

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

$$R - (1-k)B = c'(m)$$

→ From here it follows that

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

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 $m_p^* > 0$

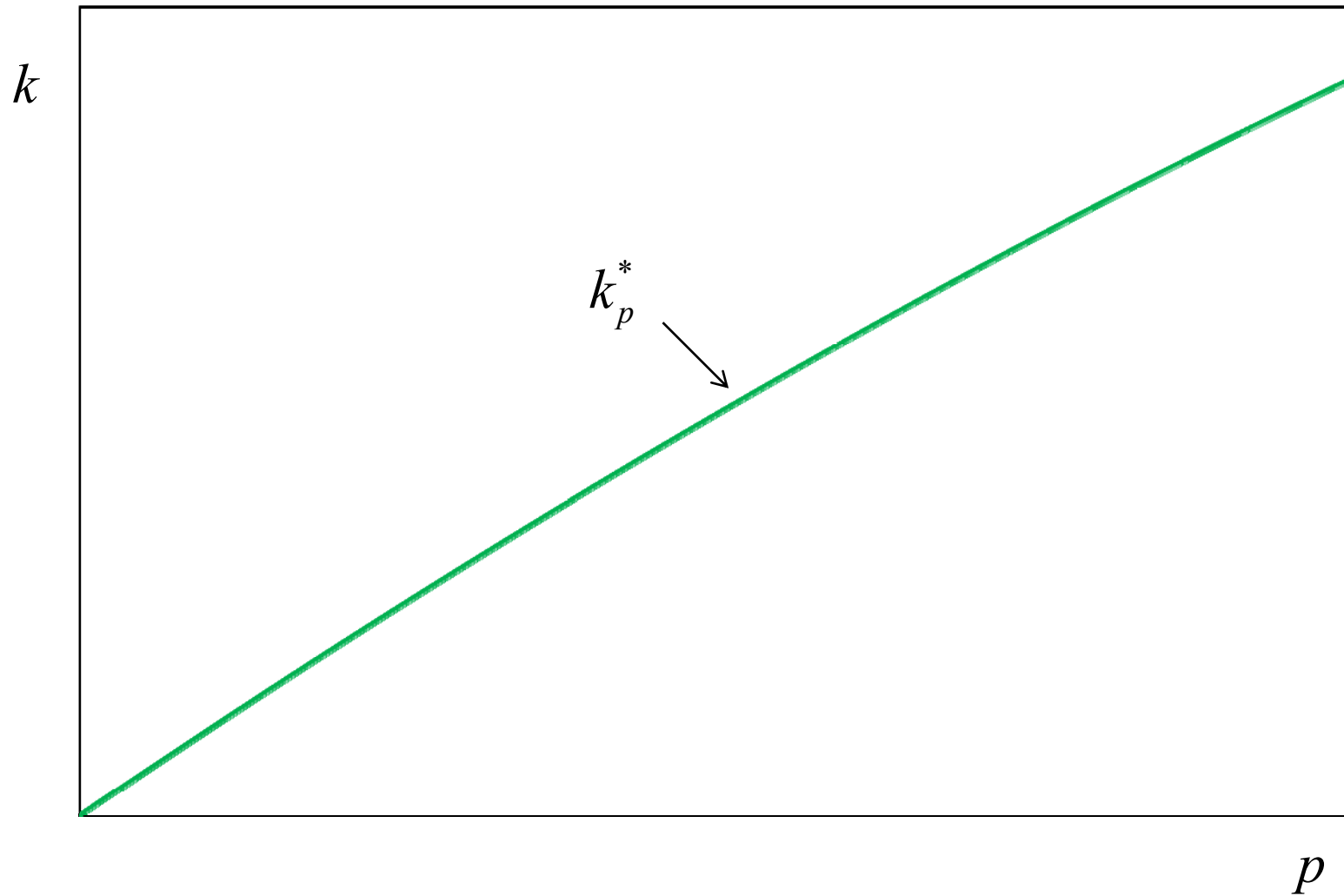
Comments on Proposition 1

- 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

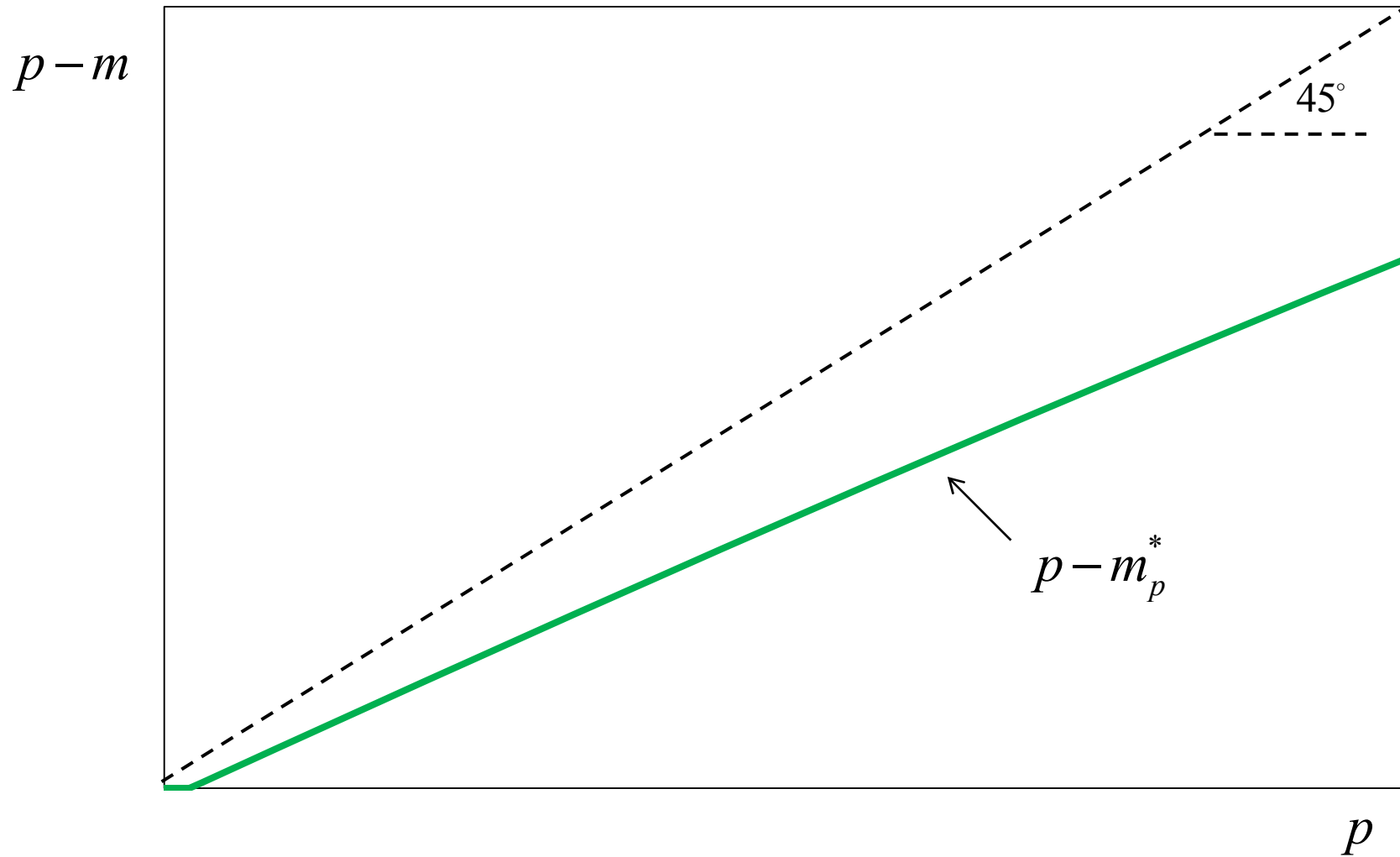
Numerical illustration

- 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

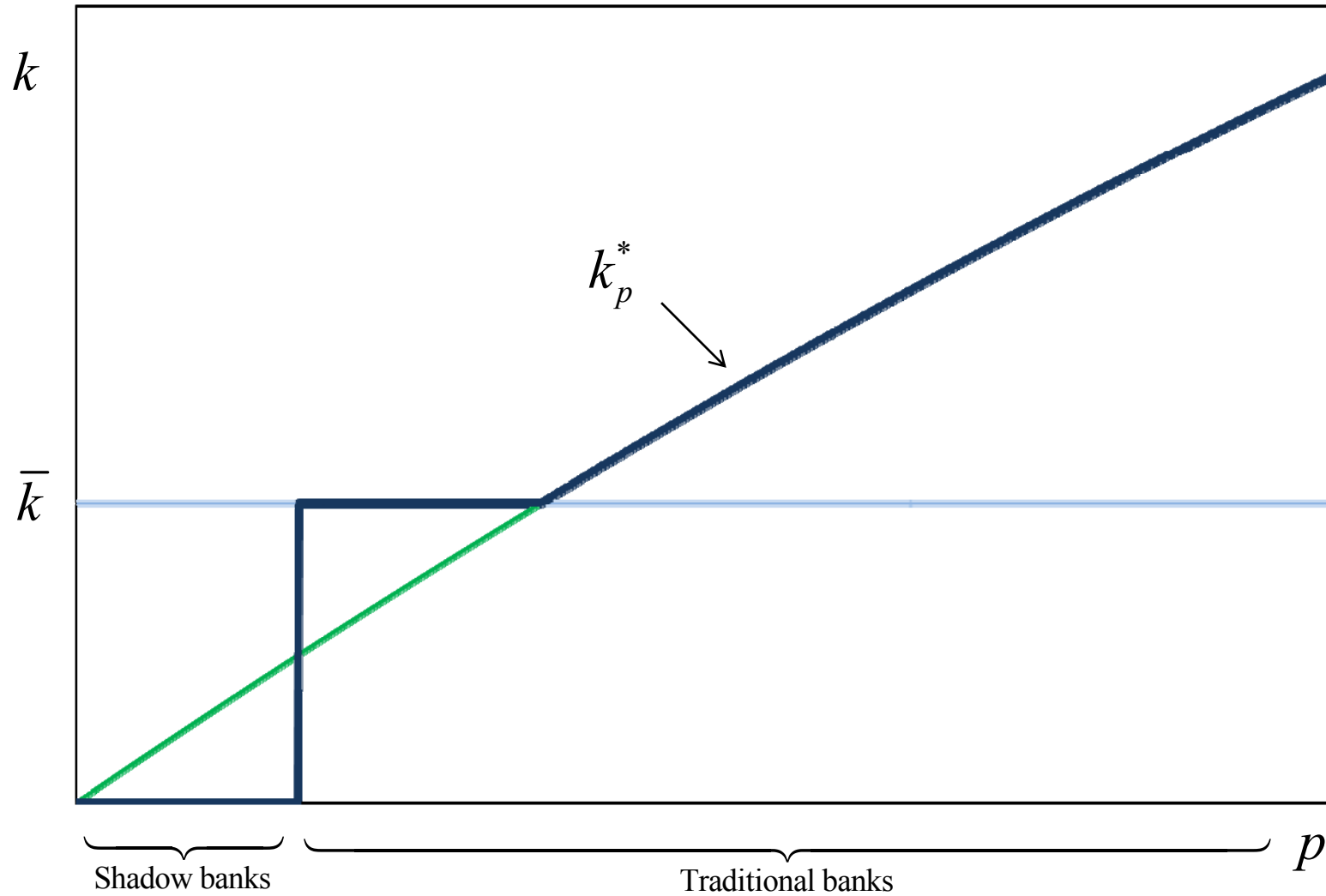
$$k_p \geq \bar{k}$$

→ Only applies to traditional banks (not shadow banks)

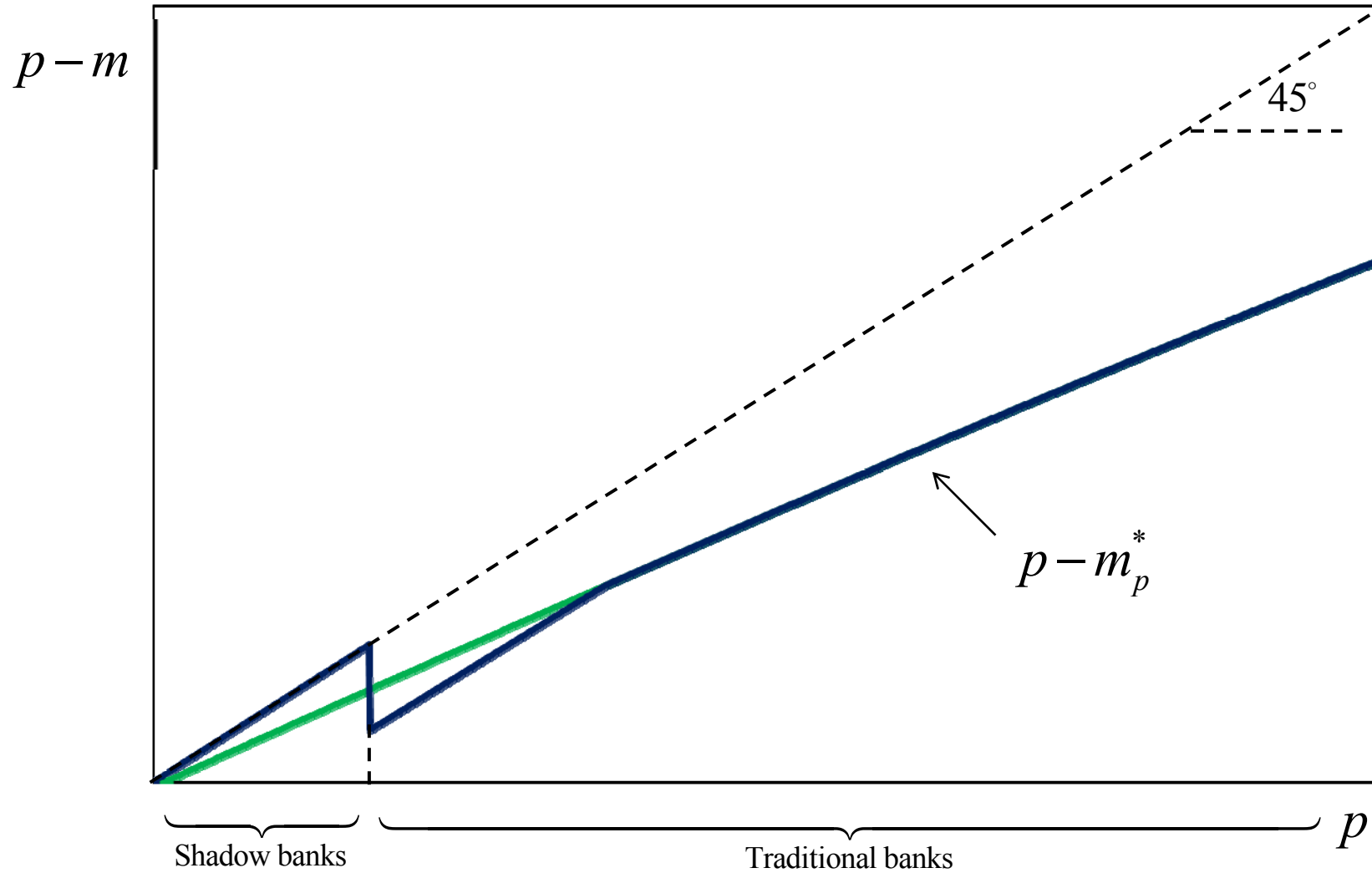
Proposition 2

- 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

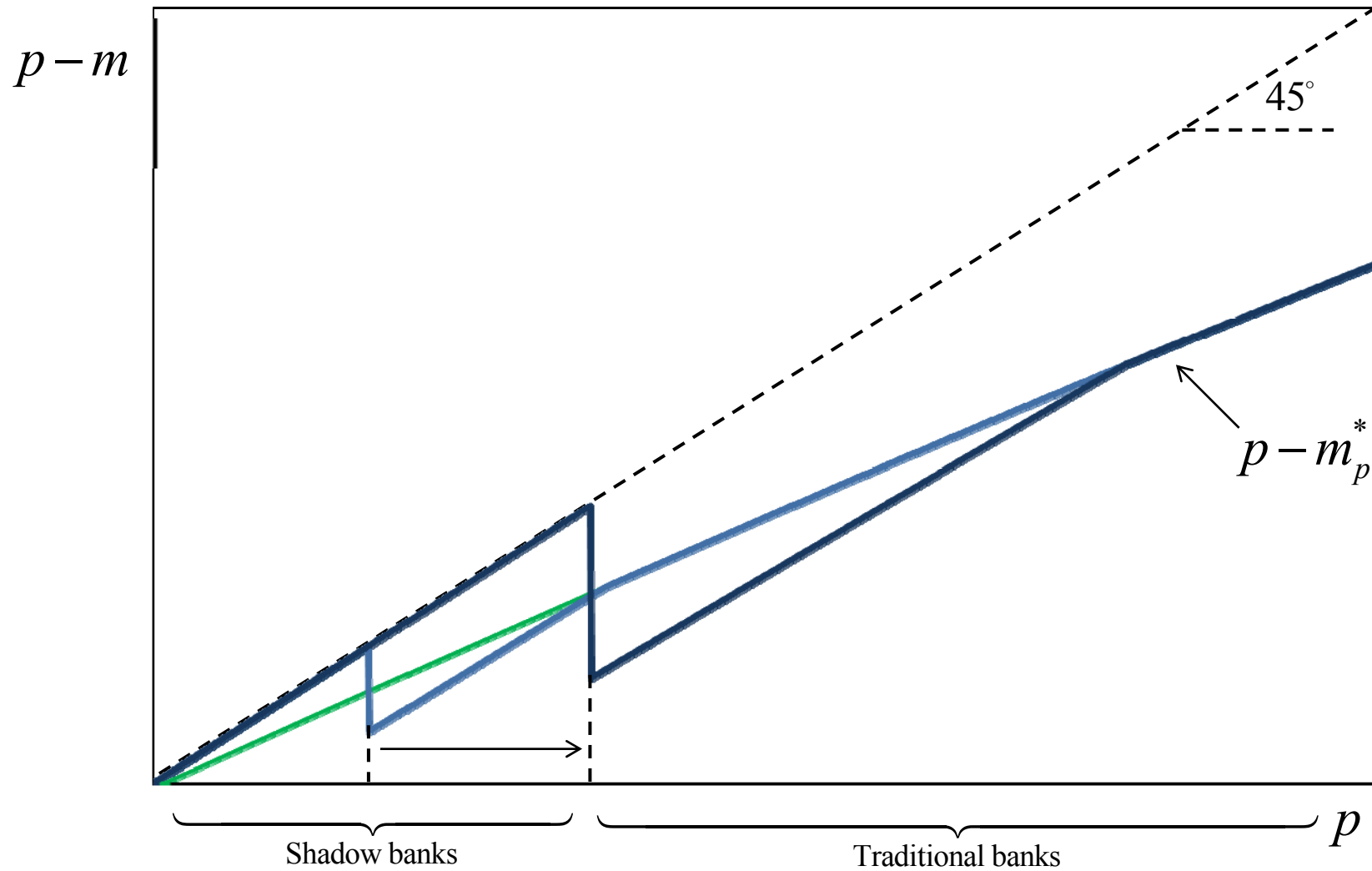
Capital under a flat requirement



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

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

Risk-based capital requirements (iii)

- To ensure

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

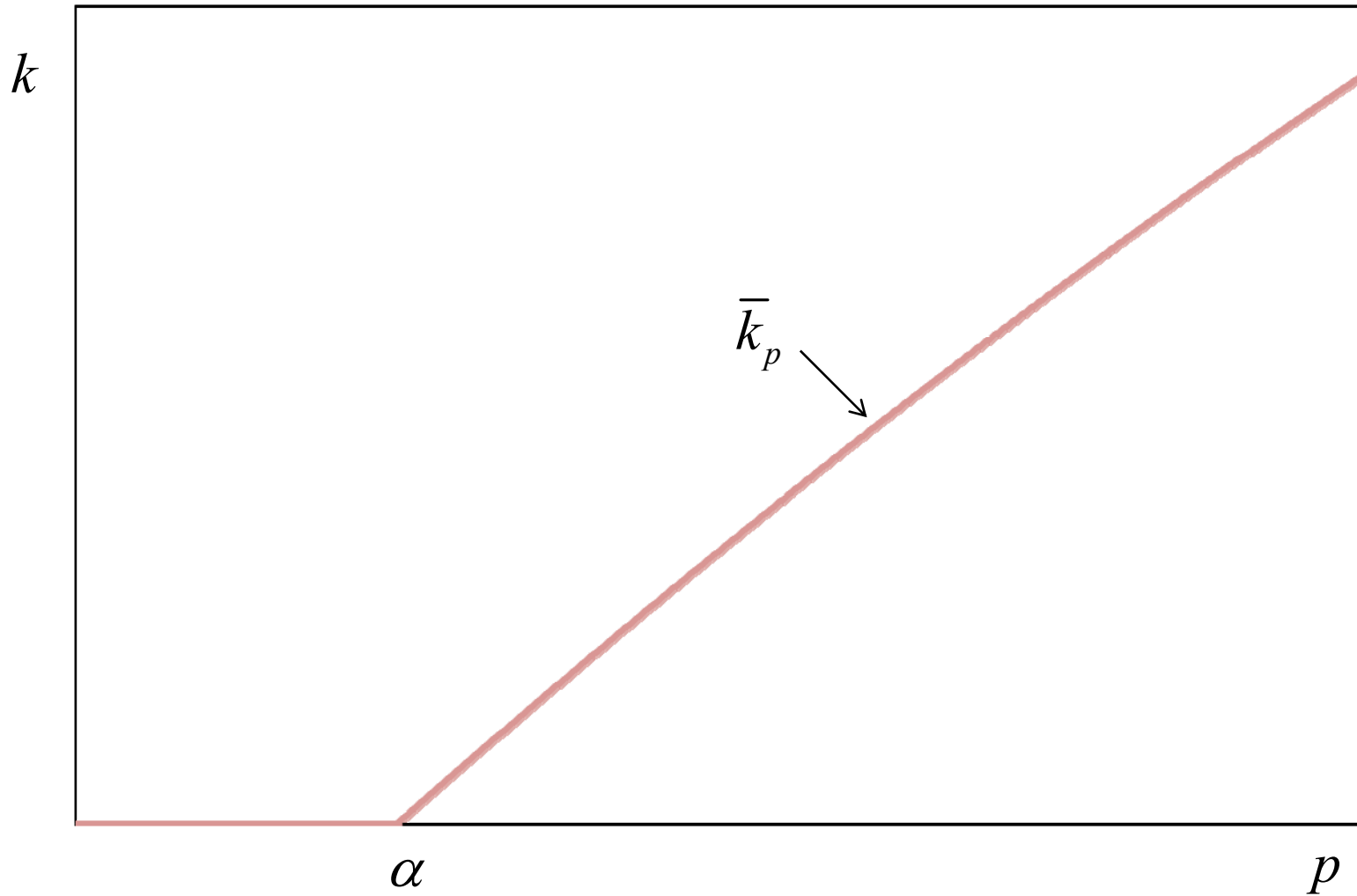
→ we require $m = p - \alpha$

- 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

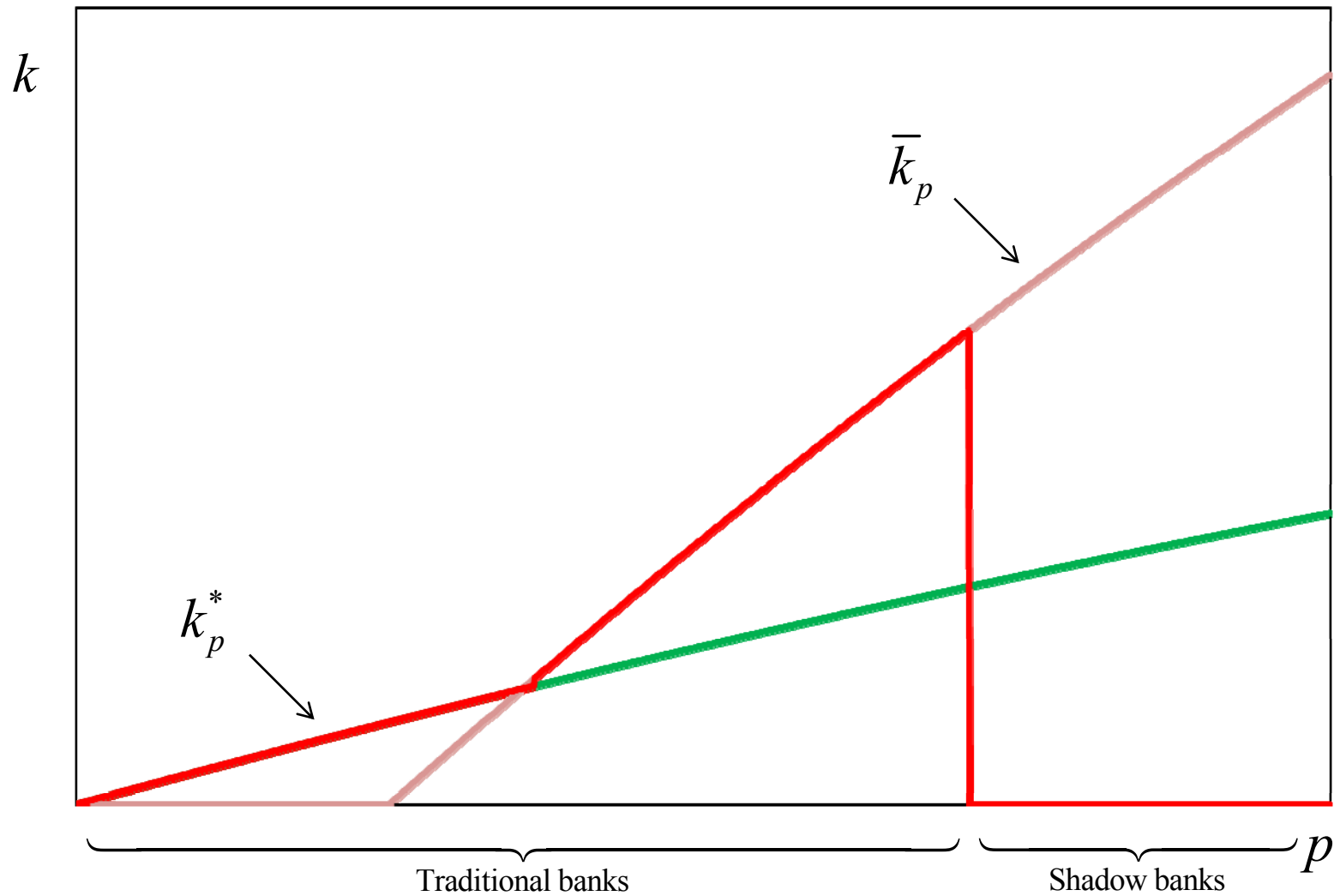
Risk-based capital requirements



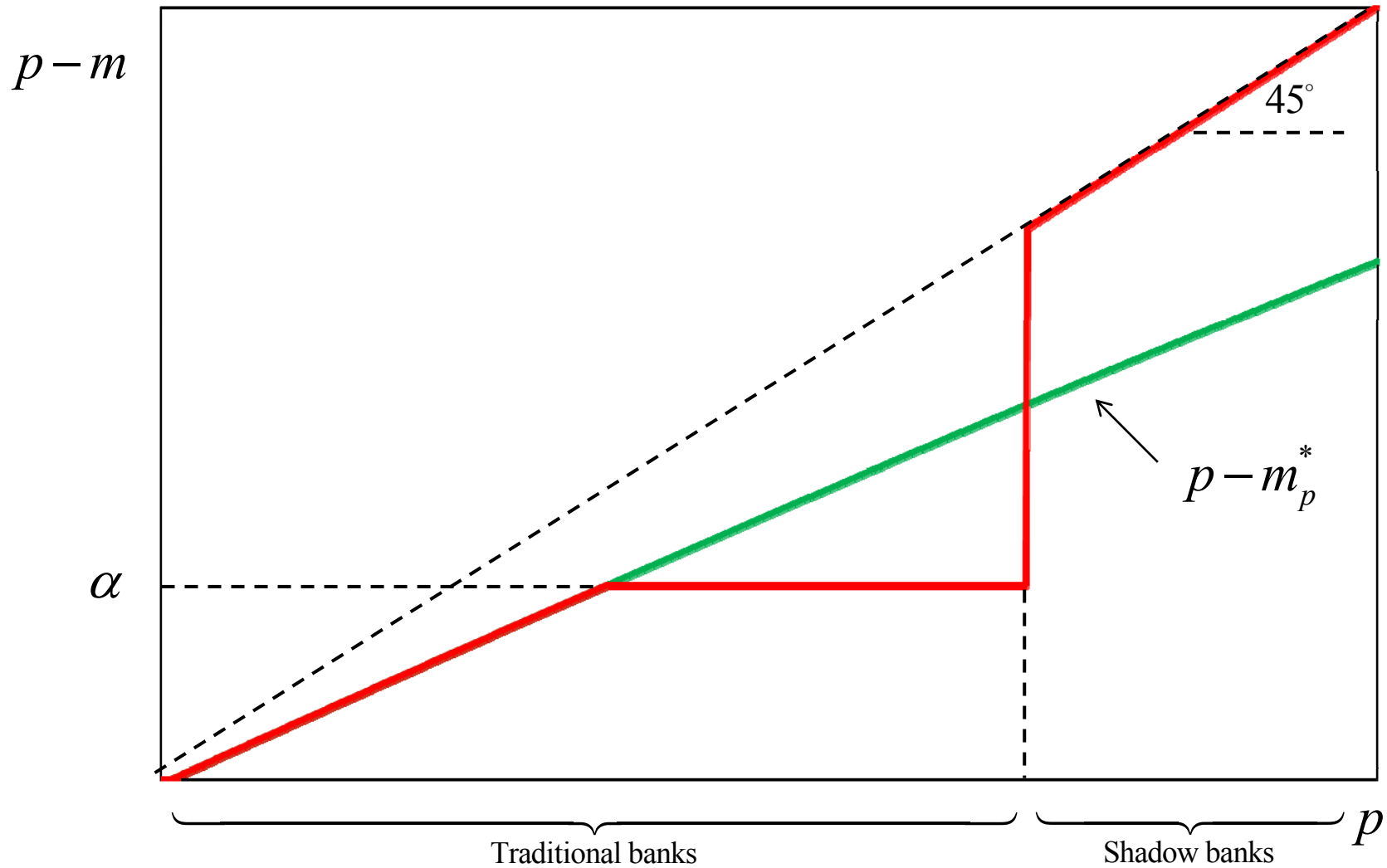
Proposition 3

- 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

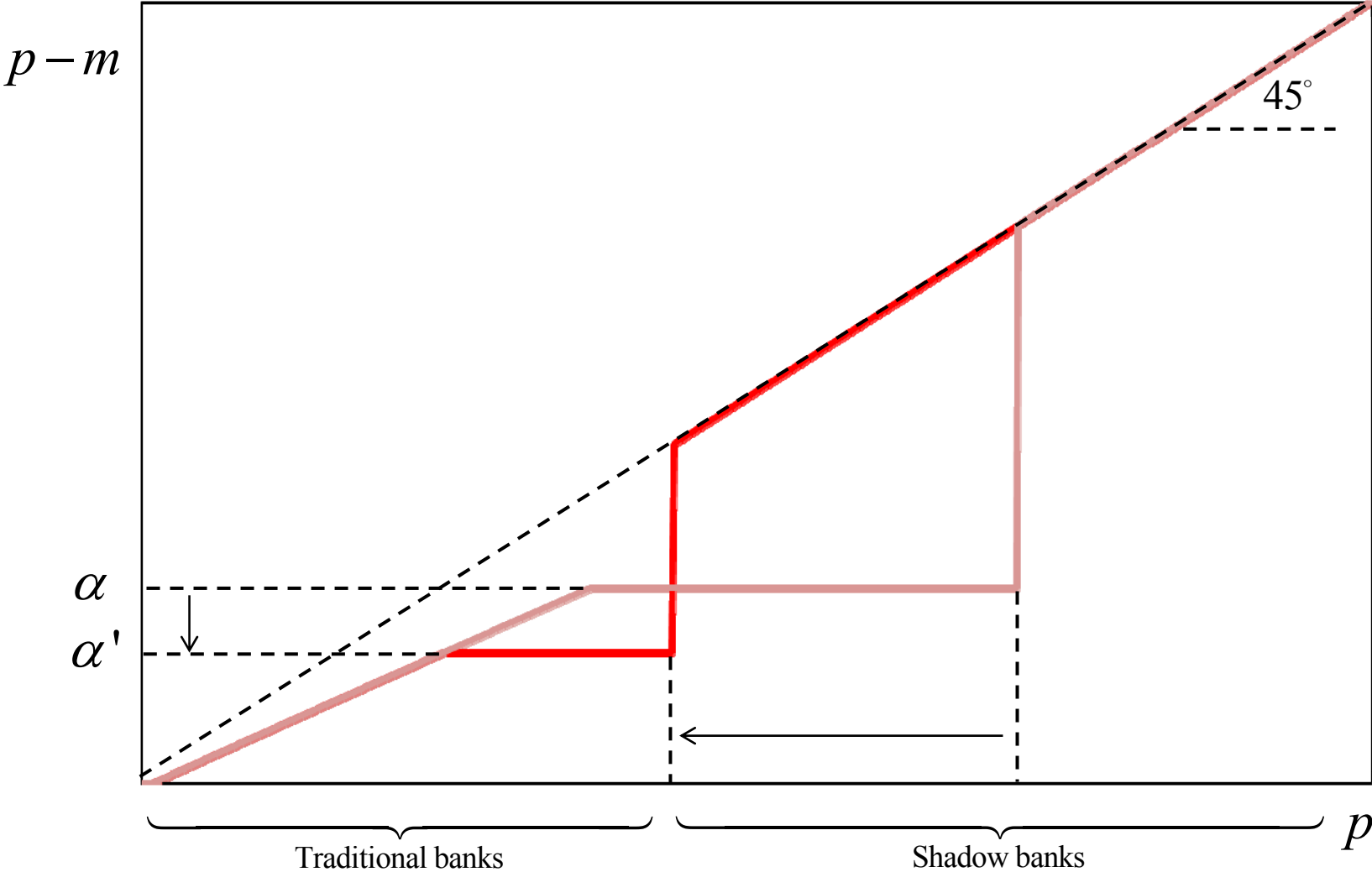
Capital under risk-based requirements



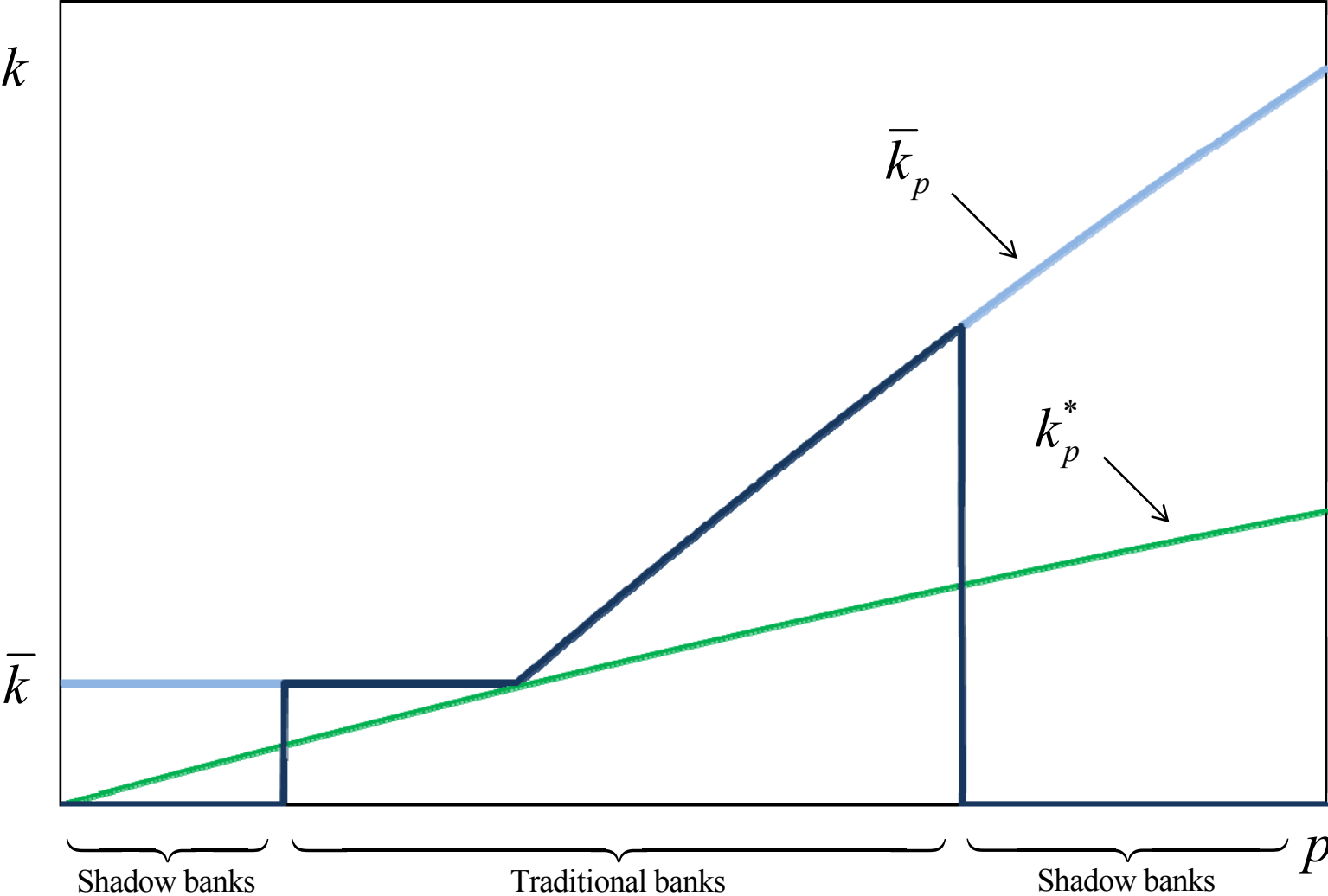
Risk under risk-based requirements



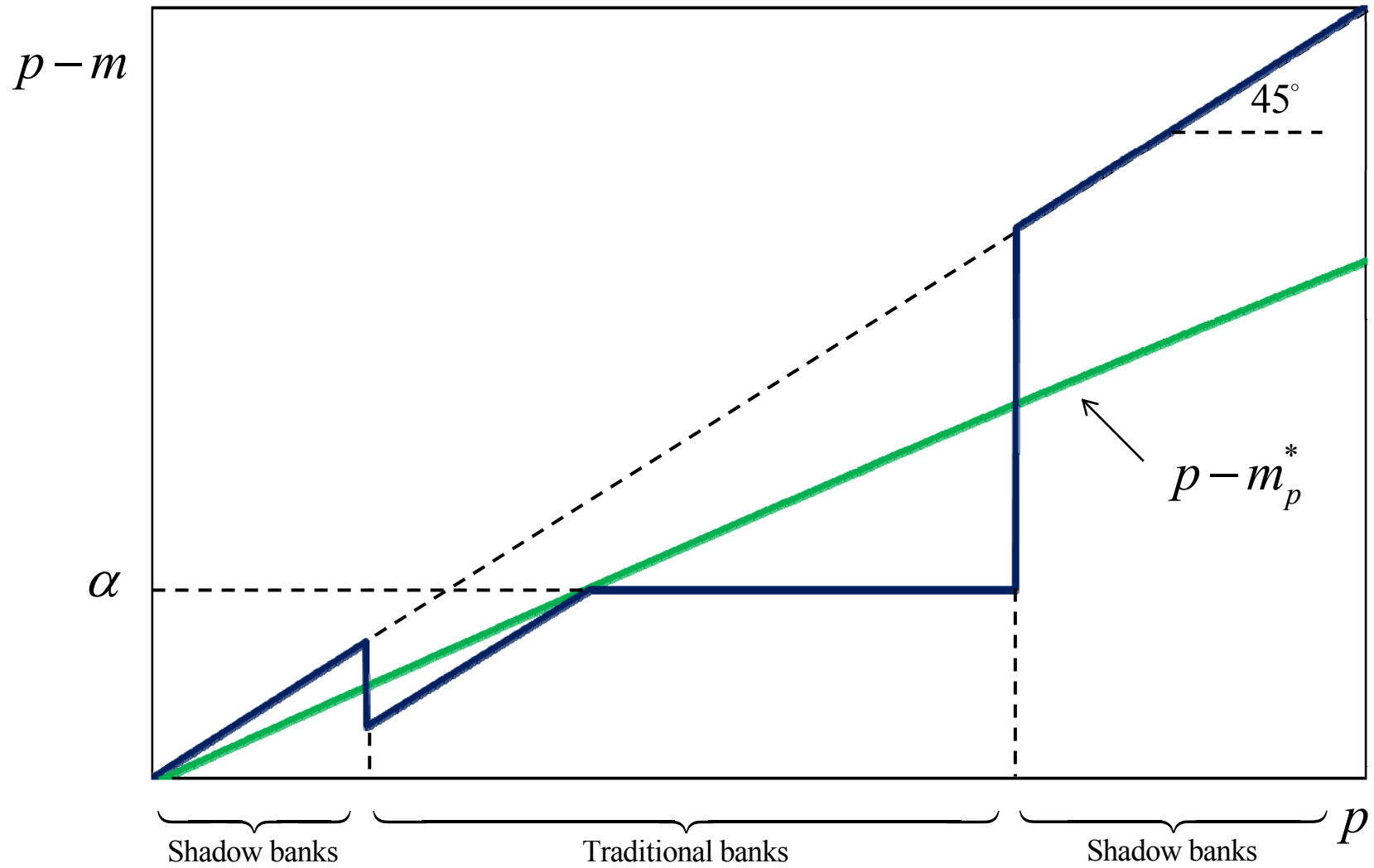
An increase in risk-based requirements



Capital under Basel III



Risk under Basel III



Part 3

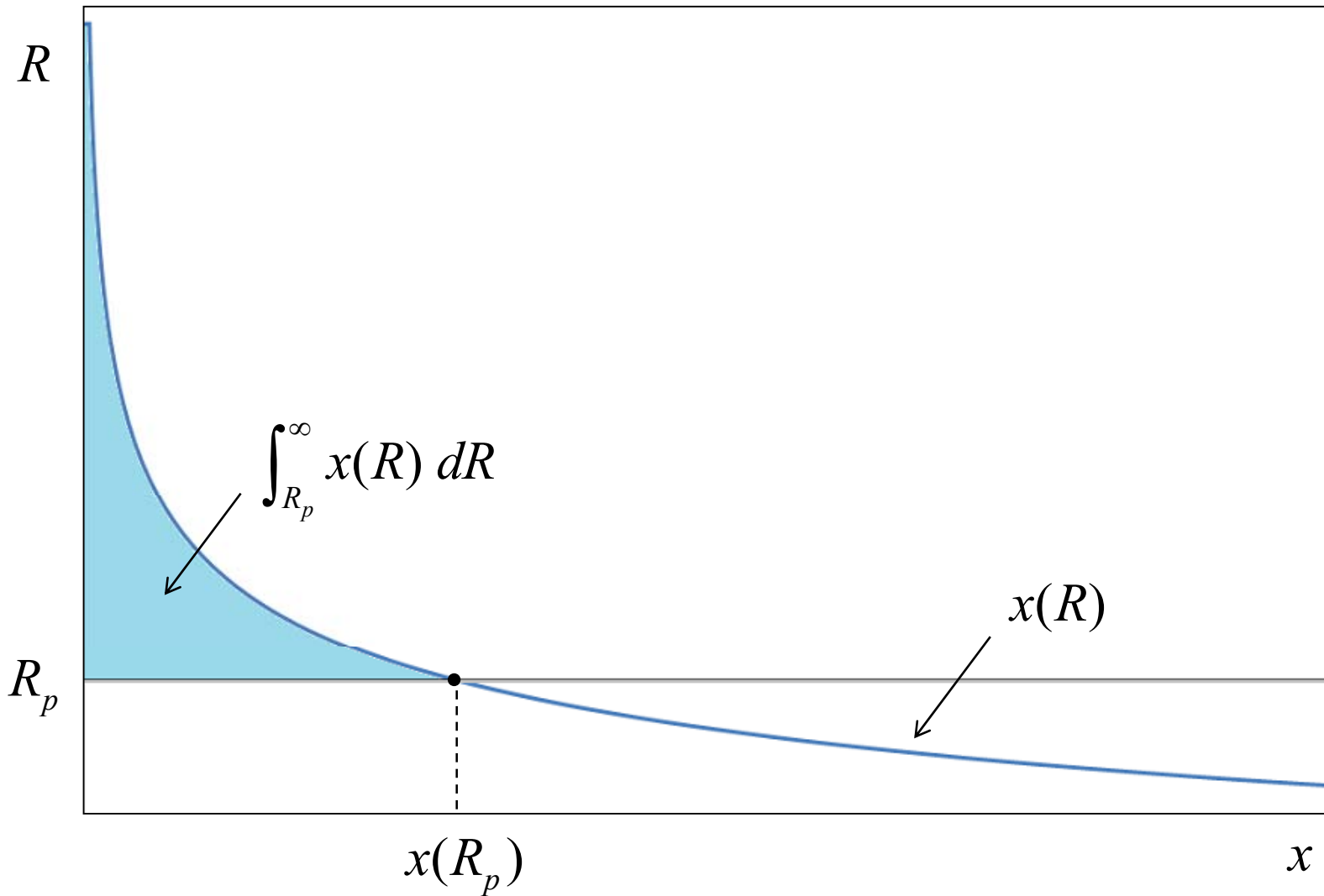
Welfare analysis

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

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

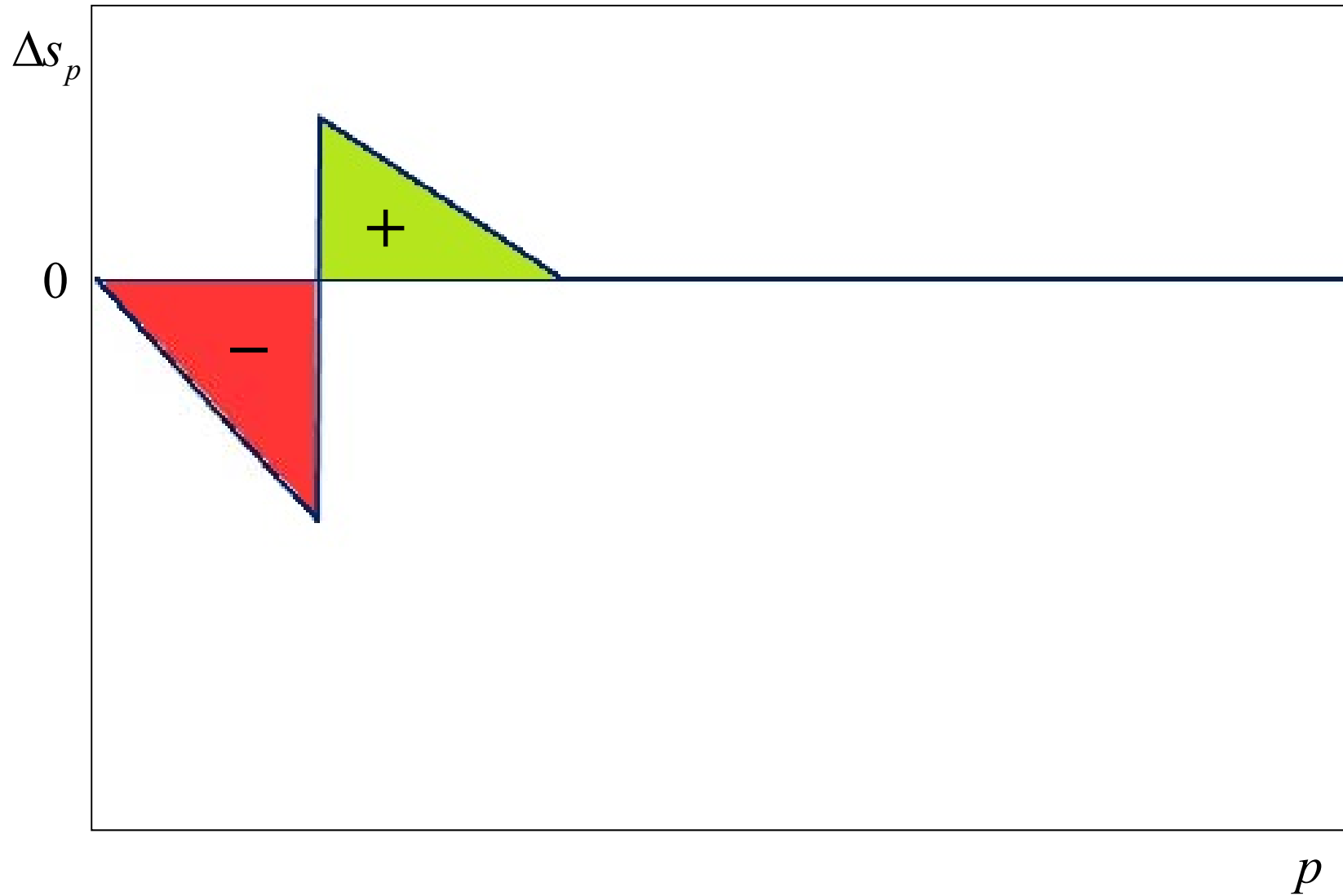
Welfare triangle



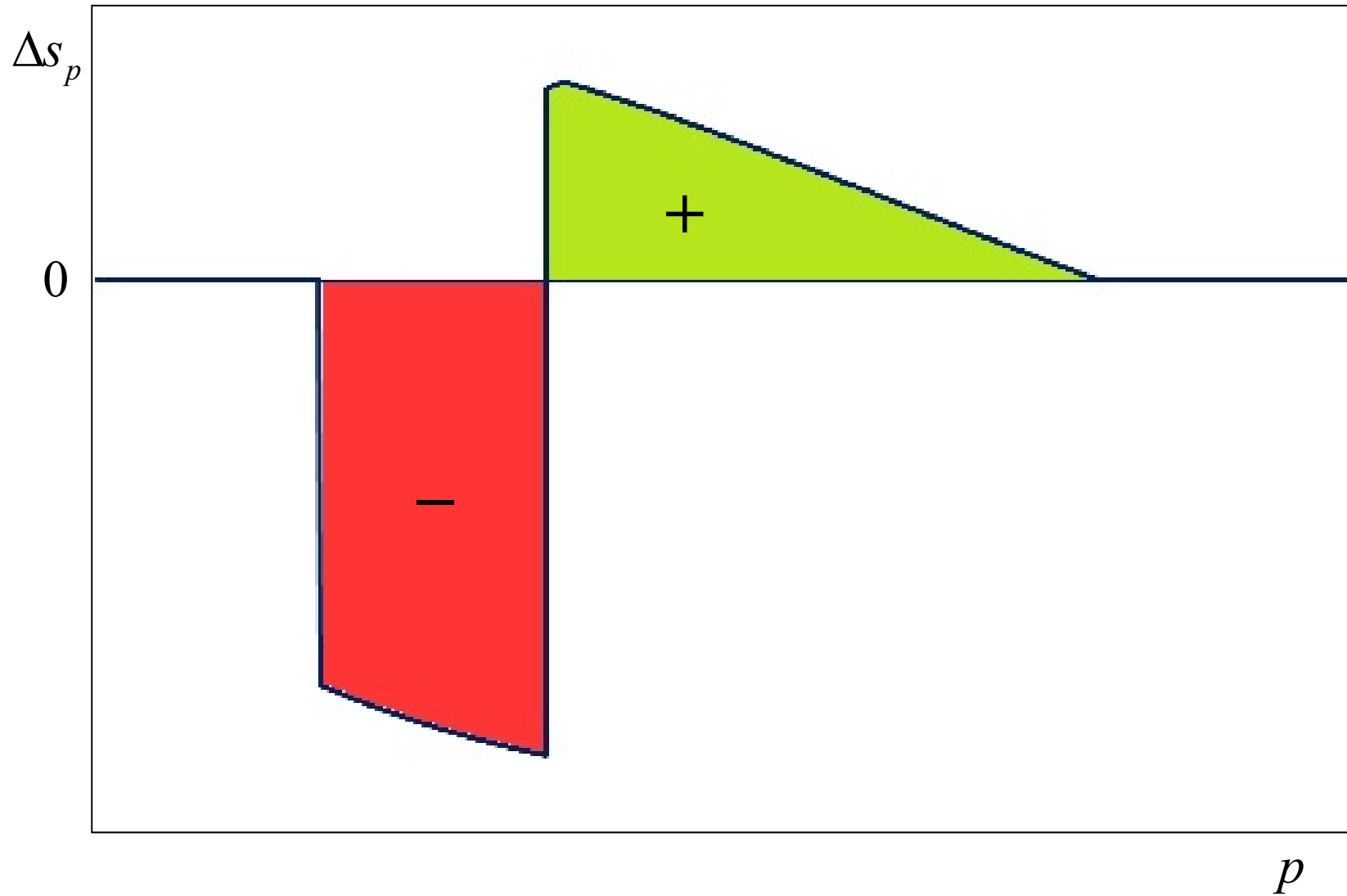
Welfare analysis

- 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

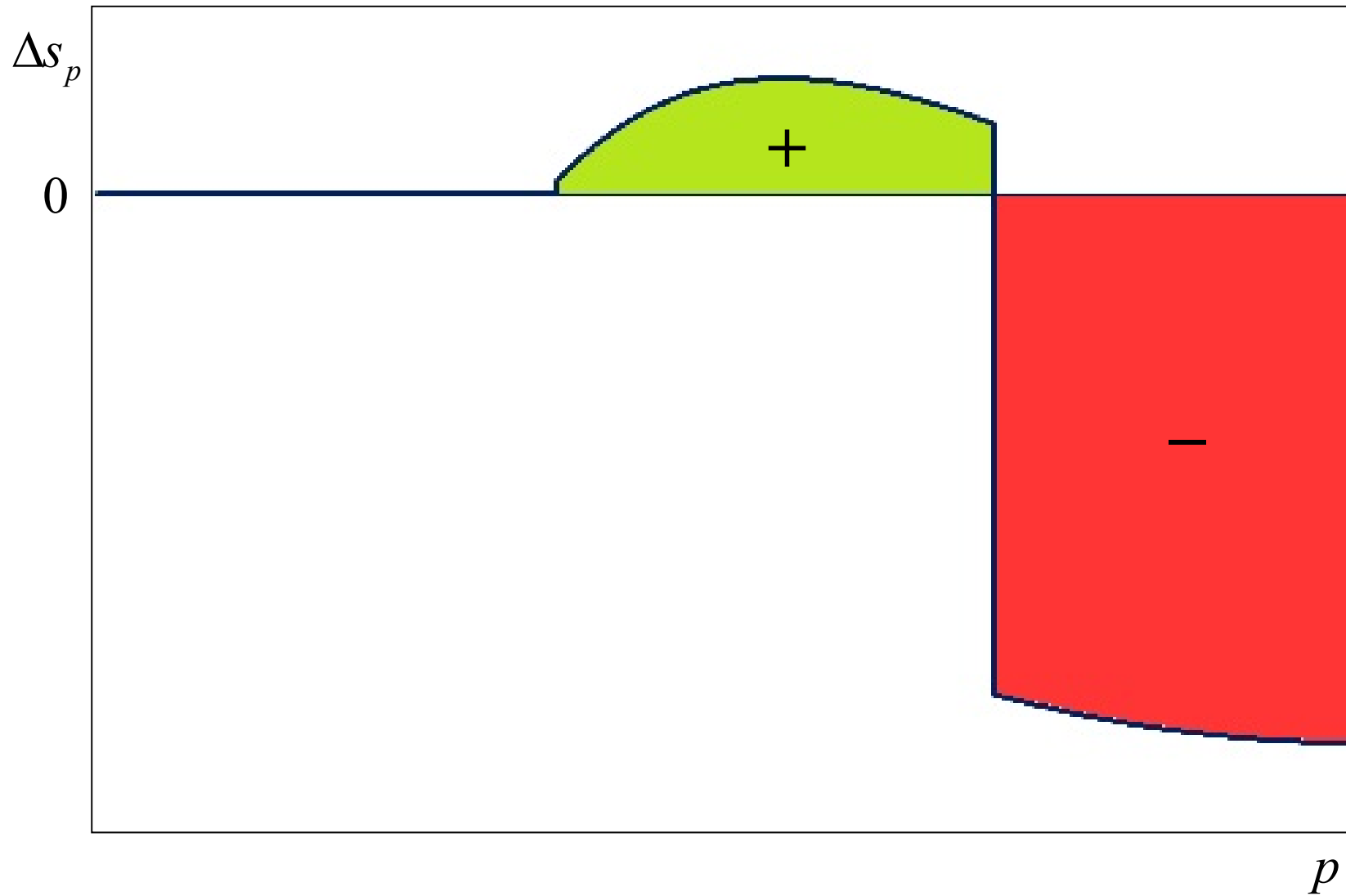
Introducing flat capital requirement



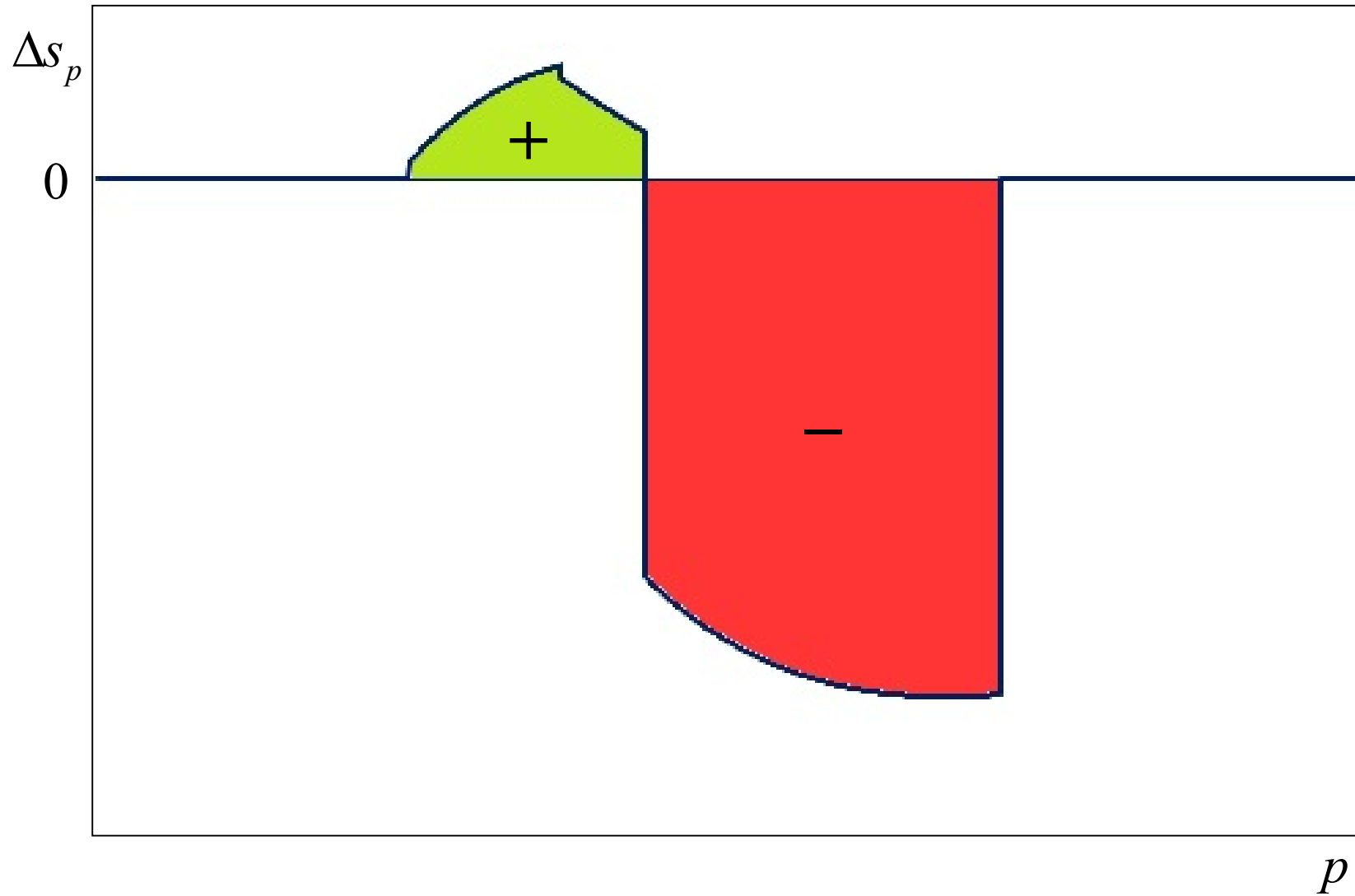
Increasing flat capital requirement



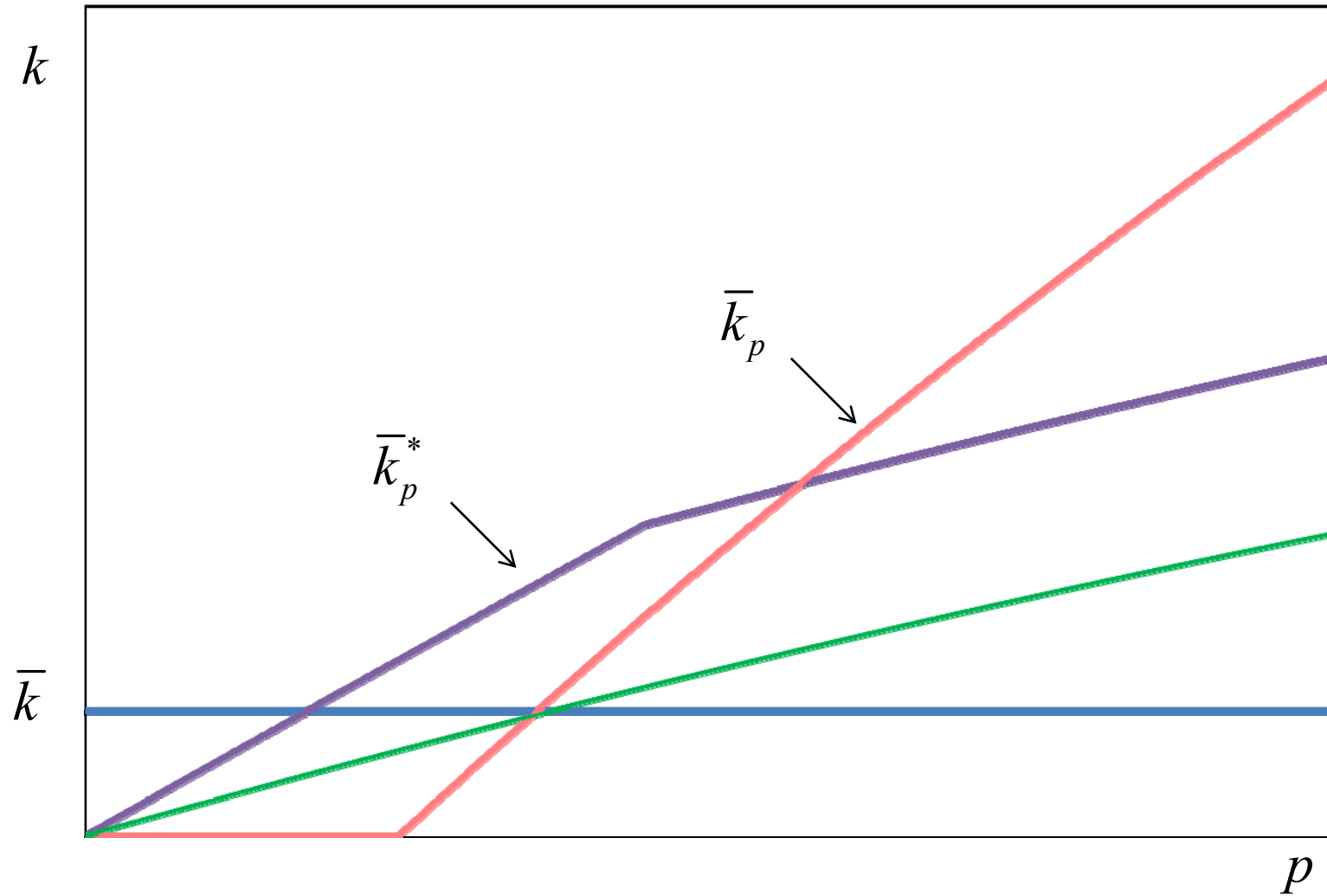
Introducing risk-based capital requirements



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

References

- Admati, A. (2014), “The Compelling Case for Stronger and More Effective Leverage Regulation in Banking,” *Journal of Legal Studies*.
- Admati, A. and M. Hellwig (2013), *The Bankers’ New Clothes*, Princeton University Press.
- Hanson, S., A. Kashyap, and J. Stein (2011), “A Macroprudential Approach to Financial Regulation,” *Journal of Economic Perspectives*.
- Herring, R. (2011), “The Capital Conundrum,” *International Journal of Central Banking*.
- Jones, D. (2000), “Emerging Problems with the Basel Capital Accord,” *Journal of Banking and Finance*.
- Martinez-Miera, D., and R. Repullo (2014), “Search for Yield,” Econometric Society Walras-Bowley Lecture.