Markets, Banks and Shadow Banks

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Motivation

"While **higher capital and liquidity requirements** on banks will no doubt help to insulate banks from the consequences of large shocks, the danger is that they **will also drive a larger share of intermediation into the shadow banking realm**."

Hanson, Kashyap, and Stein (2011)

Introduction

- Main issues to be addressed
  - → What is the difference between banks and shadow banks?
  - → How regulation affects funding through these channels?
  - → How shadow banks affect effectiveness of regulation?
- Goal is to construct a model to shed light on
  - → Effect of regulation on structure & risk of financial system
  - → Regulatory tradeoffs

What are shadow banks?

- Financial Stability Board

  → “Global Shadow Banking Monitoring Reports”

- Broad definition

  “Credit intermediation involving entities and activities outside of the regular banking system.”

- Narrow measure

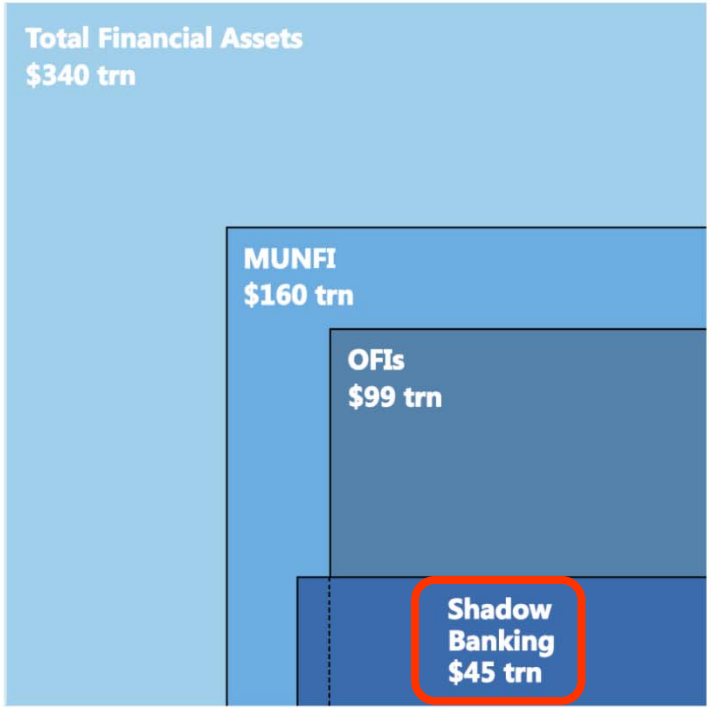
  → Activity-based approach based on five economic functions

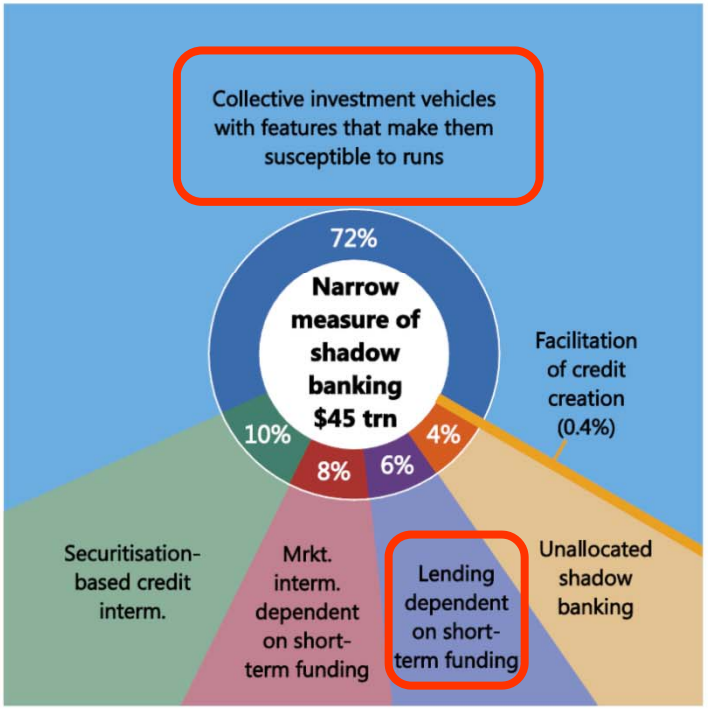
Narrow measure of shadow banking

Monitoring aggregates

USD trillion at end-2016 Exhibit 0-1

21 jurisdictions and the euro area[1] Composition of the narrow measure[2]





Economic function #1

- Management of collective investment vehicles
  - → Fixed income funds (30%)
  - → Mixed (equity and credit) funds (19%)
  - → Money market funds (16%)
  - → Credit hedge funds (13%)
- Common feature of these institutions
  - → Actively select (screen) assets included in their portfolios

Economic function #2

- Lending dependent on short-term funding
  - → Finance companies (81%)
  - → Consumer credit (7%)
  - → Leasing companies (5%)
  - → Real estate credit companies (4%)
- Common feature of these institutions
  - → Actively select (screen) loan applicants

Our approach

- Focus on two dimensions: **screening** and **regulation**
  - → Whether lenders screen borrowers
  - → Whether lenders comply with capital regulation
- Three funding modes
  - → Borrowers not screened by intermediary: **market finance**
  - → Borrowers screened by intermediary (bank)
    - + Bank chooses to be regulated: **regulated banks**
    - + Bank chooses not to be regulated: **shadow banks**

Assumptions on bank capital (i)

- Bank capital is costly but provides "skin in the game"

  → Commitment device for screening borrowers

  → Reduces the cost of (uninsured) debt

- Bank capital has to be certified

  → Given incentives to save on costly equity

Assumptions on bank capital (ii)

- Complying with regulation implies certification

  → Novel role for banking supervision

- Not complying with regulation requires private certification

  → Higher cost of capital

The emergence of shadow banks (i)

- Trade-off between costs and benefits of public certification

  → If bank capital regulation is very tough

  → Banks may prefer not to comply with regulation

  → And resort to more expensive private certification

The emergence of shadow banks (ii)

- Alternative setup based on costs and benefits of deposit insurance
  - → If bank capital regulation is very tough
  - → Banks may prefer to give up (underpriced) deposit insurance
  - → And resort to more expensive uninsured funding
- Similar qualitative results
  - → In the paper: not for today!

Overview

- Model setup
- Equilibrium
  - → Model with no capital requirements
  - → Flat capital requirements (Basel I)
  - → Value-at-Risk capital requirements (Basel II)
- Optimal capital requirements
- Extensions
- Concluding remarks

Part 1

Model setup

Model setup

- Two dates ($t = 0, 1$)
- Agents: → Set of potential **entrepreneurs**
  → Set of risk-neutral **banks**
  → Set of risk-neutral **investors**
- Entrepreneurs have projects that require outside finance
- Banks raise funds by issuing uninsured debt and equity capital

Entrepreneurs

- Continuum of entrepreneurs of observable types $p \in [0,1]$
- Each entrepreneur of type p has risky project

$$\text{Unit investment} \rightarrow \text{Return} = \begin{cases} A(x_p), & \text{with prob. } 1-p+s_p \\ 0, & \text{with prob. } p-s_p \end{cases}$$

$\rightarrow$ $s_p \in [0,p]$ is the screening intensity of lending bank

$\rightarrow$ x_p is the aggregate investment of entrepreneurs of type p

$\rightarrow$ Success return $A(x_p)$ is decreasing in x_p

Bank screening

- Screening is not observed by debtholders

  → Moral hazard problem

- Screening entails cost

$$c(s_p) = \frac{\gamma}{2}(s_p)^2, \text{ with } \gamma > 0$$

Investors

- Two types of risk-neutral investors
  - → Debtholders: require expected return normalized to 0
  - → Shareholders: require expected return $\delta > 0$ (cost of capital)

Competition assumptions

- Large set of potential entrepreneurs for each type p (free entry)

  → Success return $A(x_p)$ equals loan rate R_p

- Loan market is contestable (limit pricing)

  → Equilibrium loan rate is lowest feasible rate

Correlation assumptions

- Bank specialization

  → Each bank only lends to a single type *p* of entrepreneurs

  → To avoid modelling correlation/diversification across types

- Returns of entrepreneurs of type *p* are perfectly correlated

  → Portfolio return coincides with single project return

  → Loans' prob. of default = Banks' prob. of failure

Bank capital certification

- Bank capital has to be certified

  → Otherwise shareholders could lever up

- Certification cost per unit of capital $\eta > 0$

Part 2

Equilibrium

Part 2a

Model with no capital requirements

Banks' decisions

- Bank lending to entrepreneurs of type p sets

  (1) Capital k_p per unit of loans

  (2) Borrowing rate B_p offered to debtholders

  (3) Lending rate R_p offered to entrepreneurs

  $\rightarrow$ Such contract determines screening s_p

Banks' profits

- Profits of bank lending to type p (per unit of loans)

$$\pi_p = (1 - p + s_p)[R_p - (1 - k_p)B_p] - c(s_p) - \eta k_p$$

→ with probability $1 - p + s_p$ gets R_p and pays $(1 - k_p)B_p$

→ with probability $p - s_p$ gets zero (limited liability)

→ minus screening cost $c(s_p)$

→ minus certification cost ηk_p

Equilibrium

- An equilibrium is array $(k_p^*, B_p^*, R_p^*, s_p^*)$ that solves

$$\min R_p$$

→ subject to incentive compatibility constraint

$$s_p^* = \arg\max_s \left\{(1-p+s)[R_p^* - (1-k_p^*)B_p^*] - c(s)\right\}$$

→ debtholders' participation constraint

$$(1-p+s_p^*)B_p^* \geq 1$$

→ and shareholders' participation constraint

$$\pi_p^* \geq (1+\delta)k_p^*$$

Capital and screening

- IC constraint

$$s_p^* = \arg\max_s \left\{(1-p+s)[R_p^* - (1-k_p^*)B_p^*] - c(s)\right\}$$

$\longrightarrow$ Interior solution characterized by FOC

$$R_p^* - (1-k_p^*)B_p^* = c'(s_p^*)$$

$\longrightarrow$ "Skin in the game" effect

$$\frac{\partial s_p^*}{\partial k_p^*} > 0$$

Proposition 1

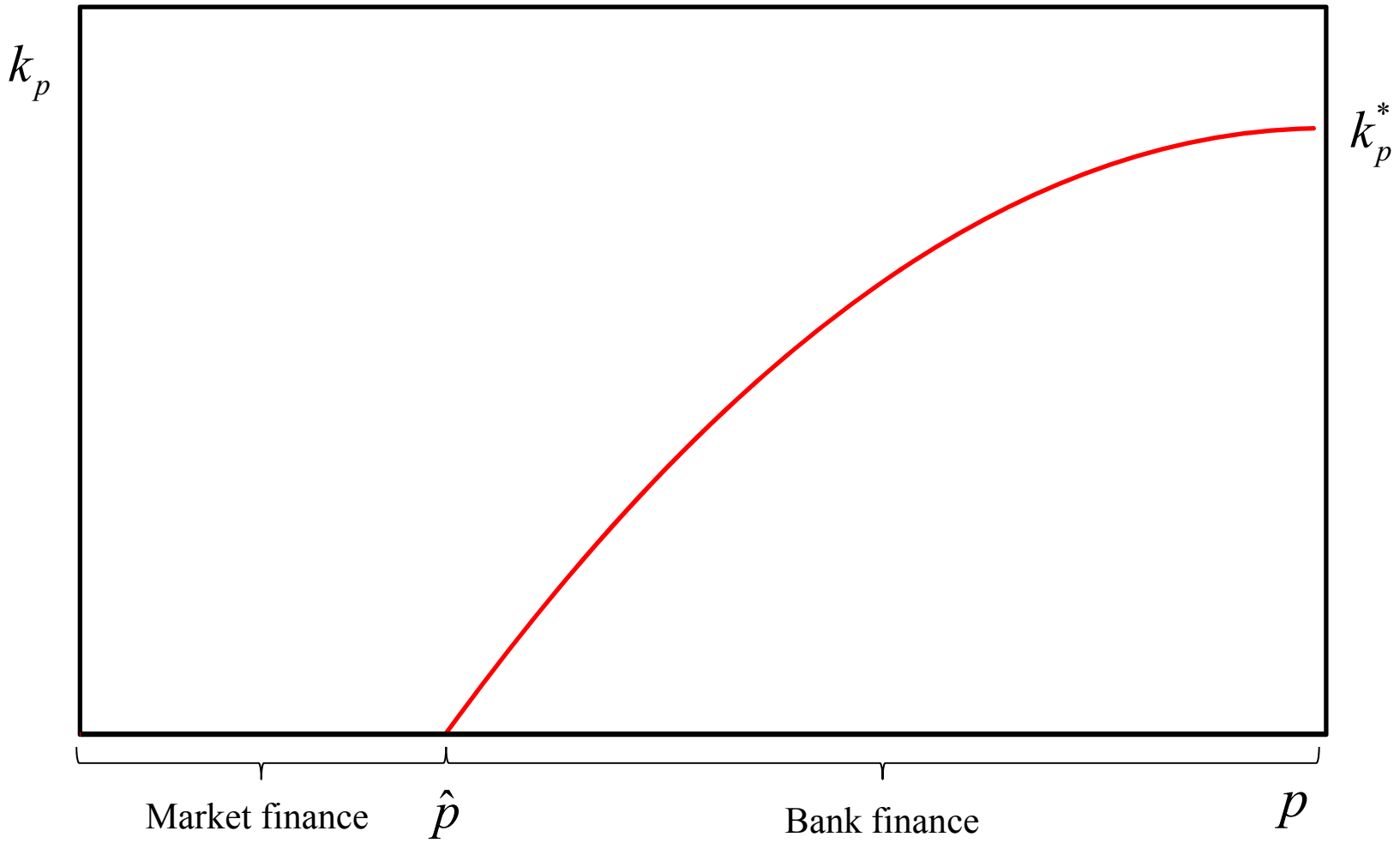
- There is a marginal type

$$\hat{p} = 1 - \sqrt{\frac{1+\delta+\eta}{(\delta+\eta)c''(0)}}$$

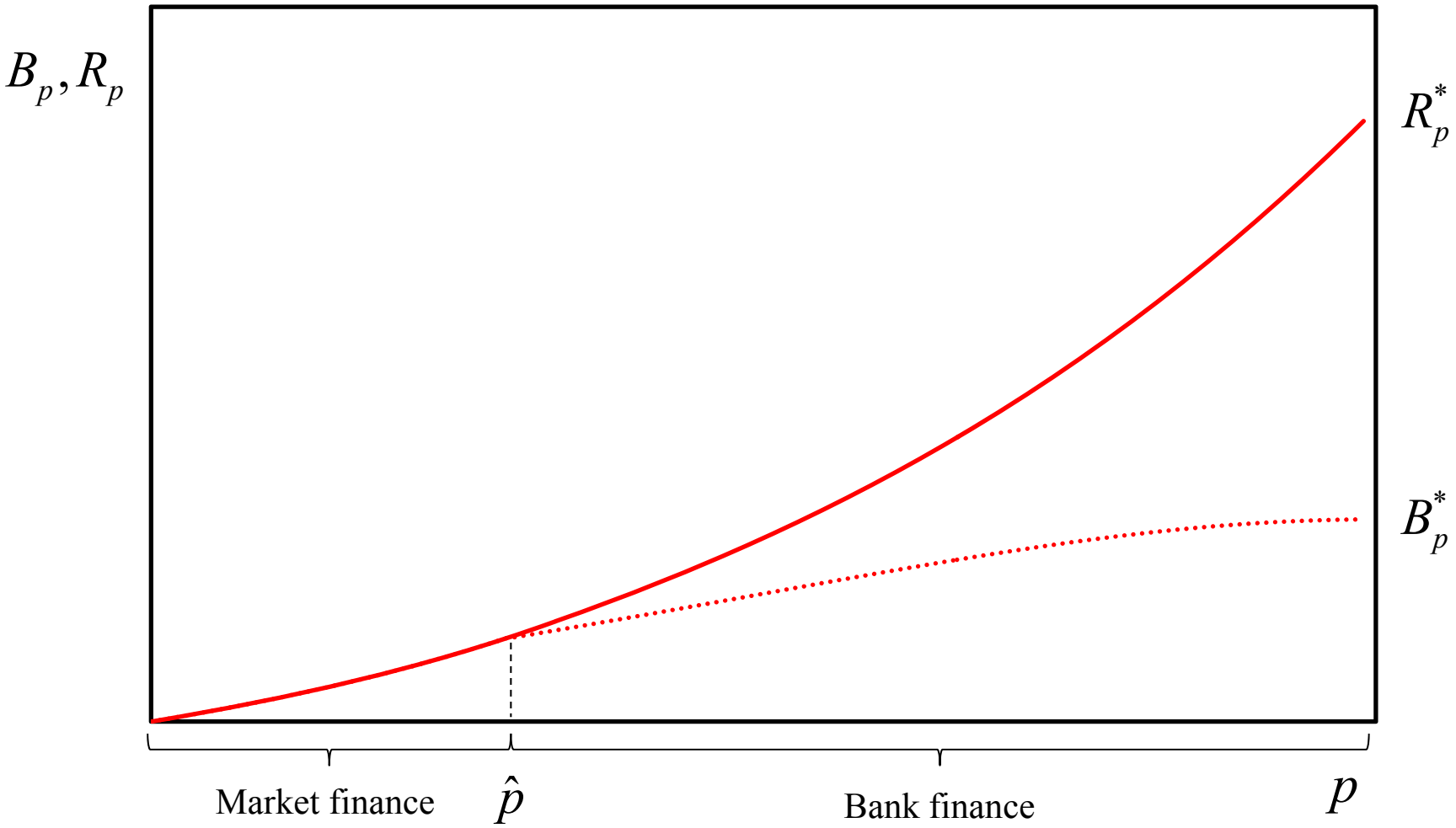
→ Safer types $p \leq \hat{p}$ choose market finance: $s_p^* = k_p^* = 0$

→ Riskier types $p > \hat{p}$ choose bank finance: $s_p^* > 0$ and $k_p^* > 0$

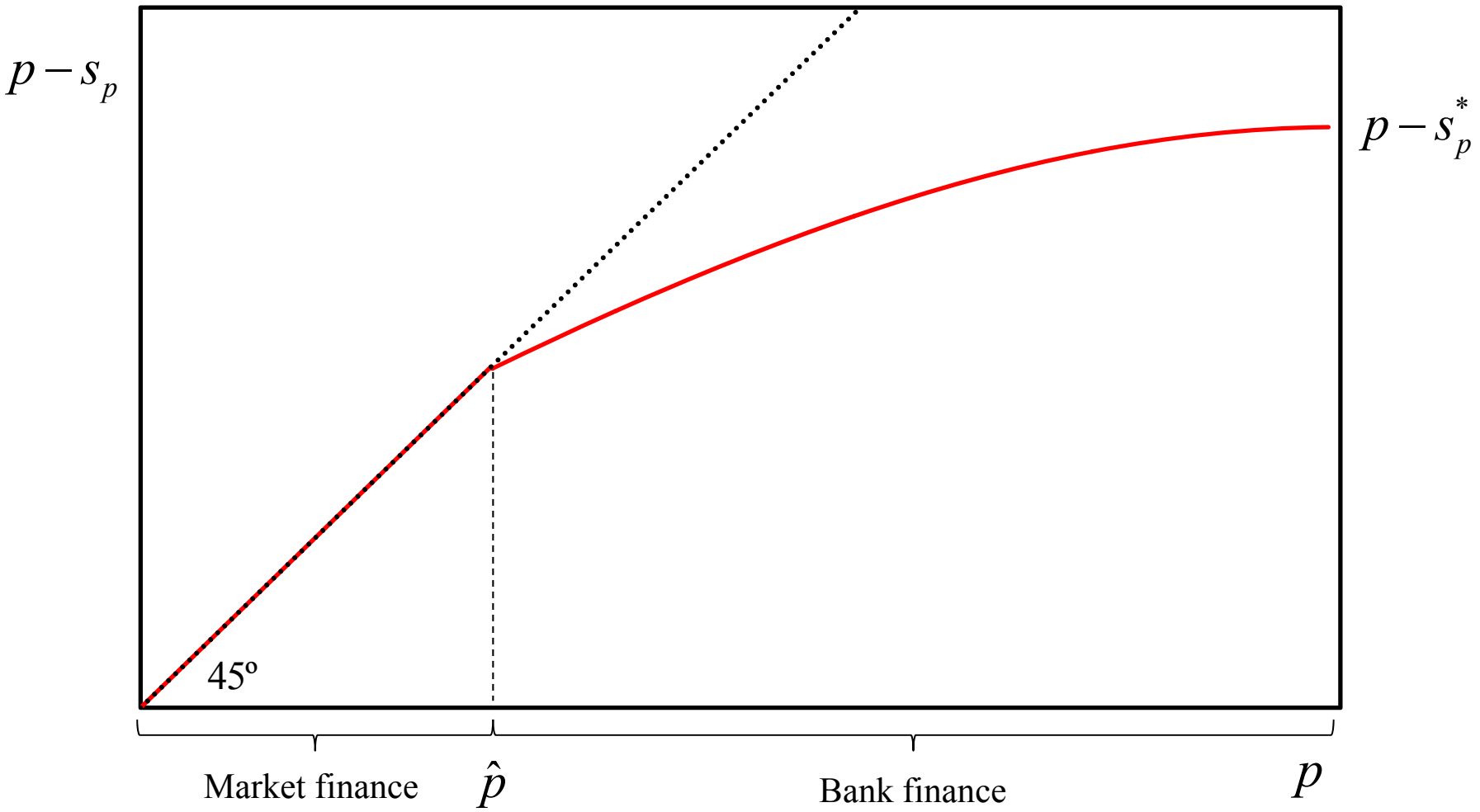
Bank capital



Borrowing and lending rates



Probability of default (PD)



Comparative statics on certification cost

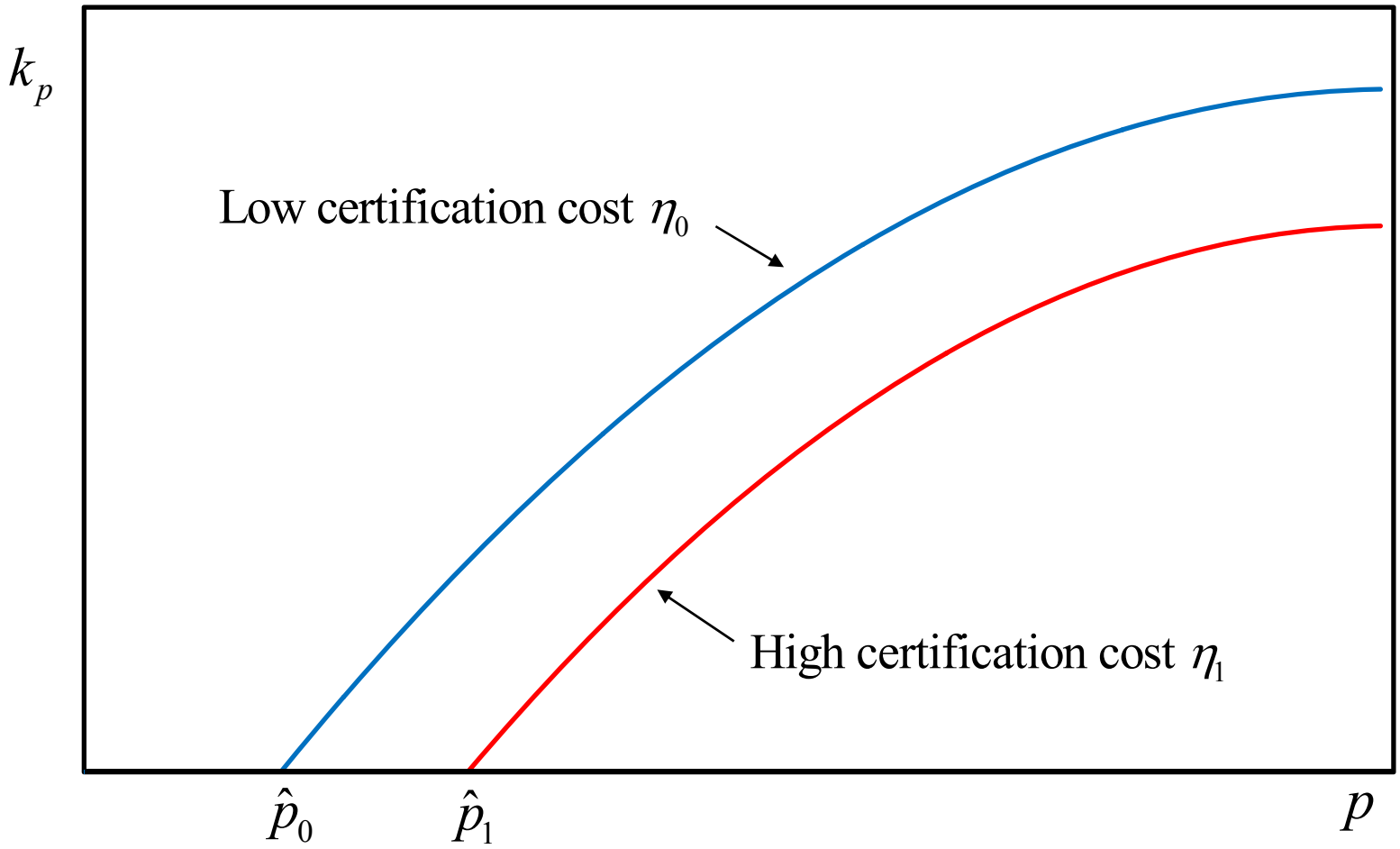
- Effect of a reduction in certification cost η (from η_1 to η_0)

  → Expands region where bank finance is optimal

  → Increases banks' capital and screening

  → Reduces entrepreneurs' probability of default

Bank capital



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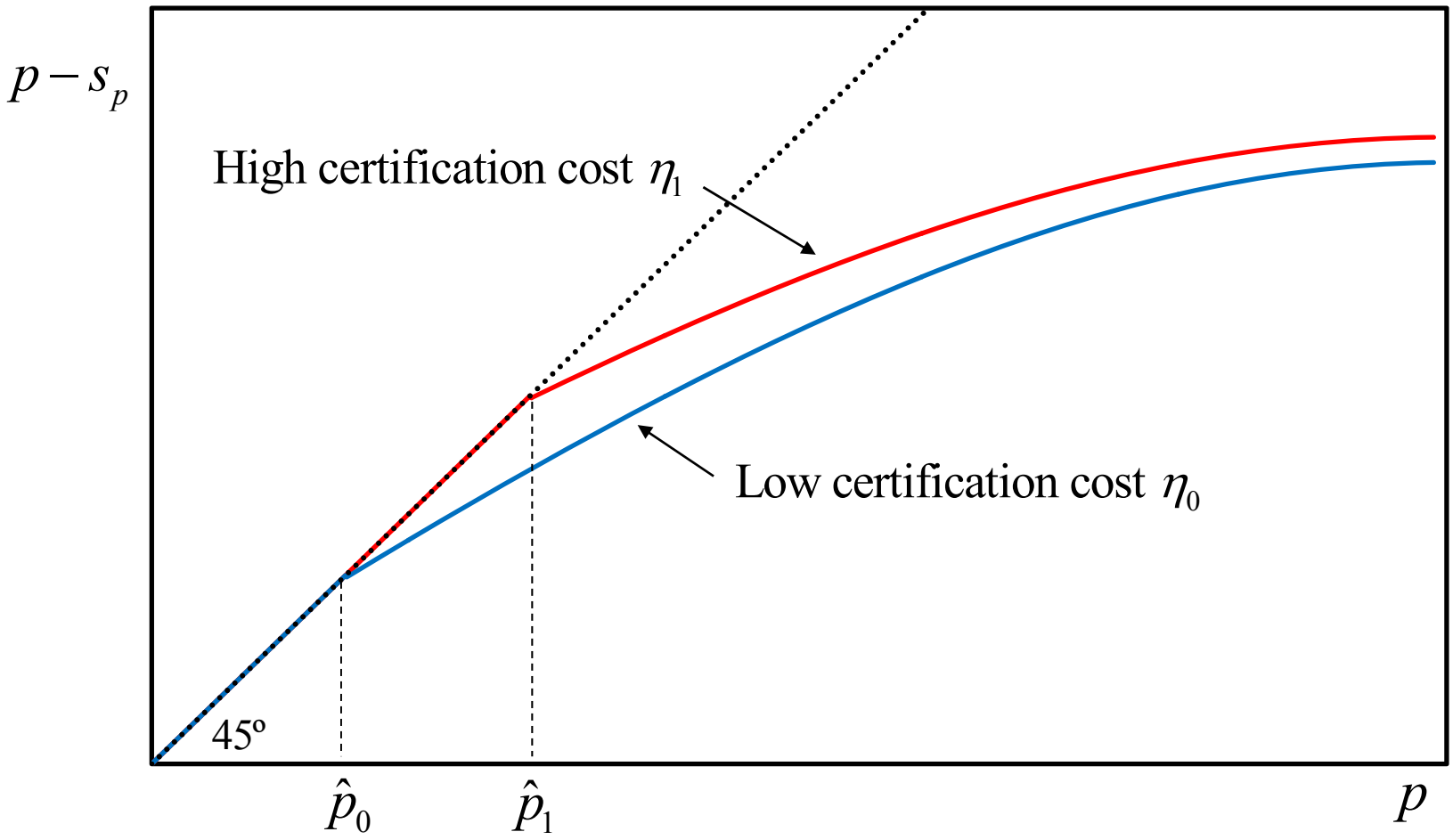


Private vs public certification

- Introduce two possible certification agencies
  - → Public agency (bank supervisor) with cost η_0
  - → Private agencies with cost $\eta_1 > \eta_0$
- Why is private certification costlier than public certification?
  - → Supervisor may have less incentive problems
  - → Supervisor may have access to richer information
- What is flip side of public certification?
  - → Banks have to comply with regulation

Part 2b

Flat capital requirements

Flat capital requirements

- Flat requirement (Basel I) or leverage ratio (Basel III)

$$k_p \geq \bar{k}$$

- Complying with regulation implies certification

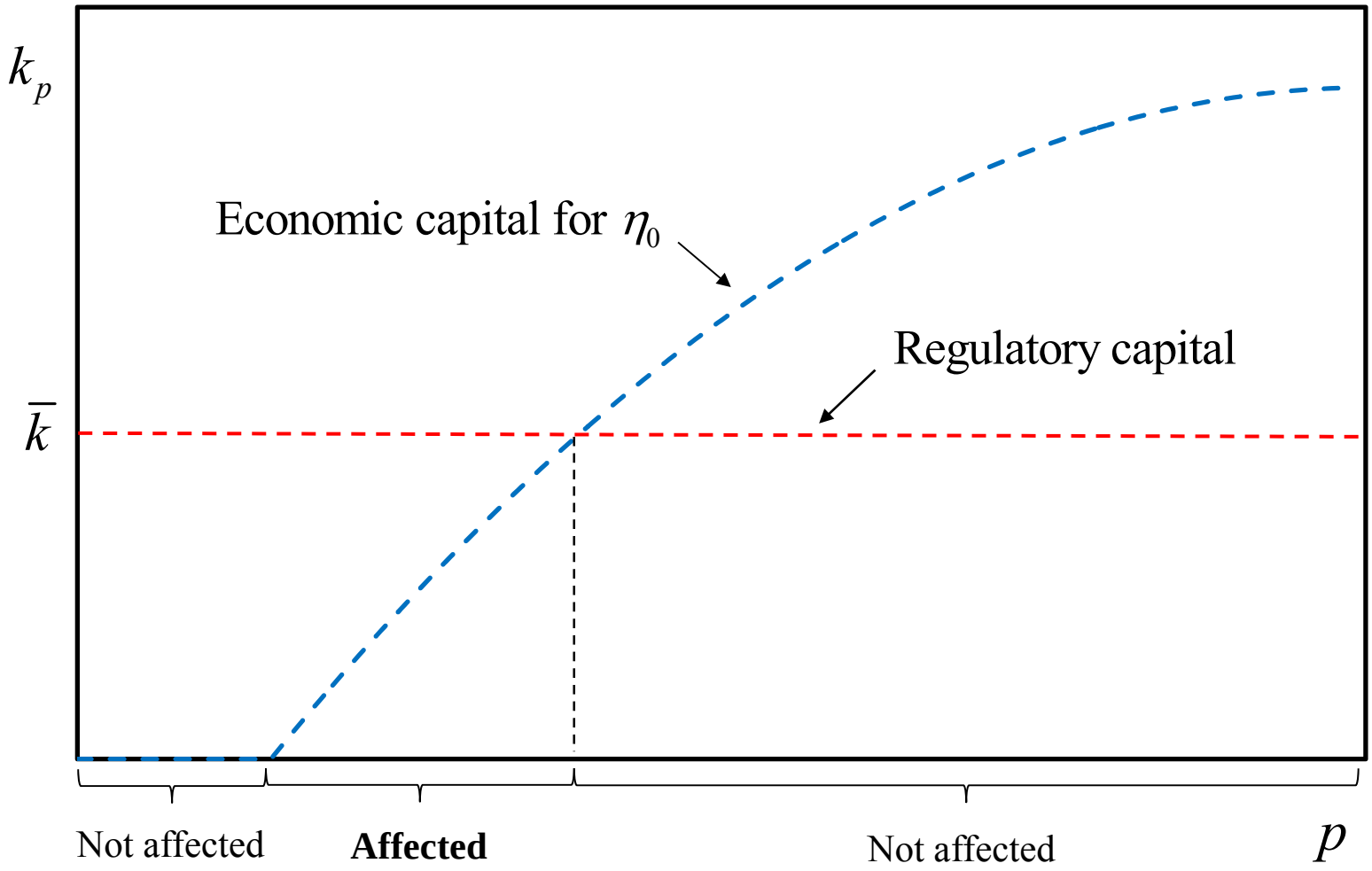
  → Certification cost $\eta_0 = 0$

- Not complying with regulation implies no public certification

  → Certification cost $\eta_1 > 0$

  → Higher cost of capital for shadow banks

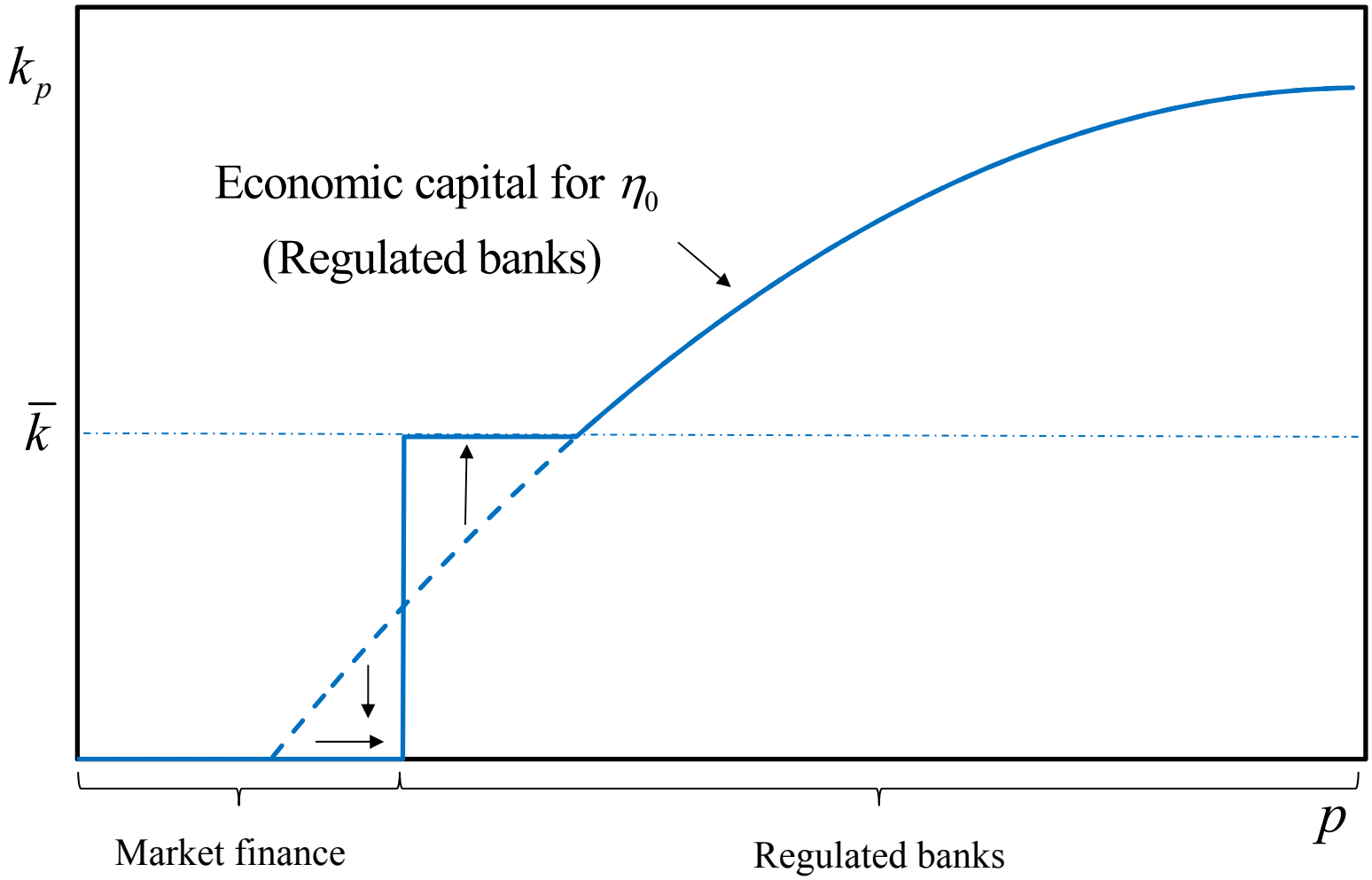
Capital with flat requirements



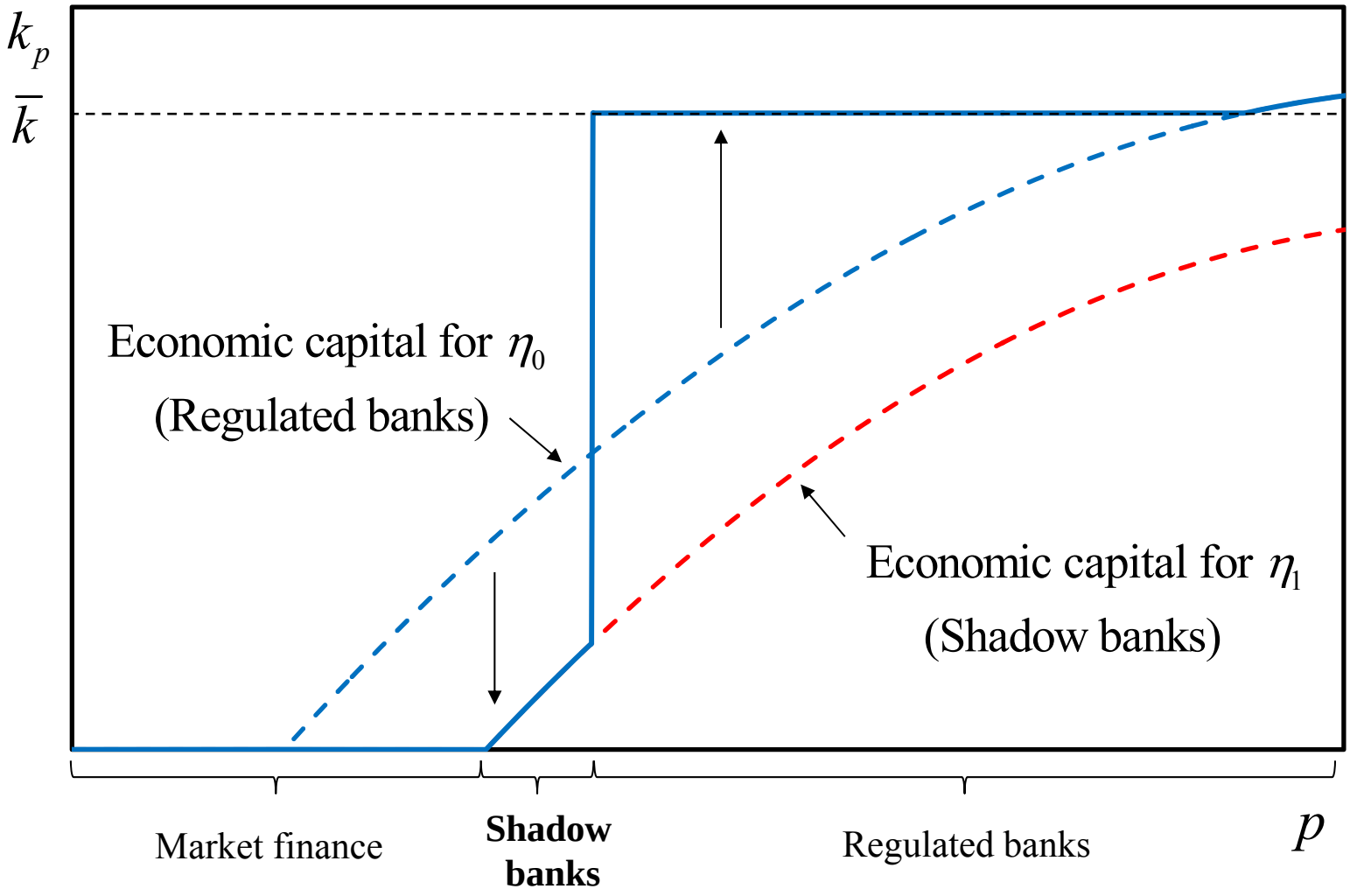
Two cases: low and high flat requirements

- With low flat requirements
  - → Only direct market finance and regulated banks
  - → No role for shadow banks
- With high flat requirements
  - → Shadow banks can profitably enter the market
  - → To fund medium-risk projects
  - → Taking over part of the regulated banks' market

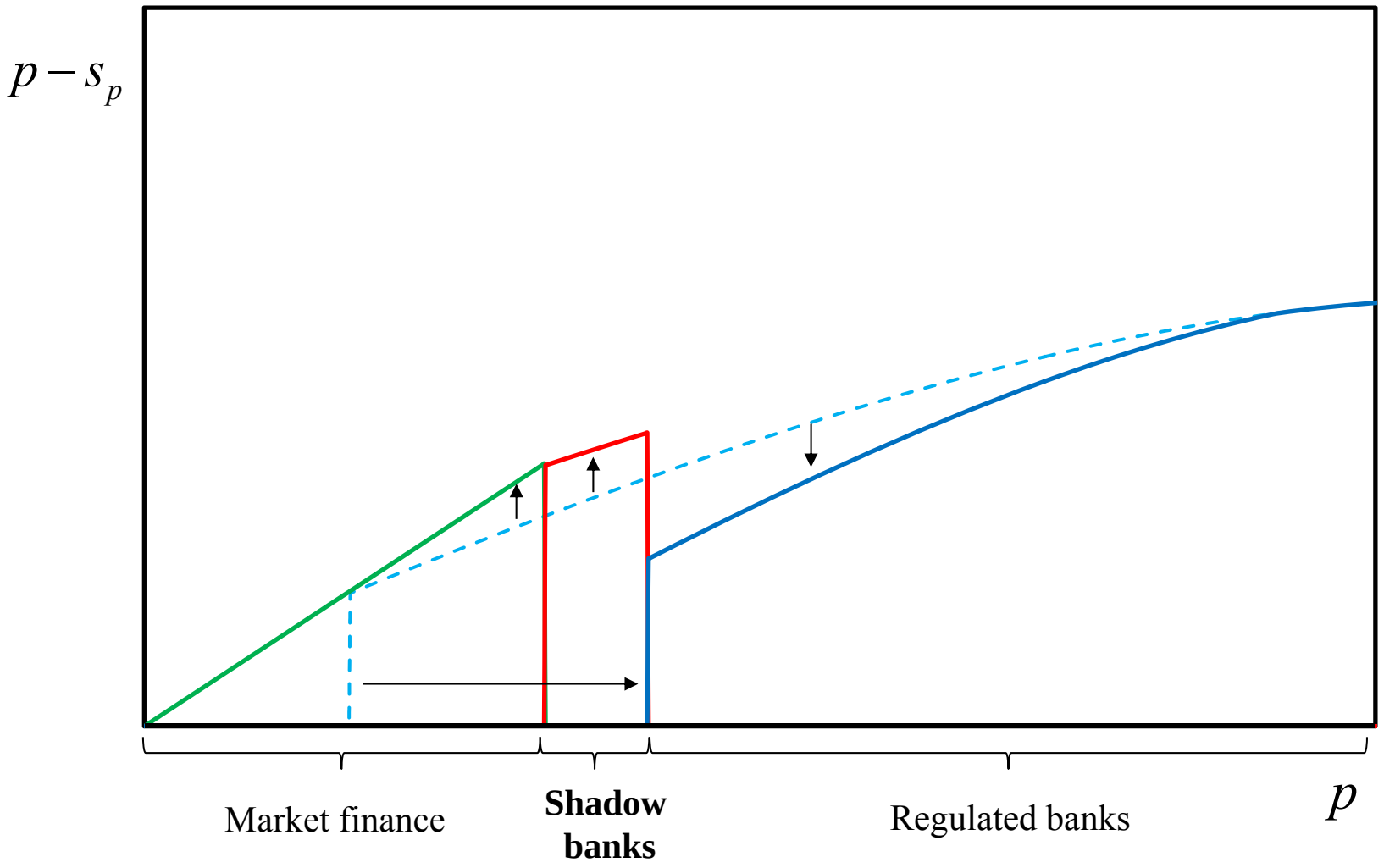
Capital with low flat requirements



Capital with high flat requirements



PD with high flat requirements



Effect of tightening flat capital requirements

- Drives safer borrowers away from regulated banks

  → Lower screening and higher risk

- Low-risk regulated banks become safer

  → Higher capital increases screening incentives

- No effect on high-risk regulated banks

  → Capital requirement is not binding

  → These banks maintain capital buffers

Part 2c

Value-at-Risk based capital requirements

VaR capital requirements (i)

- Introducing a VaR-based capital requirement (à la Basel II)

  → In Basel II

$$\Pr(\text{loan losses} \geq \bar{k}_p) = \alpha$$

  where $1 - \alpha$ is confidence level (e.g. 99.9%)

  → In our setup this is equivalent to

$$\Pr(\text{loan default} \mid \bar{k}_p) = \alpha$$

VaR capital requirements (ii)

- To ensure

$$\Pr(\text{loan default} \mid \bar{k}_p) = \alpha$$

→ we require $\bar{k}_p$ to be such that $p - s_p = \alpha$

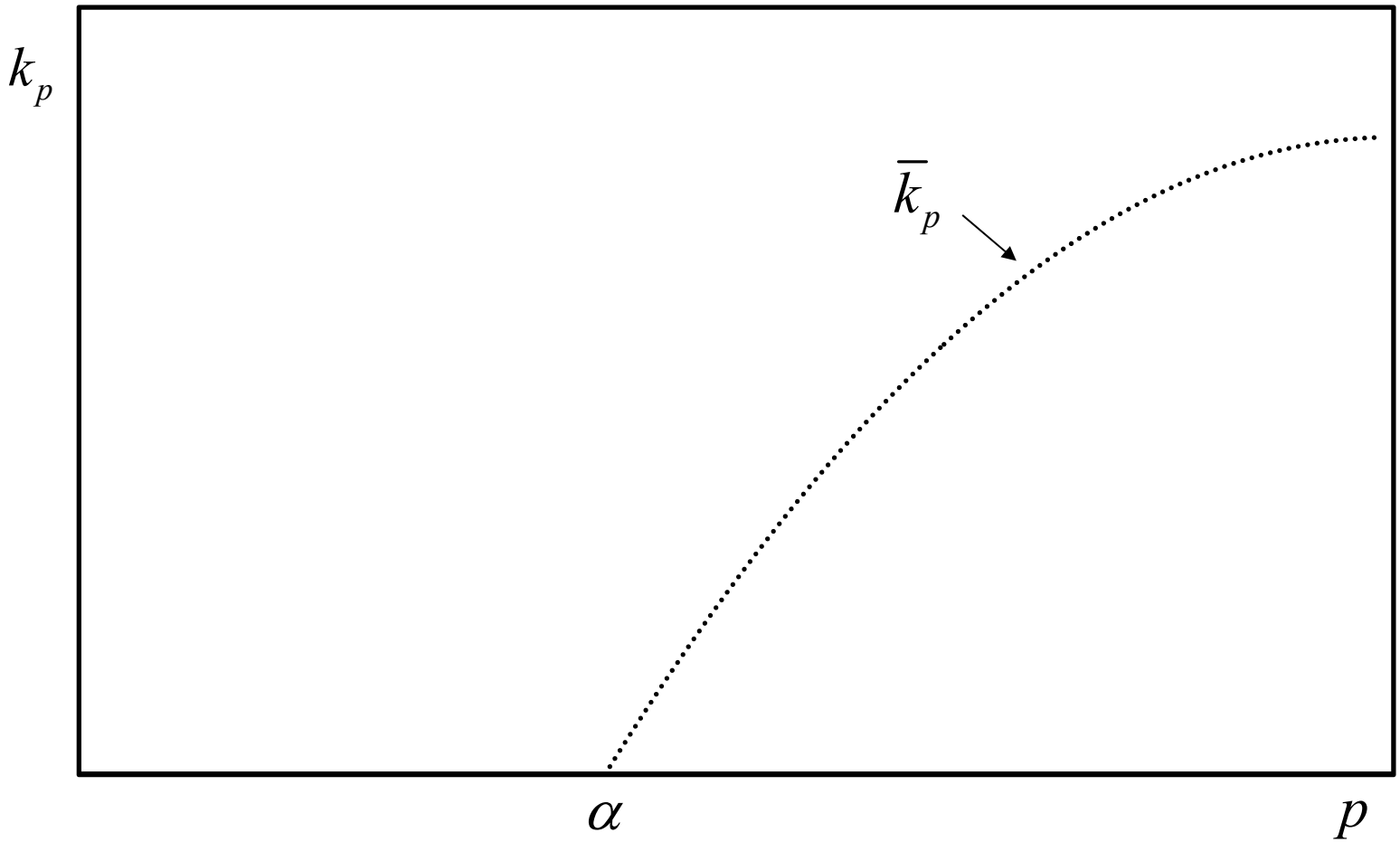
- Model then gives closed-form capital requirements formula

$$\bar{k}_p = f(p, \alpha)$$

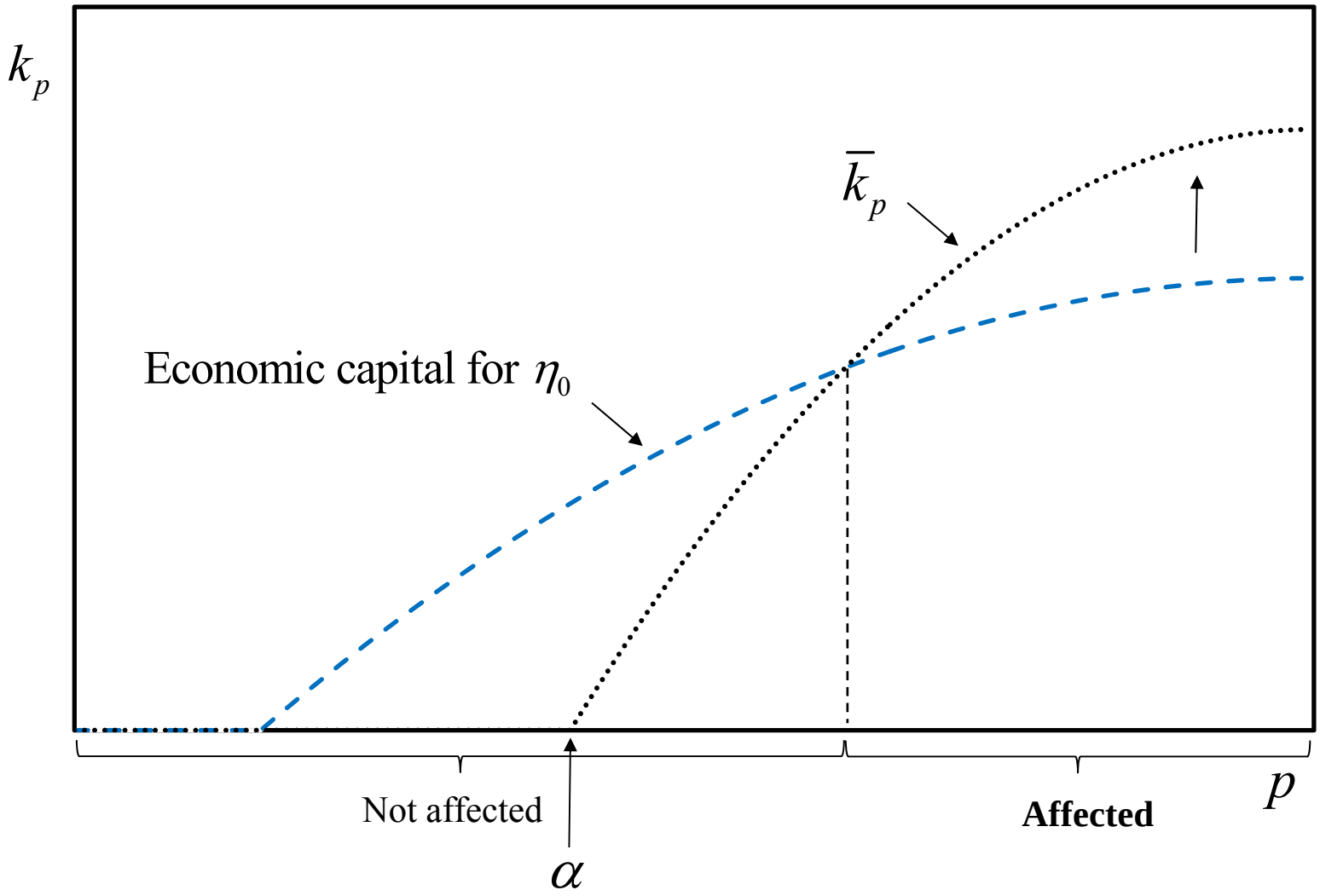
→ Increasing in risk p

→ Increasing in confidence level $1 - \alpha$

VaR capital requirements



Capital with VaR requirements



Two cases: low and high VaR requirements

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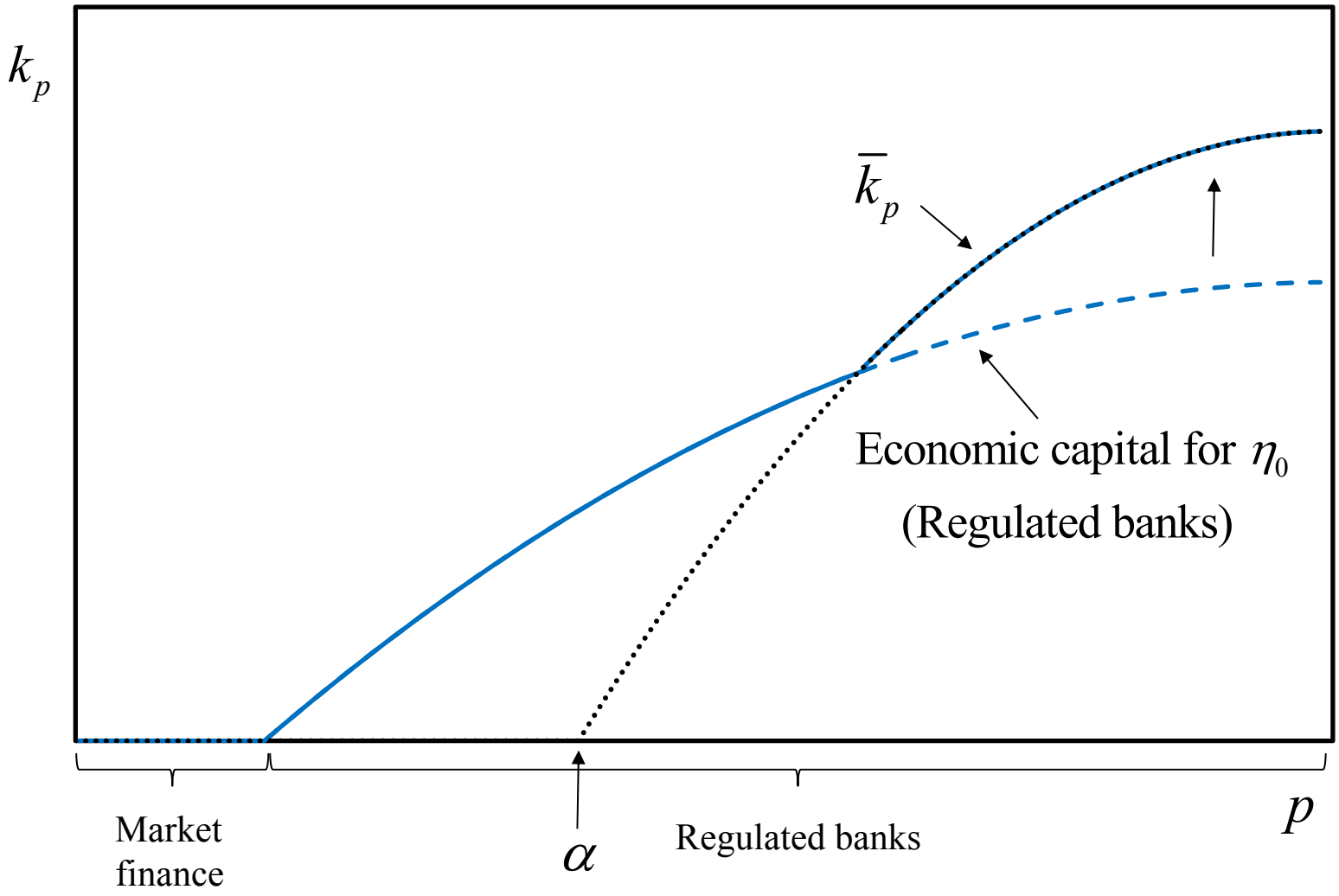
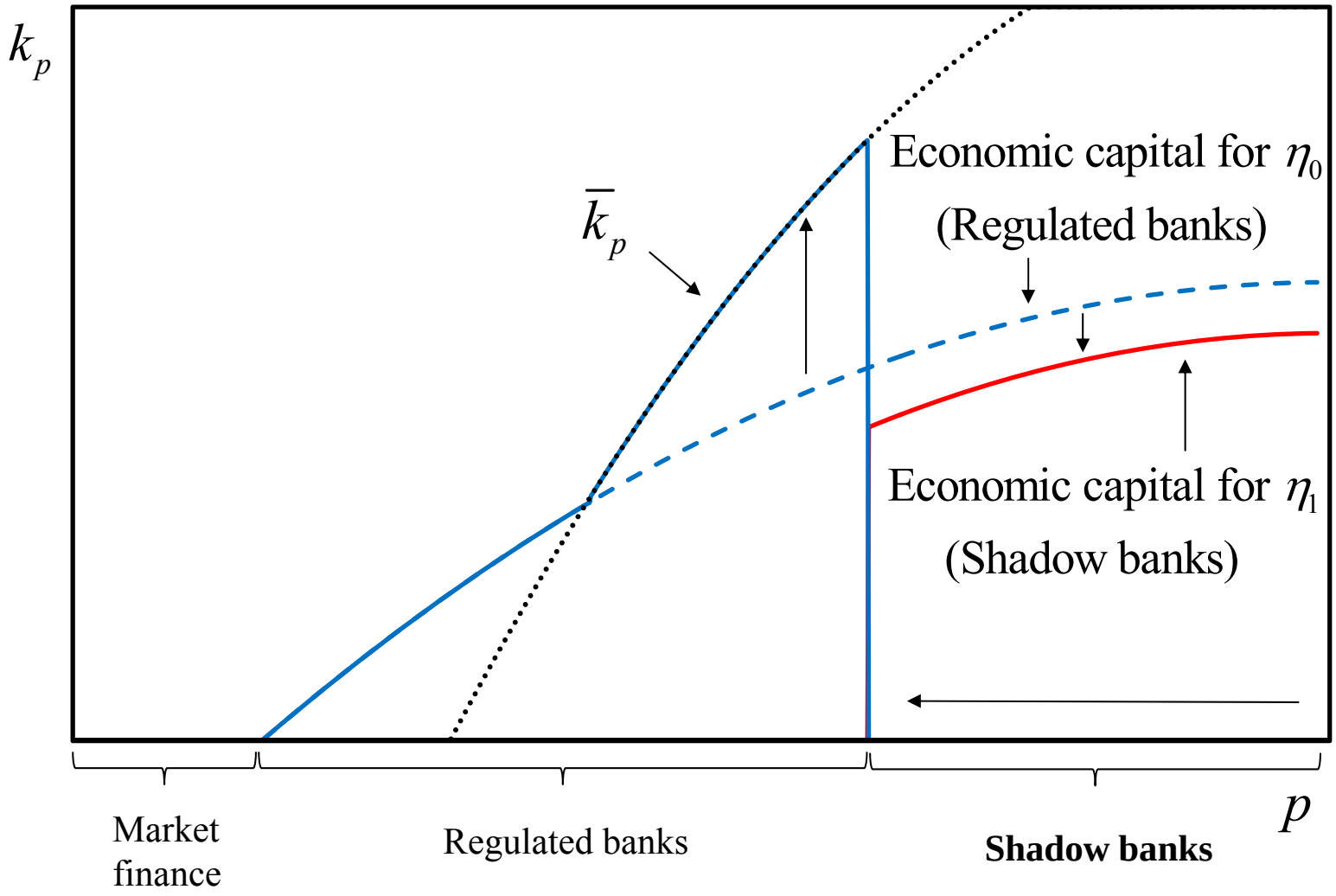
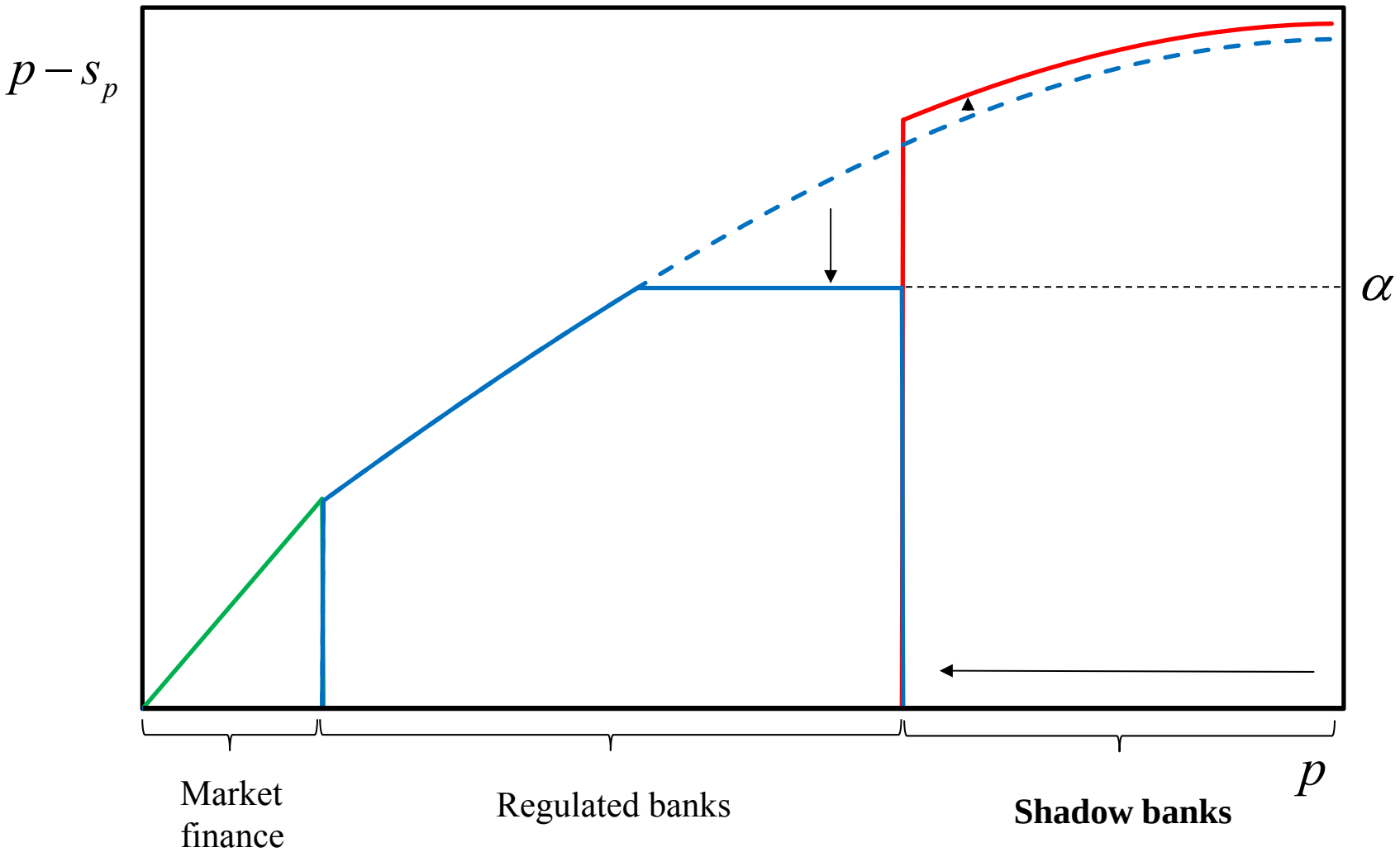
Capital with low VaR requirements



Capital with high VaR requirements



PD with high VaR requirements



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  → These banks maintain capital buffers

Part 3

Optimal capital requirements

Social welfare function (i)

- Investors receive opportunity cost of their funds

  → Participation constraints are satisfied with equality

- Entrepreneurs borrow at rates that leaves them no surplus

  → By assumption of free entry

- Social welfare comes from output produced by entrepreneurs

  → Introduce representative consumer

  → Utility function over goods produced by types $p \in [0,1]$

  → Unit investment produces unit output, if successful

Social welfare function (ii)

- Utility function of representative consumer

$$U(q,x) = q + \frac{\sigma}{\sigma - 1} \int_0^1 (x_p)^{\frac{\sigma-1}{\sigma}} dp$$

→ q is consumption of composite good

→ x_p is output of entrepreneurs of type p

→ $\sigma > 1$

Social welfare function (iii)

- Budget constraint of representative consumer

$$q + \int_0^1 A_p x_p \, dp = I$$

→ A_p is unit price of goods produced by type p

→ I is consumer's income

Social welfare function (iv)

- Maximizing the utility subject to the budget constraint gives

$$A_p = (x_p)^{-1/\sigma}$$

- Substituting this result into the utility function gives SWF

$$W(x) = I + \frac{1}{\sigma - 1}\int_0^1 (1 - p + s_p)(x_p)^{\frac{\sigma-1}{\sigma}}\, dp$$

$\rightarrow$ Taking into account that x_p obtains with prob. $1 - p + s_p$

Optimal capital requirements

- Optimal capital requirements defined by

$$k^* = \arg\max_k W(x(k))$$

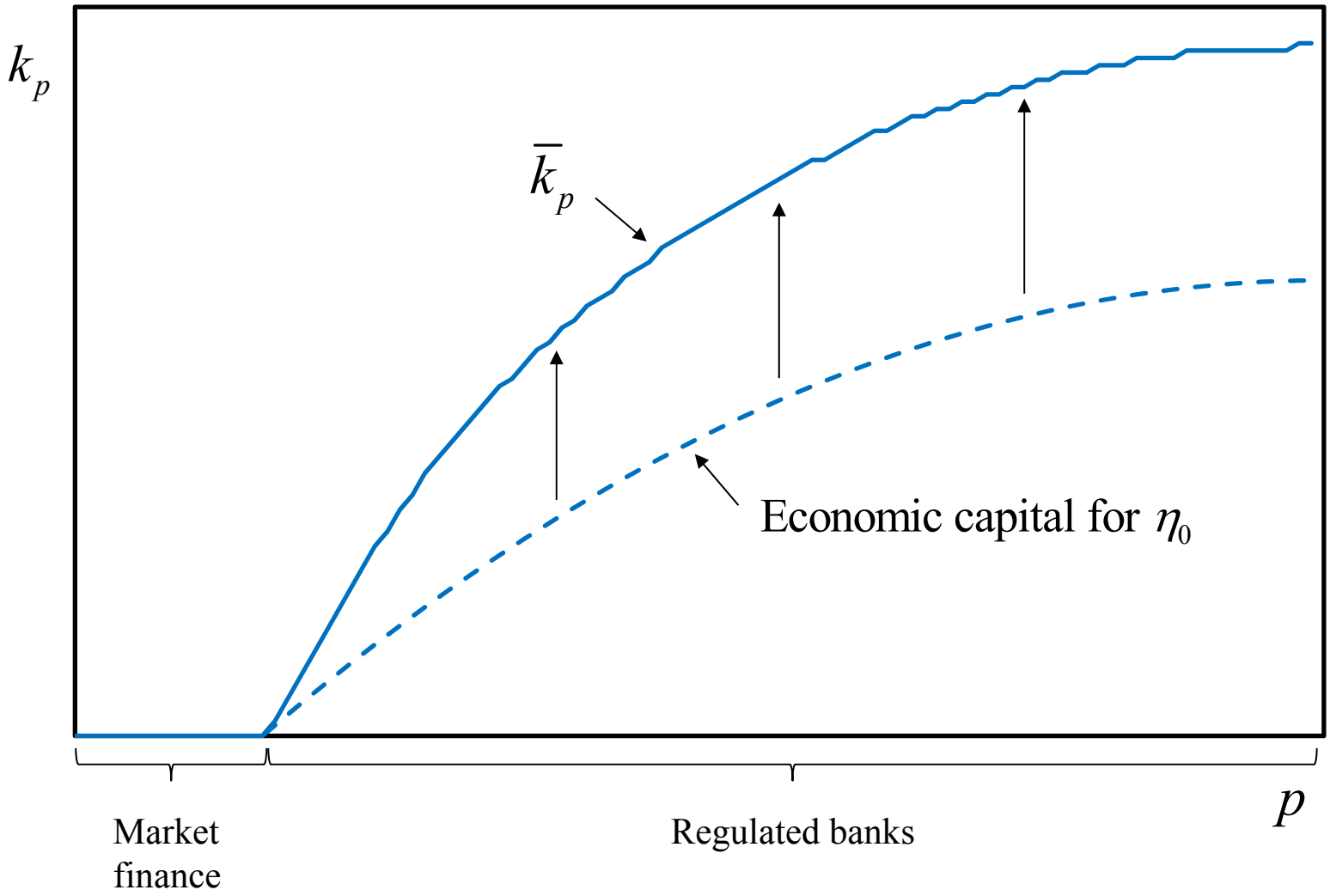
- Optimal capital requirements are risk-sensitive

  → But do not satisfy VaR condition

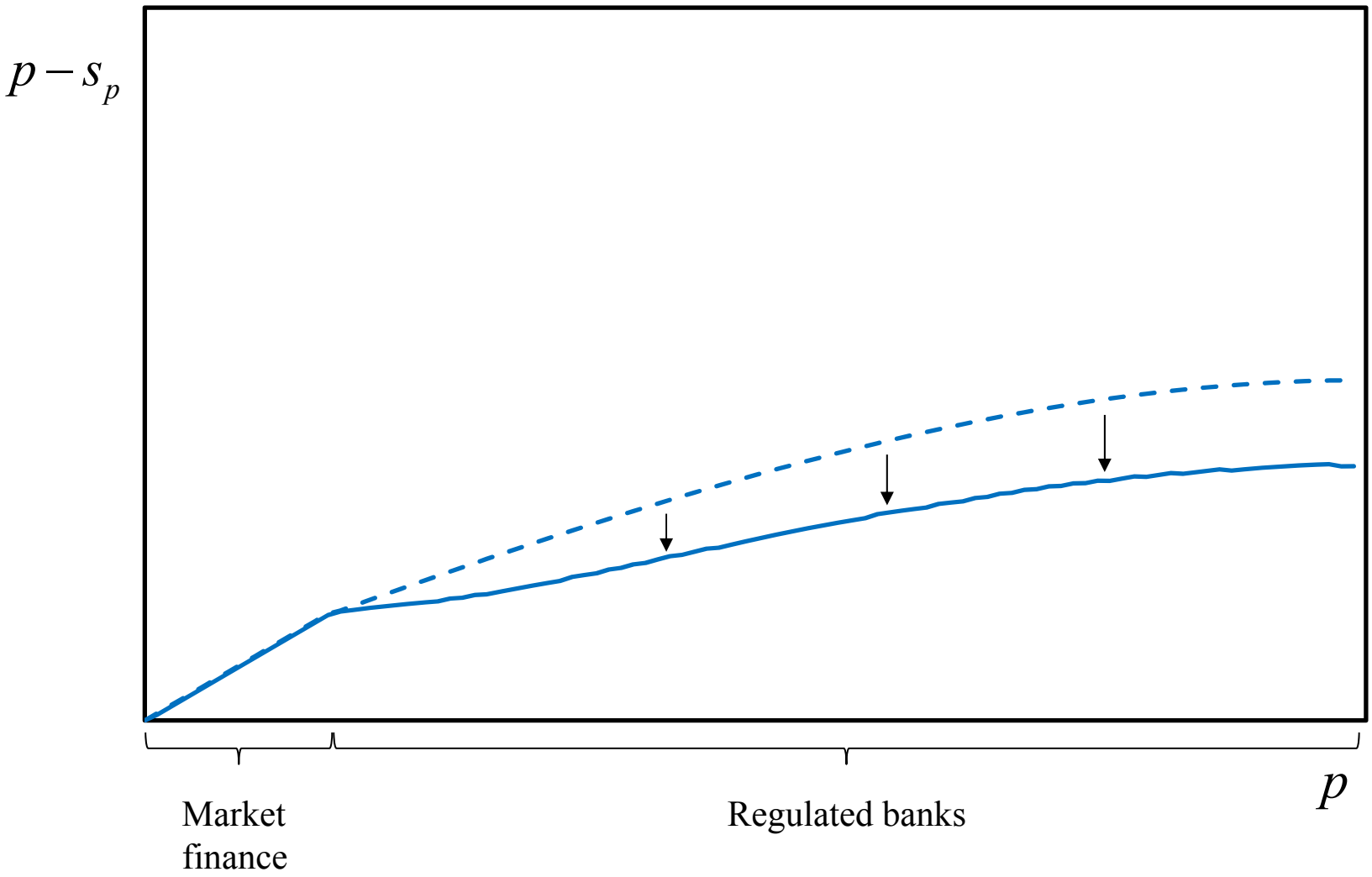
  → Lower confidence level for higher risks

  → To avoid emergence of shadow banks for riskier firms

Optimal capital requirements



PD with optimal capital requirements



Part 4

Extensions

Part 4a

Changes in funding costs

Changes in funding costs

- Two key parameters
  - → Expected return required by debtholders (safe rate) R_0
  - → Excess cost of bank capital δ

Results

- Under flat or VaR requirements shadow banks will thrive when
  - → Safe rate is low (savings glut)
  - → Cost of capital is high
- Optimal capital requirements should be lowered when
  - → Safe rate is low
    - + To avoid lending shifting out of regulated banks
  - → Cost of capital is high
    - + Rationale for countercyclical regulation

Part 4b

Endogenous cost of capital

Endogenous cost of capital

- Assume fixed supply of bank capital

  → Could also be made upward sloping

- Tightening flat or VaR capital requirements affects all banks

  → Higher risk for those not constrained by the regulation

  → Some regulated and all shadow banks will be riskier

  → As a result of the higher cost of capital

Concluding remarks

Concluding remarks (i)

- Model of the effects of bank capital regulation on

  → Structure and risk of the financial system

- Key element: distinction between regulated and shadow banks

  → Based on certification of capital by supervisor

  → Alternative: deposit insurance subsidy for regulated banks

- Shadow banking will expand with

  → Higher (supervisory) costs of public certification

  → Higher costs of deposit insurance

Concluding remarks (ii)

- Model is set in terms of entrepreneurial finance

  → Could also be interpreted in terms of household finance

- Model assumes that screening reduces probability of default

  → Could also consider reducing loss given default

Concluding remarks (iii)

- Higher capital requirements

  → Ameliorate risk-taking incentives: bright side

  → Drive some borrowers to shadow banks: dark side

  → Flat requirements lead to medium risk shadow banks

  → VaR requirements lead to high risk shadow banks

Concluding remarks (iii)

- Higher capital requirements

  → Ameliorate risk-taking incentives: bright side

  → Drive some borrowers to shadow banks: dark side

  → Flat requirements lead to medium risk shadow banks

  → VaR requirements lead to high risk shadow banks

- Optimal requirements will not be VaR-based

  → Lower confidence level for higher risk