

Markets, Banks and Shadow Banks

David Martinez-Miera

UC3M and CEPR

Rafael Repullo

CEMFI and CEPR

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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

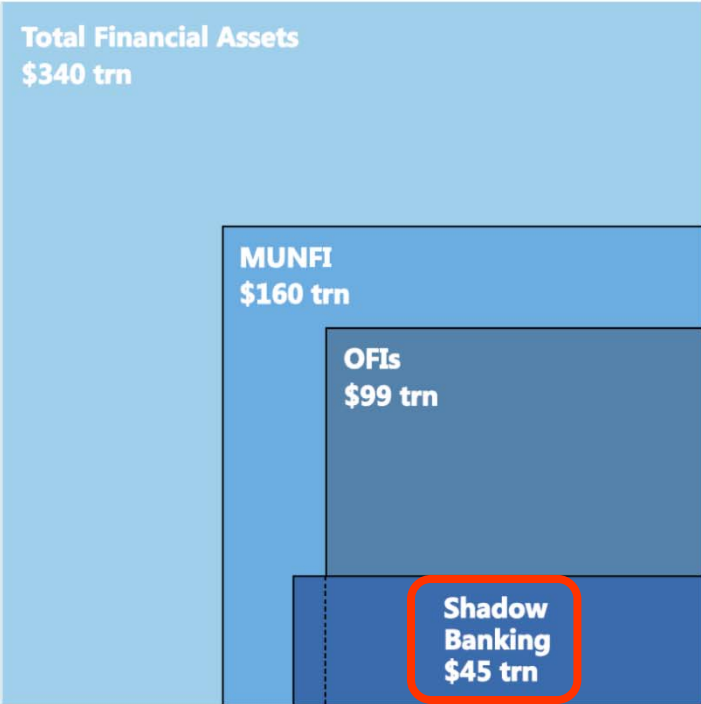
Narrow measure of shadow banking

Monitoring aggregates

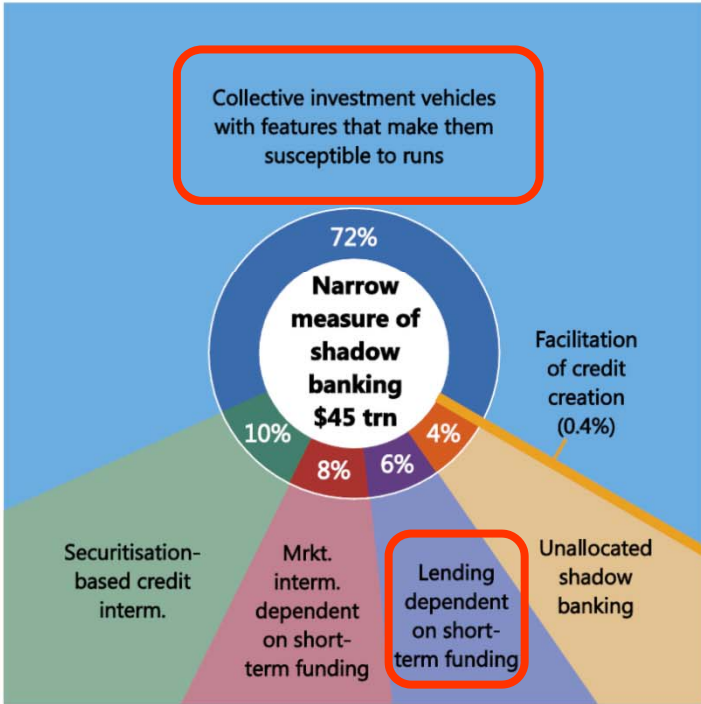
USD trillion at end-2016

Exhibit 0-1

21 jurisdictions and the euro area¹



Composition of the narrow measure²



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

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

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

→ x_p is the aggregate investment of entrepreneurs of type p

→ 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

→ 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

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

→ Interior solution characterized by FOC

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

→ “Skin in the game” effect

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

Proposition 1

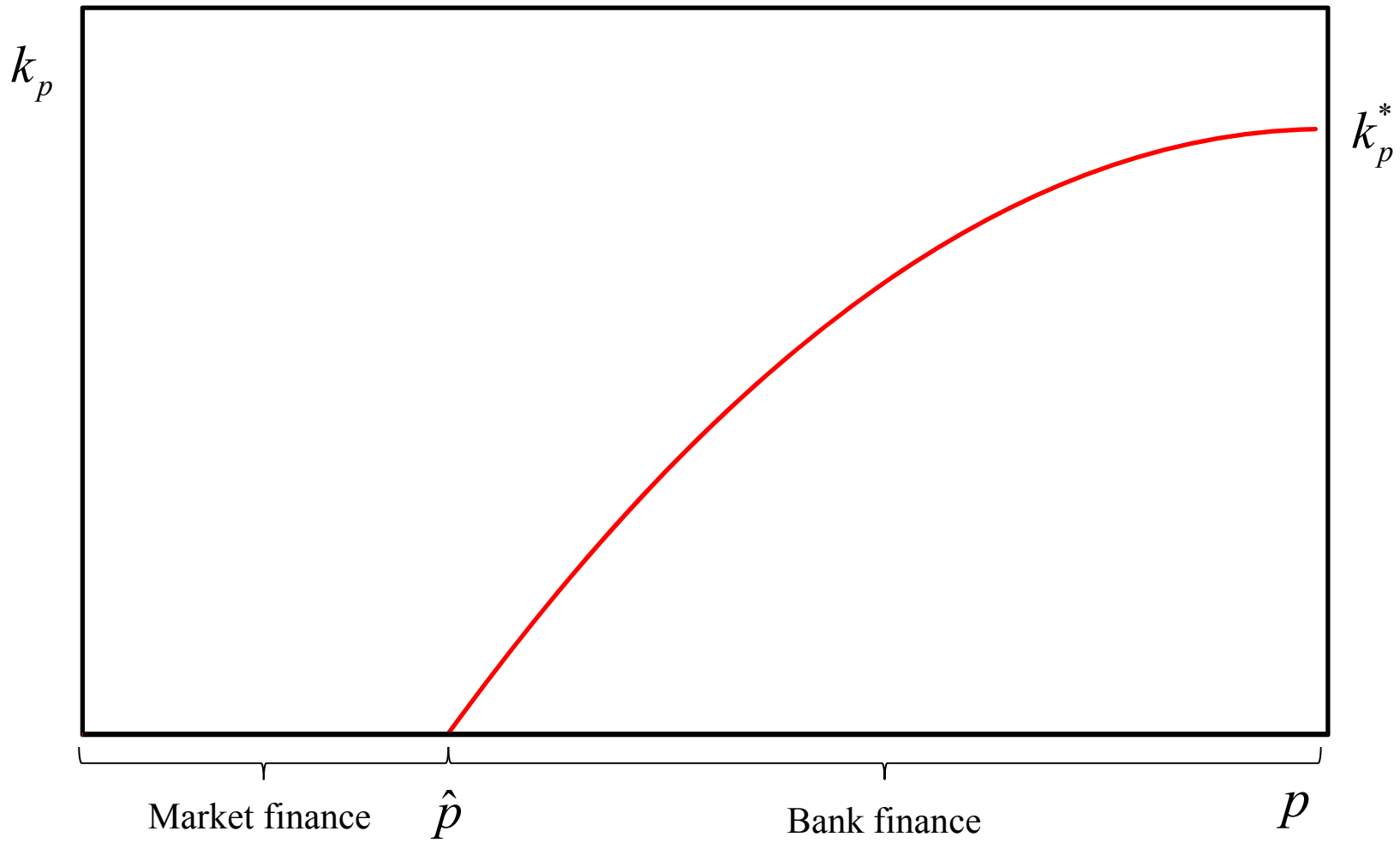
- There is a marginal type

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

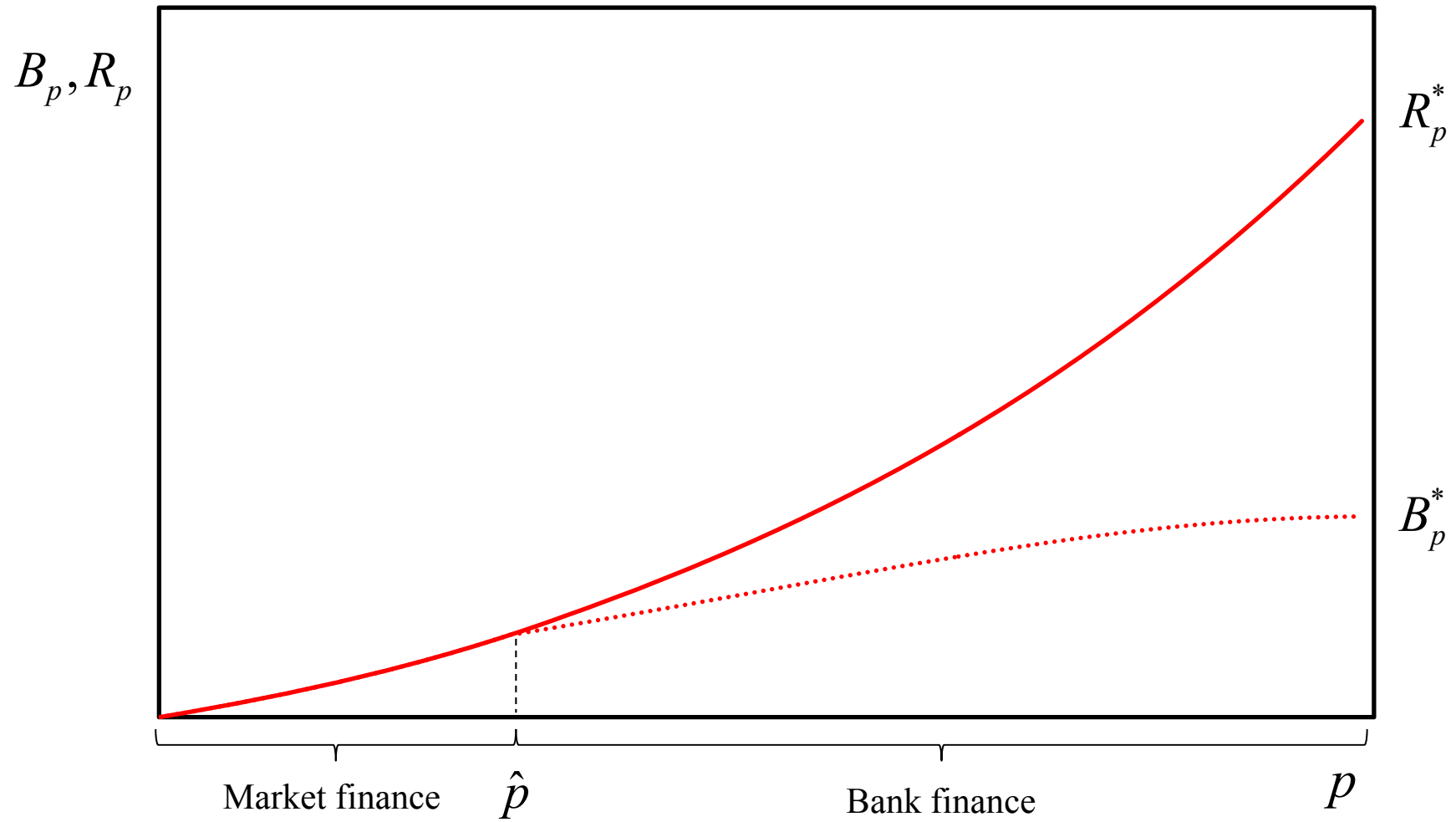
→ Safer types $p \leq \hat{p}$ choose market finance: $s_p^* = k_p^* = 0$

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

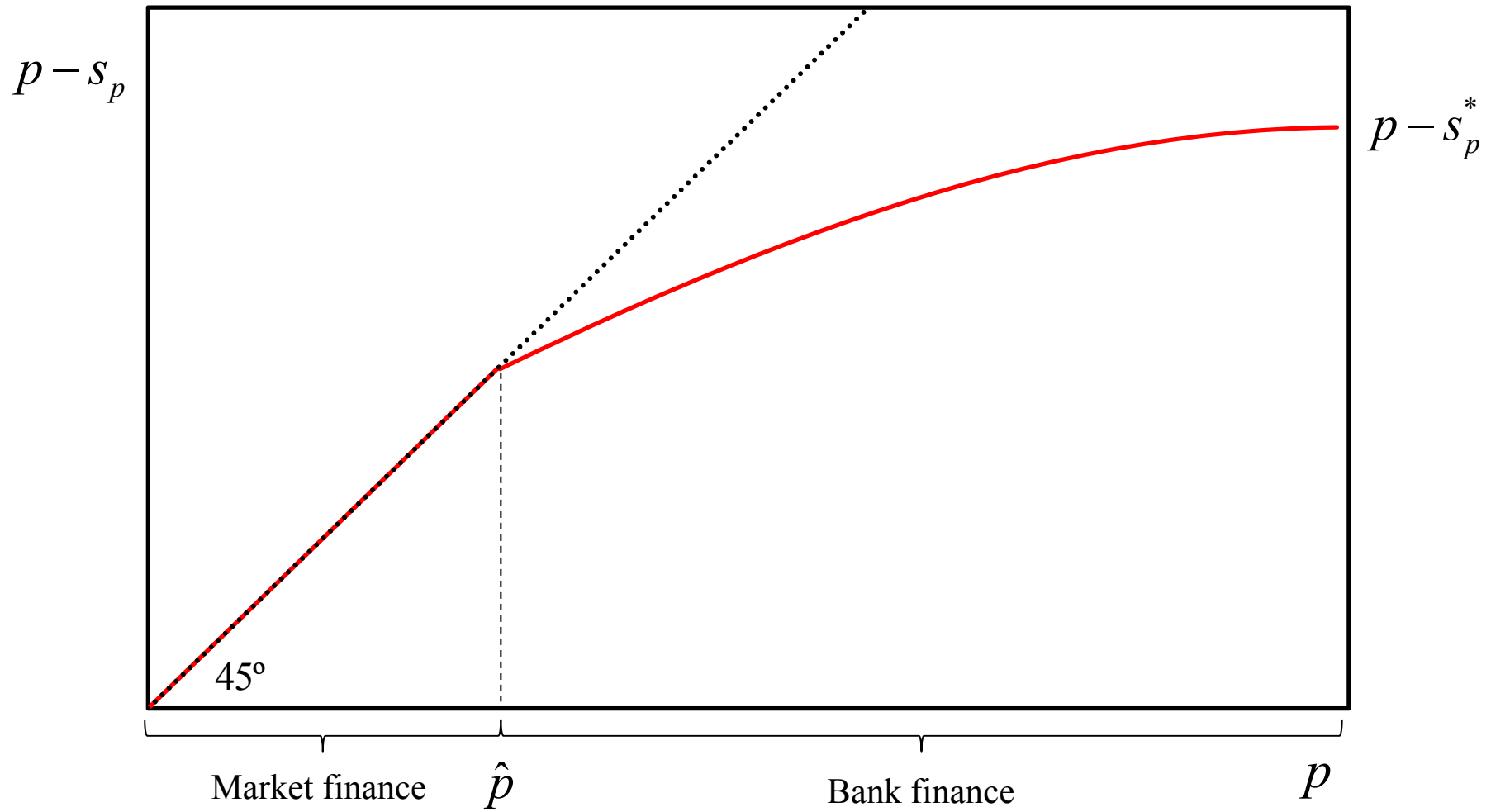
Bank capital



Borrowing and lending rates



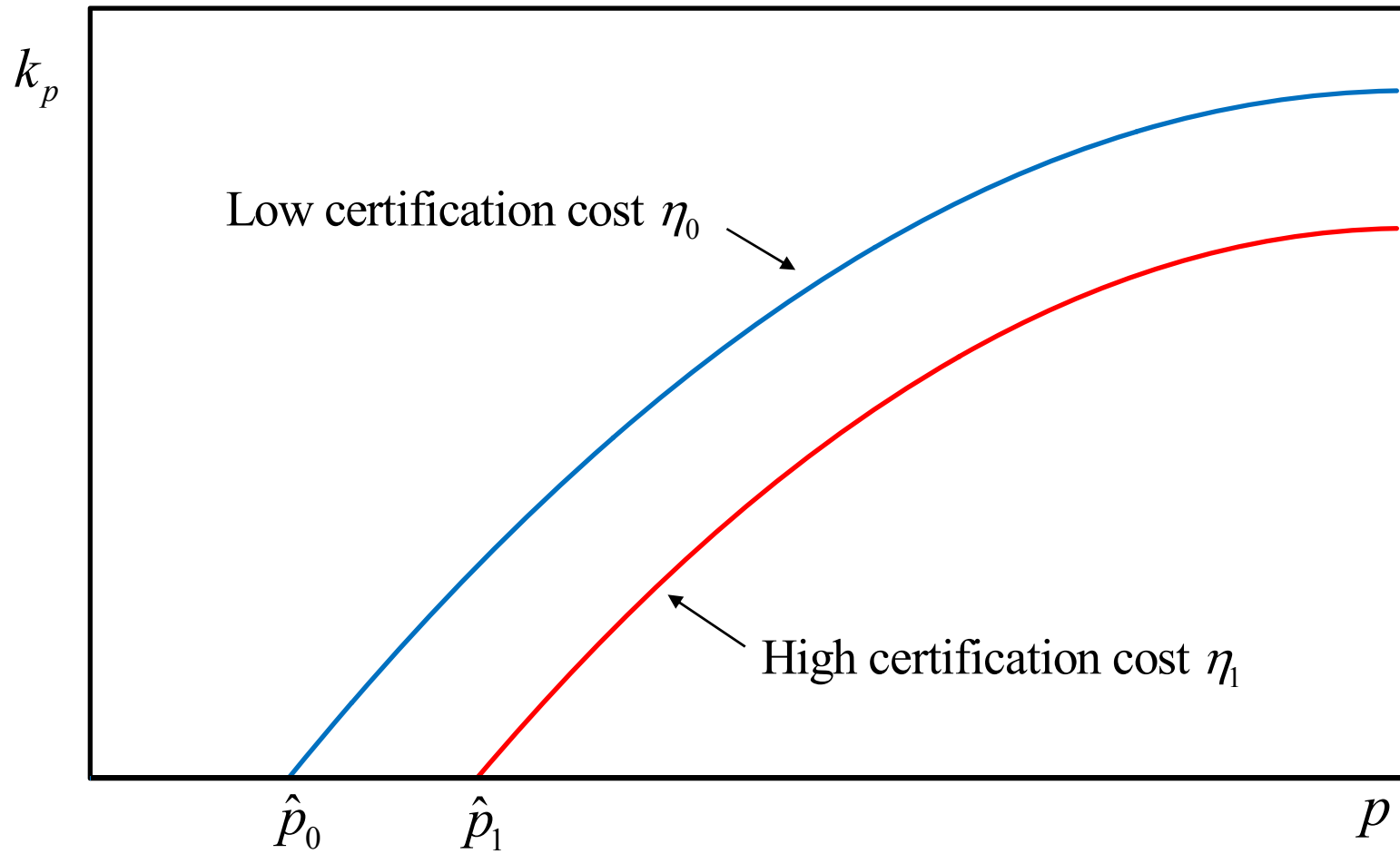
Probability of default (PD)



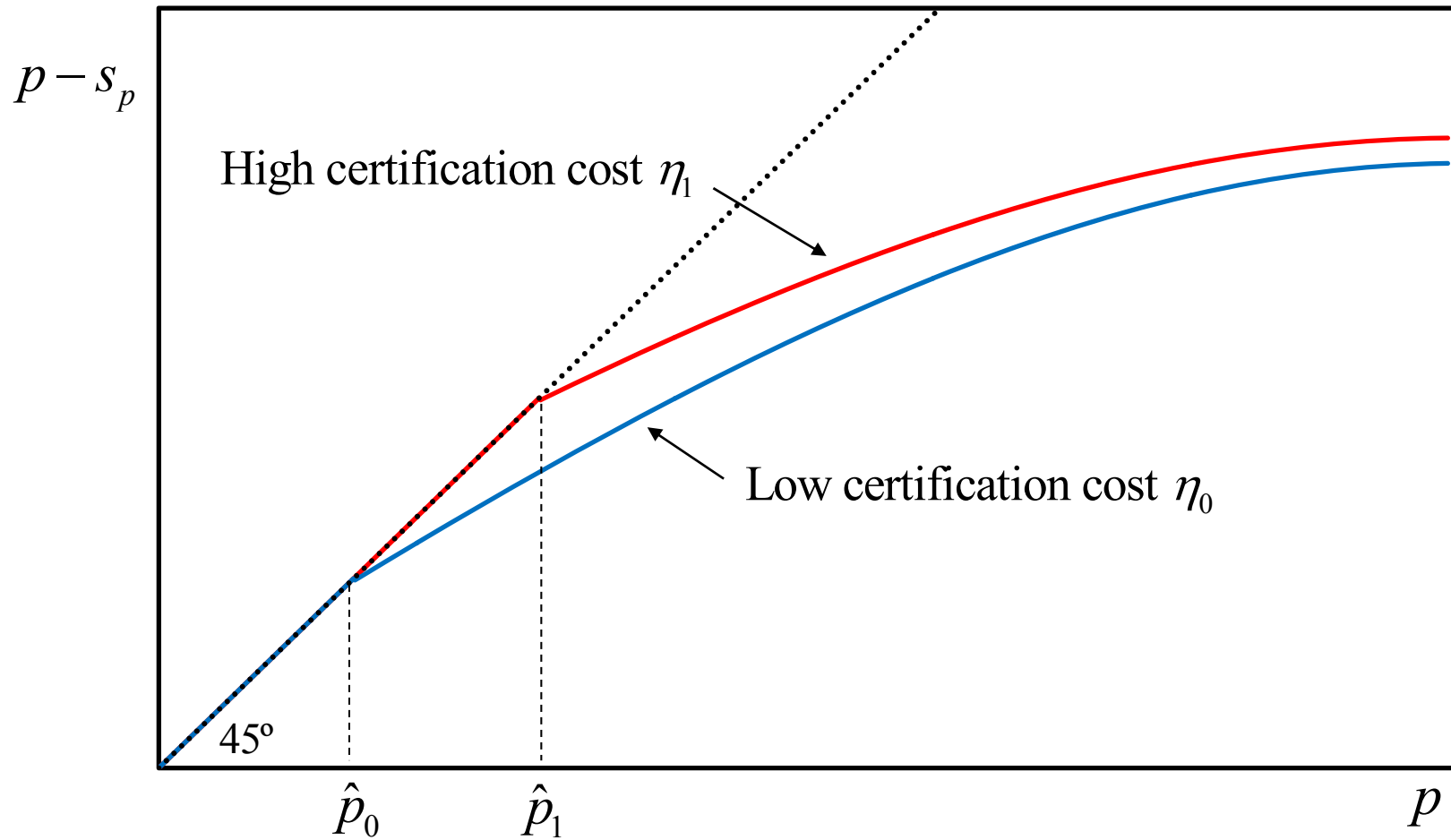
Comparative statics on certification cost

- 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



Probability of default (PD)



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

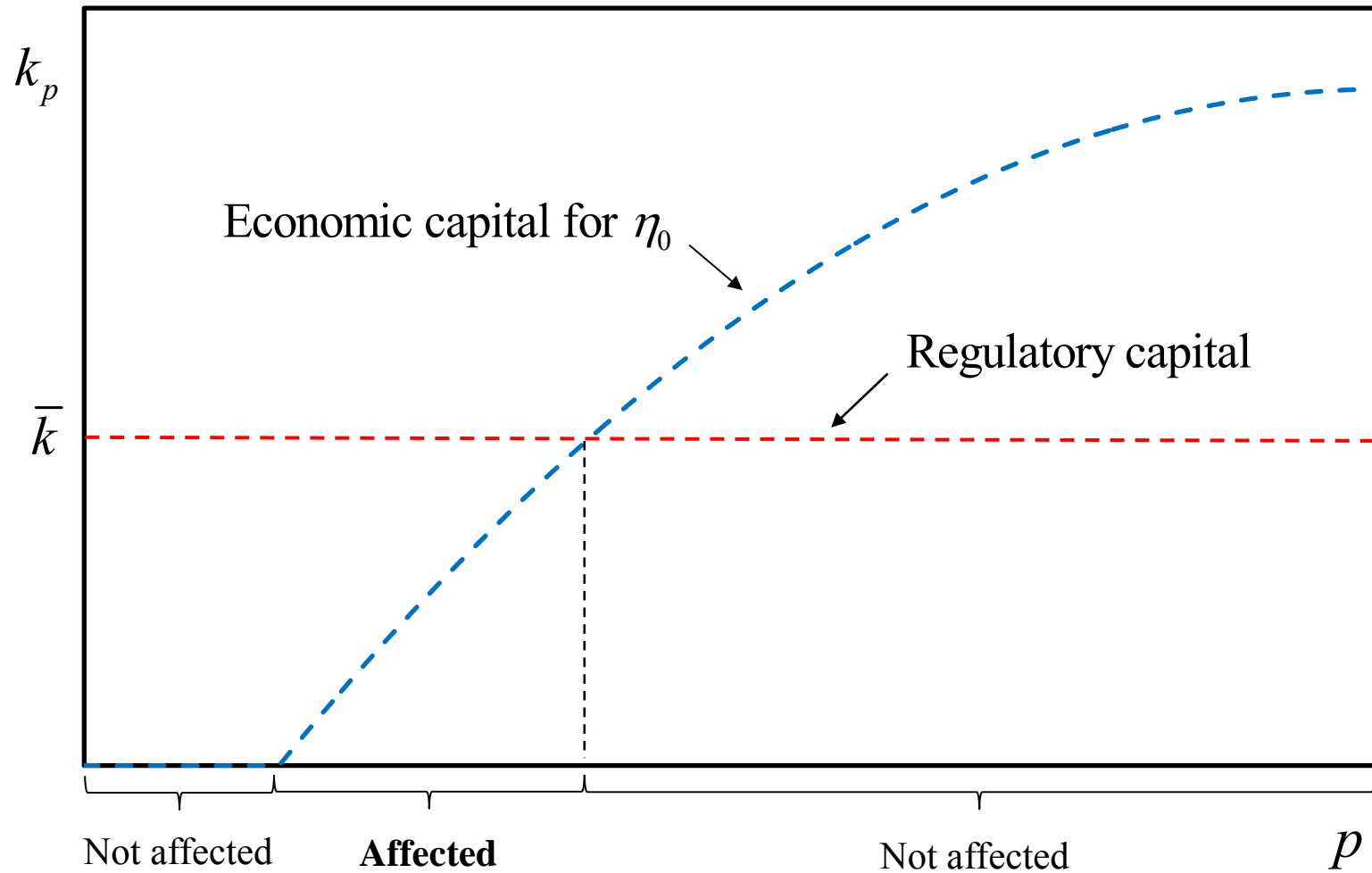
Flat capital requirements

- 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

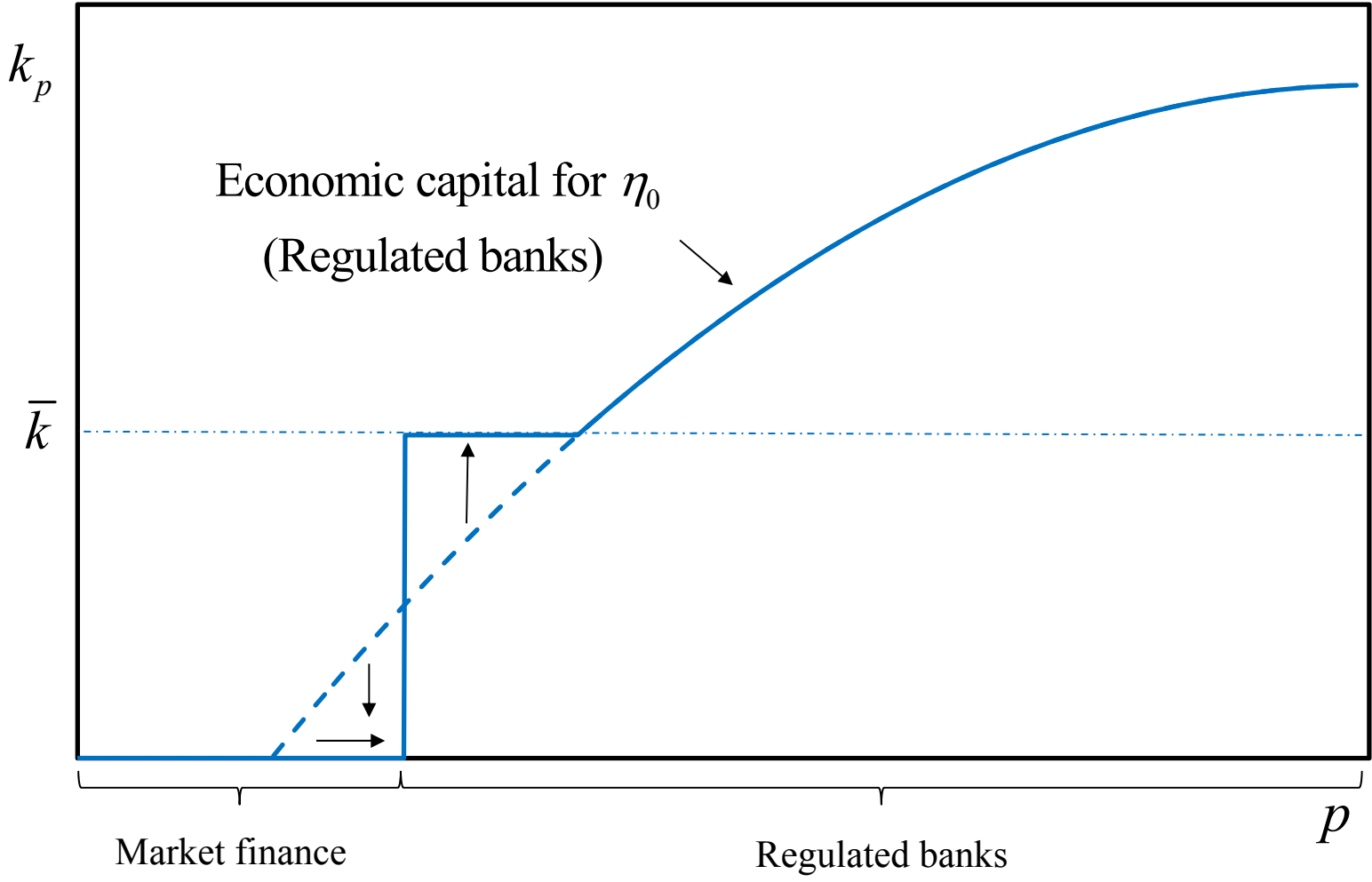
Capital with flat requirements



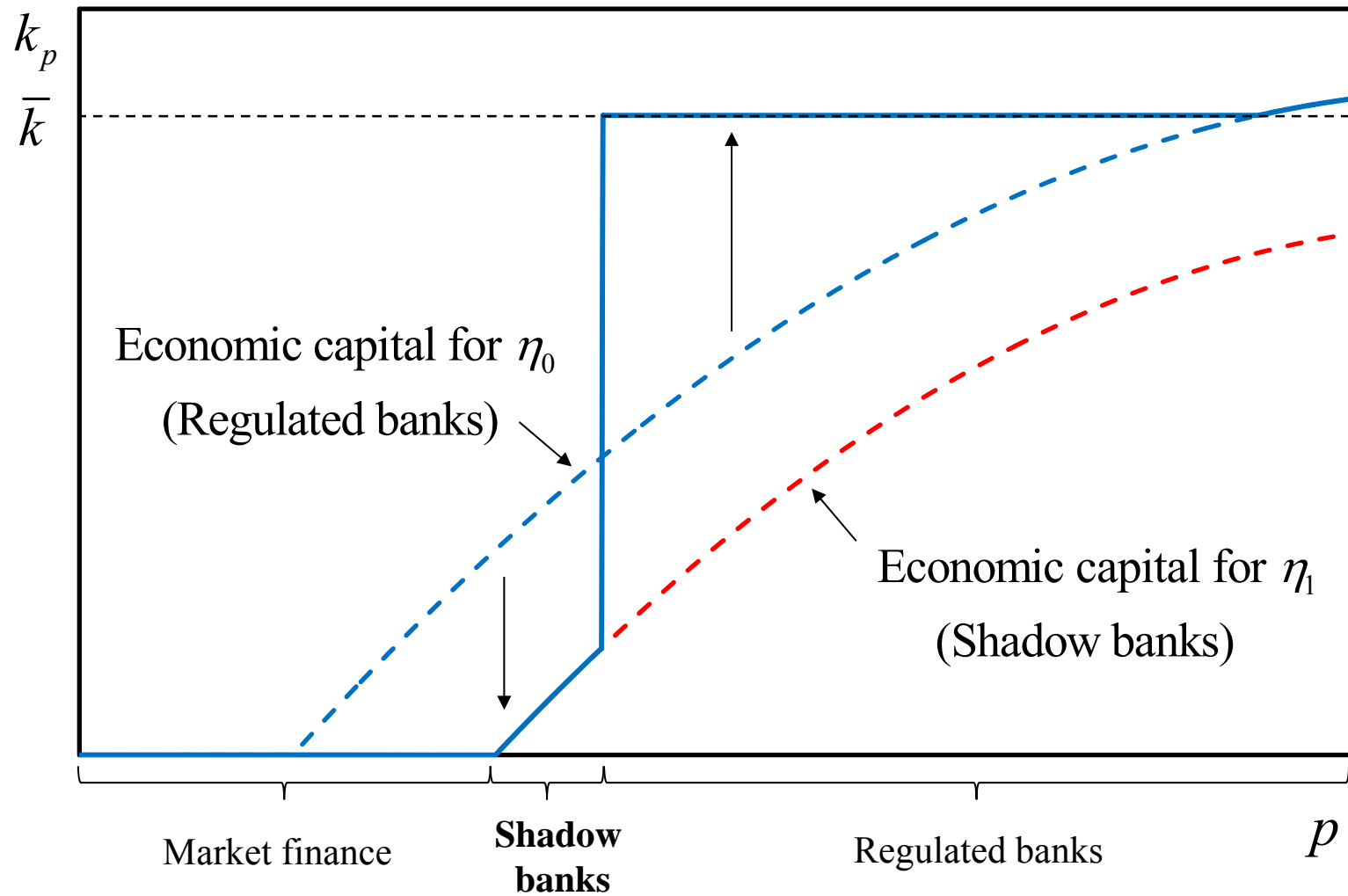
Two cases: low and high flat requirements

- 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

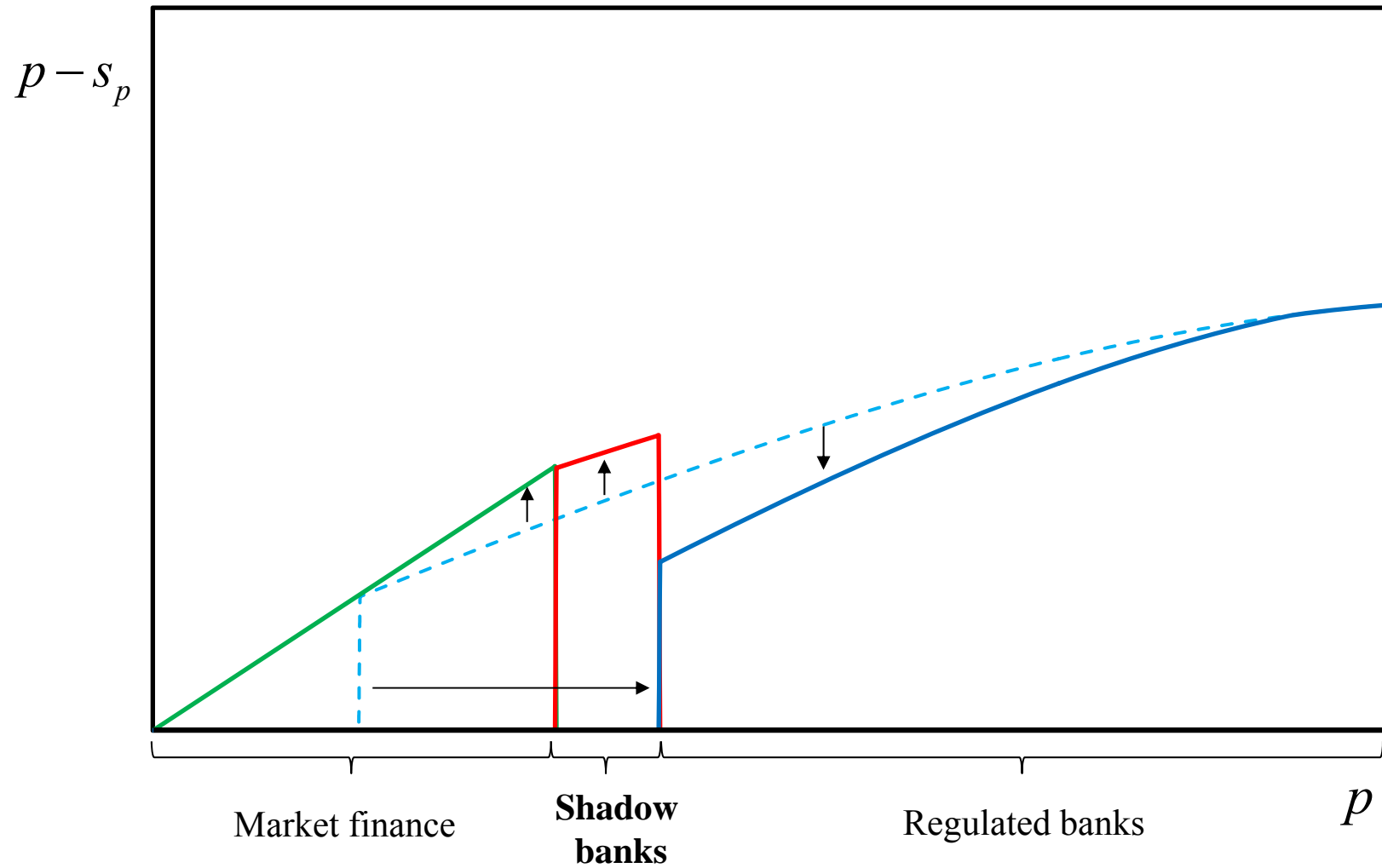
Capital with low flat requirements



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 $p - s_p = \alpha$

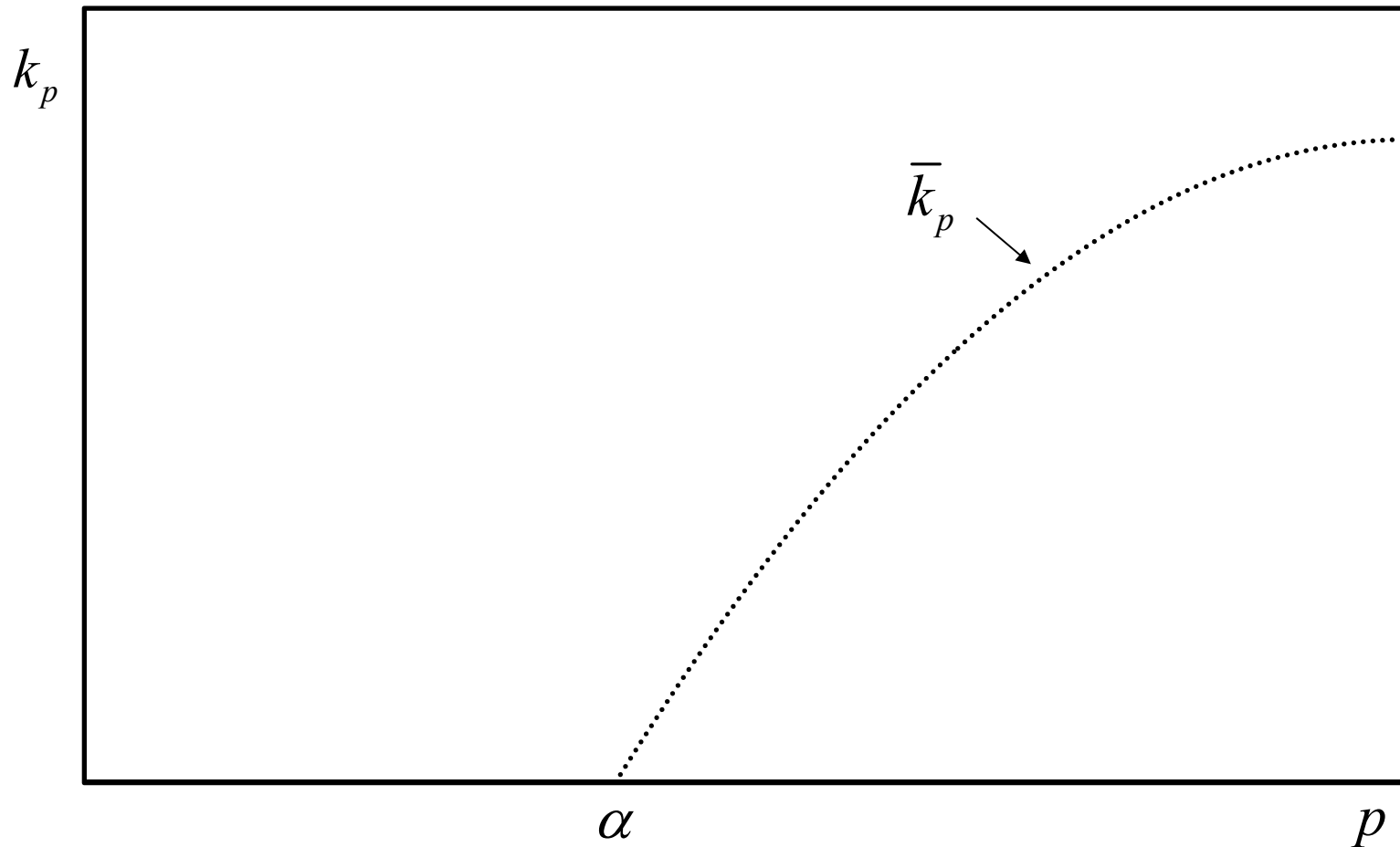
- Model then gives closed-form capital requirements formula

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

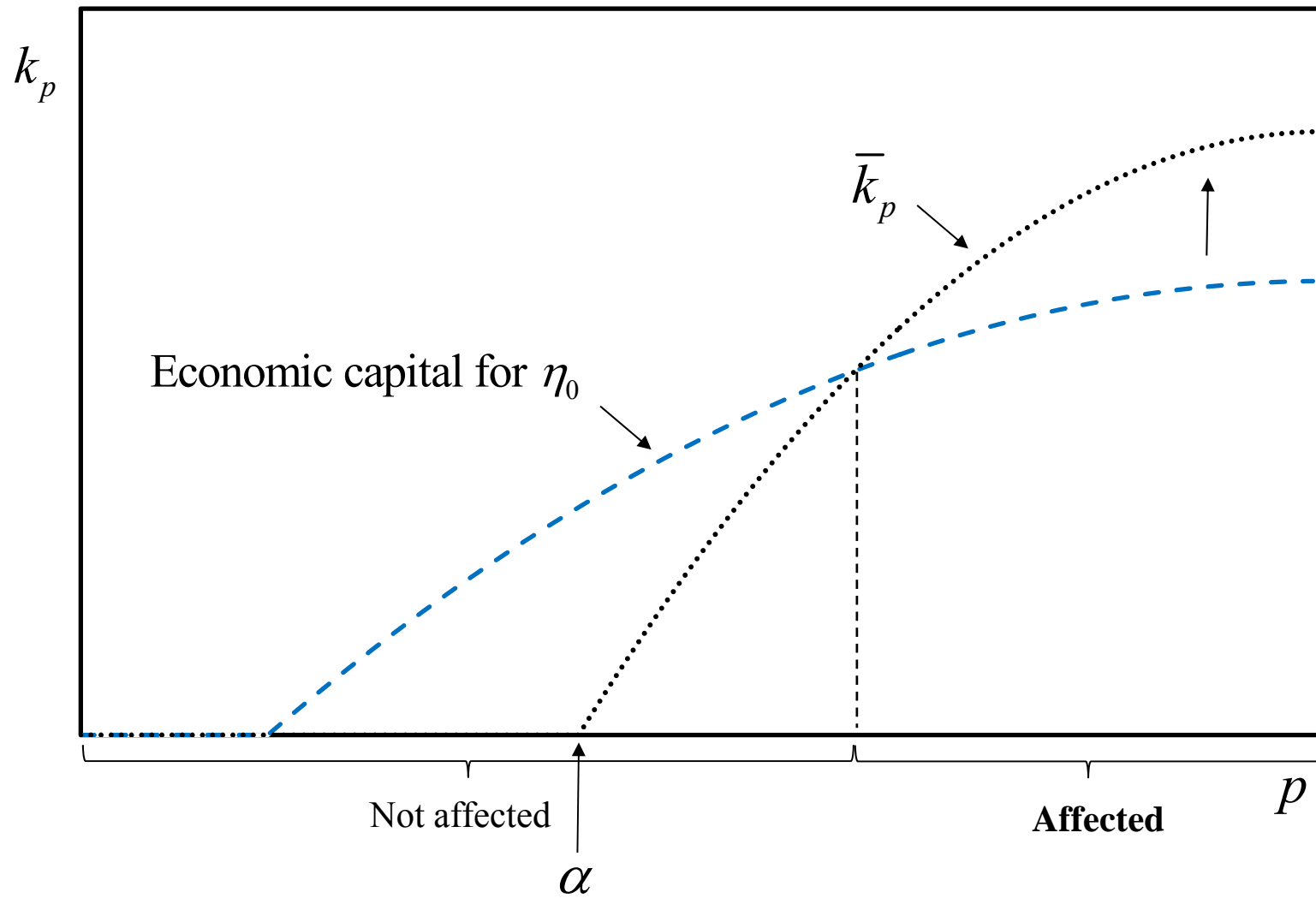
→ Increasing in risk p

→ Increasing in confidence level $1 - \alpha$

VaR capital requirements



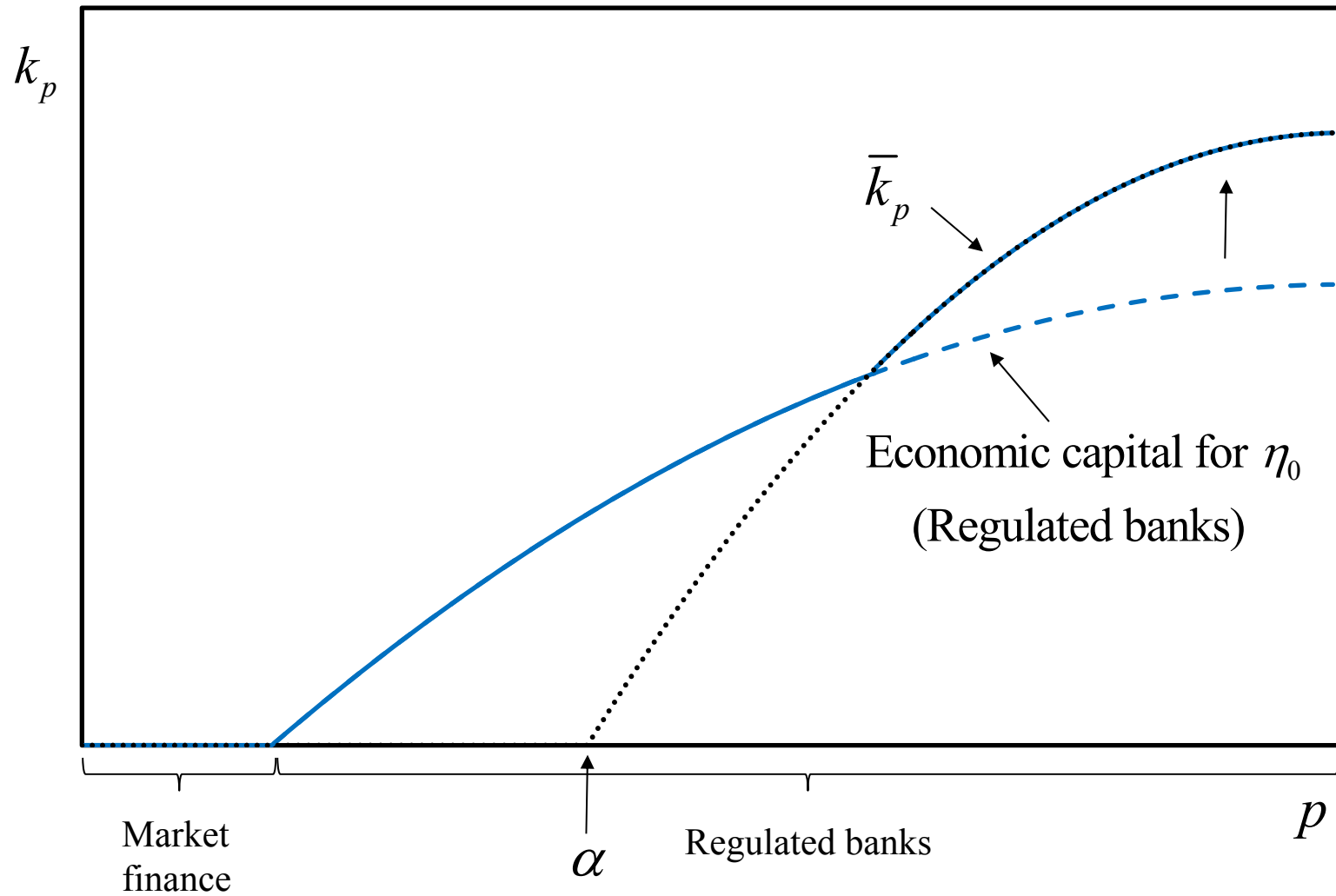
Capital with VaR requirements



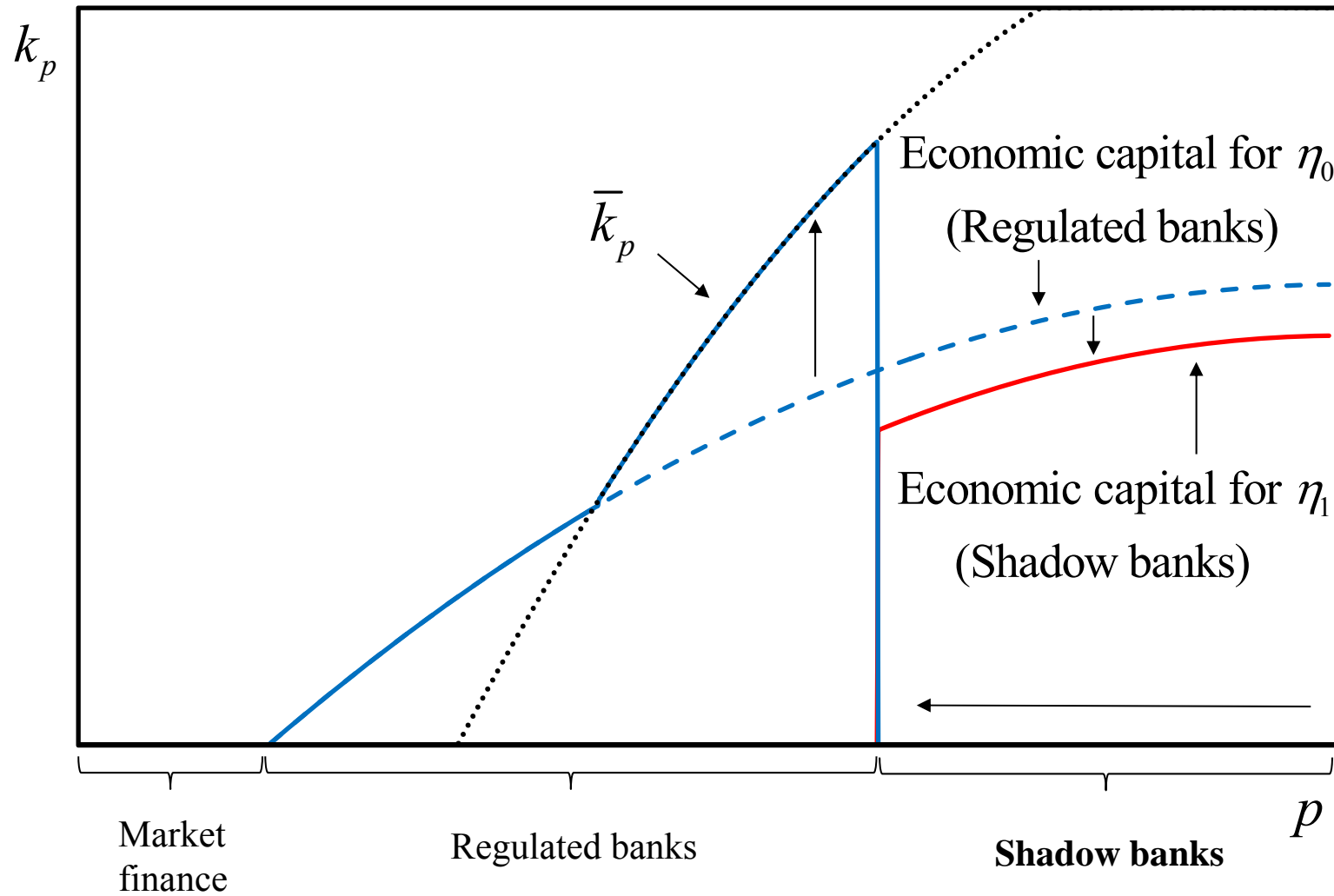
Two cases: low and high VaR requirements

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

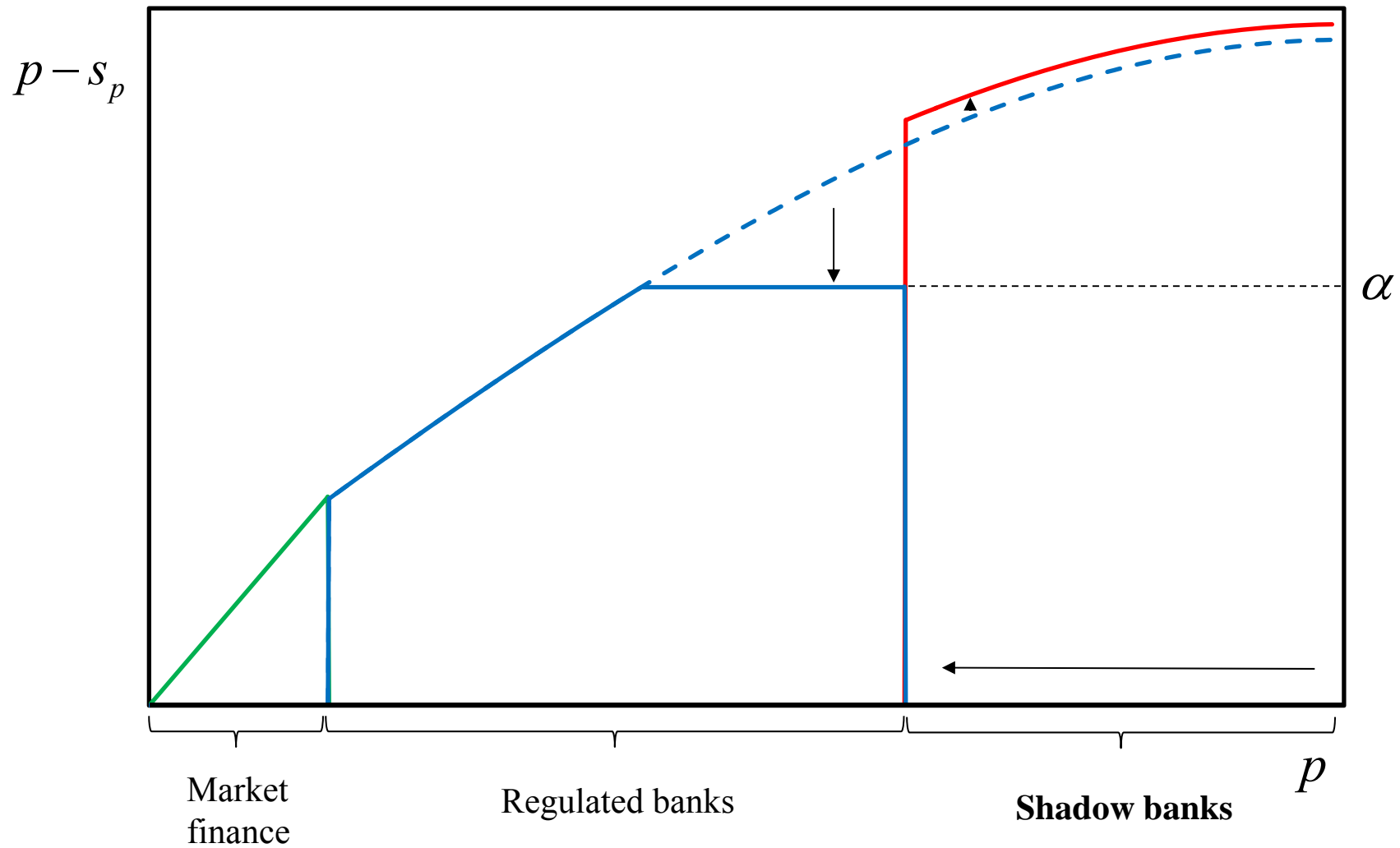
Capital with low VaR requirements



Capital with high VaR requirements



PD with high VaR requirements



Effect of tightening VaR requirements

- Drives risky borrowers away from regulated banks
 - Lower screening and higher risk
- Medium-risk regulated banks become safer
 - Higher capital increases screening incentives
- No effect on low-risk regulated banks
 - Capital requirement is not binding
 - 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

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

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

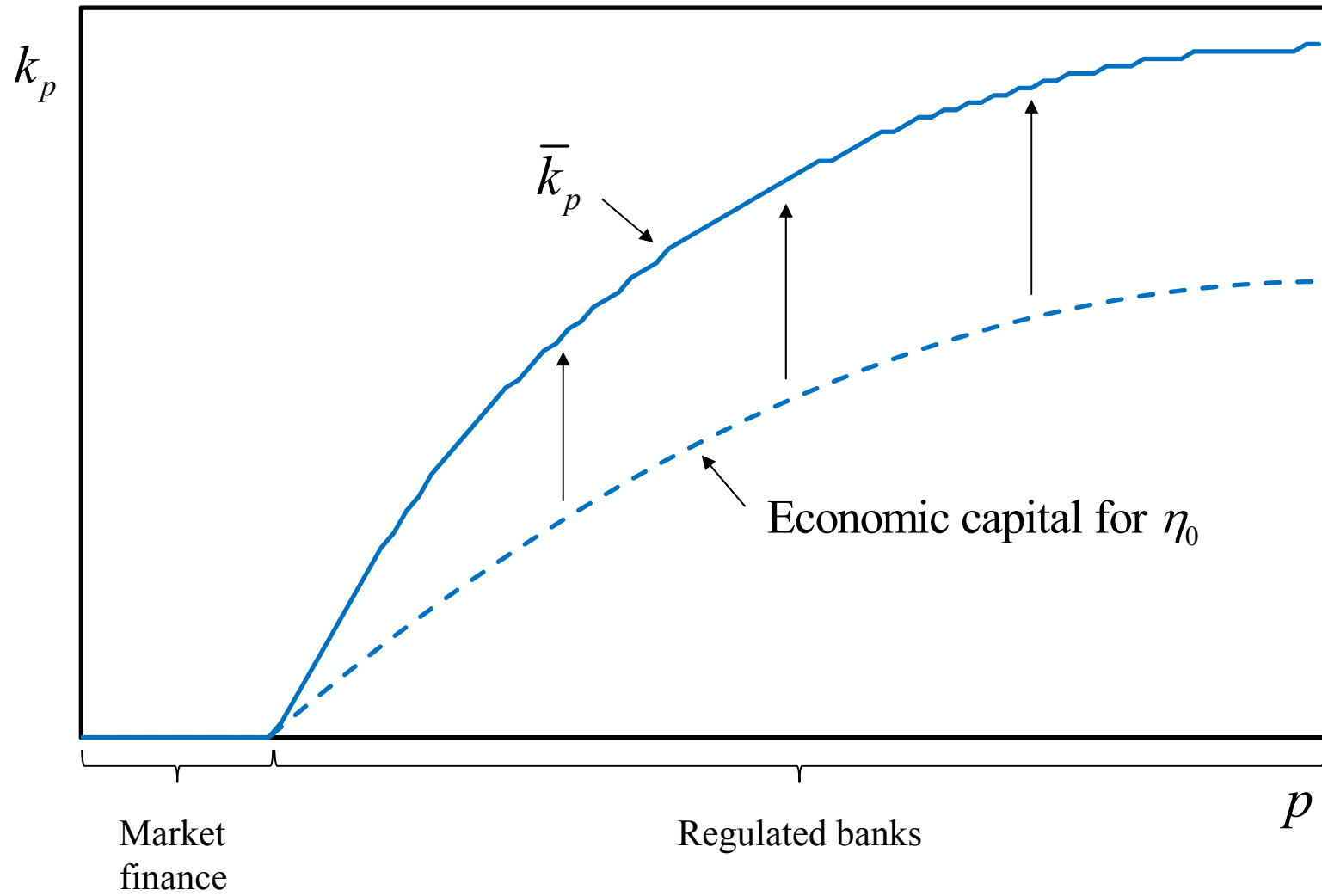
Optimal capital requirements

- Optimal capital requirements defined by

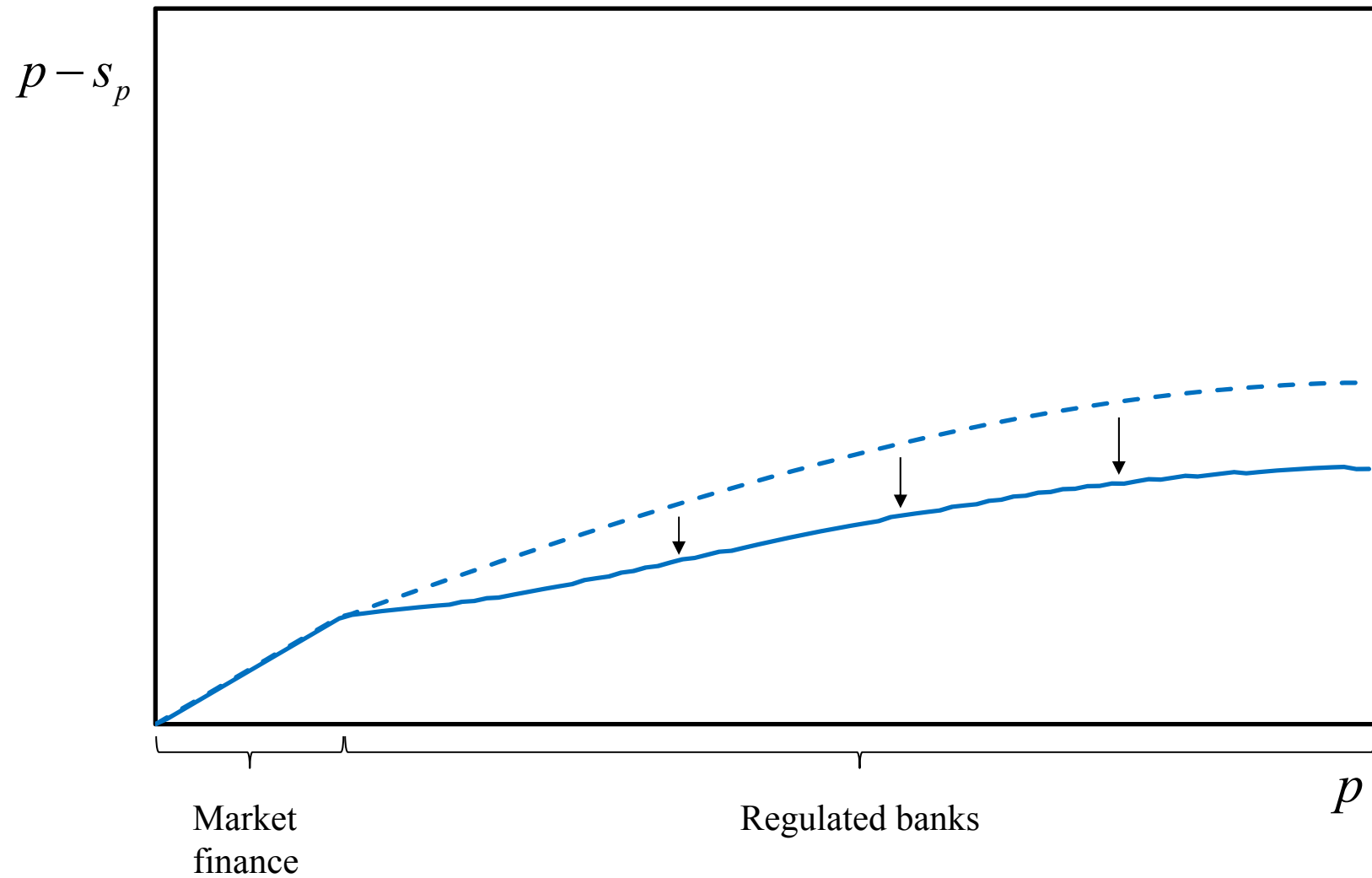
$$k^* = \arg \max_k W(x(k))$$

- 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