Financial Risk Capacity

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Introduction

- Many financial crises begin with a collapse of banks' net worth
- Financial sector's capacity to intermediate capital decreases
- Economic activity falls as capital intermediation is suboptimal

▷ Why banks can't raise equity in times of crisis?

Introduction

- Many financial crises begin with a collapse of banks' net worth
- Financial sector's capacity to intermediate capital decreases
- Economic activity falls as capital intermediation is suboptimal

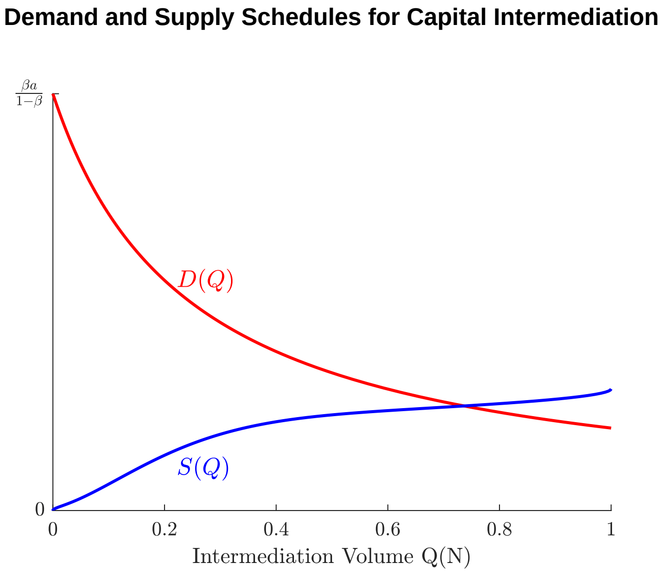
▷ Why banks can't raise equity in times of crisis?

"Mr. Chairman, when will the crisis be over?"

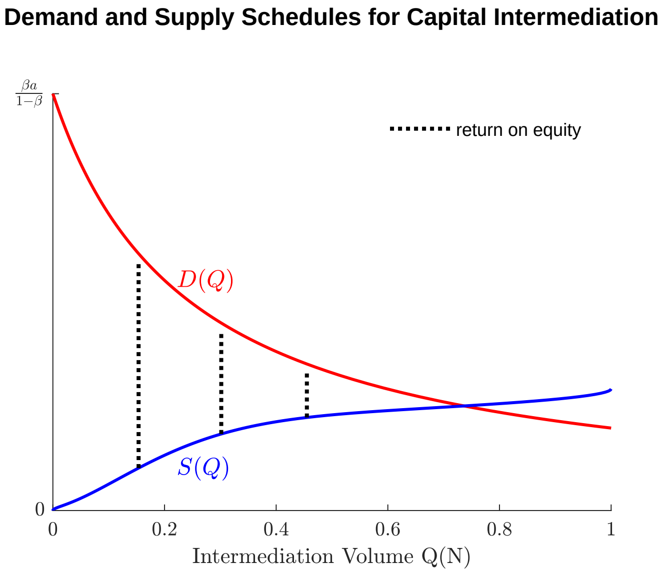
Interviewer, 60 Minutes

"When banks start raising capital on their own."

Ben Bernanke



Demand and Supply Schedules for Capital Intermediation
$\frac{\beta a}{1-\beta}$
0
$D(Q)$
$S(Q)$
0
0.2
0.4
0.6
0.8
1
Intermediation Volume Q(N)



Demand and Supply Schedules for Capital Intermediation
$\frac{\beta a}{1-\beta}$
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return on equity
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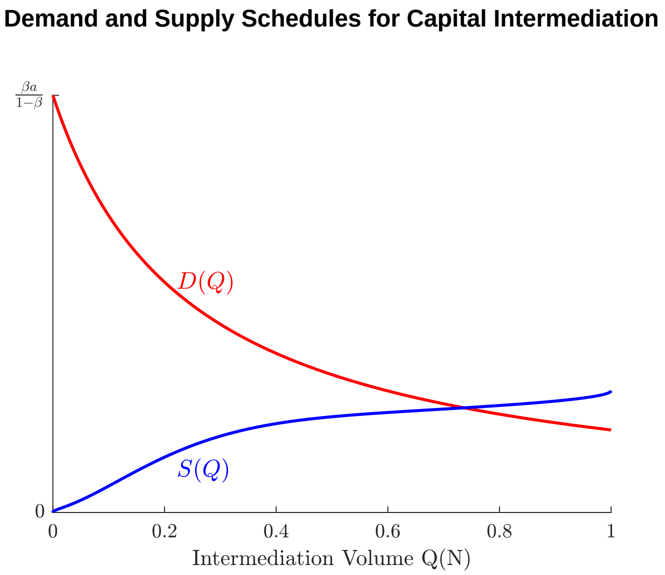
Intermediation Volume Q(N)

Why banks can't raise equity in times of crisis?

- Financial assets easily reallocated, recapitalization should be fast
- Other papers: additional frictions to prevent equity injections
- Banking theory: banks mitigate asymmetric information
- This paper: adverse selection is exacerbated by low bank net worth
  - Intermediation becomes less profitable
  - Reduces incentives to recapitalize banks



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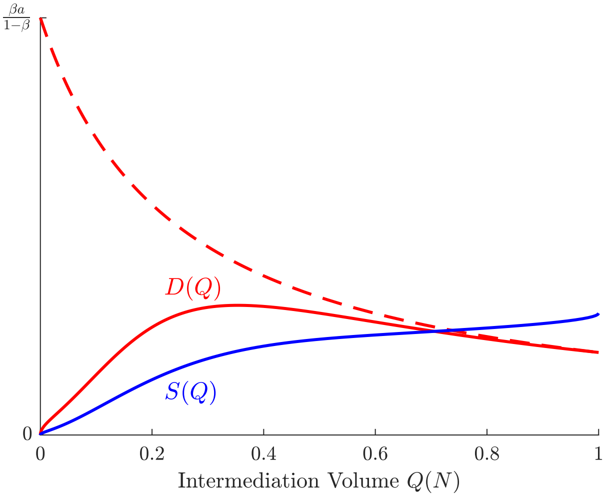
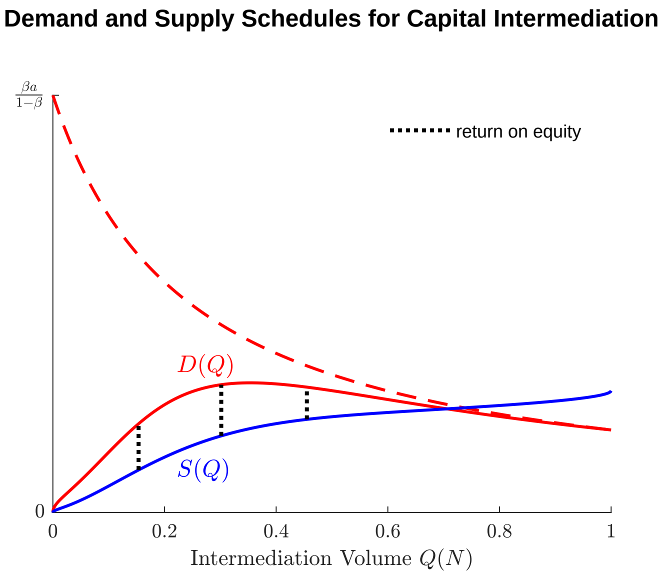
Demand and Supply Schedules for Capital Intermediation





Demand and Supply Schedules for Capital Intermediation
$\frac{\beta a}{1-\beta}$
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0.4
0.6
0.8
1
Intermediation Volume $Q(N)$

Insights

- Adverse selection is aggravated by low bank net worth
- Intermediation becomes less profitable with lower intermediation volumes
  - Bankers do not want to inject equity during crisis
- Generates amplification and persistence of banking crises

Environment

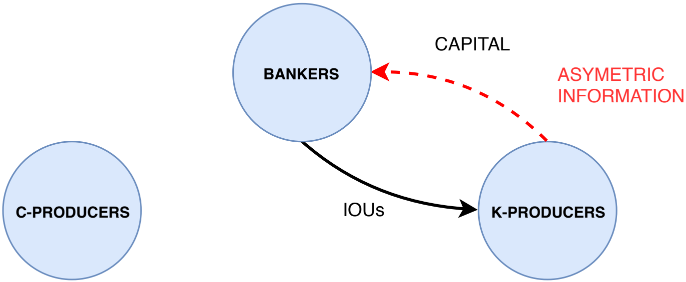
- Discrete-time, infinite horizon
- Consumption good and capital
- Unit mass of producers: produce consumption goods or capital
  - ▷ C-producers technology: $y = ak$
  - ▷ K-producers technology: $k = y/\kappa$
- Need for exchange
  - ▷ K-producers: lack consumption input for building capital
  - ▷ C-producers: lack investment opportunities to accumulate capital
- Unit mass of bankers intermediate capital
  - ▷ Capital intermediation is risky
  - ▷ Limited liability constraint: need wealth to sustain potential losses

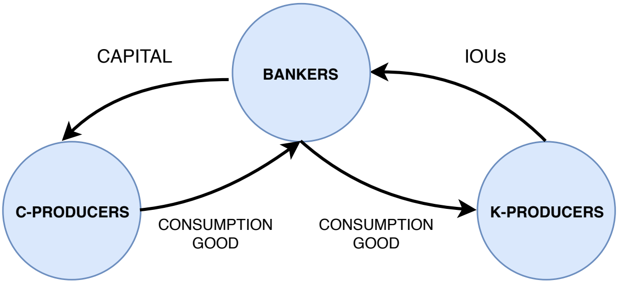
Heterogeneous Capital Quality

- Capital stock divisible into continuum
- Each unit identified with quality $\varphi \in [0, 1]$
- $\lambda(\varphi, \phi)$ is the depreciation of a φ-unit of capital given aggregate shock ϕ

$$k_{t+1} = k_t \int \lambda(\varphi, \phi_t) d\varphi$$

- Once a φ-unit of capital is scaled by $\lambda(\varphi, \phi_t)$, it becomes homogeneous
- Asymmetric information: buyer of capital do not know its quality φ
- Role for intermediation by banks
  - ▷ Big banks have technology to pool qualities
  - ▷ Better risk absorption capacity (risk neutral)


BANKERS
CAPITAL
ASYMETRIC
INFORMATION
C-PRODUCERS
IOUs
K-PRODUCERS


CAPITAL
BANKERS
IOUs
C-PRODUCERS
K-PRODUCERS
CONSUMPTION GOOD
CONSUMPTION GOOD

Assumption 1

The depreciation function is such that: $\lambda(0, \phi) = 0$.

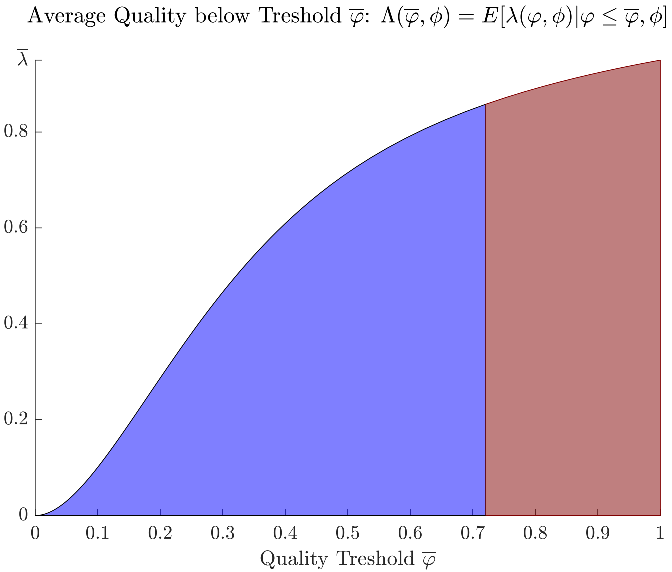
Assumption 2

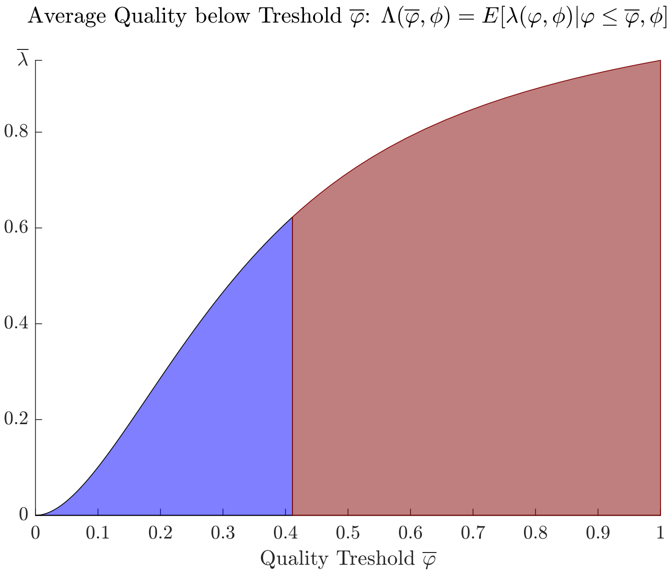
The depreciation function $\lambda(\varphi, \phi)$ *is monotone and increasing in* φ.

- K-producers sell every units of capital below a quality threshold $\overline{\varphi}$

Assumption 3

There is no aggregate risk: $\int_0^1 \lambda(\varphi, \phi) d\varphi = \overline{\lambda} \; \forall \; \phi$.


Average Quality below Treshold $\overline{\varphi}$: $\Lambda(\overline{\varphi}, \phi) = E[\lambda(\varphi, \phi) | \varphi \leq \overline{\varphi}, \phi]$
$\overline{\lambda}$
0.8
0.6
0.4
0.2
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Quality Treshold $\overline{\varphi}$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$\overline{\lambda}$
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0.6
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0.3
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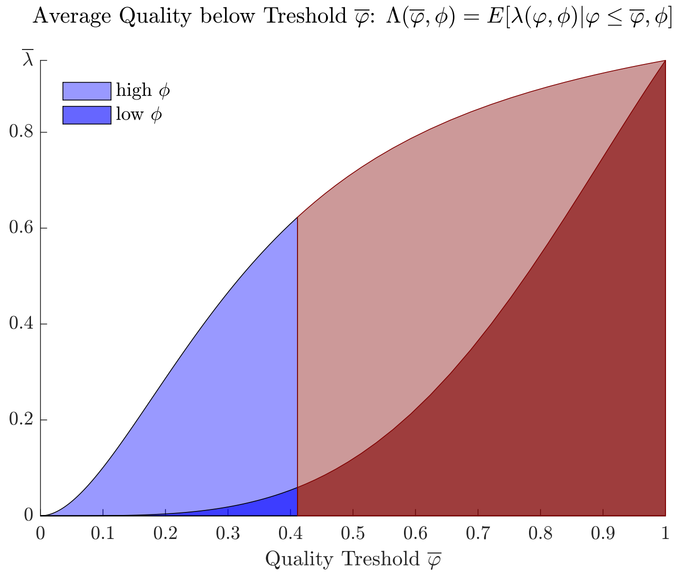


Average Quality below Treshold $\overline{\varphi}$: $\Lambda(\overline{\varphi},\phi) = E[\lambda(\varphi,\phi)|\varphi \leq \overline{\varphi},\phi]$
$\overline{\lambda}$
0.8
0.6
0.4
0.2
0
high ϕ
low ϕ
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Quality Treshold $\overline{\varphi}$

C-producers

Every period, a fraction $(1-\Delta)$ of producers become c-producers.

C-producers consume c^c or invest i^c in new units of capital at price p^d:

$$U^c(k,\eta) = \mathbb{E}_\phi \left[\max_{c^c \geq 0, i^c \geq 0} \left\{ \log(c) + \beta U(k', \eta') \right\} \right]$$

subject to their budget constraint:

$$c^c + p^d i^c = ak$$

and the law of motion for capital:

$$k' = k \int_0^1 \lambda(\varphi, \phi) d\varphi + i^c$$

K-producers

Every period, a fraction Δ of producers become k-producers.

K-producers choose threshold quality $\overline{\varphi}$, consumption c^k, and production i^k:

$$U^k(k,\eta) = \max_{\overline{\varphi}} \left\{ \mathbb{E}_\phi \left[\max_{c^k \geq 0, i^k} \left\{ \log(c^k) + \beta U(k', \eta') \right\} \right] \right\}$$

subject to their budget constraint:

$$c^k + \kappa i^k = p^s \overline{\varphi} k$$

and the law of motion for capital:

$$k' = k \int_{\overline{\varphi}}^1 \lambda(\varphi, \phi) d\varphi + i^k$$

Bankers

Bankers choose intermediation q, equity injection e, and dividend payouts d:

$$U^b(n,\eta) = \max_{e\geq 0, 1\geq d\geq 0, q\geq 0} \left\{ d - e + \mathbb{E}_\phi \left[\beta U^b(n', \eta') \right] \right\}$$

subject to the law of motion for wealth:

$$n' = n + e - \Gamma(e) - (1+\tau)d + q\pi(\overline{\varphi}, \phi)$$

and the limited liability constraint:

$$n' \geq 0 \qquad \forall \phi$$

where

$$\pi(\overline{\varphi}, \phi) = p^d(\overline{\varphi}, \phi)\Lambda(\overline{\varphi}, \phi) - p^s(\overline{\varphi})$$

and $\Lambda(\overline{\varphi}, \phi) = \frac{\int_0^{\overline{\varphi}} \lambda(\varphi, \phi) d\varphi}{\overline{\varphi}}$ is the average quality of the pool of capital

State Space

There are two aggregate quantities of interest: the aggregate capital stock,

$$K = \int_0^1 k(z)dz,$$

and the equity of the entire financial system,

$$N = \int_0^1 n(j)dj$$

The aggregate state is summarized by $\{\eta, \phi\}$:

$$\eta \equiv N/K$$

Recursive Competitive Equilibrium

A recursive competitive equilibrium is

(i) a set of price functions $\{p^s(\eta), p^d(\eta, \phi)\}$,

(ii) a set of policy functions for c-producers $\{c^c(k, \eta, \phi), i^c(k^c, \eta, \phi)\}$,

(iii) a set of policy functions for k-producers $\{\overline{\varphi}(k, \eta), c^k(k, \eta, \phi), i^k(k, \eta, \phi)\}$,

(iv) a set of policy functions for bankers $\{e(n, \eta), d(n, \eta), q(n, \eta)\}$,

(v) a set of value functions $\{U^c(k, \eta), U^k(k, \eta), U^b(n, \eta)\}$, and

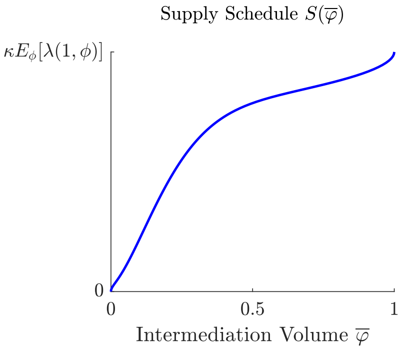
(vi) a law of motion for the aggregate state $\eta'(\eta, \phi)$ such that:

1. The agents' policy functions (ii), (iii), and (iv) are solutions to their respective problems given prices (i) the law of motion for η (vi)
2. Markets for intermediation of capital, depreciated capital, and consumption goods clear
3. The laws of motion for the state variable $\eta'(\eta, \phi)$ is consistent with equilibrium functions and demographics.

Supply Schedule $S(\overline{\varphi})$

The threshold policy is such that:

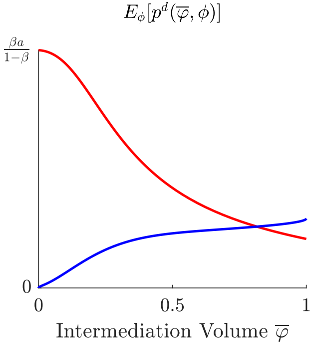
$$\overline{\varphi}(p^s) = \arg\max_{\widetilde{\varphi}} \mathbb{E}_\phi \left[\log \left(\kappa \int_{\widetilde{\varphi}}^1 \lambda(\varphi, \phi) d\varphi + p^s \widetilde{\varphi} \right) \right]$$



Demand Schedule

- From the market clearing conditions:

$$p^d(\overline{\varphi}, \phi) = \frac{\beta a(1-\Delta)}{\overline{\varphi}\Lambda(\overline{\varphi}, \phi)\Delta + (1-\beta)\overline{\lambda}(1-\Delta)}$$



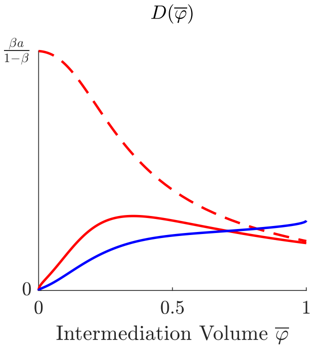
Demand Schedule

- From the market clearing conditions:

$$p^d(\overline{\varphi},\phi) = \frac{\beta a(1-\Delta)}{\overline{\varphi}\Lambda(\overline{\varphi},\phi)\Delta + (1-\beta)\overline{\lambda}(1-\Delta)}$$

- Demand schedule $D(\overline{\varphi})$:

$$D(\overline{\varphi}) = \mathbb{E}_\phi\left[\underbrace{p^d\Big(\overline{\varphi},\phi\Big)}_{\text{substitution effect}}\ \underbrace{\Lambda\Big(\overline{\varphi},\phi\Big)}_{\text{composition effect}}\right]$$



Demand Schedule

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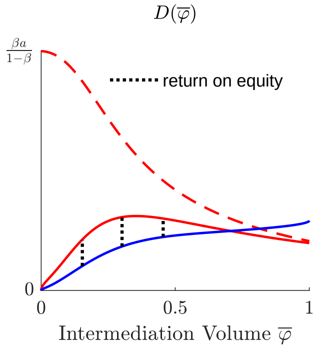
- Intermediation profits $\Pi(\overline{\varphi})$:

$$\Pi(\overline{\varphi}) = D(\overline{\varphi}) - S(\overline{\varphi})$$



Information Sensitivity

Given ϕ, the intermediation revenues are increasing in $\overline{\varphi}$,

$$\frac{\partial p^d(\overline{\varphi}, \phi)\Lambda(\overline{\varphi}, \phi)}{\partial \overline{\varphi}} > 0,$$

if and only if the following condition holds:

$$\frac{\lambda(\overline{\varphi}, \phi) - \Lambda(\overline{\varphi}, \phi)}{\overline{\varphi}} > \frac{[\Lambda(\overline{\varphi}, \phi)]^2 \, \Delta}{(1-\beta)\overline{\lambda}(1-\Delta)}.$$

Information asymmetries need to weaken sufficiently fast as more capital is intermediated.

Capital Intermediation

- The banker intermediation volume is constrained by limited liability:

$$q = \frac{n + e - \Gamma(e) - (1+\tau)d}{|\pi(\overline{\varphi}, \underline{\phi})|} \qquad \text{if} \quad D(\overline{\varphi}) - S(\overline{\varphi}) > 0$$

- The value of inside equity is given by:

$$\theta(\eta) \equiv \beta \mathbb{E}_\phi \left[u^b(\eta') \right] + \max \left\{ \beta \mathbb{E}_\phi \left[u^b(\eta') \frac{\pi(\overline{\varphi}, \phi)}{|\pi(\overline{\varphi}, \underline{\phi})|} \right], 0 \right\}$$

  where $U(n, \eta) = u^b(\eta) n$

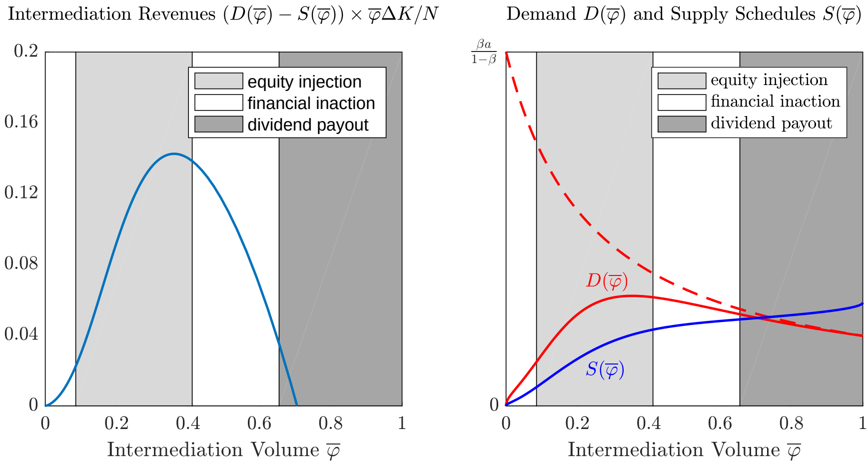
- Bankers pay dividends if

$$\theta(\eta) < 1 - \tau$$

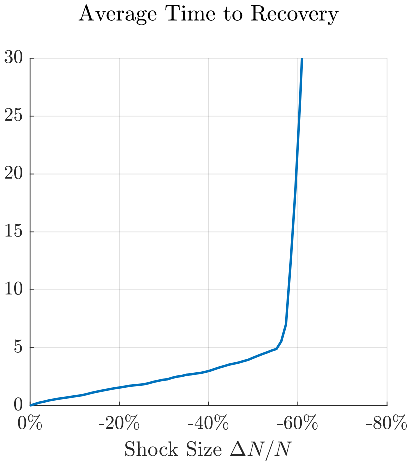
- Bankers inject equity if

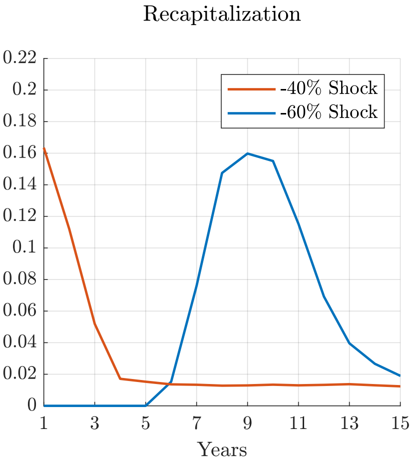
$$\theta(\eta) > 1$$

Solution

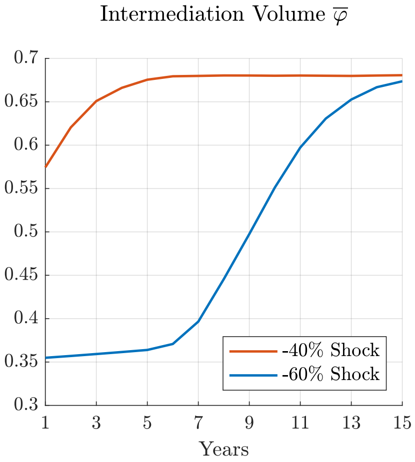

Intermediation Revenues $(D(\overline{\varphi}) - S(\overline{\varphi})) \times \overline{\varphi}\Delta K/N$
0.2
0.16
0.12
0.08
0.04
0
0
0.2
0.4
0.6
0.8
1
equity injection
financial inaction
dividend payout
Intermediation Volume $\overline{\varphi}$
Demand $D(\overline{\varphi})$ and Supply Schedules $S(\overline{\varphi})$
$\frac{\beta a}{1-\beta}$
0
0
0.2
0.4
0.6
0.8
1
equity injection
financial inaction
dividend payout
$D(\overline{\varphi})$
$S(\overline{\varphi})$
Intermediation Volume $\overline{\varphi}$

Dynamics

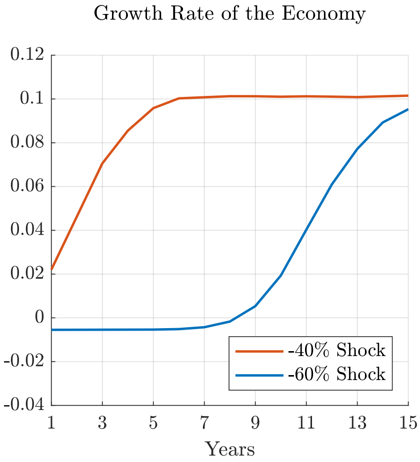

Average Time to Recovery
30
25
20
15
10
5
0
0%
-20%
-40%
-60%
-80%
Shock Size $\Delta N/N$


Recapitalization
-40% Shock
-60% Shock
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1
3
5
7
9
11
13
15
Years

Dynamics



Intermediation Volume $\overline{\varphi}$
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
1
3
5
7
9
11
13
15
Years
-40% Shock
-60% Shock



Growth Rate of the Economy
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
1
3
5
7
9
11
13
15
Years
-40% Shock
-60% Shock

Conclusion

- Adverse selection generates non-monotone expected profits

- No incentives to recapitalize when intermediation volumes are low

- Prolonged recession following large losses in bankers' net worth