optimal decisions over an asset grid using value functions
- determine invariant distribution
- assess unknown parameters
- $\rightarrow$ benchmark, observe resulting α
- change conditions, try values of m^* and R^l

Calibration

- benchmark: 1982–1989
- average real lending rate: 4.52%
- retirement, minimum consumption and UI benefits: 15%
- ϕ=2.2 (debt/equity ratio), auditing fee 3%
- distribution of returns:

  $$-29.36\% \quad 8.67\% \quad 44.60\%$$

  $$0.62\% \quad 98.33\% \quad 1.05\%$$

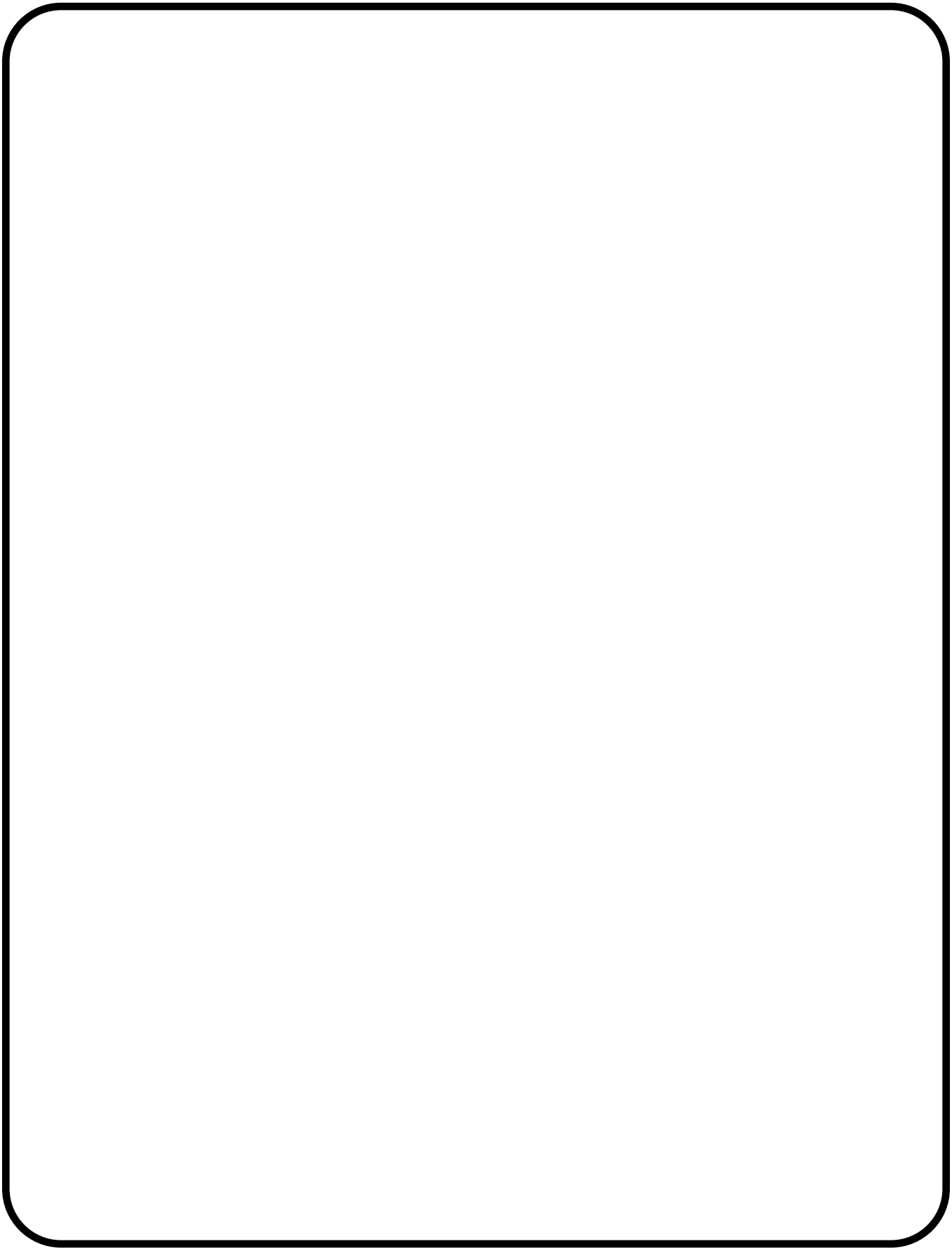
  Based on ROE, D/E ratio and the ratio of loan loss reserves to loans.
- 3% prob of retirement, 10% prob of death, unemployment rate: 2.6%, $n = 2$

Benchmark

- $m^* = 16.4$, $R^d = 4.43\%$, bonds are 18.4% of deposits (compare to 17%)
- 6% entrepreneurs, Gini on assets 0.47 (0.62)
- $\alpha = 0.067\%$

Results

- get a benchmark
- get a credit crunch
- see what monetary policy can do
- see what lending policy can do
- see what a cash injection can do



	Benchmark	Credit Crunch
Exogenous variables		
Deposit Rate, R^d (%)	4.43	4.43
Return Distribution [return (%), probability]	$\begin{bmatrix} -29.36 & 0.0062 \\ 8.67 & 0.9833 \\ 44.60 & 0.0105 \end{bmatrix}$	$\begin{bmatrix} -35.39 & 0.0138 \\ 3.94 & 0.9770 \\ 45.15 & 0.0090 \end{bmatrix}$
Unempl. Rate, u (%)	2.60	3.75
Debt/Equity, $\phi - 1$	2.67	2.69
Loss/Deposit, α (%)	0.067	0.067
Endogenous variables		
Cut-off Point, m^*	16.4	17.0
Lending rate, R^l (%)	4.52	4.70
Bonds/Deposit (%)	18.4	71.6
Total Loans	2.69	0.92
Total Deposits	3.29	3.24
Num. of Workers (%)	71	75
Num. of Entrepreneurs (%)	6	2
Wealth Gini Coefficient	0.47	0.42
Average Utility	-0.263	-0.283

Table 1: Japan, Steady State Analysis

	Interest Rate Reduction	Interest Rate Increase	Lenient Lending	Cash Injection	Cash Inj. & Int. R. Red.
Deposit Rate, R^d (%)	3.43	5.43	4.43	4.43	4.39
Loss/Deposit, α (%)	0.191	0.066	0.191	0.065	0.067
Cut-off Point, m^*	13.55	21.3	16.15	16.95	18.80
Lending rate, R^l (%)	3.67	5.67	4.67	4.67	4.63
Bonds/Deposit (%)	20.6	71.4	18.7	72.3	71.5
Total Loans	2.03	1.26	2.71	0.98	1.00
Total Deposits	2.55	4.39	3.34	3.55	3.51
Num. of Workers (%)	72	75	71	75	75
Num. of Entrepreneurs	5	2	6	2	2
Wealth Gini Coefficient	0.48	0.45	0.48	0.42	0.42
Average Utility	-0.293	-0.247	-0.264	-0.282	-0.283

Table 2: Japan, Policy Analysis

Conclusions

- Effects of monetary policy are limited, if not bad
- Implications for regulatory authorities
- Important to look at household side.

What next?

- production economy
- market for gvt bonds
- out-of-steady-state behavior
- more realistic capital regulation

With Martin Berka (UBC)

More realistic capital regulation

- Households hold shares in a mutual fund
- Mutual fund maximizes risk-adjusted return on portfolio:
  - bank deposits (insured)
  - bank equity
- Capital requirements are relative to equity
- Complex: possible corner solutions

Out-of-steady-state behavior

- Markovian aggregate shocks
- Distribution of assets evolves
- Banks react accordingly
- Trade-off during a downturn:
  - Banks reduce loans to satisfy requirements
  - Thus more people can hold equity
  - But banks are now more risky, people want to hold less equity
  - And people have less incentives to accumulate assets
  - Distribution of assets is crucial