Comparing Flat and Risk-based Capital Requirements

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The Basel Committee milestones

- Capital Accord of 1988: Basel I

  → First international agreement on capital requirements

- Market Risk Amendment of 1996

  → Introduction of internal models (VaR) in regulation

- Revised Capital Adequacy Framework of 2004: Basel II

  → Extension of use of internal models to credit risk

- The New Regulatory Framework of 2010: Basel III

  → Regulatory response to financial crisis that started in 2007

From Basel I to Basel II

- Correcting perceived shortcomings of Basel I

  → Insufficient risk differentiation

  → **Regulatory capital arbitrage (RCA)**

  "RCA is driven by large divergences that frequently arise between underlying economic risks and the notions and measures of risk embodied in regulatory capital ratios."

  David Jones (2000)

Basel II

- Replaces **flat** with **risk-based** capital requirements
- Internal Ratings-based Approach (IRB)
  - → Capital must cover losses with confidence level 99.9%
  - → Bank's probability of failure should be smaller than 0.1%

From Basel II to Basel III

- Correcting perceived shortcomings of Basel II

"The Basel II approach to regulating bank capital was a comprehensive failure. The **numerator** of the regulatory ratio did not reflect an institution's ability to absorb loss without going to resolution and the **denominator** did not capture the most important risks to which banks were exposed. Moreover, the **minimum** was set much too low."

Richard Herring (2011)

Basel III

- Numerator: Stricter definition of equity capital
- Denominator: Higher weights for riskier assets
- Minimum: Higher requirements
- Capital conservation buffer
- Countercyclical capital buffer
- **Non-risk-based leverage ratio**
- Liquidity risk requirements

Admati and Hellwig (2013)

- Capital requirements should be (i) much higher and (ii) flat

  (i) “Requiring that banks’ equity be at least on the order of 20-30 percent of their total assets would make the financial system substantially safer.”

  (ii) “The risk-weighting approach is extremely complex and has many unintended consequences that harm the financial system.”

Hanson, Kashyap, and Stein (2011)

- One should worry about impact on **shadow banking system**

  "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**."

Key issue

- Effect of higher flat and/or risk-based capital requirements

  → When we take into account shadow banking system

  → **How shadow banks affect effectiveness of regulation?**

What is the problem?

- There is no analytical framework to address these issues

  "**I am not aware of any model** that captures properly the relevant trade-offs between this or other proposals and the status quo." Anat Admati (2014)

- This paper is a first attempt to construct such framework

Overview of model

- Four types of agents
  - → **Entrepreneurs** require funds for their risky projects
  - → **Banks** fund entrepreneurs' projects
  - → **Investors** provide funds (debt and equity) to the banks
  - → **Consumers** buy output of entrepreneurs' projects
- Entrepreneurs are of different risk types
- Equity is more expensive than debt

Bank monitoring

- Banks can monitor entrepreneurs' projects

  → Reduces probability of failure

- Monitoring is costly and not observed by debtholders

  → Moral hazard problem

  → which equity capital serves to ameliorate

Two types of financial contracts

- Contracts associated with positive monitoring

  → Banks that **originate-to-hold**

  → Traditional banking system

- Contracts associated with zero monitoring

  → Market finance or banks that **originate-to-distribute**

  → Shadow banking system

Main results (i)

- Flat capital requirements
  - → Make (some) traditional banks safer
  - → Drives safest borrowers to shadow banking system
  - → Standard regulatory capital arbitrage
- Risk-based capital requirements (à la Basel II)
  - → Make (some) traditional banks safer
  - → Drives riskiest borrowers to shadow banking system
  - → Novel regulatory capital arbitrage

Main results (ii)

- Much higher flat capital requirements may be bad

  → Expand size of (low risk) shadow banking system

  → Reduce monitoring for low risk borrowers

- Much higher risk-based capital requirements may be worse

  → Expand size of (high risk) shadow banking system

  → Reduce monitoring for high risk borrowers

  → The ones that benefit from monitoring the most

Main results (iii)

- Putting together flat and risk-based requirements (à la Basel III)
  - → Expands size of shadow banking system at both ends
  - → Combines the pros and cons of Basel I and Basel II
- Optimal (welfare maximizing) regulation
  - → Lower than flat & higher than risk-based for safer types
  - → Higher than flat & lower than risk-based for riskier types

Overview

- Model setup
- Equilibrium
  - → Laissez-faire
  - → Flat capital requirements
  - → Risk-based capital requirements
- Welfare
- 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**
  → Set of **consumers**
- Entrepreneurs have projects that require bank finance
- Banks raise funds by issuing uninsured debt and equity

Entrepreneurs

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

$$\text{Unit investment} \;\rightarrow\; \text{Return} = \begin{cases} R_p, & \text{with prob. } 1-p+m \\ 0, & \text{with prob. } p-m \end{cases}$$

$\rightarrow$ $m \in [0, p]$ is the monitoring intensity of lending bank

Entrepreneurs and banks

- Single bank for each type of entrepreneur

  → All entrepreneurs of type p borrow from this bank

- Returns of entrepreneurs of type p are perfectly correlated

  → Portfolio return coincides with single project return

- Loan market is contestable (limit pricing)

  → Equilibrium loan rate is lowest feasible rate

Bank monitoring

- Monitoring is not observed by debtholders

  → Moral hazard problem

- Monitoring entails cost $c(m)$, with $c'(m) > 0$ and $c''(m) > 0$

  → For numerical results assume

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

Investors

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

Consumers

- Representative consumer à la Dixit-Stiglitz

  → Continuum of goods produced by entrepreneurs

  → CES utility function

- Price R_p of type p good determined by

$$R_p = R(x_p) = x_p^{-1/\sigma} \quad \text{with } \sigma > 1$$

  → where x_p is aggregate investment of entrepreneurs of type p

  → Loan demand function

$$x_p = x(R_p) = R_p^{-\sigma}$$

Summing up

- Three key parameters
  - → Cost of capital δ
  - → Monitoring cost parameter γ
  - → Elasticity of loan demand function σ

Part 2

Equilibrium

Part 2a

Laissez-faire

Banks' funding and lending contracts

The single bank lending to entrepreneurs of type p sets

(1) Capital k_p per unit of loans

(2) Interest rate B_p offered to debtholders

(3) Interest rate R_p offered to entrepreneurs

Such contract determines monitoring m_p

Banks' profits

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

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

→ With probability $1 - p + m_p$ gets R_p and pays $(1 - k_p)B_p$

→ With probability $p - m_p$ gets and pays 0 (limited liability)

→ With probability 1 incurs monitoring cost $c(m_p)$

→ To simplify notation let's drop subscript p

Banks' objective function

- Given loan market contestability

  → Banks' objective function is to minimize loan rates

  → subject to optimal (private) choice of monitoring

  → and debt- and shareholders' participation constraints

Optimal contract

• Optimal (limit price) contract is array (k^*, B^*, R^*, m^*) that solves

$$\min R$$

→ subject to incentive compatibility constraint (IC)

$$m^* = \arg\max_m \left\{(1-p+m)[R^* - (1-k^*)B^*] - c(m)\right\}$$

→ shareholders' participation constraint (SPC)

$$\pi_p^* = (1-p+m^*)[R^* - (1-k^*)B^*] - c(m^*) \geq (1+\delta)k^*$$

→ and debtholders' participation constraint (DPC)

$$(1-p+m^*)B^* \geq 1$$

Characterization of optimal contract (i)

- IC constraint

$$m^* = \arg\max_m \left\{(1-p+m)[R^* - (1-k^*)B^*] - c(m)\right\}$$

→ Interior solution characterized by FOC

$$\boxed{R-(1-k)B = c'(m)}$$

→ From here it follows that

$$\frac{dm}{dR} > 0, \quad \frac{dm}{dk} > 0, \text{ and } \frac{dm}{dB} < 0$$

Characterization of optimal contract (ii)

- DPC satisfied with equality

  Otherwise: lower B $\rightarrow$ higher m $\rightarrow$ lower R

- SPC satisfied with equality

  Otherwise: higher k $\rightarrow$ higher m $\rightarrow$ lower R

- Substituting DPC into SPC gives single PC

$$(1-p+m)R = 1+\delta k + c(m)$$

$\rightarrow$ Expected return = funding cost + monitoring cost

Proposition 1

- There is a marginal type

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

→ Banks lending to types $p \leq \hat{p}$ choose $k_p^* = m_p^* = 0$

→ Banks lending to types $p > \hat{p}$ choose $k_p^* > 0$ and $m_p^* > 0$

Comments on Proposition 1

- Safer entrepreneurs borrow from shadow banks (or the market)

  → No capital and no monitoring

- Riskier entrepreneurs borrow from traditional banks

  → Positive capital and positive monitoring

- Higher cost of capital (δ) or higher cost of monitoring (γ)

  → Expand the set of entrepreneurs funded by shadow banks

- If monitoring cost is sufficiently small ($\gamma \leq 1+1/\delta$)

  → All entrepreneurs borrow from traditional banks

Numerical illustration

- Focus on qualitative results

  → Not a calibration

- Parameters chosen to facilitate graphical representation

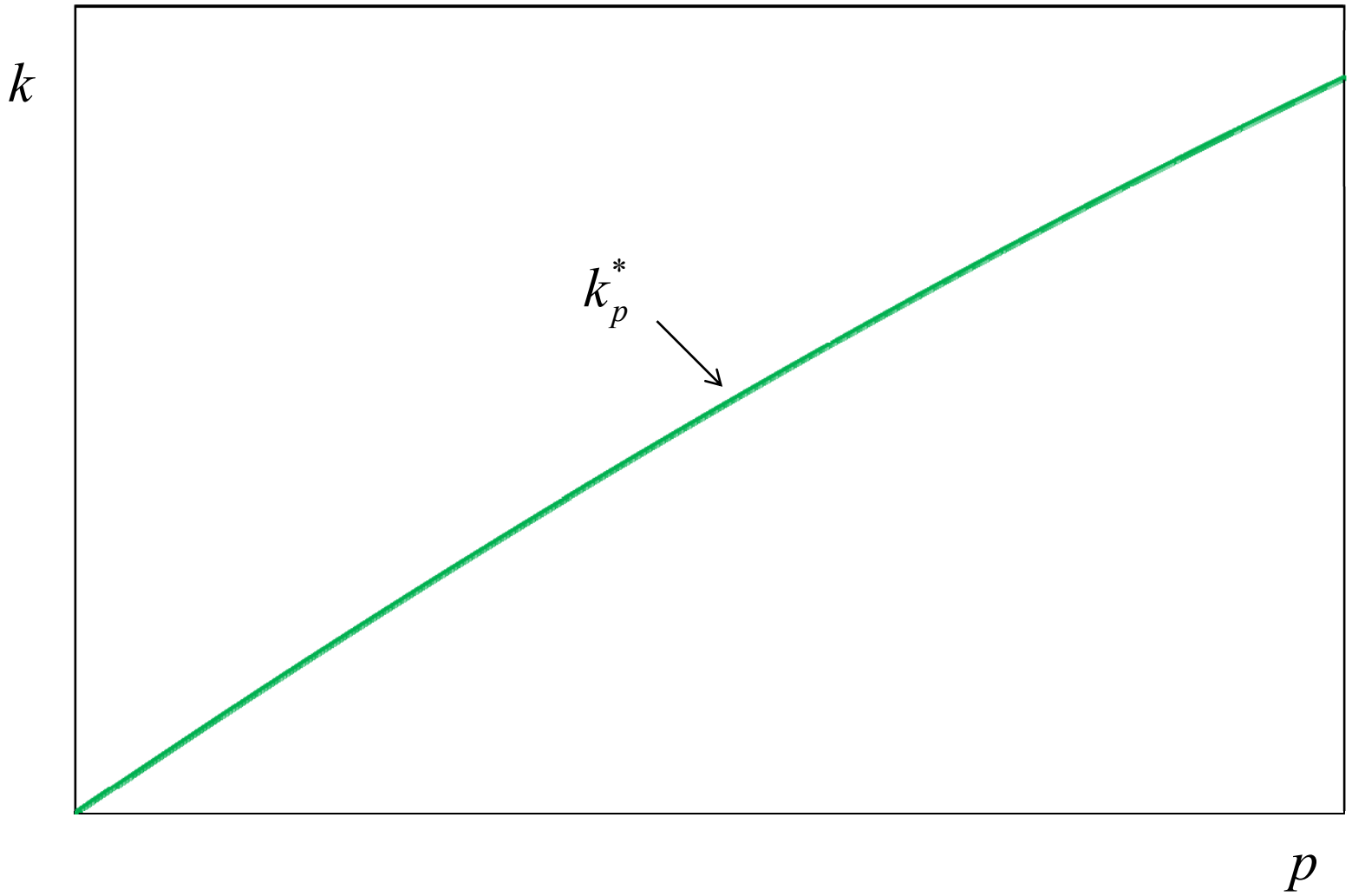
  → Monitoring cost parameter $\gamma = 6$

  → Cost of capital $\delta = 20\%$

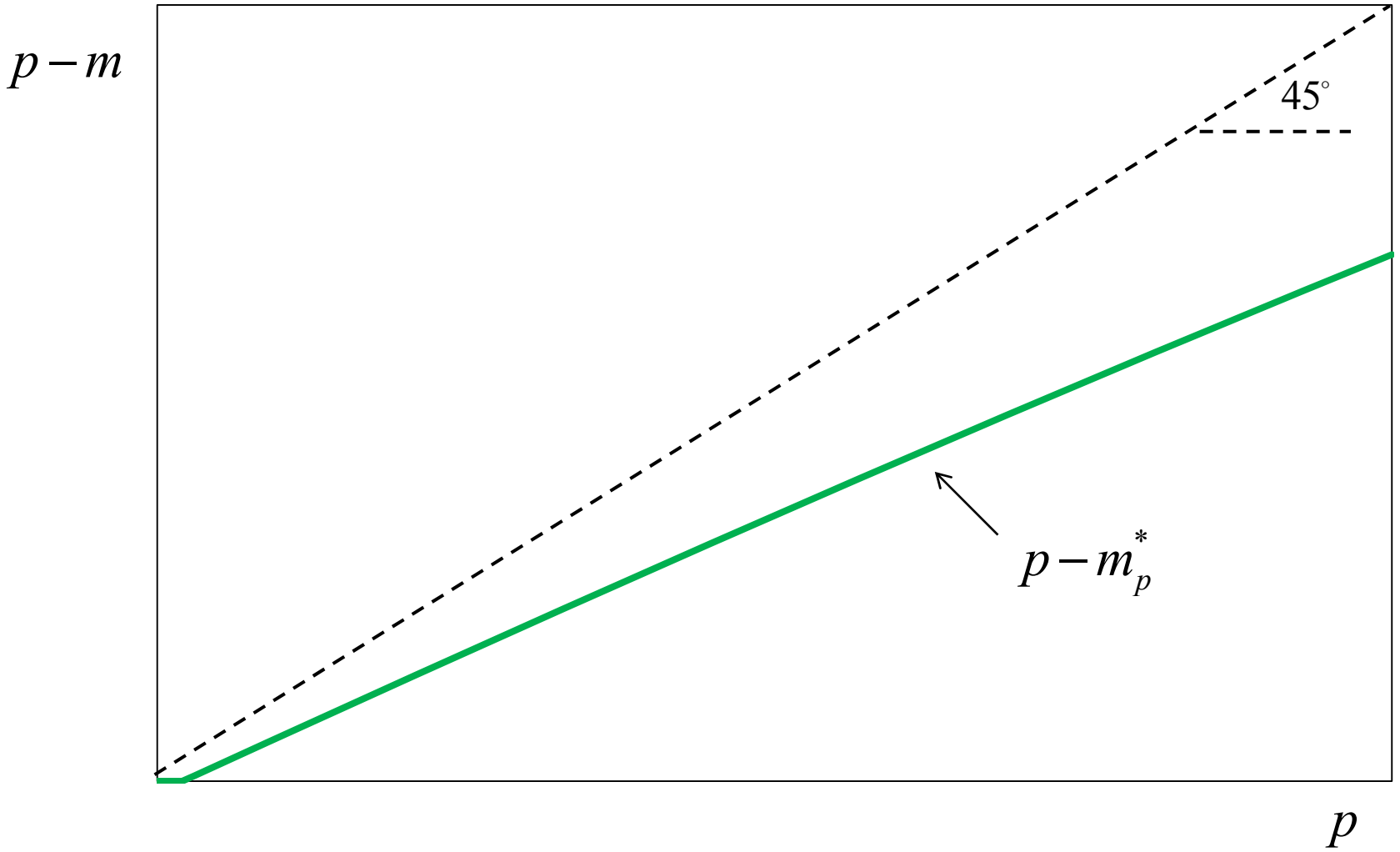
- These parameters imply $\hat{p} = 0$

  → No shadow banking in the absence of regulation

Capital under laissez-faire



Risk under laissez-faire



Part 2b

Flat capital requirements

Flat capital requirements

- Introducing a flat capital requirement à la Basel I

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

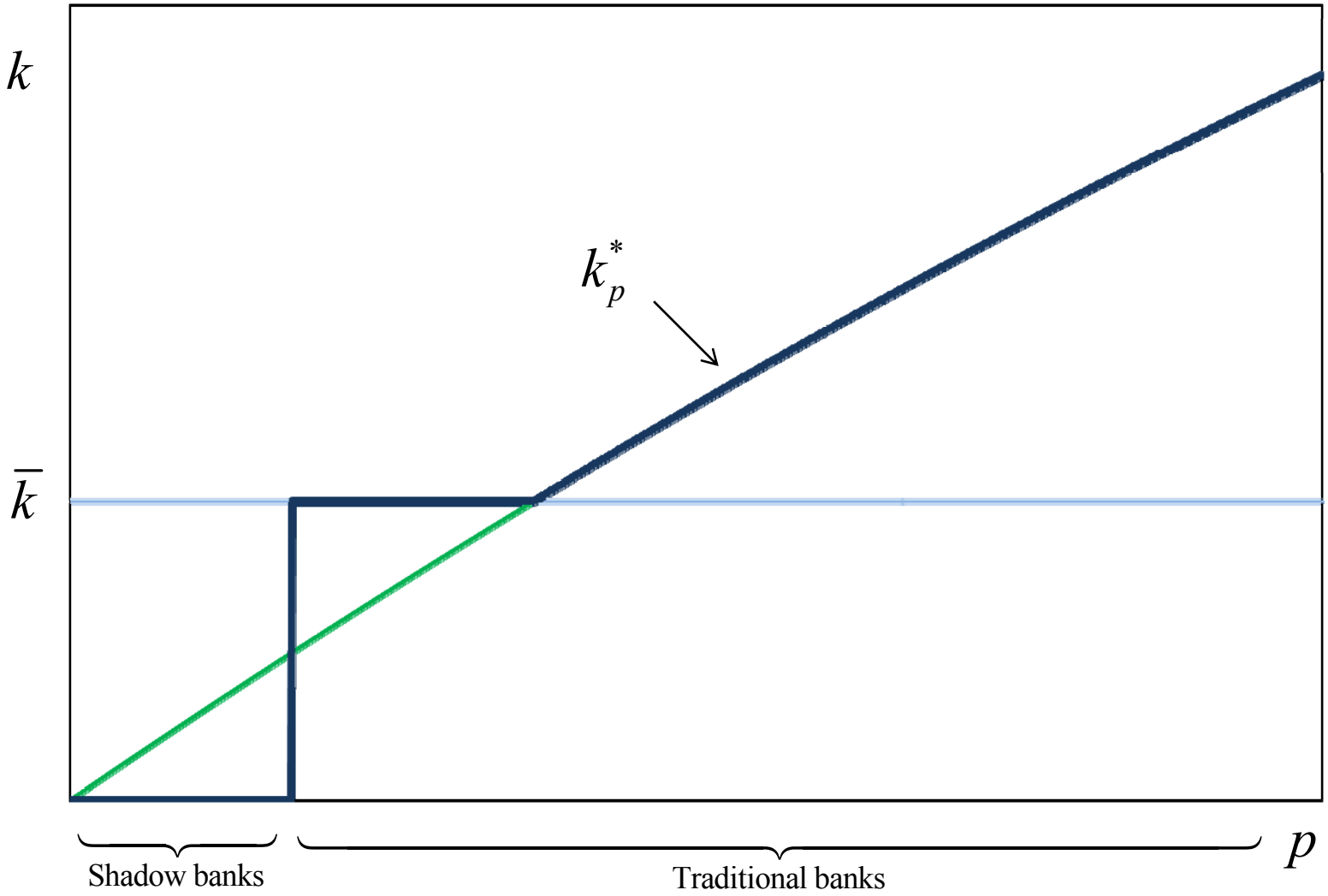
→ Only applies to traditional banks (not shadow banks)

Proposition 2

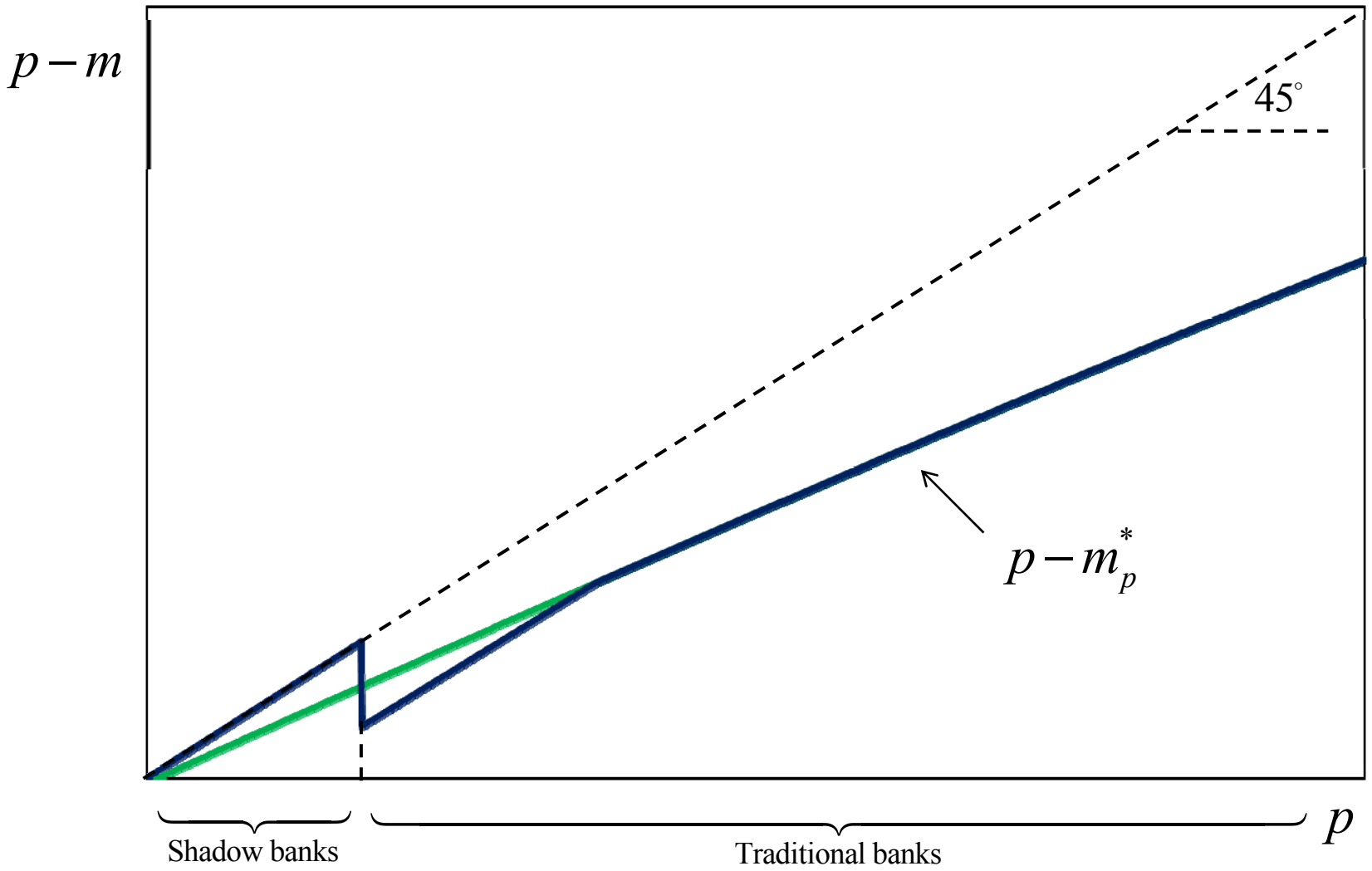
- Effects of flat capital requirement
  1. Drives safest borrowers to shadow banking system
  2. Safer traditional banks become safer
  3. Riskier traditional banks remain as before

  → First effect rationalizes idea of regulatory capital arbitrage

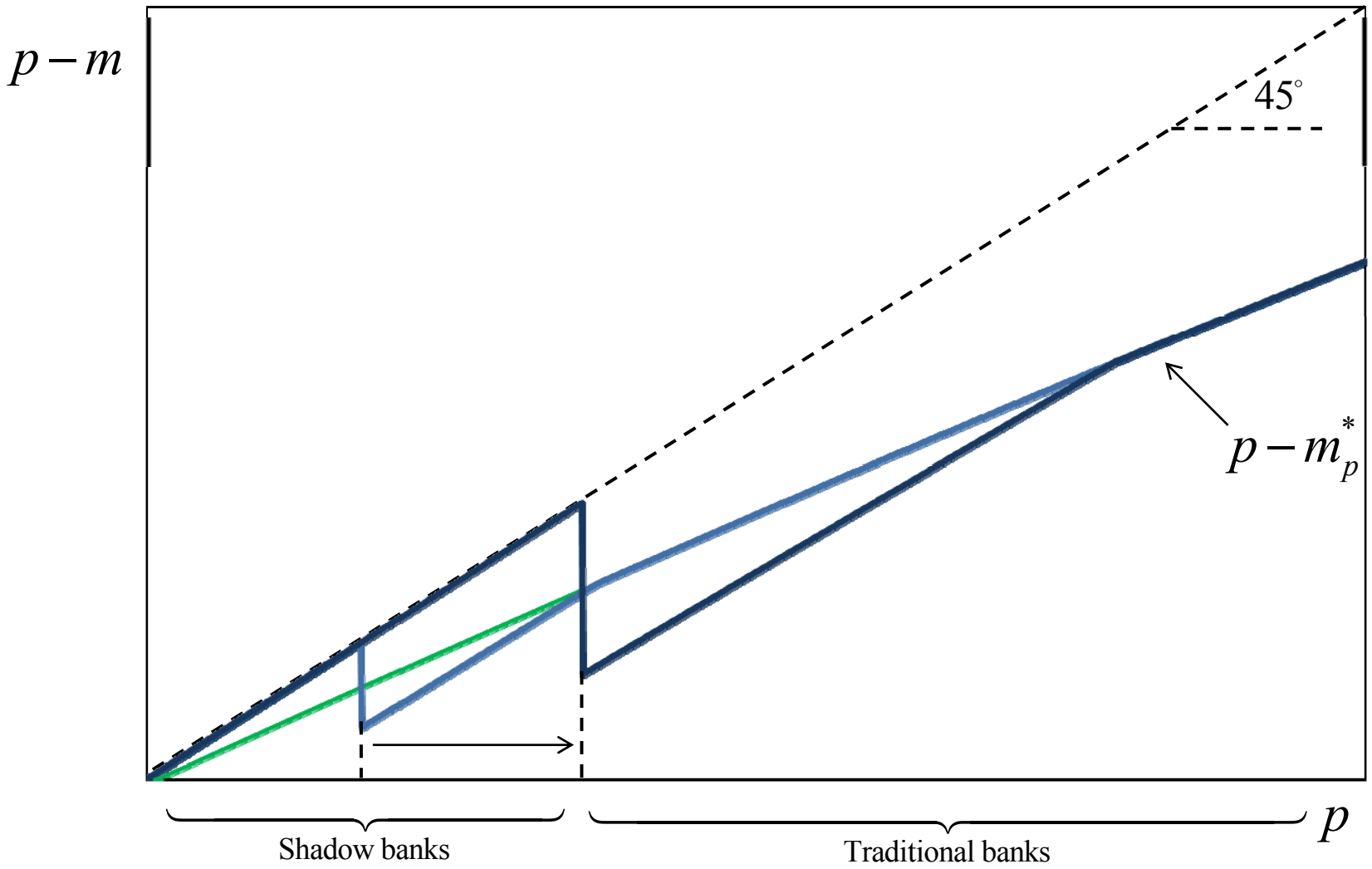
Capital under a flat requirement



Risk under a flat requirement



Increasing flat requirement



Part 2c

Risk-based capital requirements

Risk-based capital requirements (i)

- Introducing a risk-based capital requirement à la Basel II

  → In Basel II

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

  → We postulate

$$\Pr(\text{bank failure} \mid \bar{k}) = \alpha$$

Risk-based capital requirements (ii)

- Three equations

  → FOC: $R-(1-k)B=c'(m)$

  → DPC: $(1-p+m)B=1$

  → SPC: $(1-p+m)[R-(1-k)B]-c(m)=(1+\delta)k$

- FOC + DPC imply: $(1-p+m)R=1-k+(1-p+m)c'(m)$
- DPC + SPC imply: $(1-p+m)R=1+\delta k+c(m)$

  → Subtracting these two expressions we get

$$\boxed{(1+\delta)k=(1-p+m)c'(m)-c(m)}$$

Risk-based capital requirements (iii)

- To ensure

$$\Pr(\text{bank failure} \mid \bar{k}_p) = p - m = \alpha$$

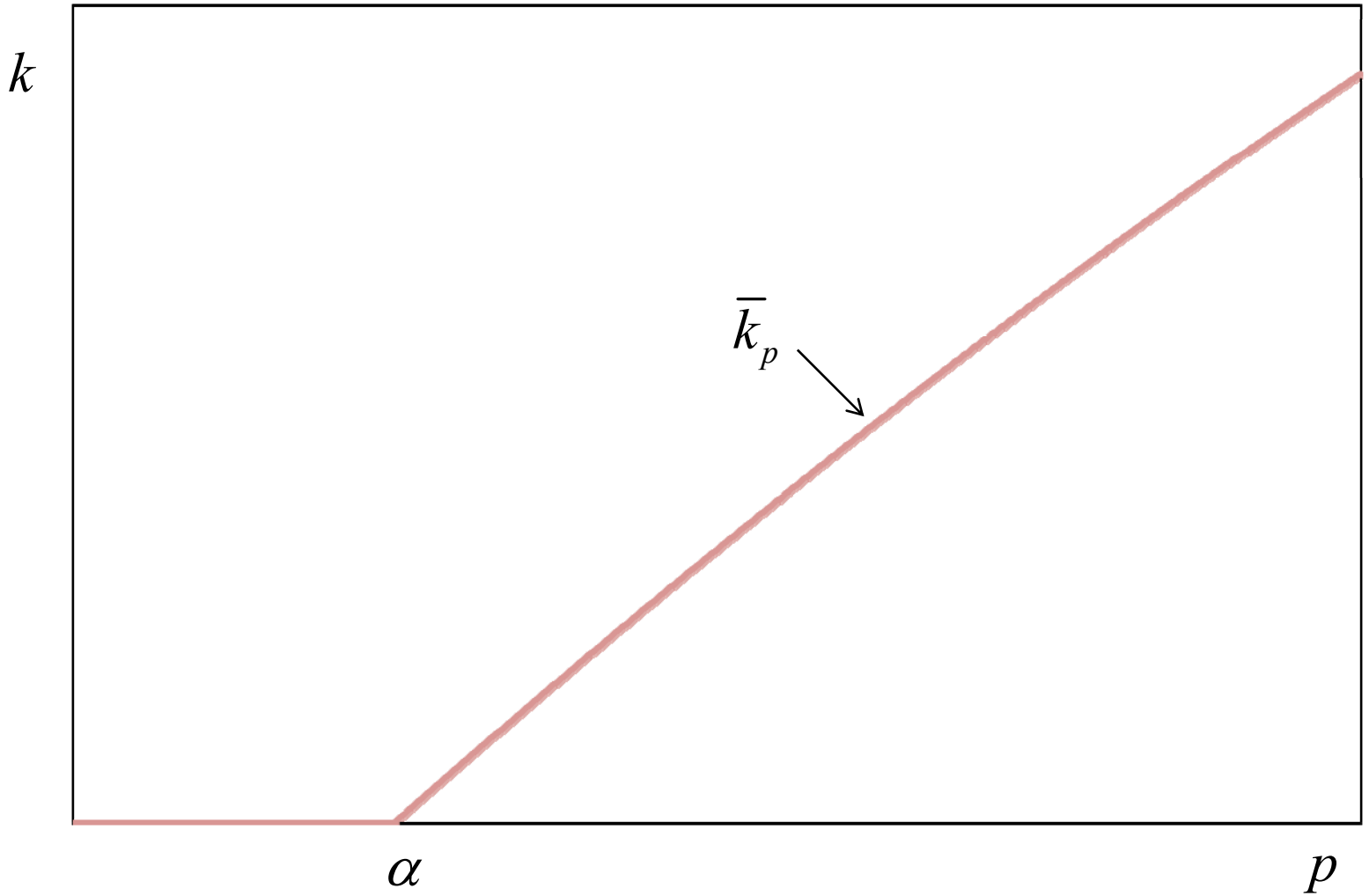
→ we require $m = p - \alpha$

- Hence we get the following capital requirements formula

$$\bar{k}_p = \frac{(1-\alpha)c'(p-\alpha) - c(p-\alpha)}{1+\delta}$$

→ Depends on risk p, confidence level α, and cost of capital δ

Risk-based capital requirements

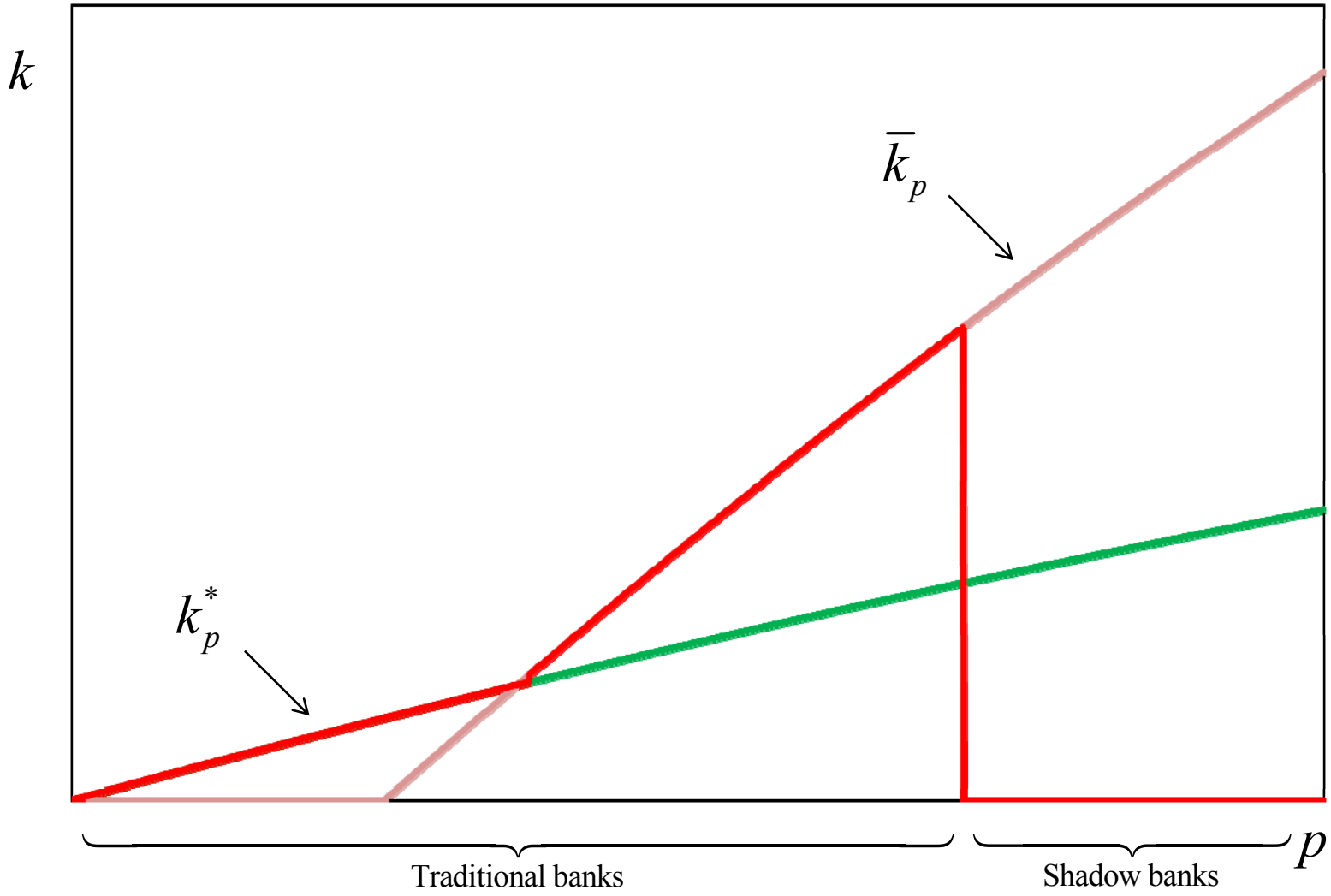


Proposition 3

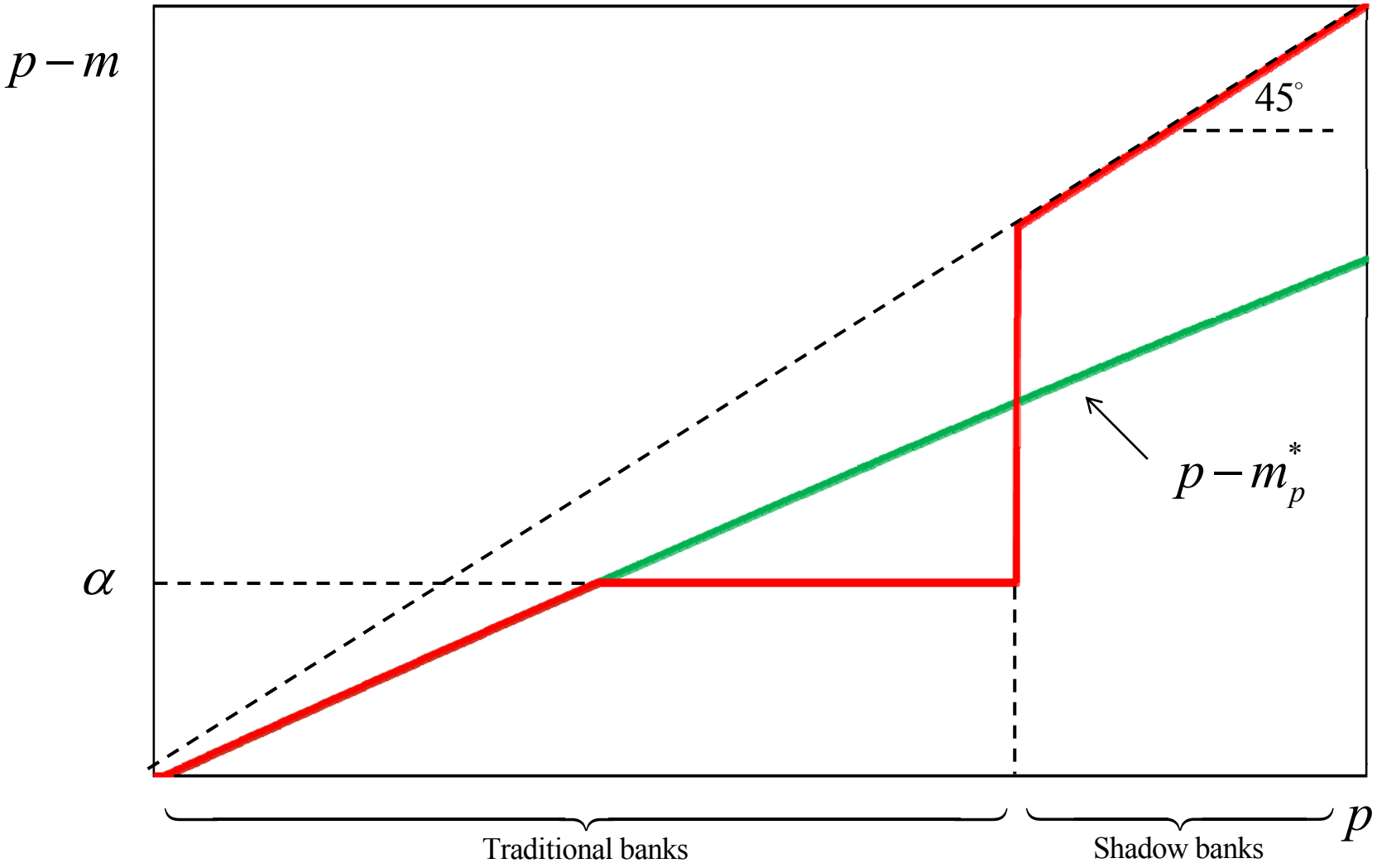
- Effects of risk-based capital requirement
  1. Drives riskiest borrowers to shadow banking system
  2. Riskier traditional banks become safer
  3. Safer traditional banks remain as before

  → First effect is novel and has been overlooked

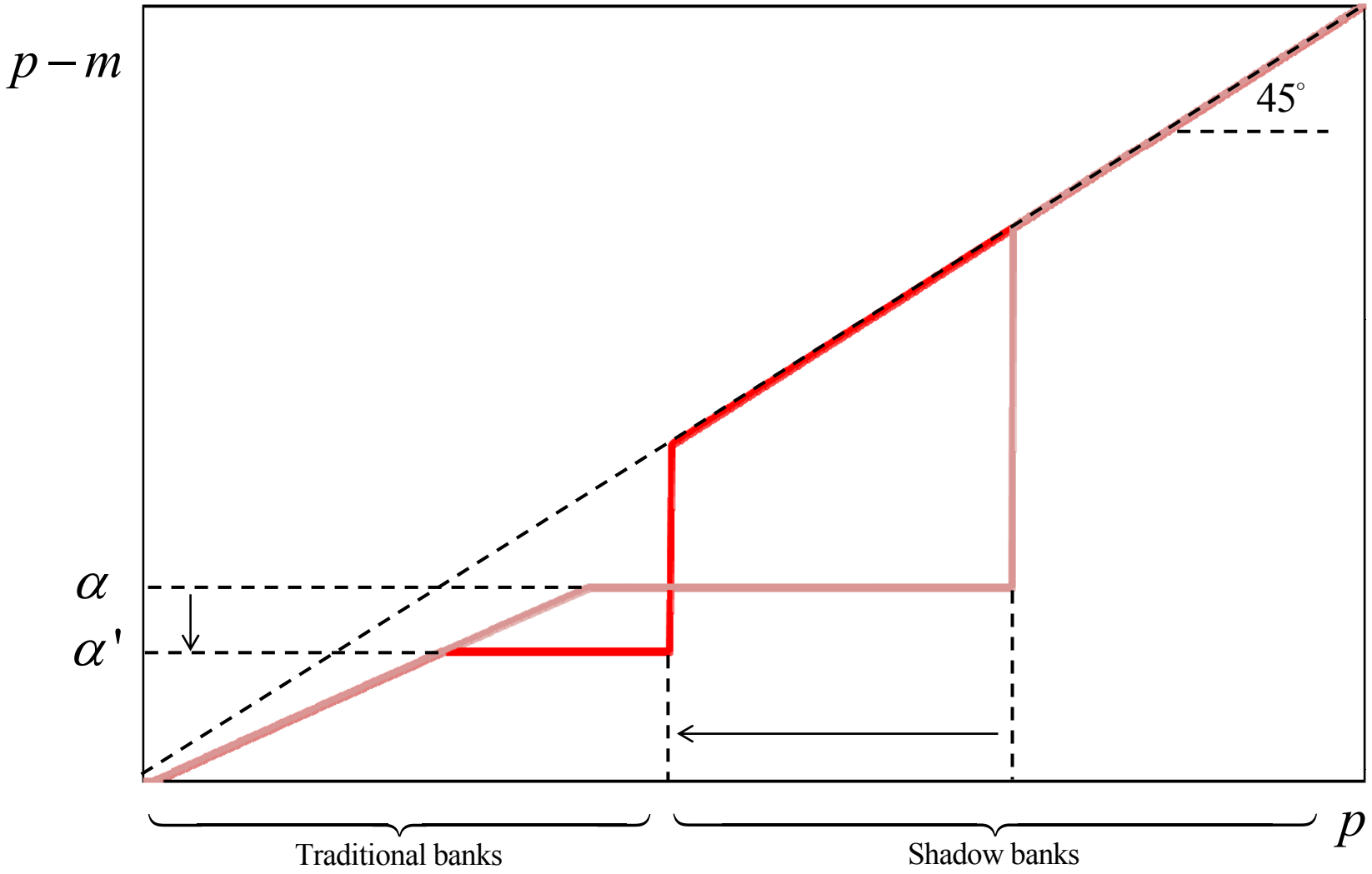
Capital under risk-based requirements



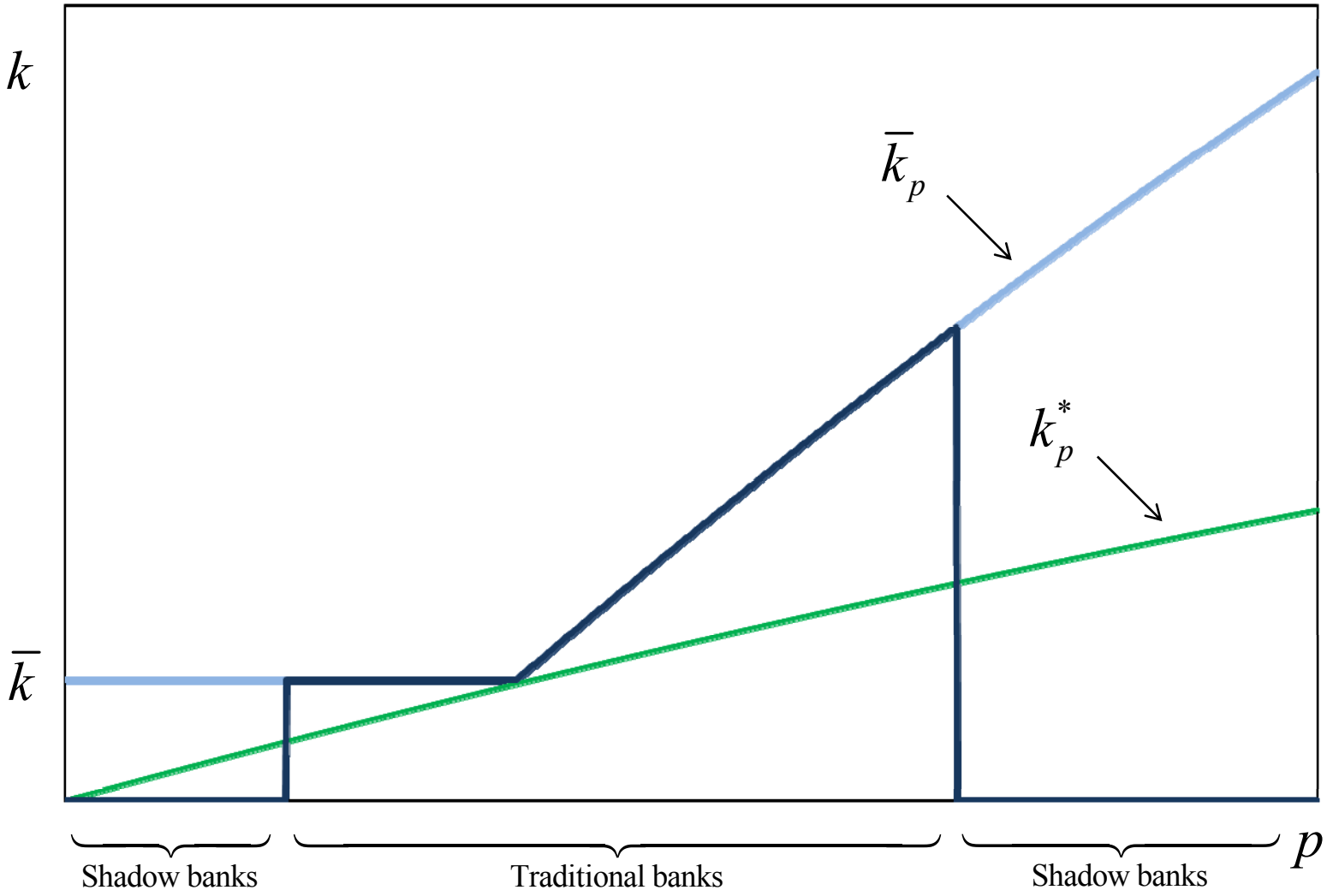
Risk under risk-based requirements



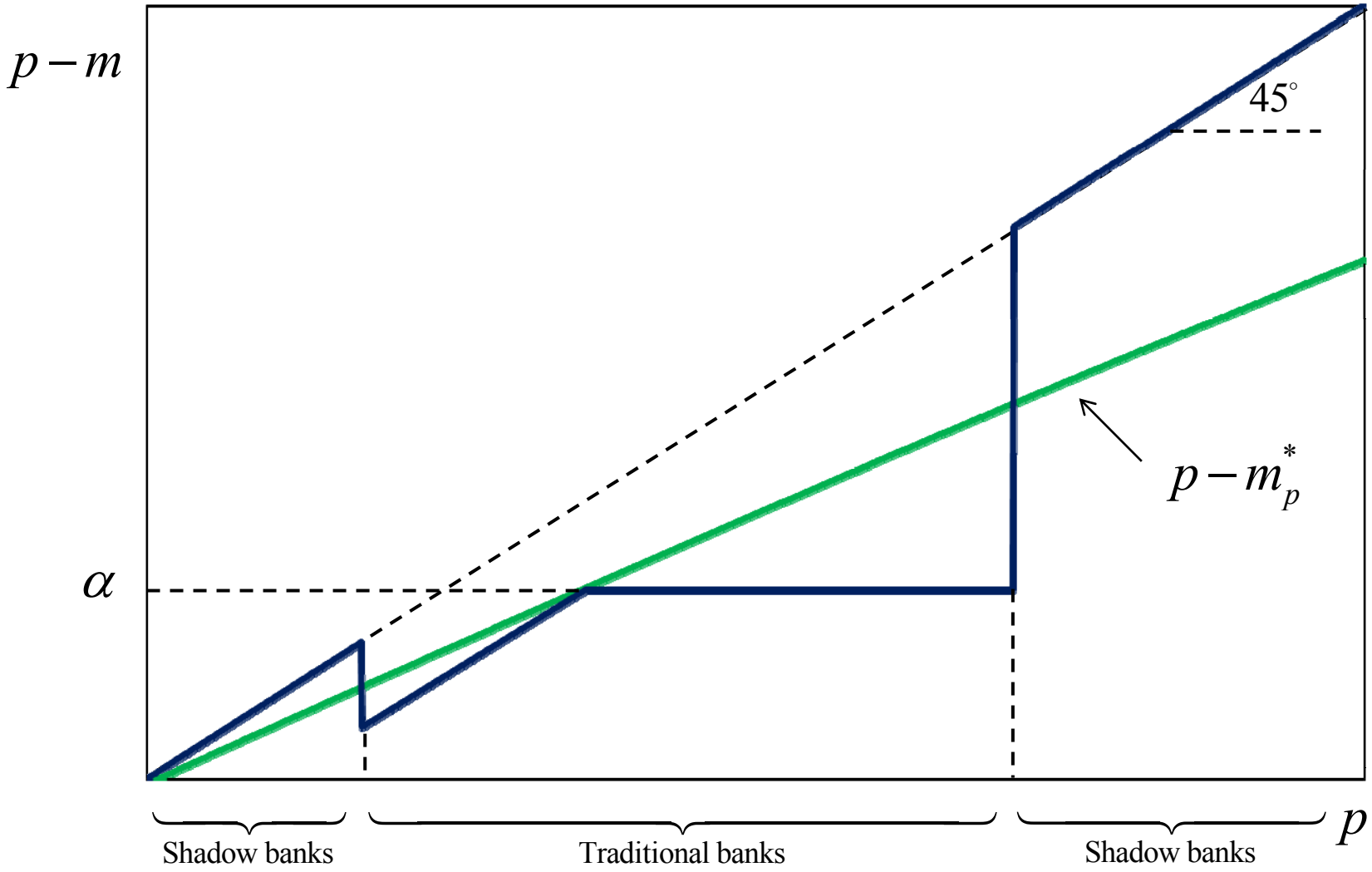
An increase in risk-based requirements



Capital under Basel III



Risk under Basel III



Part 3

Welfare analysis

Social welfare

- Debt- and shareholders get required return on their investments

  → May be ignored in welfare calculation

- Entrepreneurs get zero profits

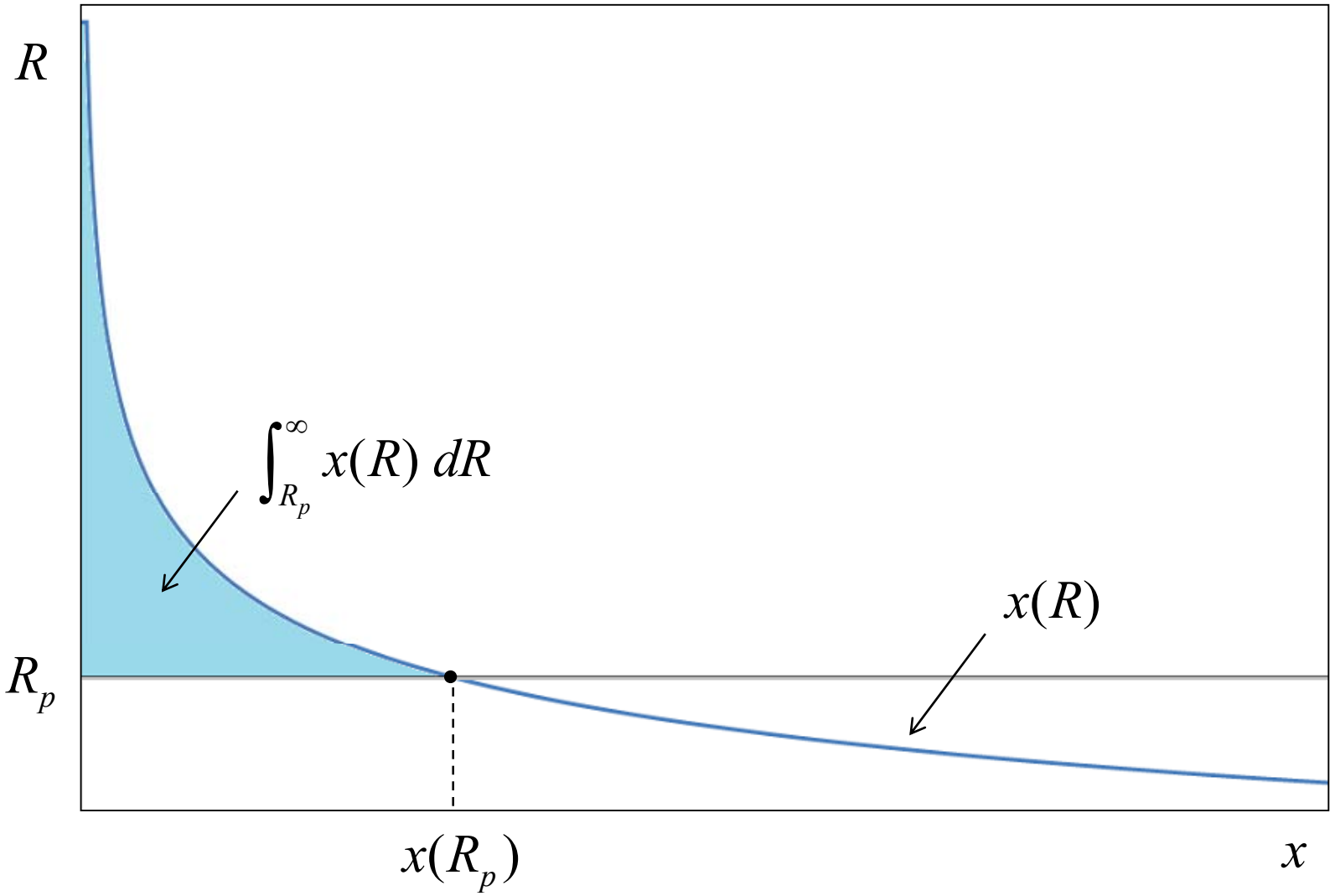
- Focus on consumers' surplus

  → Triangle under loan demand function $x(R_p) = R_p^{-\sigma}$

  → Multiplied by probability of success

$$s_p = (1 - p + m_p) \int_{R_p}^{\infty} R^{-\sigma} dR = (1 - p + m_p) \frac{R_p^{1-\sigma}}{\sigma - 1}$$

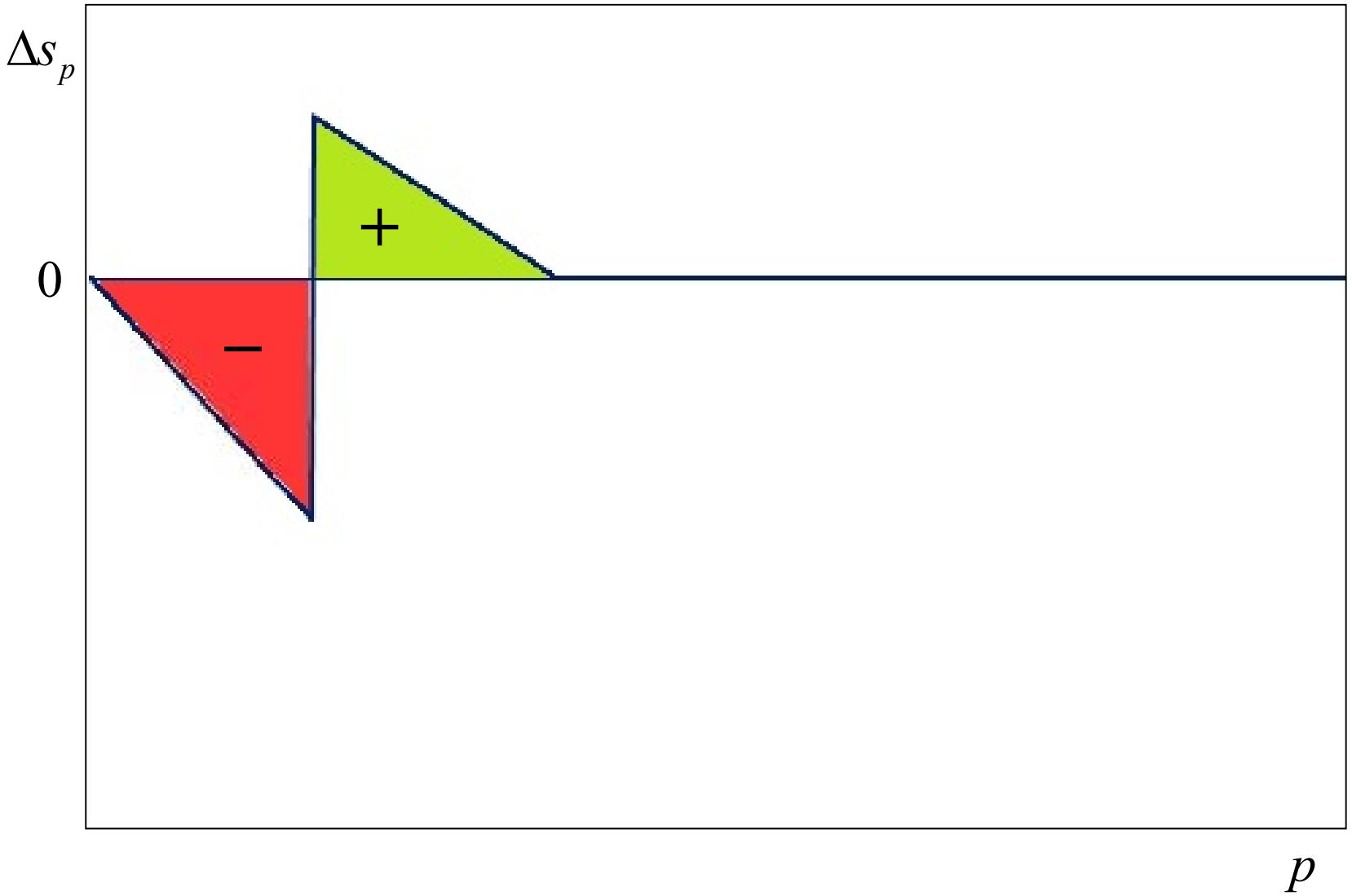
Welfare triangle



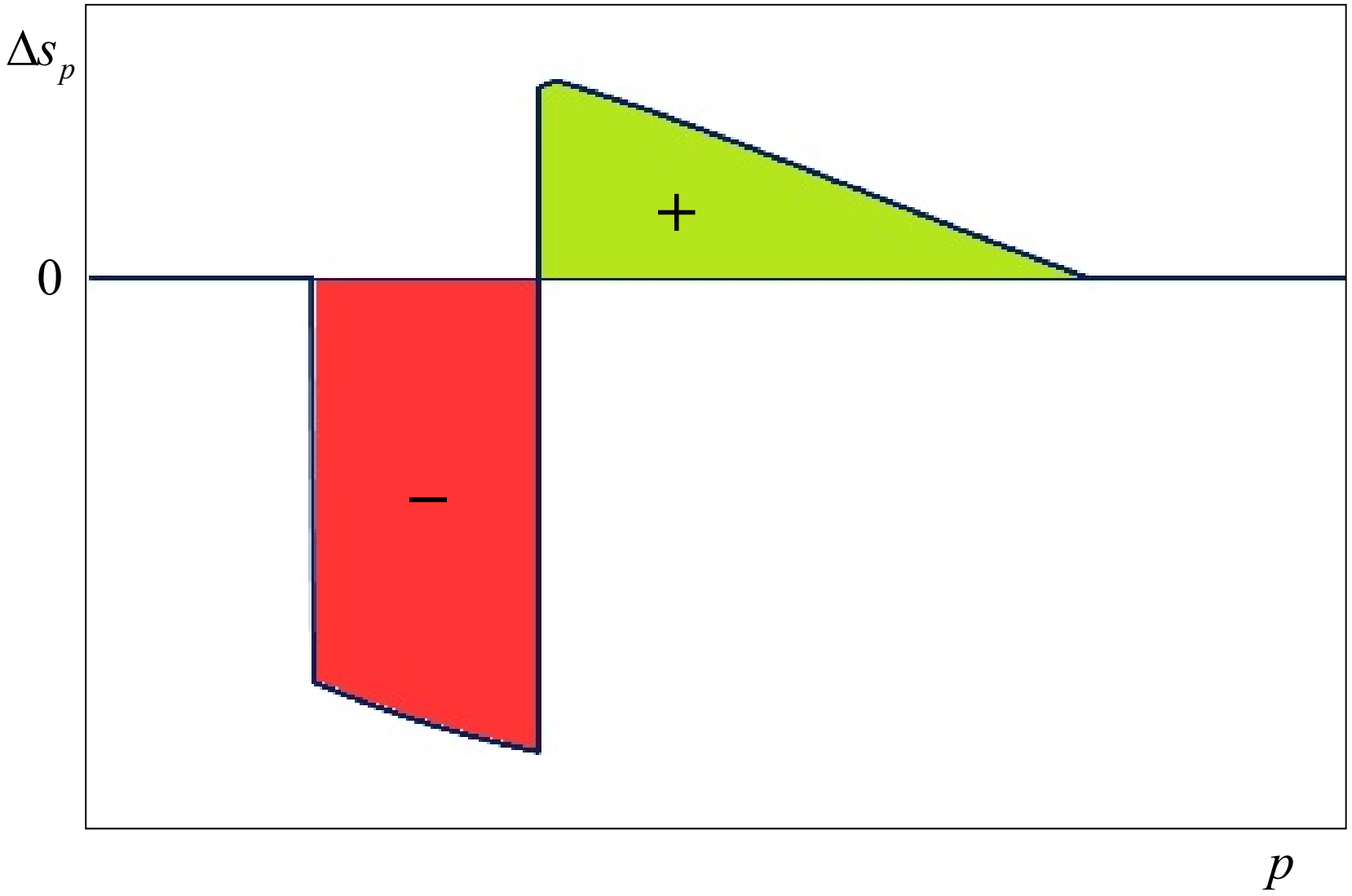
Welfare analysis

- Effect of the following regulatory changes
  - → Introducing flat capital requirement (Basel I)
  - → Increasing flat capital requirement
  - → Introducing risk-based capital requirement (Basel II)
  - → Increasing risk-based capital requirement
- Optimal capital requirements

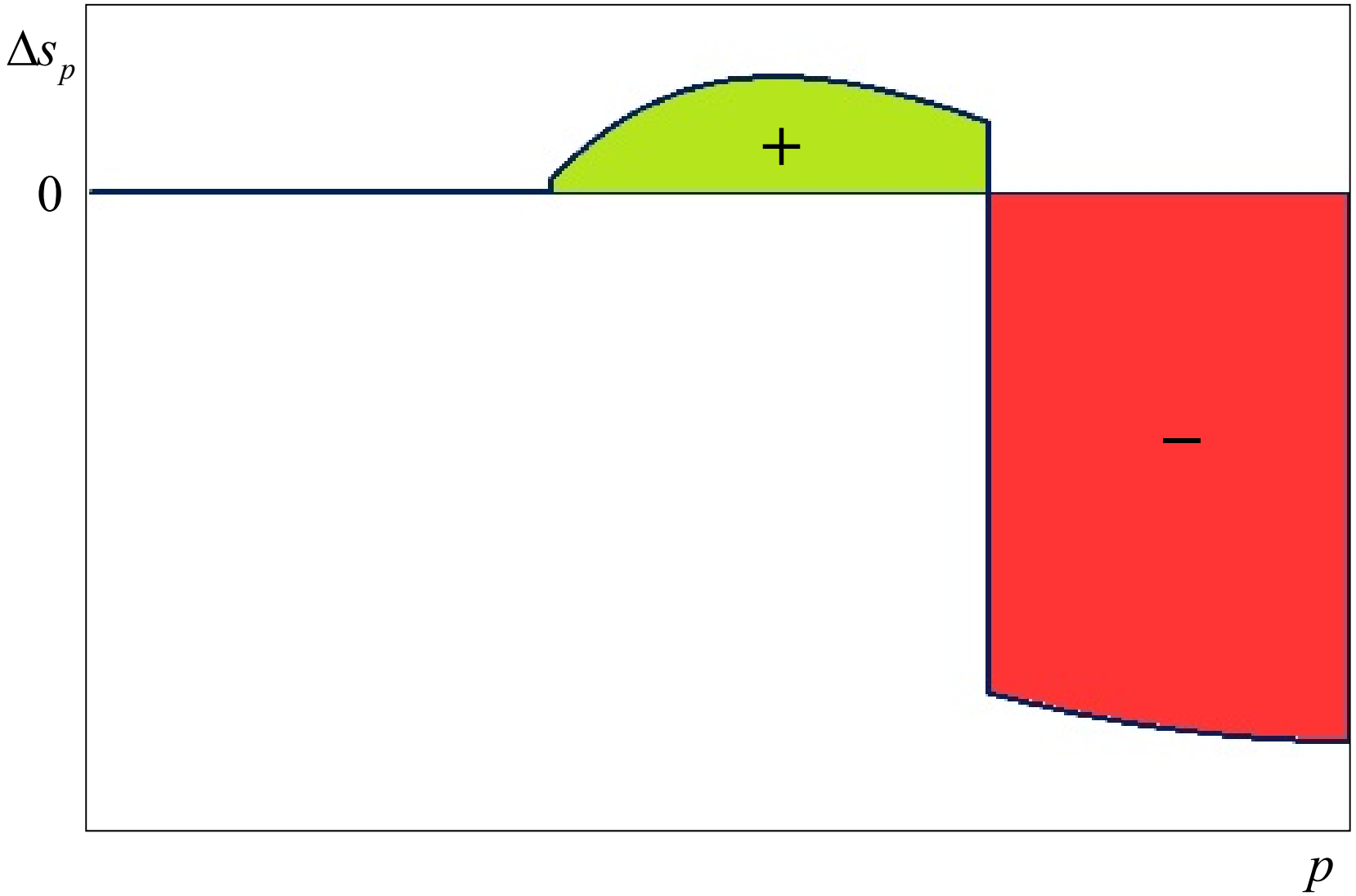
Introducing flat capital requirement



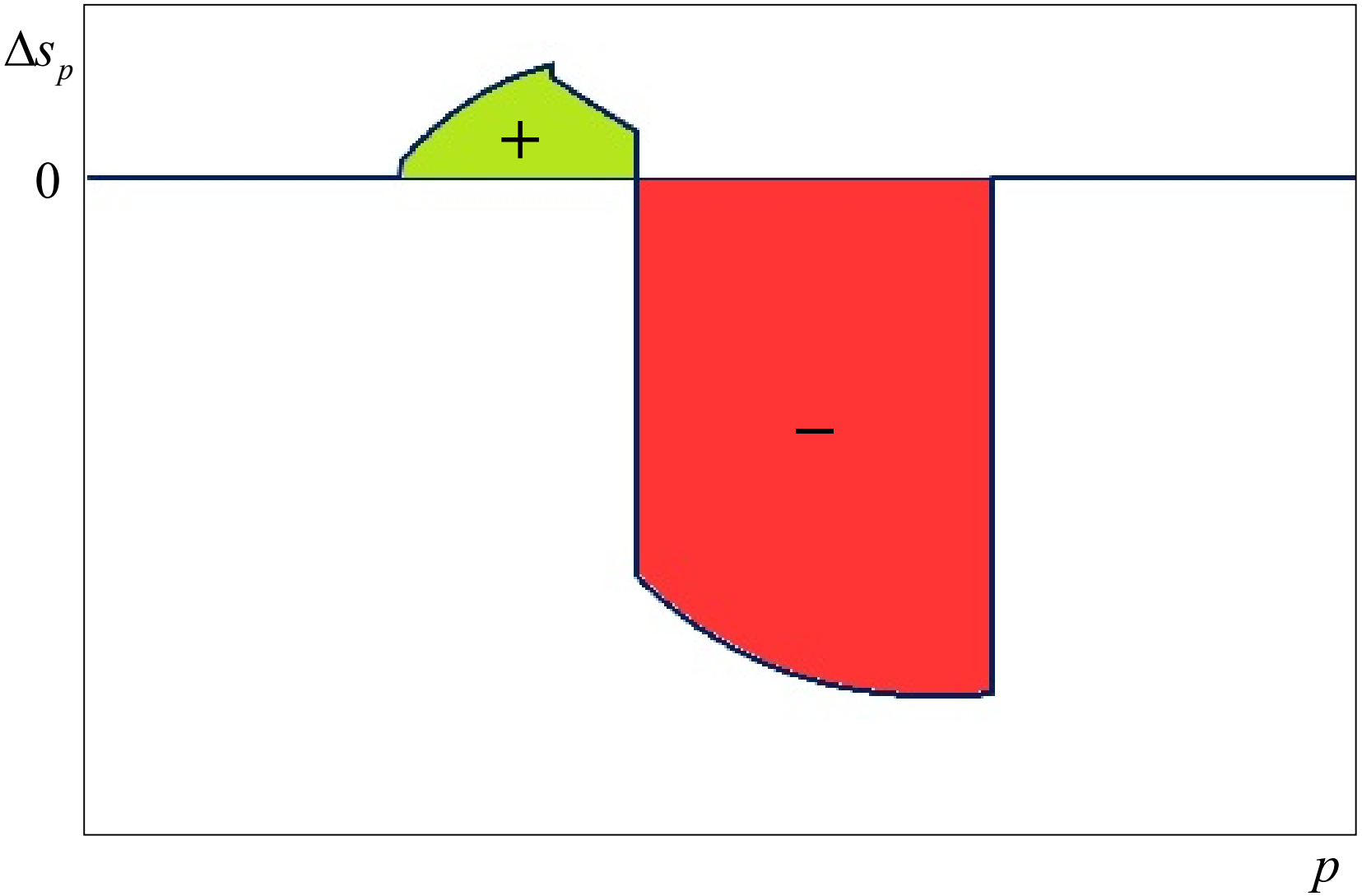
Increasing flat capital requirement



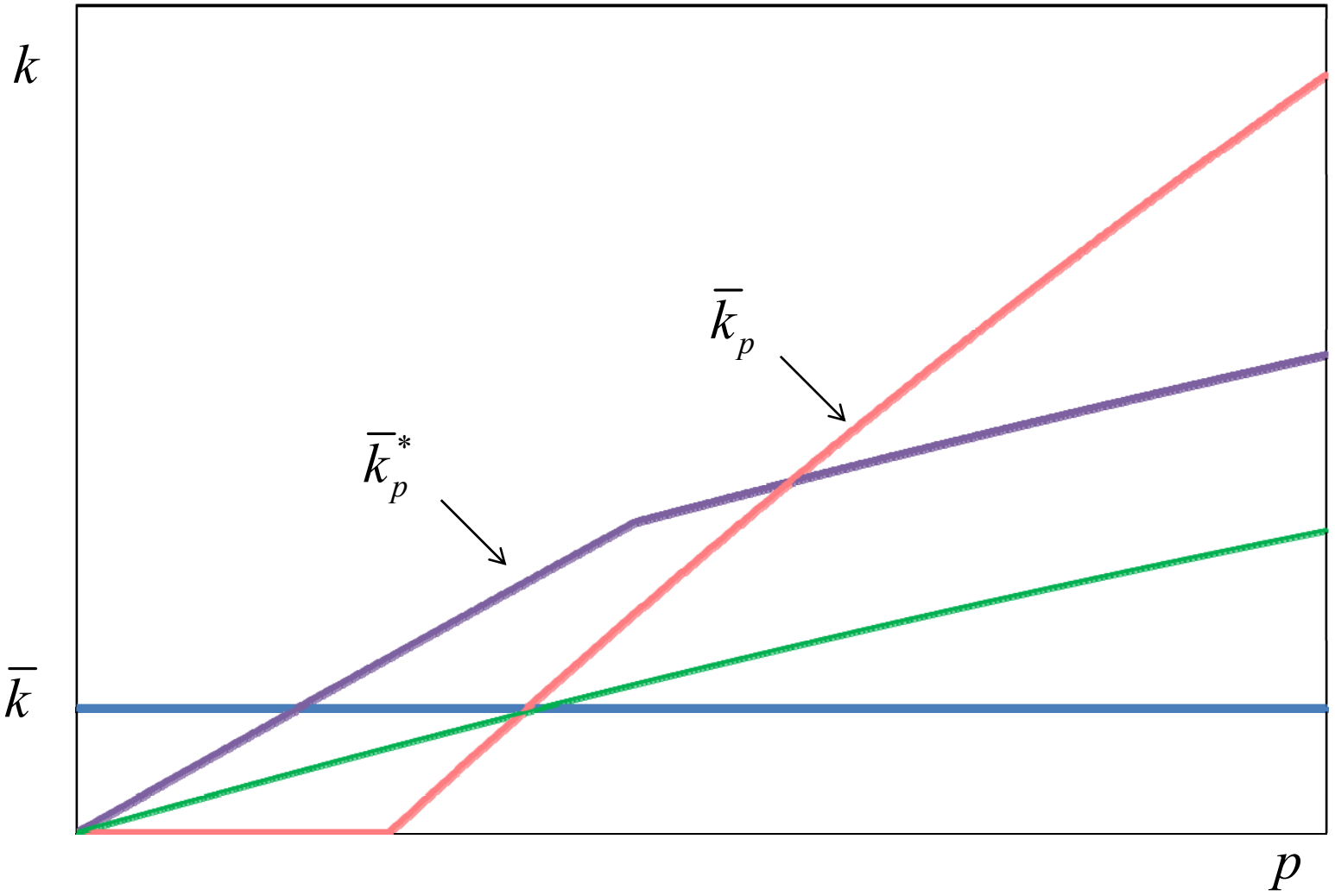
Introducing risk-based capital requirements



Increasing risk-based capital requirements



Optimal capital requirements



Concluding remarks

Summing up

- Simple model of the effects of bank capital regulation
  - → Flat and risk-based capital requirements
  - → Competition of shadow banking system
- Framework for thinking about relevant trade-offs
  - → Focus on qualitative results
  - → Possible building block for richer models

Main results

- Flat capital requirements

  → Make (some) traditional banks safer

  → **Drives safest borrowers to shadow banking system**

- Risk-based capital requirements (à la Basel II)

  → Make (some) traditional banks safer

  → **Drives riskiest borrowers to shadow banking system**

Trade-offs

- Higher capital requirements
  - → Ameliorate risk-taking incentives: bright side
  - → Increase cost of funding: dark side
- Optimal capital requirements
  - → Lower than flat & higher than risk-based for safer types
  - → Higher than flat & lower than risk-based for riskier types

Some important caveats

- Key role of assumption that equity is more expensive than debt

  → Otherwise 100% capital

- Model completely ignores implementation issues (like Basel)

  → Potential manipulation of risk-weights

  → Rationale for leverage ratio

A final remark

- Model highlights key feature of Basel capital requirements

  → Based on purely statistical approach

  → Capital requirements defined by condition

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

- **Need to bring economics into banking regulation**

  → Think in terms of welfare trade-offs

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