Comparing Flat and Risk-based Capital Requirements

Rafael Repullo
CEMFI and CEPR
(joint work with David Martinez-Miera)

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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
  \rightarrow \text{Laissez-faire}
  \rightarrow \text{Flat capital requirements}
  \rightarrow \text{Risk-based capital requirements}

• Welfare

• Concluding remarks
Part 1

Model setup
Model setup

• Two dates \((t = 0, 1)\)

• Agents: \(\rightarrow\) Set of potential **entrepreneurs**

  \(\rightarrow\) Set of risk-neutral **banks**

  \(\rightarrow\) Set of risk-neutral **investors**

  \(\rightarrow\) 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

Unit investment $\rightarrow$ 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

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

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

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

→ 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 $\delta$
  → Monitoring cost parameter $\gamma$
  → Elasticity of loan demand function $\sigma$
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
  \[
  \min R
  \]
  \[\text{subject to incentive compatibility constraint (IC)}\]
  \[
  m^* = \arg \max_m \left\{ (1 - p + m)[R^* - (1 - k^*)B^*] - c(m) \right\}
  \]
  \[\text{shareholders’ participation constraint (SPC)}\]
  \[
  \pi_p^* = (1 - p + m^*)[R^* - (1 - k^*)B^*] - c(m^*) \geq (1 + \delta)k^*
  \]
  \[\text{and debtholders’ participation constraint (DPC)}\]
  \[
  (1 - p + m^*)B^* \geq 1
  \]
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

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

\[\rightarrow \text{Expected return} = \text{funding cost} + \text{monitoring cost}\]
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 ($\delta$) or higher cost of monitoring ($\gamma$)
  → 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

$k^*$

$p$
Risk under laissez-faire

\[ p - m \]

\[ p - m^*_p \]
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

\[ k_p^* \]

Shadow banks  Traditional banks

\[ k \]

\[ \bar{k} \]
Risk under a flat requirement

$p - m$

Shadow banks

Traditional banks

$p - m^*_p$

$p - m$
Increasing flat requirement

$p - m$

$p - m^*_p$

$45^\circ$

Shadow banks

Traditional banks
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 $\alpha$, and cost of capital $\delta$
Risk-based capital requirements

\[ k \] vs. \[ p \]

\[ \bar{k}_p \]
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

\[ p - m \]

\[ \alpha \]

\[ p - m^*_p \]

Traditional banks

Shadow banks
An increase in risk-based requirements
Capital under Basel III

Shadow banks

Traditional banks

Shadow banks

$k$

$ar{k}$

$k_p$

$k^*$

$p$
Risk under Basel III

$\alpha$

$pm$

$pm^*$

$p - m^*_p$

Shadow banks

Traditional banks

Shadow banks

$p$
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

\[ \int_{R_p}^{\infty} x(R) \, dR \]
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

\[ \Delta s_p \]
Introducing risk-based capital requirements
Increasing risk-based capital requirements

\[ \Delta s_p \]

\[ 0 \]
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


