Bank Regulation under Fire Sale Externalities

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Disclaimer: The analysis and the conclusions set forth are those of the authors and do not indicate concurrence by other members of the research staff or the Board of Governors.

Motivation: Background

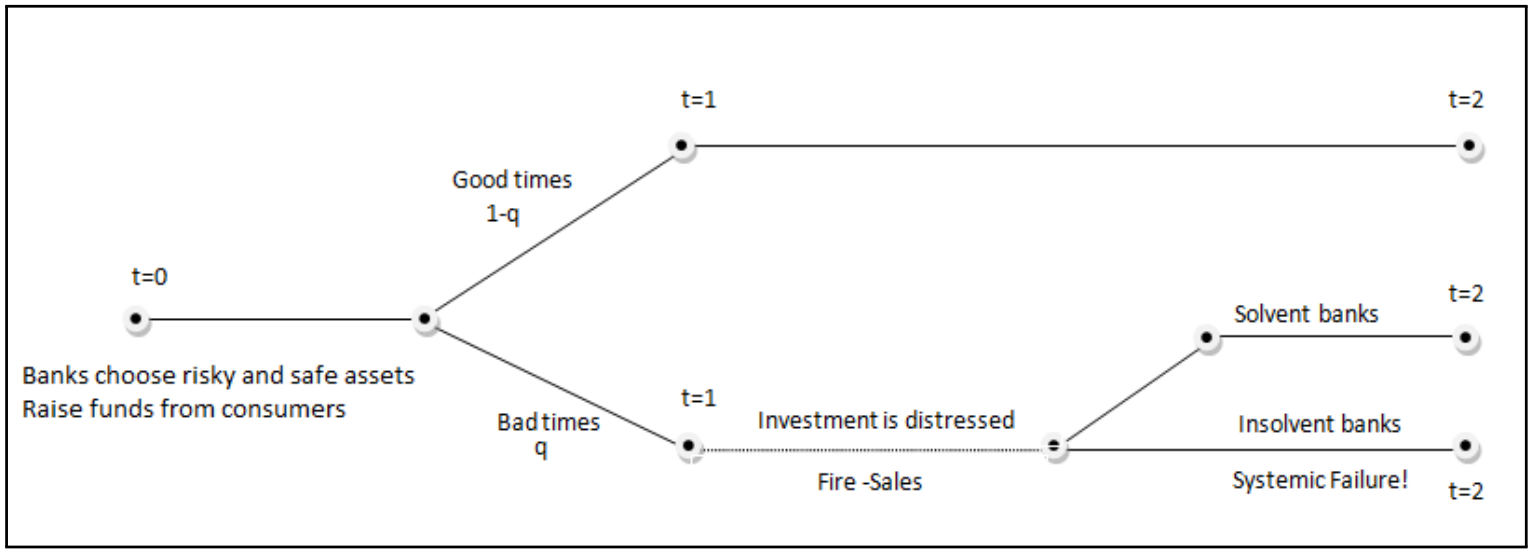
- The recent crisis was characterized by massive illiquidity.
- The regulation before the crisis was predominantly micro-prudential and focused on capital requirements.
- Basel III supplements capital regulations with liquidity requirements and focuses on macro-prudential measures.

Research Questions

- Can we trust the institutions to properly manage their liquidity, once excessive risk taking has been controlled by the capital requirement?

- What are -if any- the advantages and disadvantages of simple liquidity ratio requirements that supplement the capital regulations?

Sketch and the Timing of the Model



Agents

A continuum of banks with a unit mass.

A continuum of consumers with a unit mass.

A financial regulator (*e.g.* a central bank).

A continuum of global investors with a unit mass.

Related Literature

Financial Regulation
Holmstrom and Tirole (1998), Acharya (2003), Farhi and Tirole (2009), Goodhart et al (2013), Kashyap, Tsomocos and Vardoulakis (2014)

Asset Fire Sales
Williamson (1988), Shleifer and Vishny (1992, 2011), Kiyotaki and Moore (1997), Lorenzoni (2008), Gai et al. (2008), Korinek (2011), Stein (2012)

Incomplete Markets
Hart (1975), Stiglitz (1982), Geanakoplos and Polemarchakis (1986)

Key Results

- The lack of complementary liquidity ratio requirements harms the purpose of the regulation on excessive risk taking:
  - Inefficiently low investment in socially profitable risky assets
  - More severe financial crises.
- Banks keep lower liquidity ratios compared to the competitive equilibrium when regulation is focused on limiting risky investment only.

The Model: Basic Setup

Three dates: $t = 0, 1, 2$.

Two states of the world at $t = 1$
- Good state with probability $1 - q$
- Bad state with probability q

Two goods:
- A consumption good (liquid asset)
- A capital good (risky asset)

Banks have a technology that converts consumption goods into capital goods one-to-one at $t = 0$.

Capital goods are illiquid: they may never be converted into consumption goods.

Technology

Risky asset: Banks choose capital good level (n_i)

Safe assets: Banks are endowed with a storage technology with unit returns.

A bank hoards total safe assets of $n_i b_i$ where $b_i \in [0, 1]$.

The total cost of funds is $D(n_i(1 + b_i))$ where $D'(\cdot) > 0$ and $D''(\cdot) > 0$.

There is limited liability for bank owners and a deposit insurance.

Capital fully depreciates at $t = 2$.

Liquidity Shock at $t = 1$

Three dates: $t = 0, 1, 2$.

Two states of the world at $t = 1$

- Good state with probability $1 - q$
- Bad state with probability q

Good state:

- No liquidity shock
- Bank's assets yield $Rn_i + n_i b_i$ units of consumption goods at $t = 2$

Bad state:

- Investment distressed, has to be restructured to remain productive.
- Restructuring costs are c units of consumption goods per capital.
- Banks can use liquid resources $n_i b_i$ to carry out the restructuring.
- Banks fire sale assets if liquid resources are not sufficient.

Global Investors' Problem

Global investors are endowed with large liquid resources at $t = 0$ and 1.

They choose how much capital y to buy from banks at $t = 1$

$$\max_{y \geq 0} \quad F(y) - Py \tag{1}$$

FOCs:

$$F'(y) = P \tag{2}$$

Define global investors' demand function $D(P)$

$$y = D(P) \equiv F'(P)^{-1} \quad \Longleftarrow \boxed{\text{Downward Sloping Demand}}$$

Basic Assumptions

A1: CONCAVITY $F'(y) > 0$ and $F''(y) < 0$, with $F'(0) \leq R$.

Global investors face decreasing returns to scale.

A2: ELASTICITY $\epsilon_{P,y} = -\frac{\partial y}{\partial P}\frac{P}{y} = -\frac{F'(y)}{yF''(y)} > 1$

Rules out multiple equilibria in the asset market at $t = 1$.

A3: RANGE $R - cq > 1$

Expected return on risky investment is greater one.

A4: COST $D'(\cdot) > 0$ and $D''(\cdot) > 0$.

Deposits have convex cost to banks.

Crisis and Fire-Sales

A bank decides what fraction of capital to sell $(1-\gamma_i)$

$$\max_{0\leq\gamma_i\leq 1} \pi_i = R\gamma_i n_i + P(1-\gamma_i)n_i + b_i n_i - cn_i \tag{3}$$

subject to the budget constraint

$$P(1-\gamma_i)n_i + b_i n_i - cn_i \geq 0 \tag{4}$$

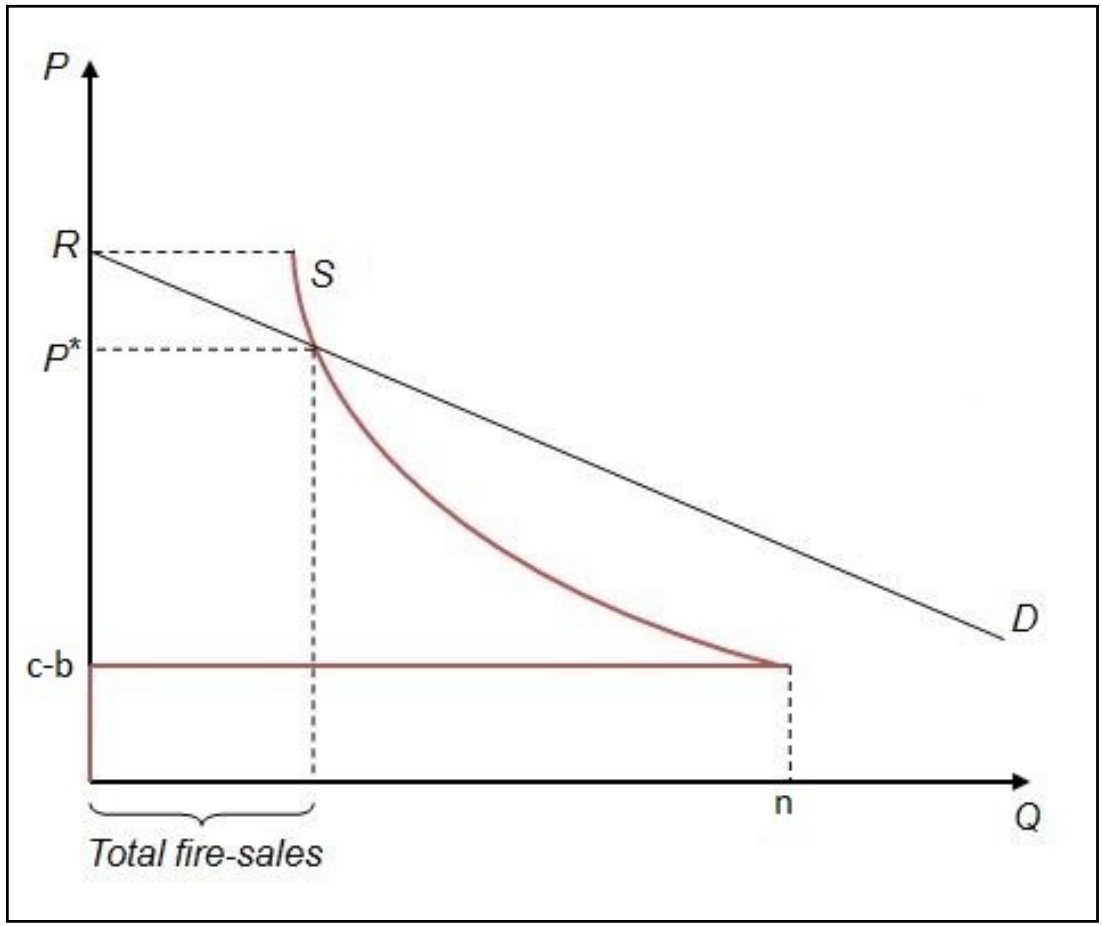
In equilibrium $c < P \leq R$. Hence, the BC binds, and we obtain

$$\gamma_i = 1 - \frac{c-b_i}{P} \tag{5}$$

and the fraction of assets sold is

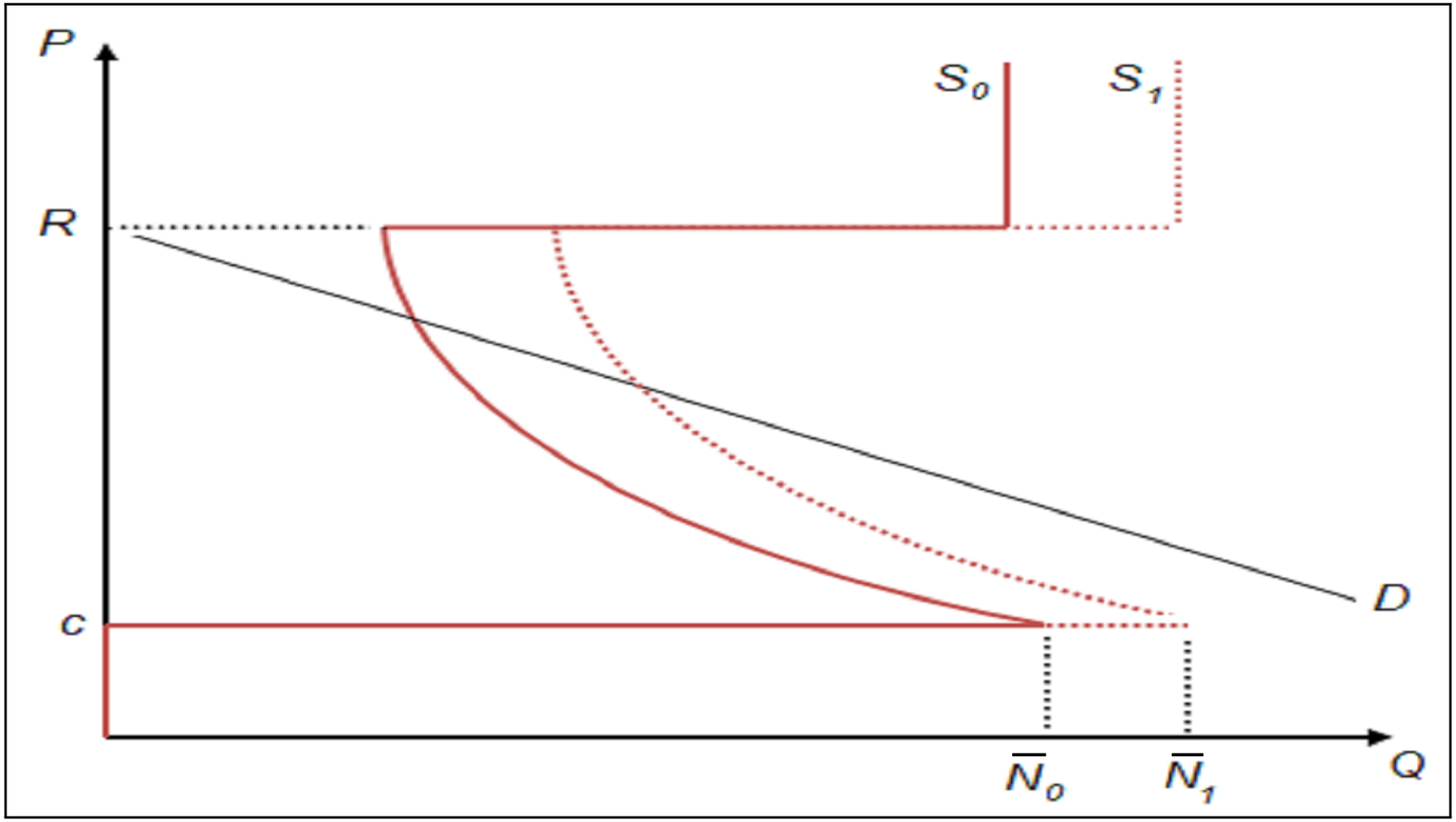
$$1-\gamma_i = \frac{c-b_i}{P} \quad \Longleftarrow \boxed{\text{Downward Sloping Supply}}$$

Asset Market Equilibrium at t=1



Equilibrium price, P, and the fraction of assets retained by banks in equilibrium, $\gamma = 1 - (c - b)/P(n, b)$, are functions of n and b.

Asset Market Equilibrium: Comparative Statics



Lemma 1: A higher initial risky investment (n) or a lower a liquidity ratio (b) increases the severity (lower asset prices) and the cost (more asset fire-sales) of financial crises.

Three Cases

We will compare and contrast three cases

- Competitive eq: No regulation
- Partial Regulation: Only the amount of risky investment (n_i) is regulated, i.e. pre-Basel III
- Complete Regulation: Both risky investment and liquid holdings are regulated

Partial Regulation

Proposition 3

Banks decrease their liquidity ratio as the regulator tightens the limit on risky investment, i.e. $b_i'(n) > 0$.

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- Stricter limits on risky investment $\rightarrow$ lower liquid holdings.
- Regulator responds by limiting risky investment even more.
- Could this have contributed to the recent liquidity crisis?

Competitive Equilibrium vs Partial Regulation

Lemma 2

$n > n^*$
$b > b^*$

Competitive Equilibrium vs Partial Regulation

Lemma 2

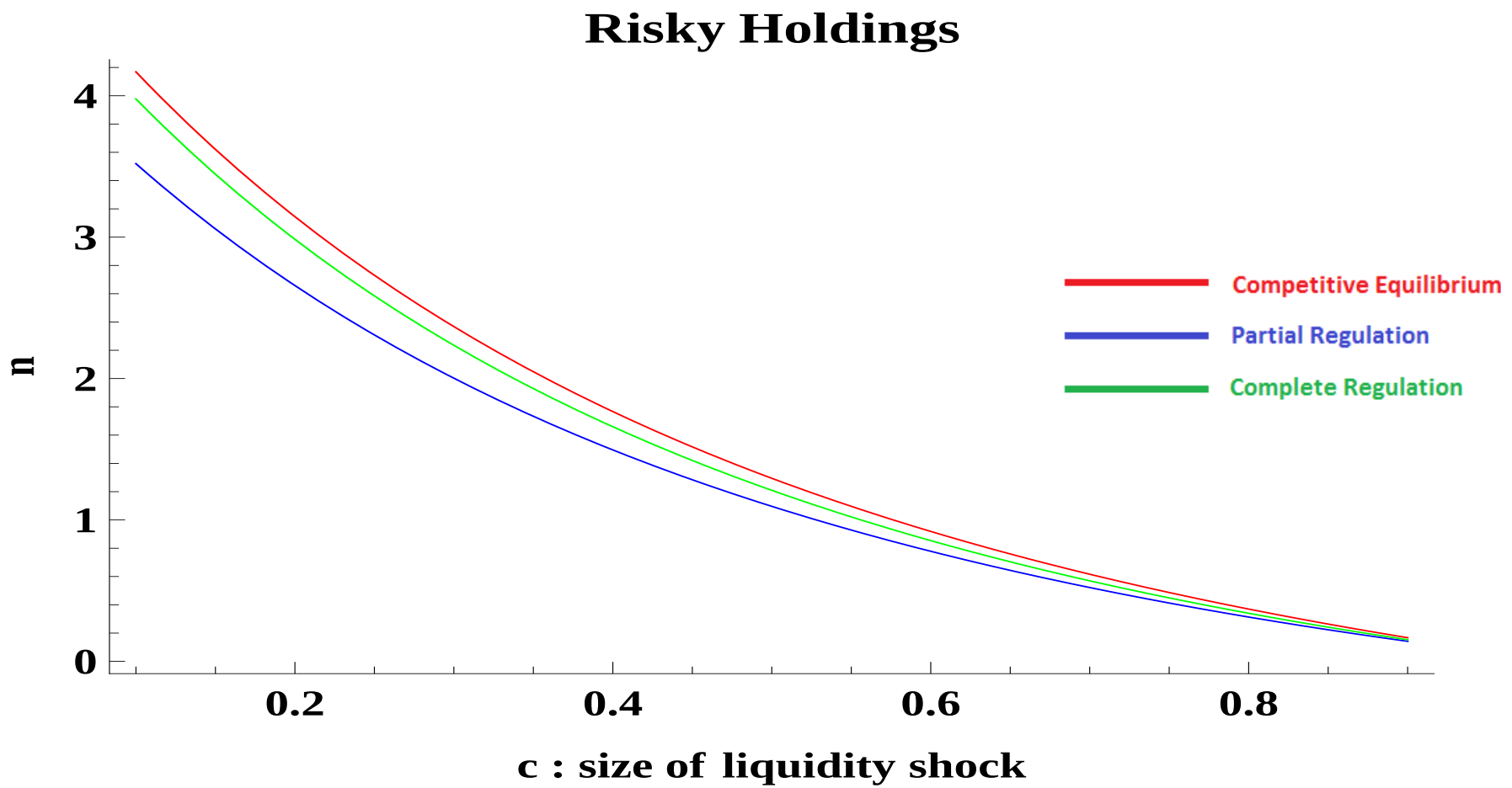
$n > n^*$
$b > b^*$

- There is over investment in the risky asset under competitive equilibrium.
- Banks are less liquid under partial regulation: They undermine the purpose of regulation.
- Banks are restricted to take risk on the investment side, they switch to the liquidity channel.

Comparing Risky Holdings (n)

Proposition 4

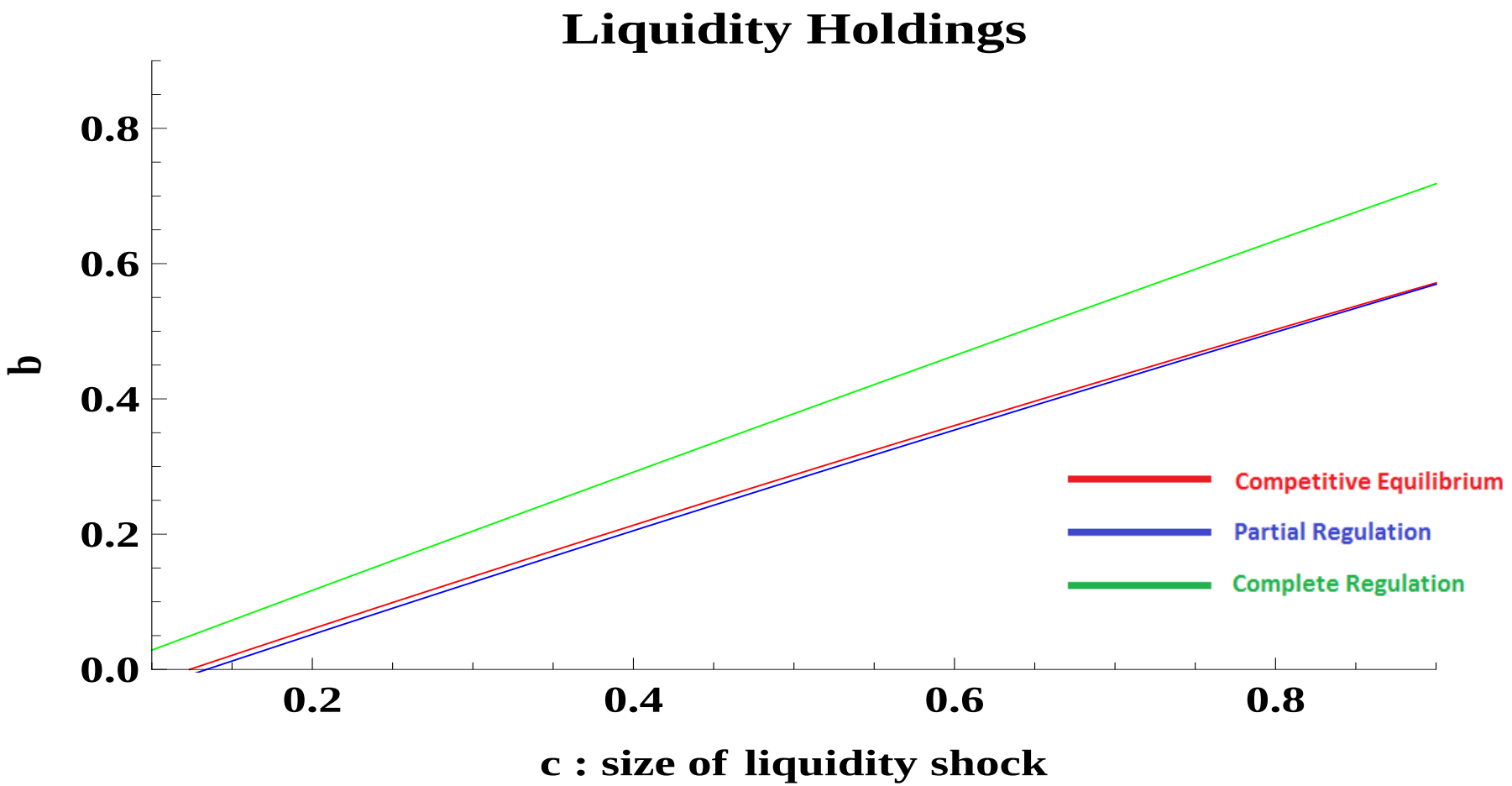
$n > n^{**} > n^{*}$



Comparing Liquidity Hoarding (b)

Proposition 5

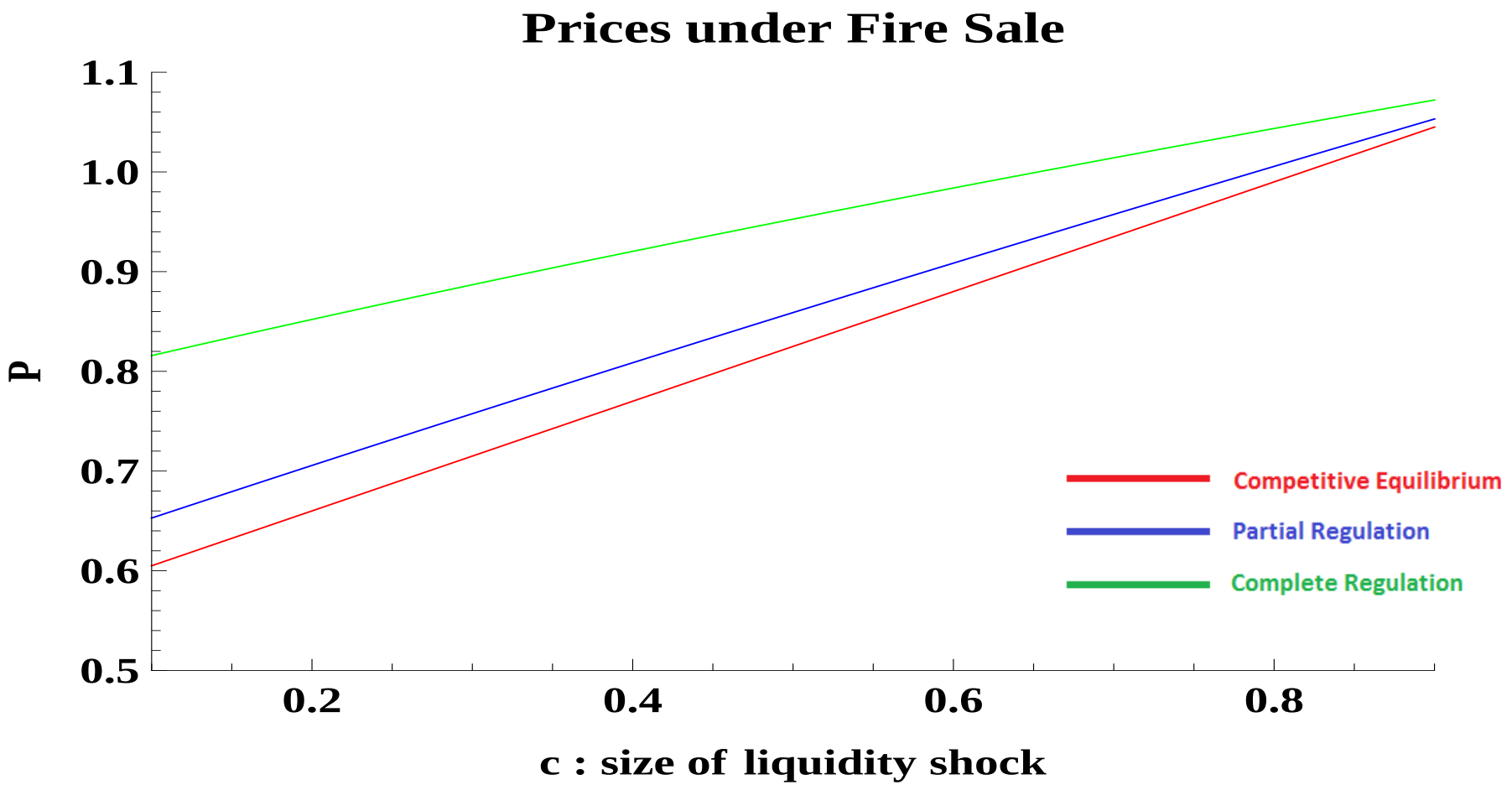
$b^{**} > b > b^{*}$



Fire-sale price of risky asset

Proposition 6

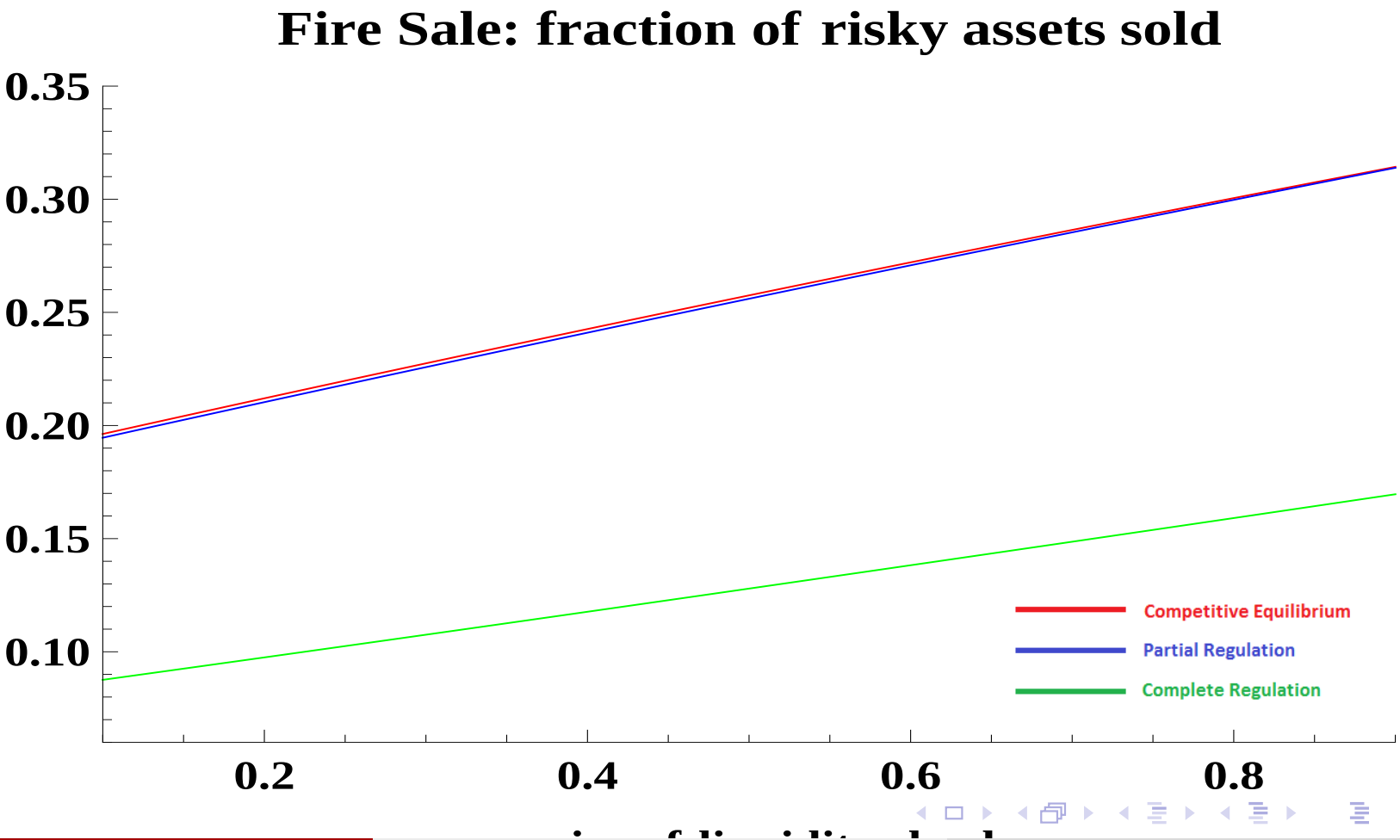
$P^{**} > P^{*} > P$



Severity of the crisis: fraction of risky assets sold

Proposition 7

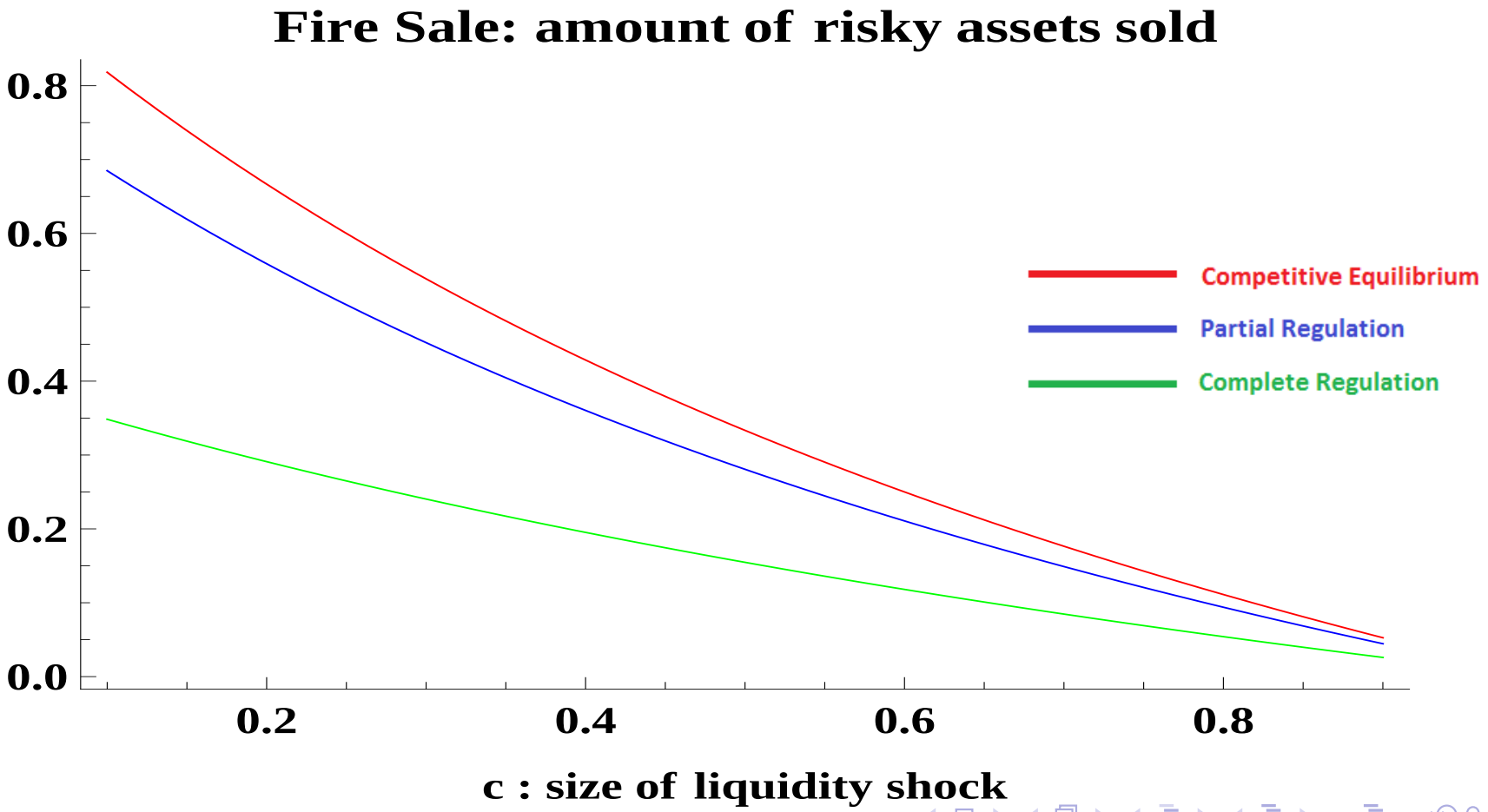
$1-\gamma > 1-\gamma^{*} > 1-\gamma^{**}$



Severity of the crisis: total amount of risky assets sold

Proposition 8

$$(1-\gamma)n > (1-\gamma^*)n^* > (1-\gamma^{**})n^{**}$$



Partial vs Complete Regulation

- Looking at $n^{**} > n^{*}$, one may think that entering the interim period with n^{*} rather than n^{**} should be safer.
- However, fire-sales are bigger under *partial* regulation:
  - Ratio: $1 - \gamma^{*} > 1 - \gamma^{**}$
  - Level: $(1 - \gamma^{*})n^{*} > (1 - \gamma^{**})n^{**}$
- Level of risky investment is not as informative for fire-sales.
- The important thing is not the level of risky investment; it is how the risky investment is backed by liquid assets.

Advantages of Regulating Liquidity

- More funds for high return projects: $n^{**} > n^{*}$
- More liquidity: $b^{**} > b^{*}$
- Less fire-sales:
  - Ratio: $1 - \gamma^{*} > 1 - \gamma^{**}$
  - Level: $(1 - \gamma^{*})n^{*} > (1 - \gamma^{**})n^{**}$
- Higher fire sale prices: $P^{**} > P^{*}$

Conclusion

- The lack of complementary liquidity ratio requirements harms the purpose of the regulation on excessive risk taking:
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