Principles of Banking (II): Microeconomics of Banking (4) Credit Market

Jin Cao
(Norges Bank Research, Oslo & CESifo, München)
Outline

1. Introduction

2. Credit Rationing in Market Equilibrium
   - Adverse selection and credit demand
   - Credit supply and credit rationing
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Bank-borrower relationship

- So far we have focused mostly on *liability side* frictions
  - Uncertainty in depositors’ liquidity preference leads to *liquidity risk*, and principal-agent problems imply that *capital* is needed to align banks’ incentives;
  - With a little touch on asset side: *liquid assets* needed to buffer liquidity shocks;
- However, main problem on asset side is banks’ decision on risky loans, or *bank-borrower relationship*
  - Obviously plagued by *uncertainty* and *asymmetric information*;
  - Which lead to *credit risks* in banking.
Loanable funds and credit rationing

- A result of such frictions is the puzzling credit rationing phenomenon
  - Borrowers’ demand for credit is higher than available loans provided by banks ("unsatisfied fringe of borrowers", Keynes, 1930);
  - Some borrowers’ demand is turned down even if they are willing to pay higher interest rate for loans;
- Is it consistent with basic demand and supply analysis
  - Given that banks are profit-maximizing?
  - Any implication on banks’ risk-taking incentives?
Credit rationing obviously happens in temporary market disequilibrium: e.g., frictions that prevent market from quickly adjusting to shocks;

Credit rationing can emerge as a permanent phenomenon in equilibrium: increasing loan rate leads to

- Higher interest income from loans, but
- Riskier projects chosen by borrowers due to adverse selection;
- Profit-maximizing loan supply balances these two effects, with implied loan rate lower than market clearing rate;

We’ll focus on the second type of credit rationing.
Agents, technology and information

- There are many risk-neutral entrepreneurs in the economy, each
  - Has a project which needs initial investment $k$;
  - Has wealth $W < k$: needs to borrow $L = k - W$ to start the project;
  - Has an outside option: deposit in banks with safe return $\delta$;
- Projects are identical in rate of return, but different in risk. For entrepreneur $i$’s project:
  - Returns $R_i$ if successful, with probability $p_i$ (with probability density function $f(p_i)$); zero otherwise;
  - Expected return $R_0 = R_i p_i$ is identical for all projects;
  - Likelihood of success $p_i$ is entrepreneur’s private information.
There are risk-neutral banks in the economy

- Issue loan $L$ to each entrepreneur who wants to start projects;
- Do not know $p_i$ of each entrepreneur;
- Compete in deposit market, maximizing gross return to depositors;
- Charge uniform loan rate $r$ to maximize gross return. Assume $R_i > (1 + r)L$ for all entrepreneurs: loans are fully paid when projects are successful; zero otherwise.

There are depositors (not explicitly modelled), whose aggregate supply of deposit $d(\delta)$ is an increasing function of deposit rate $\delta$. 
Credit demand

- The expected return to individual entrepreneur is
  \[ E[\pi_i] = p_i[R_i - (1 + r)L] = R_0 - p_i(1 + r)L \geq (1 + \delta)W; \]
  \[ p_i \leq \frac{R_0 - (1 + \delta)W}{(1 + r)L} = \bar{p}(r); \]

- The participation constraint implies
  - Only risky entrepreneurs with \( p_i \leq \bar{p}(r) \) will borrow;
  - And \( \frac{d\bar{p}(r)}{dr} < 0 \) implies higher loan rate increases the riskiness of loans: adverse selection.
The aggregate demand of loans is decreasing with \( r \), and with \( \frac{d\bar{p}(r)}{dr} < 0 \) this gives the demand curve for loans:

\[
D(r) = L \int_{0}^{\bar{p}(r)} f(p_i) \, dp_i,
\]
Equilibrium loan rate and credit supply

- The banks’ decision problem is

\[
\max_r E[\pi_b] = (1 + r) L \int_0^{\bar{p}(r)} p_i f(p_i) dp_i;
\]

- The effect of increasing loan rate is

\[
\frac{dE[\pi_b]}{dr} = L \int_0^{\bar{p}(r)} p_i f(p_i) dp_i + \left(1 + r\right) \frac{d\bar{p}(r)}{dr} \left(1 + r\right) L\bar{p}(r) f(\bar{p}(r));
\]

- Two diverting effects:
  - \((A) > 0\): \(r \uparrow\) increases profit from the borrowers;
  - \((B) < 0\): \(r \uparrow\) decreases the threshold of borrowers, less but riskier borrowers: lower quality for the pool of loans.
The equilibrium loan rate $r^*$ is determined by

$$\frac{dE[\pi_b]}{dr} = 0;$$

And the deposit rate $\delta$ is determined by zero profit condition

$$E[\pi_b] = (1 + r) \int_{0}^{\overline{p}(r)} p_i f(p_i) \, dp_i = (1 + \delta) \int_{0}^{\overline{p}(r)} f(p_i) \, dp_i,$$

where

$$1 + \delta = \frac{(1 + r) \int_{0}^{\overline{p}(r)} p_i f(p_i) \, dp_i}{\int_{0}^{\overline{p}(r)} f(p_i) \, dp_i}.$$
The relationship between deposit and loan rates is

\[
\frac{d\delta}{dr} = \frac{\int_0^{\bar{p}(r)} p_i f(p_i) \, dp_i}{\int_0^{\bar{p}(r)} f(p_i) \, dp_i} - \left(1 + r\right) \frac{\int_0^{\bar{p}(r)} p_i f(p_i) \, dp_i \bar{p}'(r) f(\bar{p})}{\left[\int_0^{\bar{p}(r)} f(p_i) \, dp_i\right]^2} + \frac{(1 + r) \bar{p}'(r) \bar{p} f(\bar{p})}{\int_0^{\bar{p}(r)} f(p_i) \, dp_i} \geq 0; \tag{A}
\]

\[
\left(1 + r\right) \frac{\int_0^{\bar{p}(r)} p_i f(p_i) \, dp_i \bar{p}'(r) f(\bar{p})}{\left[\int_0^{\bar{p}(r)} f(p_i) \, dp_i\right]^2} \leq 0; \tag{B}
\]

Two diverting effects on \(\delta\):

- \((A) > 0\) (remember \(\bar{p}'(r) < 0\)): \(r \uparrow\) increases gross profit, more return to depositors;
- \((B) < 0\): \(r \uparrow\) attracts only riskier borrowers, more projects fail, less return.
Banks’ loanable funds, or loan supply, is determined by deposits they collect, \( d(\delta) \), an increasing function of \( \delta \).

- \( \delta \) may increase with \( r \) (when \( r \) is small) or decrease with \( r \) (when \( r \) is large);
- Implies banks’ loan supply is a hump-shaped curve.

\[ \ell \]
Credit rationing

- The equilibrium \((r^*, \ell^*)\) implies credit rationing: excess demand for loans \(Z = \tilde{\ell} - \ell^*\).

Banks would never choose \(\hat{\ell}\) — which implies market clearing rate \(\hat{r}\) — since profit is not maximized under \(\hat{\ell}\): \(\hat{r}\) would attract too many risky projects and increase the likelihood of failure.
Conclusion

- Bank-borrower relationship is heavily plagued by *asymmetric information*: strong implication for banks’ *risk management* and *credit supply*
  - Borrowers may behave improperly, pocketing private benefit and leaving too much risk to banks;
  - Banks have to take this into account when issuing loans: to induce borrowers to behave as desired, and cut back credit supply to minimize losses from risky loans;

- *Credit rationing* happens in equilibrium, so that some borrowers’ credit demand has to be rejected
  - Lower loan rate than market clearing rate, avoiding attracting too many risky projects;
  - Credit rationing is optimal, as long as *adverse selection* problem exists.
References

(★: Recommended reading)

