Principles of Banking (II): Microeconomics of Banking (5) Industrial Organization of Banking

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Outline

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(If they care about what I say,) the views expressed in this manuscript are those of the author’s and should not be attributed to Norges Bank.
The industrial organization of banking

- Industrial organization (IO) is all about *competition*, *market structure*, and *market power*;
- Classical IO questions are still valid for banking industry, for example
  - Competition structure? Seems to be *oligopolic* in many countries: a few big banks plus numerous smaller ones;
  - Market outcome? How are *prices* (borrowing and lending rates) determined as a result of competition? How much do they reflect the market power?
  - Market competition and *consumer welfare*, abuse of market power, regulation, etc.
However, there are also many IO questions special to banking, or more important than other industries.

- Banks are competing in both loan and deposit markets, which makes it less obvious for analyzing banks’ strategic behavior and market outcomes;
- Market outcomes in banking (e.g. aggregate credit supply) have strong implication for macroeconomy, and are also subject to macroeconomic shocks. Feedback between the two adds more challenges to IO of banking;
- Bank competition greatly relates to banks’ risk-taking behavior: beyond consumer welfare, it has strong implication for financial stability;
- Market structure evolves with bank competition: banking dynamics has to be taken into account for regulation.
In this course, we focus on one issue from IO of banking: *competition* and *stability*. Obviously competition reduces banks’ profit margin, while the further consequence is not that obvious: Does higher competition induces banks to take more risks, destabilizing the entire financial system? Three hypotheses.

- **Charter value hypothesis**
  - Banks want to maximize its discounted value of future profits, or *charter value*; while
  - Higher competition erodes banks’ future profits, so that they will invest more on risky assets;
  - Bank competition is *destabilizing* the financial system.
Bank competition and financial stability (cont’d)

- **Moral hazard hypothesis**
  - Banks may use its market power to exploit borrowers (entrepreneurs), leading to *high* loan rates;
  - High loan rates encourage *moral hazard* incentives, inducing entrepreneurs to take *riskier* projects. This gives entrepreneurs higher private return, while increases the likelihood of projects’ failure;
  - Higher bank competition reduces banks’ market power, hence results in *lower* loan rates, easing moral hazard problem. Entrepreneurs will choose *safer* projects;
  - Bank competition is *stabilizing* the financial system.
Bank competition and financial stability (cont’d)

- **Information production hypothesis.** May refer to two propositions:
  - *Monitoring incentives.* Competition in deposit market raises banks’ funding cost ⇒ induces banks to cut down monitoring costs ⇒ more failure from projects ⇒ destabilizing financial system;
  - *Winner’s curse from screening projects*
    - Screening technology is *imperfect*: bad projects may be selected as good ones and get loans, good projects may be rejected as bad ones;
    - If number of banks is low, increasing number of banks raises the share of good ones in selected projects, however
    - If the number passes a certain threshold, further increasing number reduces the share of good ones in selected projects;
    - Competition may stabilize / destabilize financial system.
A theory of bank competition and financial stability

- Boyd & De Nicolò (2005) provides a theory of bank competition and financial stability, capturing both charter value concerns and moral hazard problem;

- Whether competition stabilizes or destabilizes financial system depends on who is taking the risks
  - If banks are choosing projects: more competition ⇒ higher funding cost ⇒ riskier projects ⇒ lower stability; However,
  - If there’s a loan market and entrepreneurs are choosing
    - If banks set too high loan rate, entrepreneurs would go for riskier projects, higher likelihood of failure where banks are left with nothing;
    - Therefore, banks will give up some rents and set lower loan rate, inducing entrepreneurs play safer;
    - More competition ⇒ lower loan rates ⇒ safer projects ⇒ higher stability.
There are \( N \) risk neutral banks engaged in Cournot competition (on quantity) in deposit market. They

- Have no initial resources, no bank capital;
- Have access to a constant return-to-scale (CRS) technology with variable net return \( R \). \( R \) can take any value over \([0, R]\).

For any project \( R \) chosen by a bank

- It returns \( R \) with probability \( p(R) \), 0 otherwise;
- Assumption 1: \( p(0) = 1, p(R) = 0, p'(\cdot) < 0, p''(\cdot) \leq 0 \).

Riskier project yields higher return. The assumption ensures that expected return \( Rp(R) \) is strictly concave: it increases with \( R \) up to a certain level, and then decreases, i.e., there is an optimal level of risk taking.
There are numerous risk neutral **depositors**. They

- Have no production technology. Have to deposit in banks;
- *Aggregate* supply of deposits $D = \sum_{i=1}^{N} D_i$ increases with deposit rate $r_D(D)$. **Assumption 2**: $r_D(0) \geq 0$, $r_D'(\cdot) > 0$, $r_D''(\cdot) \geq 0$.

The assumption ensures that deposit rate is convex in aggregate deposit supply. Since deposit is banks’ only funding resource, $r_D$ is in fact banks’ funding cost; $r_D(D)$ is therefore a typical convex cost function.

**Deposits are fully insured**

- Depositors get repaid in any case, so deposit supply does not depend on risks;
- Banks pay a flat rate insurance premium $\alpha > 0$. 
Banks’ decision problem and Nash equilibrium

- Bank $i$’s decision problem is to choose project ($R_i$) and quantity of deposit ($D_i$) to maximize profit, taken other banks’ decision as given

$$\max_{(R_i, D_i)} \prod_i = p(R_i) \left[ R_i D_i - r_D \left( \sum_{j \neq i} D_j + D_i \right) D_i - \alpha D_i \right];$$

- First order conditions present the bank’s best response functions

\[
\begin{align*}
\frac{\partial \prod_i}{\partial R_i} &= p'(R_i) \left[ R_i D_i - r_D \left( \sum_{j \neq i} D_j + D_i \right) D_i - \alpha D_i \right] + p(R_i) D_i = 0, \\
\frac{\partial \prod_i}{\partial D_i} &= p(R_i) \left[ R_i - r'_D \left( \sum_{j \neq i} D_j + D_i \right) D_i - r_D \left( \sum_{j \neq i} D_j + D_i \right) - \alpha \right] = 0.
\end{align*}
\]
Banks’ decision problem and Nash equilibrium (cont’d)

- Banks are symmetric, so Nash equilibrium \((R^*, D^*)\) should be the same for all banks. First order conditions therefore become

\[
\begin{align*}
p'(R^*) [R^* D^* - r_D (ND^*) D^* - \alpha D^*] + p(R^*) D^* &= 0, \\
R^* - r'_D (ND^*) D^* - r_D (ND^*) - \alpha &= 0.
\end{align*}
\]

- For easier understanding, assume \(p(R) = 1 - AR\) with \(A > 0\) and \(R \in [0, \frac{1}{A}]\), as well as \(r_D (D) = B_0 + B_1 D\) with \(B_0, B_1 > 0\)

\[
\begin{align*}
-A [R^* D^* - (B_0 + B_1 ND^*) D^* - \alpha D^*] + (1 - AR^*) D^* &= 0, \\
R^* - B_1 D^* - (B_0 + B_1 ND^*) - \alpha &= 0.
\end{align*}
\]
Banks’ decision problem and Nash equilibrium (cont’d)

- Eliminating $D^*$ to get
  \[ R^* = \frac{\frac{1}{A} + \alpha + B_0 - \frac{N}{N+1} (\alpha + B_0)}{2 - \frac{N}{N+1}}, \]
  
- It’s easily seen that **competition increases risk taking**
  - $\frac{\partial R^*}{\partial N} > 0$, banks take more risk under increasing competition;
  - $\lim_{N \to +\infty} R^* = \bar{R} = \frac{1}{A}$, banks take highest possible risk under perfect competition;

- Mechanism: competition↑ ⇒ bank’s profit from market power↓ ⇒ banks have to get profit from riskier projects ⇒ shifting the risks to insured depositors.
Nash equilibrium with loan market

- Instead of banks’ running projects by themselves, there are risk neutral **entrepreneurs**, each borrowing one unit from banks and running the risky projects;
  - Since there’s no bank capital, aggregate loans to entrepreneurs is equal to aggregate deposits, $L = \sum_{i=1}^{N} D_i$;
  - Banks face a downward sloping demand curve for loans: loan rate $r_L$ decreases with $L$.

- **Assumption 3**: $r_L(0) > 0$, $r_L'(\cdot) < 0$, $r_L''(\cdot) \leq 0$ and $r_L(0) > r_D(0)$.

  The assumption characterizes a concave, downward sloping demand curve. And in the limiting case, loan rate should be higher than deposit rate.
Nash equilibrium with loan market (cont’d)

- Now it’s the entrepreneurs who choose the projects. Given loan rate $r_L$, an entrepreneur’s decision problem is

\[ \max_{R \in [0, \bar{R}]} \Pi_e = p(R)(R - r_L); \]

- The first order condition ($FOC_E$) shows the following must hold in equilibrium

\[ \frac{\partial \Pi_e}{\partial R} = p'(R)(R - r_L) + p(R) = 0 \Rightarrow R^* + \frac{p(R^*)}{p'(R^*)} = r_L \ (FOC_E). \]
Nash equilibrium with loan market (cont’d)

- One bank $i$’s problem is to make decision on how much deposit it takes, $D_i$:
  - Taking into account other banks decisions, which \textit{directly} affect deposit rate $r_D(D)$
  - As well as loan rate $r_L(L)$, which \textit{indirectly} determines entrepreneurs’ risk taking via $(FOC_E)$

\[
\max_{D_i} \Pi_i = p(R) \left[ r_L \left( \sum_{j \neq i} D_j + D_i \right) D_i - r_D \left( \sum_{j \neq i} D_j + D_i \right) D_i - \alpha D_i \right],
\]

\[s.t. \ R + \frac{p(R)}{p'(R)} = r_L \text{ with } 0 \leq R \leq \bar{R}.
\]
Nash equilibrium with loan market (cont’d)

- For easier understanding, assume $p(R) = 1 - AR$ with $A > 0$ and $R \in [0, \frac{1}{A}]$, $r_L(L) = \frac{1}{A} - CL$ with $C > 0$, as well as $r_D(D) = B_0 + B_1D$ with $B_0, B_1 > 0$, then

$$\max_{D_i} \Pi_i = (1 - AR) \left[ \left( \frac{1}{A} - C \left( \sum_{j \neq i} D_j + D_i \right) \right) D_i - \left( B_0 + B_1 \left( \sum_{j \neq i} D_j + D_i \right) \right) D_i - \alpha D_i \right],$$

s.t. $R - \frac{1 - AR}{A} = \frac{1}{A} - C \left( \sum_{j \neq i} D_j + D_i \right)$ with $0 \leq R \leq \bar{R}$.

- The bank’s optimal decision is characterized by the first order condition

$$\frac{\partial \Pi_i}{\partial D_i} = 0.$$
Nash equilibrium with loan market (cont’d)

- Solving the first order condition (as your exercise) to get

\[ D^* = \frac{1}{A} - \left( \alpha + B_0 \right) \frac{(N + 1)}{N(C + B_1)(N + 2)}; \]

- Combining with \((FOC_E)\) to get

\[ R^* = \frac{1}{A} - \frac{1}{A} \left( \frac{\alpha + B_0}{(C + B_1)(N + 2)} \right) \frac{C}{2}; \]

- It’s easily seen that competition reduces risk taking (as your exercise)
  - \( \frac{\partial R^*}{\partial N} < 0 \), banks take less risk under increasing competition;
  - \( \lim_{N \to +\infty} r_L - r_D - \alpha = 0 \), banks take lowest possible risk and make zero profit under perfect competition.
Introduction

Competition and Financial Stability

Conclusion

As in standard industrial organization theories, one main issue here is the implication of banks’ behavior in competition, e.g., competitive pricing, market power, etc.; However, the bigger challenge is to analyze the impact of bank competition on banks’ risk taking

- How is competition translated to equilibrium borrowing / lending rates, i.e., banks’ net interest margin?
- How do banks respond by adjusting their investment portfolio, i.e., risk taking? Implication for financial stability?
References

(★: Recommended reading)
