Financial Intermediation, Competition and Risk: A General Equilibrium Exposition

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Is there a trade-off between bank competition and financial stability?

- **YES**, according to a partial equilibrium version of the ***Charter Value Hypothesis (CVH)***
- ***CVH:*** Under limited liability and unobservable risk choices, higher funding costs due to increased competition will erode a bank's charter value (expected profits), prompting a bank to take on more risk
- The ***CVH*** is a key concept rationalizing the need for capital regulation under deposit insurance

Partial equilibrium: YES, there is a trade-off

- Banks as entities raising funds from insured depositors, and choosing the risk of their investment portfolio.
- If deposits become more expensive due to increased competition for funding, then there is an incentive for banks to take on more risk (dozens of papers)
- **CVH applies to banks**

$$p(X - R^D)I - \frac{\alpha p^2}{2}$$

Partial Equilibrium: NOT NECESSARILY

- **If the CVH is applied to entrepreneurs rather than banks**, then entrepreneurs will choose higher risk when loan rates are higher due to less competition in loan markets
- **The CVH applies to both entrepreneurs and banks**

$$\text{Profits } (E): p(X - R^L)I - \frac{\alpha p^2}{2}$$

$$\text{Profits } (B): p(R^L)(R^L - R^D)I$$

What about GENERAL EQUILIBRIUM?

- Allen and Gale (2004b) and Boyd, De Nicolò and Smith (2004):
- **Perfect competition is Pareto optimal** under complete markets, and constrained Pareto optimal under incomplete markets, with financial "instability" as a necessary condition of optimality
- **This contrasts with the conventional wisdom** based on many partial equilibrium formulations of the CVH

Yet, the comparison is not appropriate since.....

..These general equilibrium models do not feature the type of *moral hazard* in investment associated with financing choices on which the CVH is based

What We Do

- We assess the general equilibrium implications of the CVH for competition, financial stability and welfare
- The choice of the risky investment is unobservable by investors
- **This is precisely the type of information asymmetry generating the *moral hazard* problem highlighted in the CVH**

How We Do It?

- In our set-up, agents **first** choose to become either firm-entrepreneurs, or bank-entrepreneurs, or depositors, and **then** they make their investment and financing decisions.
- **We establish a mapping between bank market power rents and investment and consumption allocations *independently of* any specific assumption on the mechanism generating a given level of bank market power rents**

Three Steps

- **First,** we identify equilibriums with intermediation parameterized by a given interest rate on debt contracts.
- **Second**, we characterize first best and constrained optimality, and define a perfectly competitive equilibrium as the interest rate that supports a *core* allocation.
- **Lastly**, bank market power rents are defined as the *deviation* of an equilibrium interest rate from the interest rate prevailing at a core (perfectly competitive) allocation.

Key Results

- The CVH remains a good *description of incentives*, but it is *not* necessarily a good predictor of actual *outcomes*.
- Lower banks' market power rents imply:

✓ *Lower economy-wide risk*

✓ *Lower capital ratios*

✓ More *efficient production plans*

✓ *Pareto-ranked real allocations*

Why? In partial equilibrium...

- ...the amount of available funding for a bank or a firm as either given, or represented by supply and demand functions that are ***determined independently***
- An increase in the cost of funding prompts either banks, or firms financed by banks, to choose riskier investment ***for any given amount of funding they obtain***

$$p(X - R^D)I - \frac{\alpha p^2}{2}$$

..While in general equilibrium...

- ....agents' specialization choices as well as their funding decisions are ***not*** independent. Thus, ***an increase in the cost of funding will also increase the amount of funding available for investment.***
- The equilibrium *outcome* of an increase in the cost of funding results in **borrowers choosing a *lower rather than a higher* level of risk.**

$$p(X - R^D)I - \frac{\alpha p^2}{2}$$

Implications

- In general equilibrium the implications of the ***CVH*** for **bank risk** and **bank capitalization** turn to be exactly the opposite to what a partial equilibrium set-up would imply
- This is empirically relevant
- General equilibrium modeling is **necessary** for optimal policy design

Plan

- The Basic Model
- Equilibrium with Banks and Depositors
- Optimality and Intermediary Rents
- Equilibrium with Firms, Intermediaries and Depositors
- Empirical and Policy Relevance

The Basic Model : Time, Endowments and Preferences

- There are 3 dates: 0,1,2
- There is a continuum of agents on $[0,1]$ indexed by q
- Agent q has an endowment of qW good and labor l
- Total goods in the economy are $W\int_0^1 qdq = \frac{W}{2}$ with $W > 1$
- Preferences are $U(c) = c$ and $V(l) = \frac{\alpha}{2}l^2$

The Basic Model: Technologies (1)

- All agents have a *costly* access to set of risky projects to become an *entrepreneur* or an *investor*
- Agent $q \in [0,1]$ employs an "entrepreneurial" technology which allows to choose and operate a risky technology by transforming the endowment into an amount $k \in [0, W)$

The Basic Model: Technologies (2)

- Becoming an entrepreneur amounts to choose a project with yields X with probability $p \in [0,1]$ and 0 otherwise
- Choosing p requires labor according to the linear technology $p = l$
- Thus, an entrepreneur will incur a disutility

$$V(p) = \frac{\alpha}{2} p^2$$

The Basic Model: Contracts and Information (1)

- Once agents have become entrepreneurs or investors, they pool resources to finance investment at date 1. **We call these coalitions of entrepreneurs and investors "banks".**
- Investors, called depositors, finance banks with **simple debt contracts**.
- These contracts pay a fixed amount per unit invested if the investment outcome is successful, and 0 otherwise.

The Basic Model: Contracts and Information (2)

- Banks and depositors will bargain over $\hat{R}$ at date 1.
- A lower $\hat{R}$ will be viewed as associated with a stronger bargaining power of banks *vis a vis* depositors.

Two cases:

- ***Moral hazard :*** $\hat{R} = R$ independent of the (unobservable) choice of risk
- ***No-moral hazard:*** $\hat{R} = R / p$, *the* choice of p is publicly observed by both banks and depositors

Model Timing

- **At period 0** agents decide to become entrepreneurs or investors
- **At period 1** entrepreneurs pool resources to finance projects: this coalitions are called *banks* and they bargain an interest rate R with investors
- ✓ **Observe:** Since the production technology is constant return to scale, the size distribution of banks is indeterminate. Any result we obtain is *independent of* market structure
- **At period 2** uncertainty is solved and payments are made

Equilibrium with Banks and Depositors: the Moral Hazard Case (1)

- Let I denote the total investment in risky technology, given I , any coalition of measure $\lambda > 0$ chooses p to maximize

$$\left(p[(X-R)I + Xk] - \frac{\alpha p^2}{2} \right) \lambda \qquad (1)$$

The Moral Hazard Case (2)

- The optimal choice of p satisfies

$$p^* = \frac{(X - R)I + Xk}{\alpha} \qquad (2)$$

- The profits per entrepreneur are

$$\Pi(I) \equiv p^*[(X-R)I + Xk] - \frac{\alpha p^{*2}}{2} = \frac{[(X-R)I + Xk]^2}{2\alpha} \qquad (3)$$

The Moral Hazard Case (3)

- An agent will become an entrepreneur if

$$\Pi(I) \geq p^{*} RqW \qquad (4)$$

- Let $\hat{q}$ denote the agent indifferent between being an entrepreneur or an investor:

$$\Pi(I) = p^{*} R\hat{q}W \qquad (5)$$

The Moral Hazard Case (4)

Definition. *An* ***equilibrium with intermediation*** *is a triplet* $(I^*, p^*, \hat{q}^*)$ *and a value*

$R \in \{\hat{R} \in (0, X] : I^* \geq 0, p^* \in (0,1), q^* \in (0,1)\}$ *such that:*

$$p^* = \frac{(X - R)I^* + Xk}{\alpha} \qquad (6)$$

$$\Pi(I^*) = p^* R \hat{q}^* W \qquad (7)$$

$$I^* = W \int_{\hat{q}^*}^{1} q dq = \frac{W(1 - \hat{q}^{*2})}{2} \qquad (8)$$

The Moral Hazard Case (5)

Proposition 1. *In the moral hazard economy with banks and depositors an equilibrium with intermediation exists and it is unique for every* $R \in (\frac{Xk}{2W}, X]$

Proposition 2. *In the moral hazard economy with banks and depositors:*

$$I_R^* > 0,\ \hat{q}_R^* < 0,\ p_R^* > 0,\ K_R^* < 0 \ \text{and}\ p_k^* > 0.$$

The No-Moral Hazard Case

Proposition 3. *In the no-moral hazard economy with banks and depositors an equilibrium with intermediation exists and it is unique for every*

$$R \in \left(\frac{X^2 k^2}{2\alpha W}, \frac{X^2 (W + 2k)^2}{4\alpha W} \right)$$

Proposition 4. *In the no-moral hazard economy with banks and depositors:*

$$I_R^* > 0,\ \hat{q}_R^* < 0,\ p_R^* > 0,\ K_R^* < 0 \text{ and } p_k^* > 0.$$

Optimality and Intermediary Rents (1)

- the set of Pareto optimal allocations solves the following

$$\text{Max } V \equiv q(C^E - \frac{\alpha}{2} p^2) + \int_q^1 C^I(q)dq \quad (18)$$

Subject to

$$qC^E + \int_q^1 C^I(q)dq = pX(I+k)q \quad (19)$$

$$I + kq + W\int_0^q qdq = \frac{W}{2} \quad (20)$$

Optimality

Proposition 5. *In the moral hazard economy with banks and depositors, there is no equilibrium with intermediation that supports the Pareto optimal allocation.*

Proposition 6. *In the moral hazard economy with banks and depositors , R^* is an equilibrium with intermediation that supports the second best allocation.*

Proposition 7. *In the no-moral hazard economy with banks and depositors, there exist a unique R^0 such that the corresponding equilibrium with intermediation supports the (first best) Pareto optimal allocation.*

Intermediary Rents

- As in Boyd and Prescott (1986), we identify ***perfect competition*** among banks with an equilibrium in which **bank coalitions offer contract terms supporting allocations in the *core* of this economy.**

$$\rho = \left| R^* - R \right|$$

- **Market power rents are defined accordingly**

Key Proposition

- **Proposition 8** *In both the moral-hazard and no-moral hazard economies with banks and depositors, the equilibrium level of risk converges to the optimal level of risk from below, to the optimal level of bank capitalization from above, and to a best allocation as market power rents vanish, i.e.* $\hat{p} \uparrow p^*$, *and* $\hat{K} \downarrow K^*$ *as* $\rho \to 0$.

Equilibrium with Firms, Intermediaries and Depositors (1)

- We assume that the outcome of the project can be observed only at a monitoring cost by outsiders
- At date 0, agents decide whenever to be a bank, a firm or an investor (depositor)
- At date 1, banks raise funds from depositors, promising R^D per unit invested if the bank is solvent. At the same time, they offer funds to firms at the rate R^L per unit invested if the firm is solvent

Equilibrium with Firms, Intermediaries and Depositors (2)

- An entrepreneur can ***either become*** **a** ***firm, or*** choose to use an "intermediation" technology, becoming a ***bank***
- The outcome of the project can be observed only at a monitoring cost by outsiders
- An entrepreneur can become a bank by observing the outcome of one project and intermediate funds. The resource cost of doing so is the entire amount of date 1 goods

Equilibrium with Firms, Intermediaries and Depositors (3)

- We analyze two polar cases:

1. Perfectly correlated projects
2. Independent projects

Perfectly Correlated Projects (1)

- If an entrepreneur is a firm, he chooses p to maximize

$$p[(X - R^L)I + \frac{Xk}{2}] - \frac{\alpha p^2}{2} \qquad (27)$$

- The optimal choice of p satisfies

$$p^* = \frac{(X - R^L)I + \frac{Xk}{2}}{\alpha} \qquad (28)$$

Perfectly Correlated Projects (2)

- Its profits are

$$\Pi^E \equiv p^* \frac{[(X - R^L)I + \frac{Xk}{2}]}{2} \qquad (29)$$

- If entrepreneur is a bank, its profits are

$$\Pi^B \equiv p^*(R^L - R^D)I \qquad (30)$$

Perfectly Correlated Projects (3)

- The equilibrium value of R^L that satisfies $\Pi^E = \Pi^B$

$$R^L = \frac{X}{3}\left(1 + \frac{k}{2I}\right) + \frac{2}{3}R^D \qquad (31)$$

- Substituting (31) in (28) and (29), one obtains expressions for risk and entrepreneurs profits given by:

$$p^* = \frac{\frac{2}{3}(X - R^D)I + \frac{Xk5}{6}}{\alpha} \qquad (32)$$

$$\Pi^E(I) = \frac{[\frac{2}{3}(X - R^D)I + \frac{Xk5}{6}]^2}{2\alpha} \qquad (33)$$

Perfectly Correlated Projects (4)

- When set $R^D = R$ (32) and (33) yield *the same type of expressions* of equations (8) and (9):

all derivations and propositions applied to the moral hazard economy with banks and depositors apply to this moral hazard economy with firms, banks and depositors

Independent Projects

- When consider the independent project case, as before,

all derivations and propositions applied to the no-moral hazard economy with banks and depositors apply to this moral hazard economy and independent risks with firms, banks and depositors

Conclusion

- Lower banks' market power rents imply:
  - ✓ *Lower economy-wide risk*
  - ✓ *Lower capital ratios*
  - ✓ More *efficient production plans*
  - ✓ *Pareto-ranked real allocations*
- **A general equilibrium economy with investment choices subject to moral hazard delivers implications identical to those obtained** by Allen and Gale (2004b) and Boyd, De Nicolò and Smith (2004) **in economies lacking these features.**

Empirical and Policy Relevance

- **Barriers of entry**: Jayaratne and Strahan (1998), Barth, Caprio and Levine (2004) and Beck (2006a and 2006b)
- **Competition and growth**: Cetorelli and Gambera (2001) and Cetorelli and Strahan (2006)
- **Competition and risk**: Boyd, De Nicolò and Jalal (2006, 2009) and Boyd, De Nicolò and Loukoianova (2007)
- **General equilibrium modeling is necessary for optimal policy design**