
Capital Regulation and Tail Risk

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The views expressed in this paper are those of the authors and do not necessarily represent those of DNB or IMF.

Lessons from the Crisis: Bank Capital

- **Calls for more bank capital in response to crisis**
 - Basel III
 - doubles the minimal capital ratio
 - conservation and countercyclical buffers
- **Arguments in favor of higher capital**
 - Ex-post: capital as a buffer
(absorbs losses and reduces the risk of insolvency)
 - Ex-ante: more capital reduces risk-shifting incentives
(“skin in the game” effect)

Capital and Tail Risk

- **Higher bank capital: Necessary...but not sufficient**
 - Compensating the cost of capital (Hellmann et al., 2000)
 - Correlation risks (Acharya, 2009)
 - Funding risks (Perotti and Suarez, 2010)
- **Tail risk: negatively skewed gambles**
 - Carry trades reliant on ST wholesale funding (Gorton, 2010)
 - Contingent liabilities on systemic risk (Acharya and Richardson, 2009)
 - Undiversified housing exposure (Shin, 2009)
- **Tail risk was low in traditional loan-oriented banking**
 - “Skin in the game” effect dominated, hence higher capital → lower risk-taking

This Paper

- Reviews the effectiveness of capital regulation, and in particular of excess capital buffers, in dealing with tail risk events

- **Under tail risk**

- **Buffer and incentives effects of capital diminish**

- Higher capital does not absorb extreme tail losses
 - Losses go deep in debt value

- **Capital may enable risk-taking**

Excess buffers →

A bank can afford to lose *some* capital (low cost of losing capital) →

Putting capital to risk

The Model

Set-up

- Main ingredients
 - Bank is managed by an owner-manager (the banker) with limited liability
 - Prudential framework based on minimal capital ratio
 - Rising capital is costly (asymmetric information, agency problem)
 - Bank has access to a tail risk project
- There are 3 dates ($0, \frac{1}{2}, 1$), no discounting, and everyone is risk-neutral

Projects

- **A bank**, capital and deposits, $C + D = 1$
- **Projects**, investment at 0, returns at 1
 - **Safe**: $R_S > 1$
 - **Risky**:
 - $R_H > R_S$ w.p. p
 - $0 < R_L < 1$ w.p. $1-p-\mu$
 - $R_0 = 0$ w.p. μ ; captures tail risk
- **Risk-shifting**
 - **Safe** has higher NPV: $R_S > pR_H + (1-p-\mu)R_L$
 - A bank with low capital prefers **Risky**: $R_S - 1 < p(R_H - 1)$

Capital Regulation

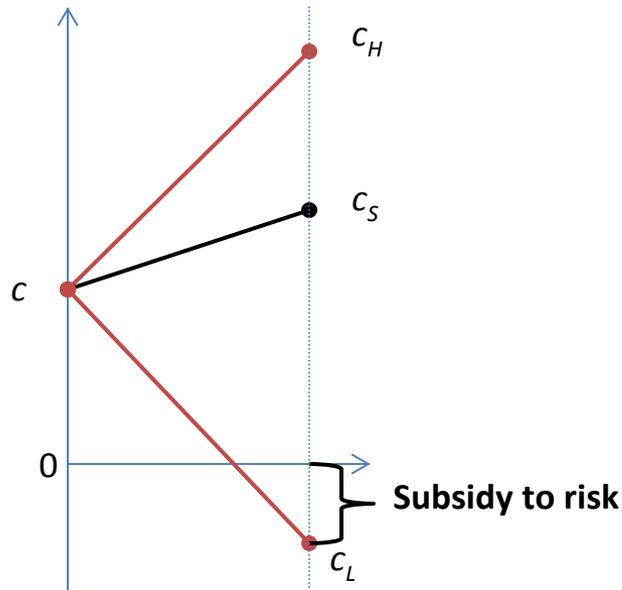
- **At date 0:** initial capital $c > c_{min}$ (by assumption)
- **At date $\frac{1}{2}$**
 - Final outcome of the project becomes known
 - Bank's capital ratio: $c_i = (R_i - D)/R_i$, with $i = \{S, H, L, 0\}$
- If $c_i < c_{min}$ (undercapitalized bank) \rightarrow Corrective action
 - Raise new equity (cost T), or
 - Close down (lose positive capital, if any)
- **Safe:** $c_S > c_{min}$
- **Risky:** $c_H > c_{min}$
 $c_0 < 0 < c_{min}$
 c_L , depending on R_L and c (negative, positive but insufficient, sufficient)
 $c_L: \quad ? < 0 < ? < c_{min} < ?$

Intuition

Capital and Risk-taking: Traditional

No tail risk, no capital adjustment cost ($\mu=0, T=0$)

Capital ratio



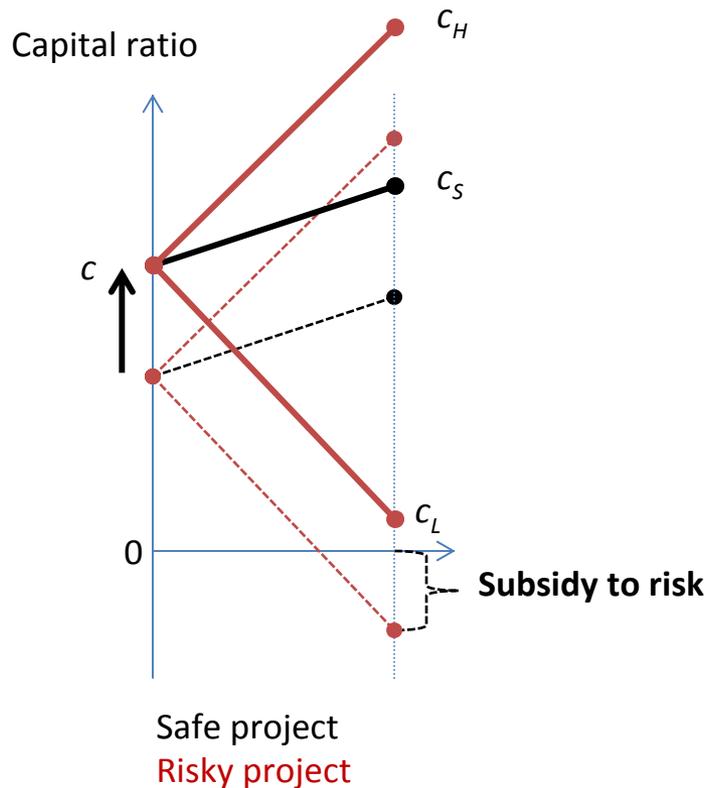
Safe project
Risky project

Capital ratio: $(\text{assets} - \text{debt}) / \text{assets}$

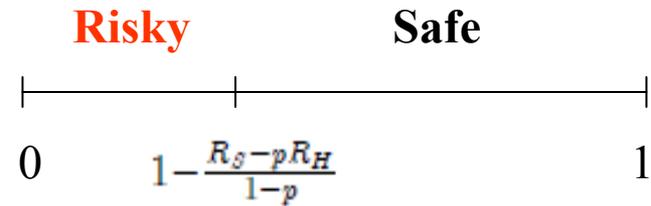
- Banks do not internalize losses when **negative capital**
- Too much risk-taking

Capital and Risk-taking: Traditional (cont'd)

No tail risk, no capital adjustment cost ($\mu=0, T=0$)



Less incentives for risk-taking
(less chance of $c_L < 0$)

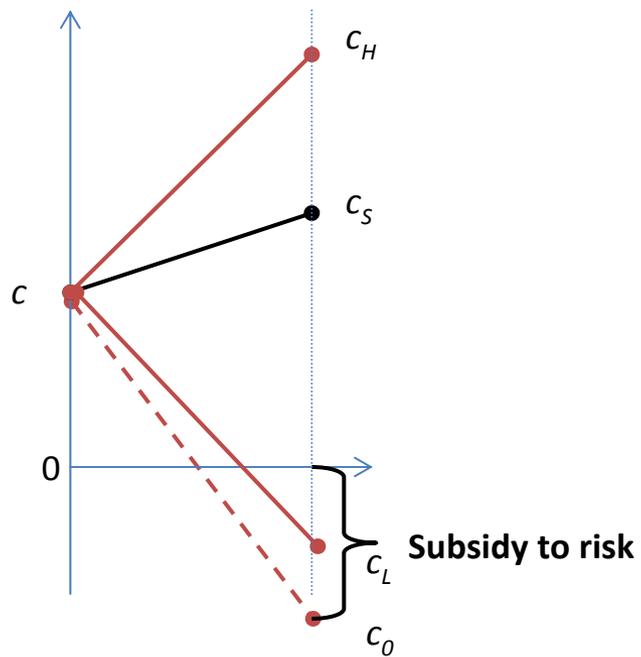


More capital \rightarrow Lower risk

“Skin in the game” and Tail Risk

Tail risk, **no** capital adjustment cost ($\mu > 0, T = 0$)

Capital ratio



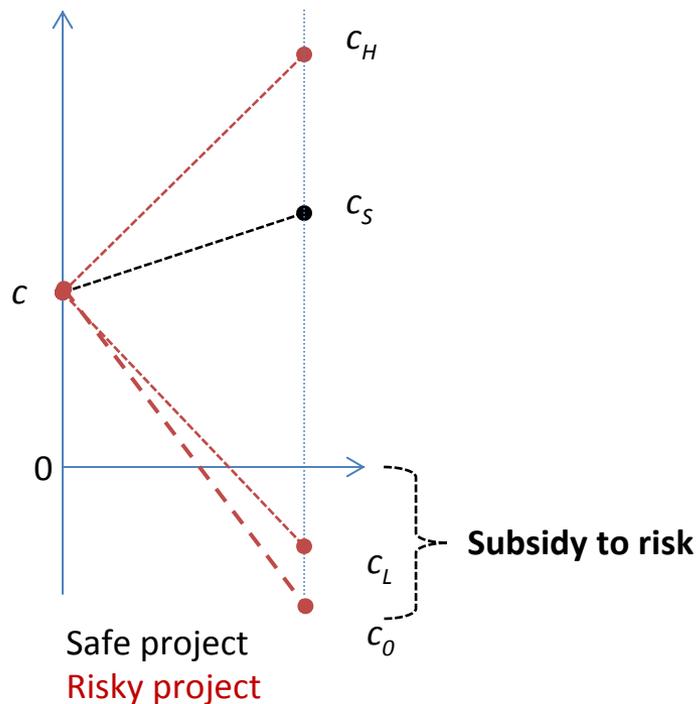
Safe project

Risky project

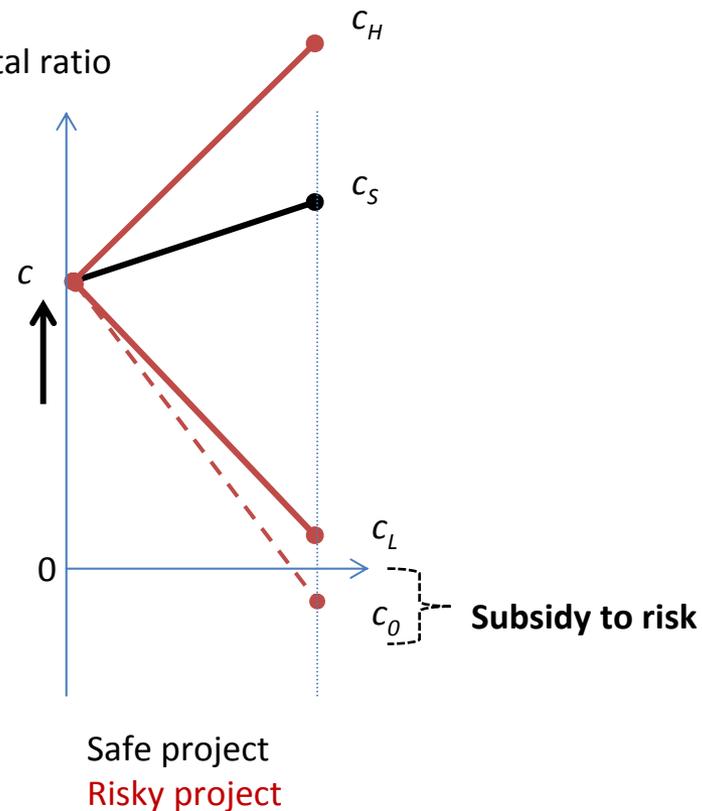
“Skin in the game” and Tail Risk (cont’d)

Tail risk, **no** capital adjustment cost ($\mu > 0, T = 0$)

Capital ratio

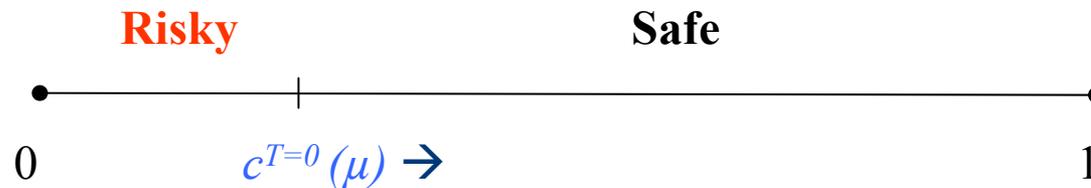


Capital ratio



More capital \rightarrow Reduces but does not eliminate risk incentives

“Skin in the game” and Tail Risk (cont’d)

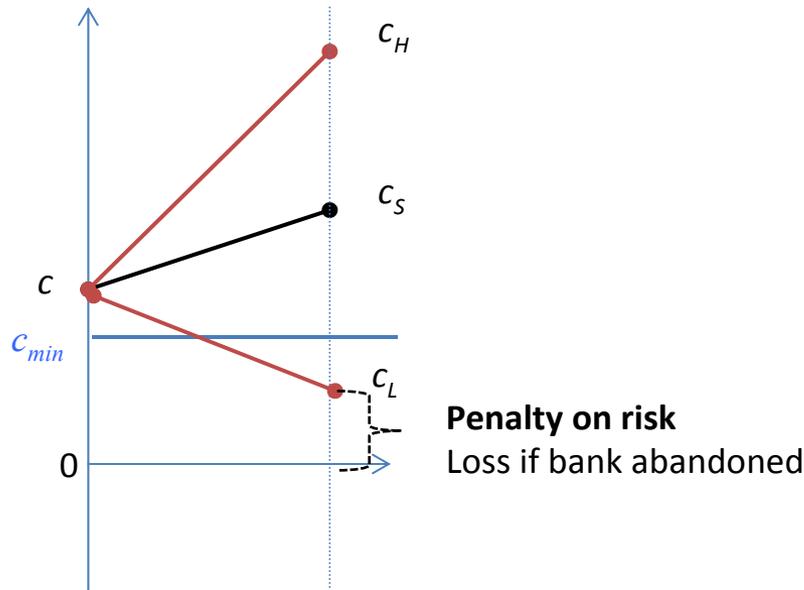


- Higher $\mu \rightarrow$ more initial capital is required to maintain incentives to select the safe project
- Tail risk limits the effectiveness of required capital for controlling bank risk-taking

Capital and Risk-taking: Enabling effect

No tail risk, capital adjustment cost ($\mu = 0, c_{min} > 0$)

Capital ratio

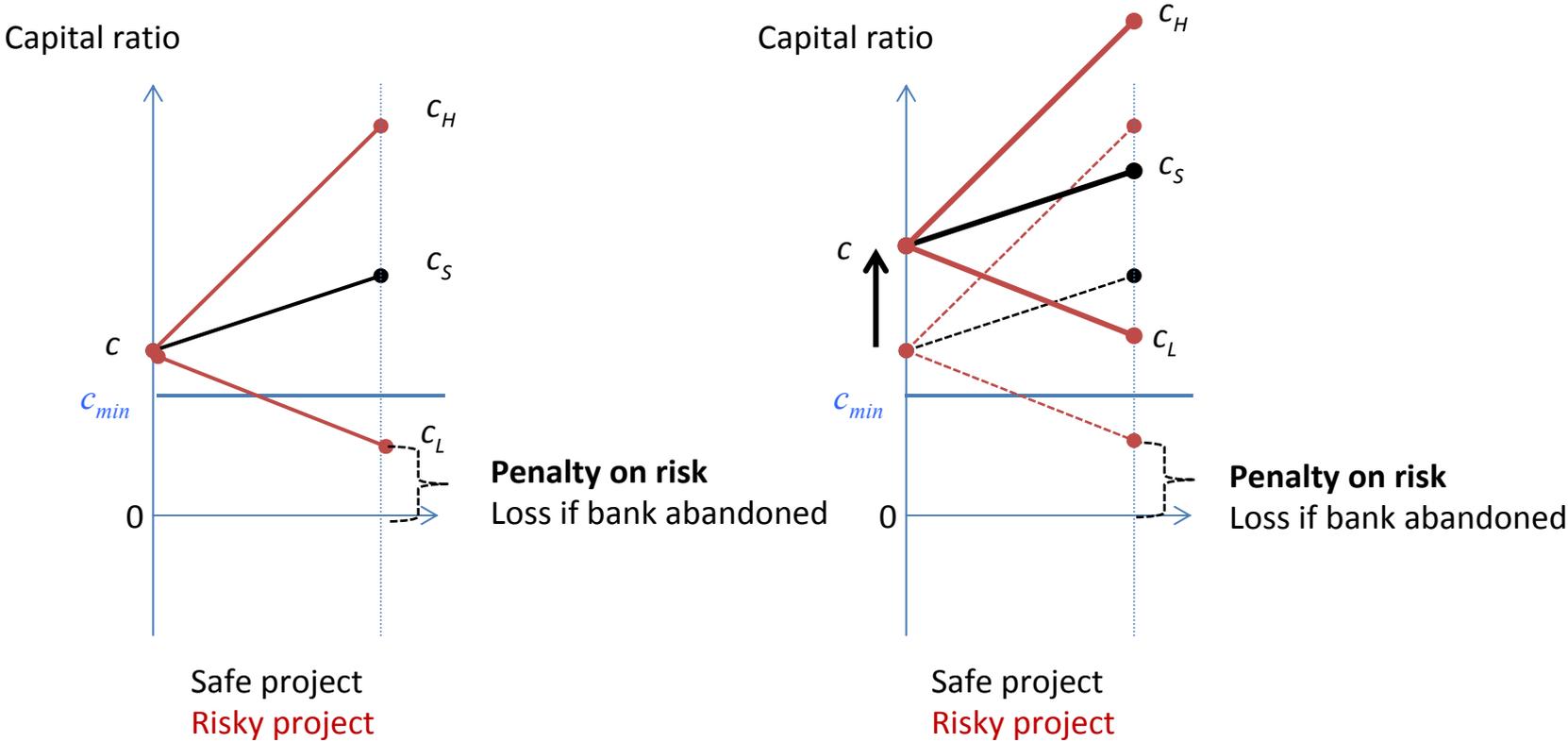


Safe project
Risky project

c_{min} : Minimal capital requirement

Capital and Risk-taking: Enabling effect (cont'd)

No tail risk, capital adjustment cost ($\mu = 0, c_{min} > 0$)

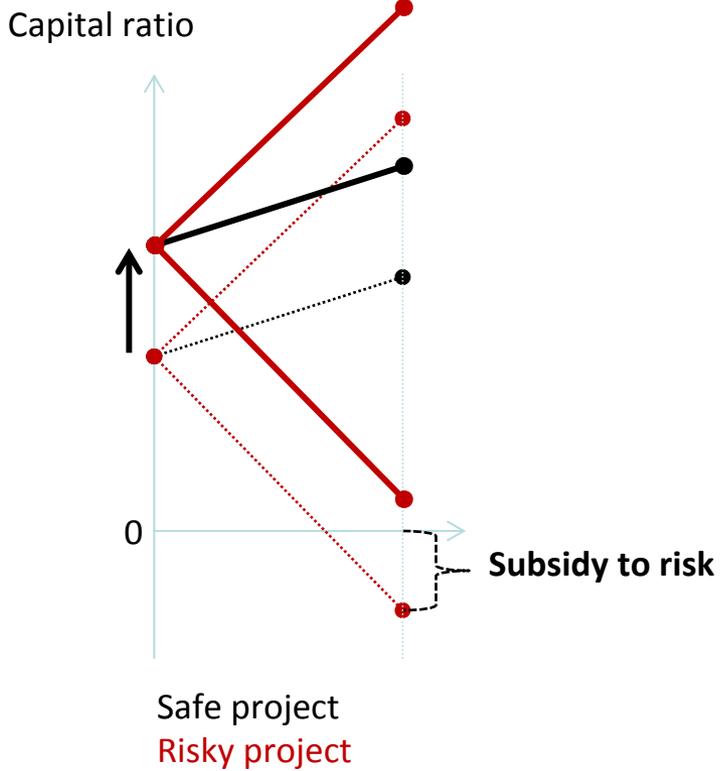


c_{min} : Minimal capital requirement

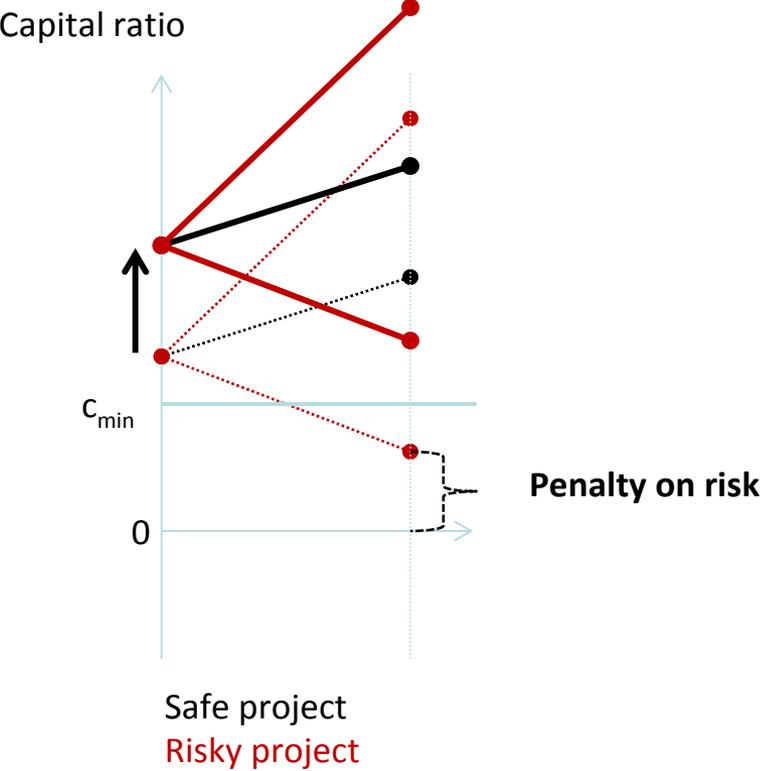
**More capital \rightarrow More incentives for risk
(less chance $c_L < c_{min}$)**

The two opposite effects of higher capital

Limited liability effect



Capital adjustment cost effect

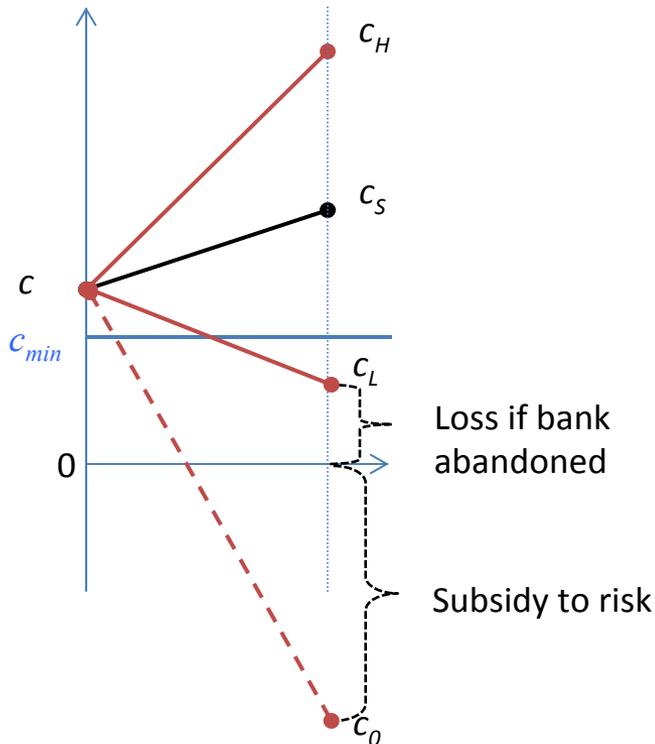


Putting together: Tail risk

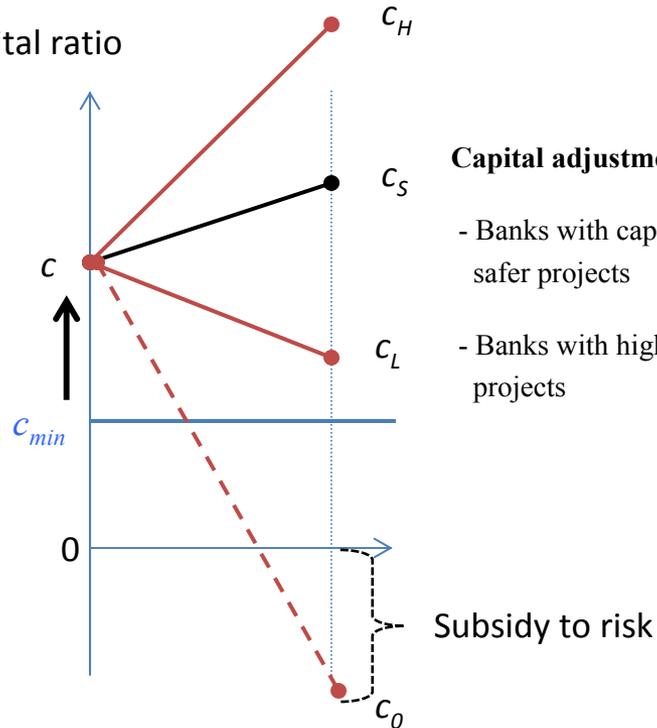
When is risk bad ?

- in the presence of left tail projects: $\mu > 0$

Capital ratio



Capital ratio



Capital adjustment cost effect dominates:

- Banks with capital closer to minimal choose safer projects
- Banks with higher capital choose riskier projects

Higher capital \rightarrow Higher excess risk

Solving the model

Recapitalization Decision



- | | | |
|--|---|--|
| <ul style="list-style-type: none"> • No recapitalization; • Bank is abandoned; • Banker gets zero payoff. | <ul style="list-style-type: none"> • The bank is recapitalized at cost T; • Banker gets a positive payoff $R_L - (1 - c) - T$ | <ul style="list-style-type: none"> • Capital is sufficient; • Banker gets positive payoff $R_L - (1 - c)$ |
|--|---|--|

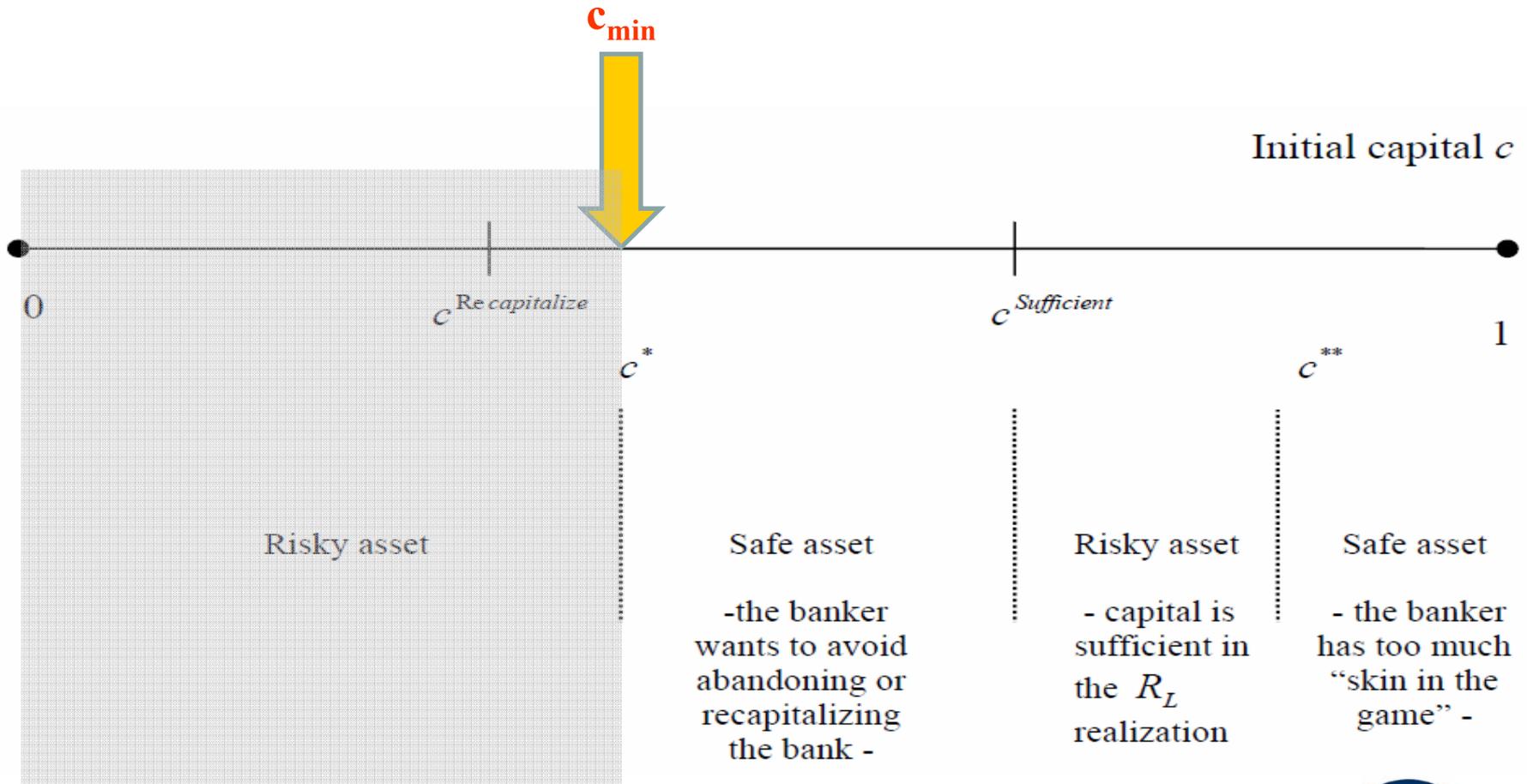
$$c^{\text{Recapitalize}} = 1 + T - R_L.$$

$$c^{\text{Sufficient}} = 1 - (1 - c_{\min})R_L.$$

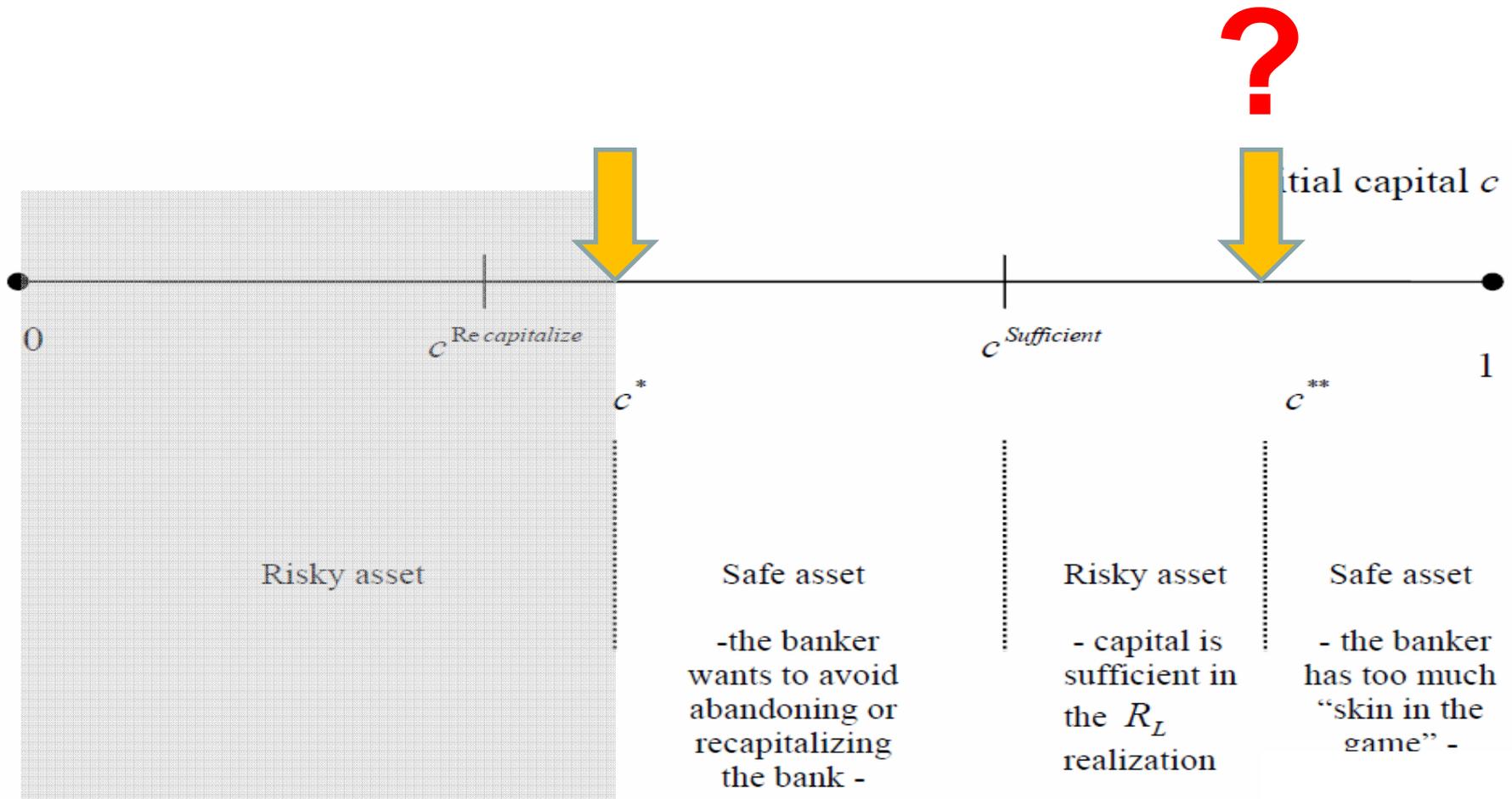
With $c^{\text{Recapitalize}} < c^{\text{Sufficient}}$ for $T < c_{\min}R_L$.

Project Choice

There are parameter values such that:



Minimal capital

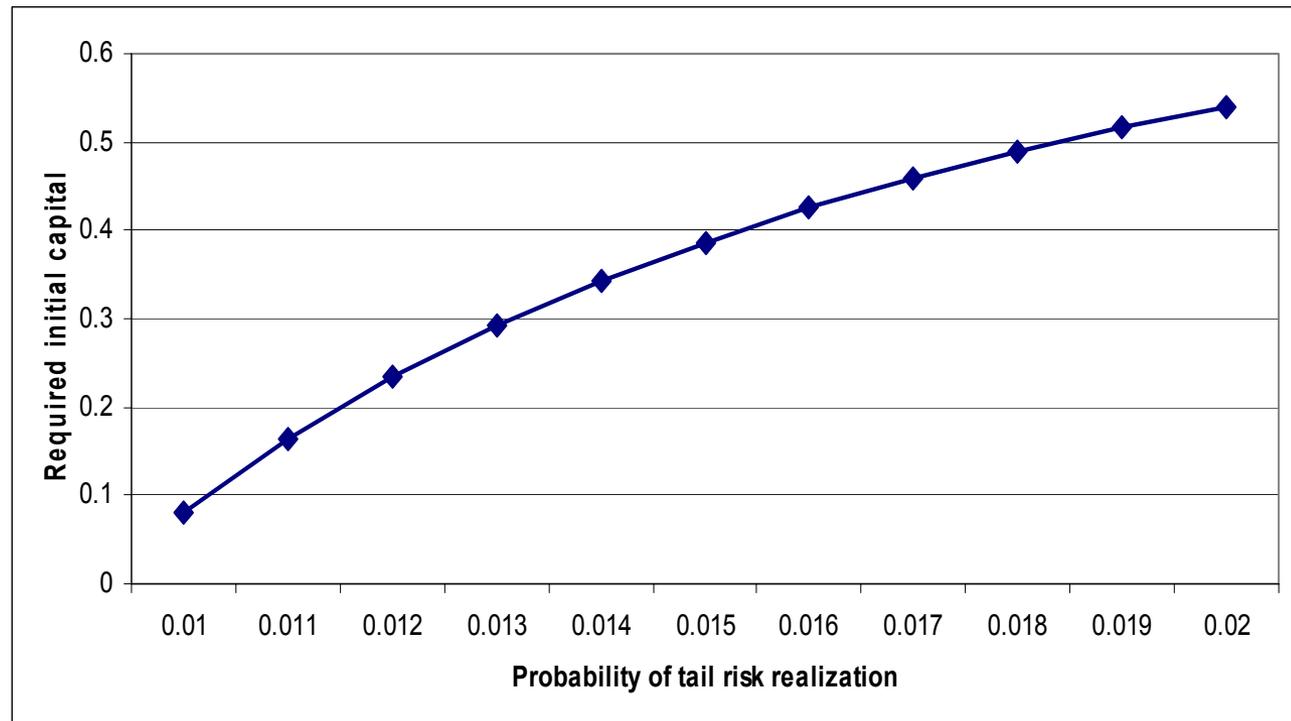


Capital req'ts not effective for tail risk

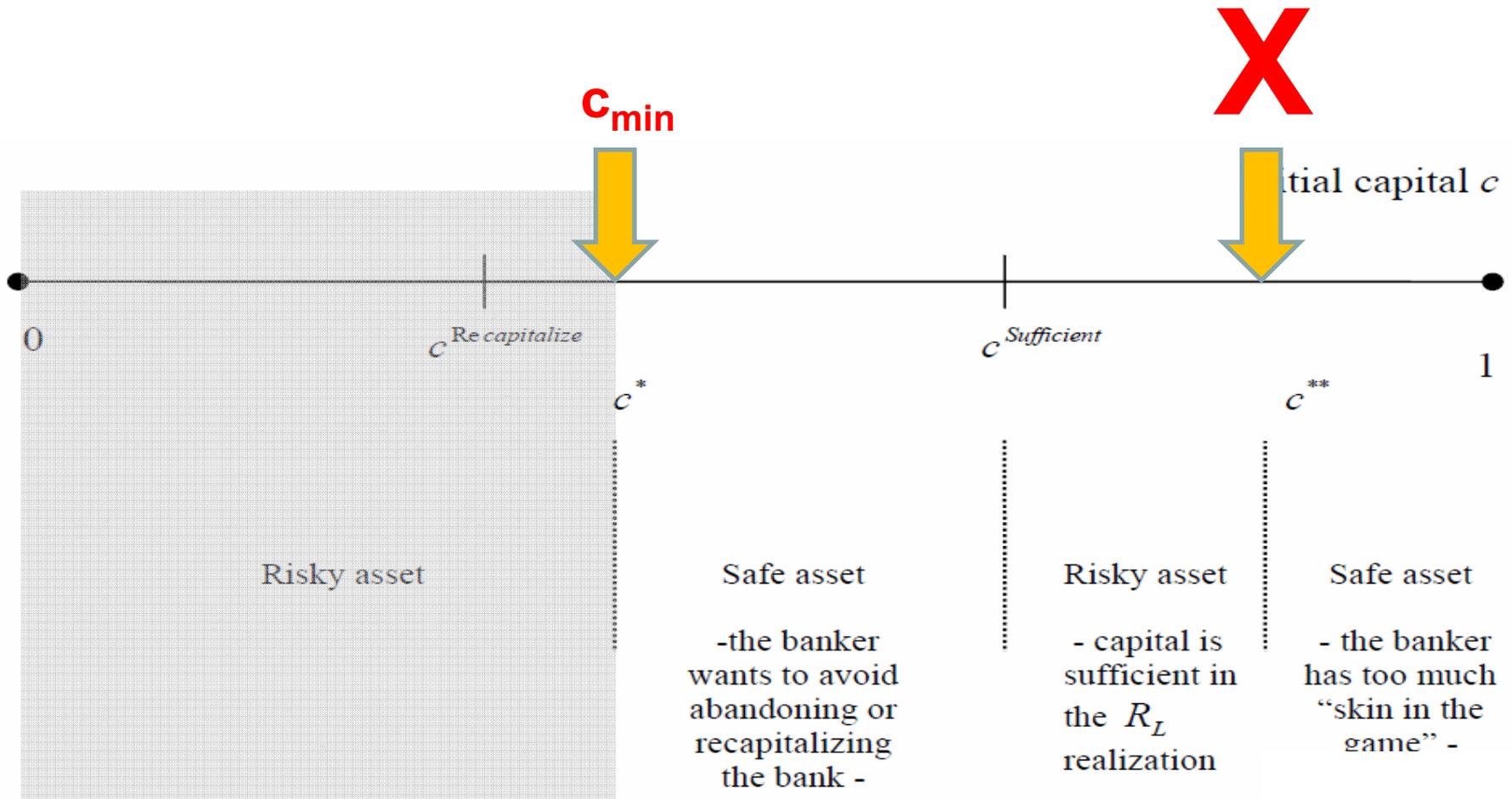
Exercise: Capital necessary to prevent risk-shifting

- $R_S = 1.03$
- $R_H = 1.14$; $R_L = 0.92$; $R_0 = 0$; $p = .5$; $\mu = .01$ // $E(R) = 1.021$
- $c^{**} = 8\%$

- Increase μ
holding $E(R)$
fixed
- Impact on c^{**}

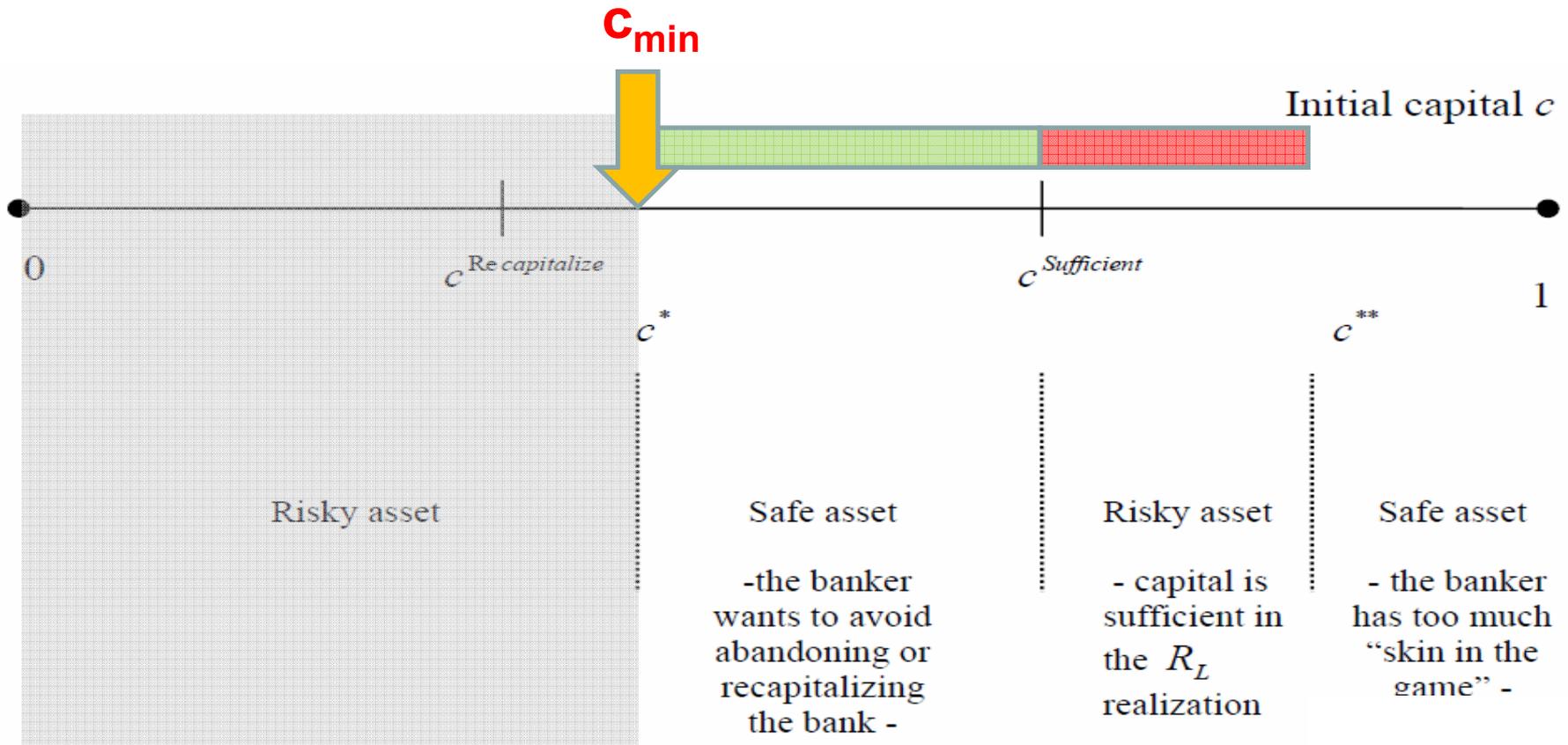


Capital req'ts not effective for tail risk



Policy

Focus on Excess capital



Deal with skewed returns directly

- How to deal with skewed returns ?
 - **Not by capital ratios alone**
(similar with liquidity, exposure, correlations)
 - **Prohibit extreme bets or increase their ex-ante cost**
(Acharya et al., 2010; Perotti and Suarez, 2009)
 - **Enhanced supervision to capture tail risk**
(particularly for well-capitalized banks)

Conclusions

- Capital is useful
 - ... but it is ineffective in dealing with tail risk
 - ... impossible to control all risk-taking using a single instrument
- Capital may **enable** risk-taking
- Need a distinct approach (direct + regulatory focus)