Capital Requirements in Banking

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Introduction

- Should we regulate banks?

Introduction

- Should we regulate banks?
  - Are they important for society?
  - Do they undertake socially unoptimal actions (risk)?
- Banks are vulnerable; bank failures & financial instability produce sizable costs for the financial system, taxpayers, and the economy at large
- 1. Liabilities held by small, dispersed, unsophisticated or short-term investors, often implictly or explicitly insured, call for regulation and supervision
- 2. Bank failures produce large negative externalities (on the payment and financial system, public finances and the macroeconomy)
- 3. Banks' maturity transformationmakes themvulnerable to runs; some failures may be triggered by liquidity problems; safety-net type solutions to liquidity problems cause or aggravate moral hazard, calling for regulation

Introduction

- How should we regulate them?
  - **Capital regulation**
  - Competition
  - Deposit rate ceilings
  - Ban activities
  - Etc.

Introduction

- Banks are funded with equity and debt
  - We will call equity as capital (indistinguishably)
  - Careful it is not physical capital (macro)
- Why should banks hold capital?
  - If they do, how much and of which type?

Introduction

- Main reason to hold equity is to make banks safer
  - Lower probability of a bank defaulting
    - Lower negative externalities of bank failure
    - Credit crunch, payment system disruptions
  - Lower costs for tax payers
- Do banks want to hold equity?
  - Incentives not to hold equity by bank shareholders
    - Tax advantages of debt
    - Deposit insurance (implicit subsidy of debt)
    - Bailout guarantees (explicit or implicit)
    - etc.

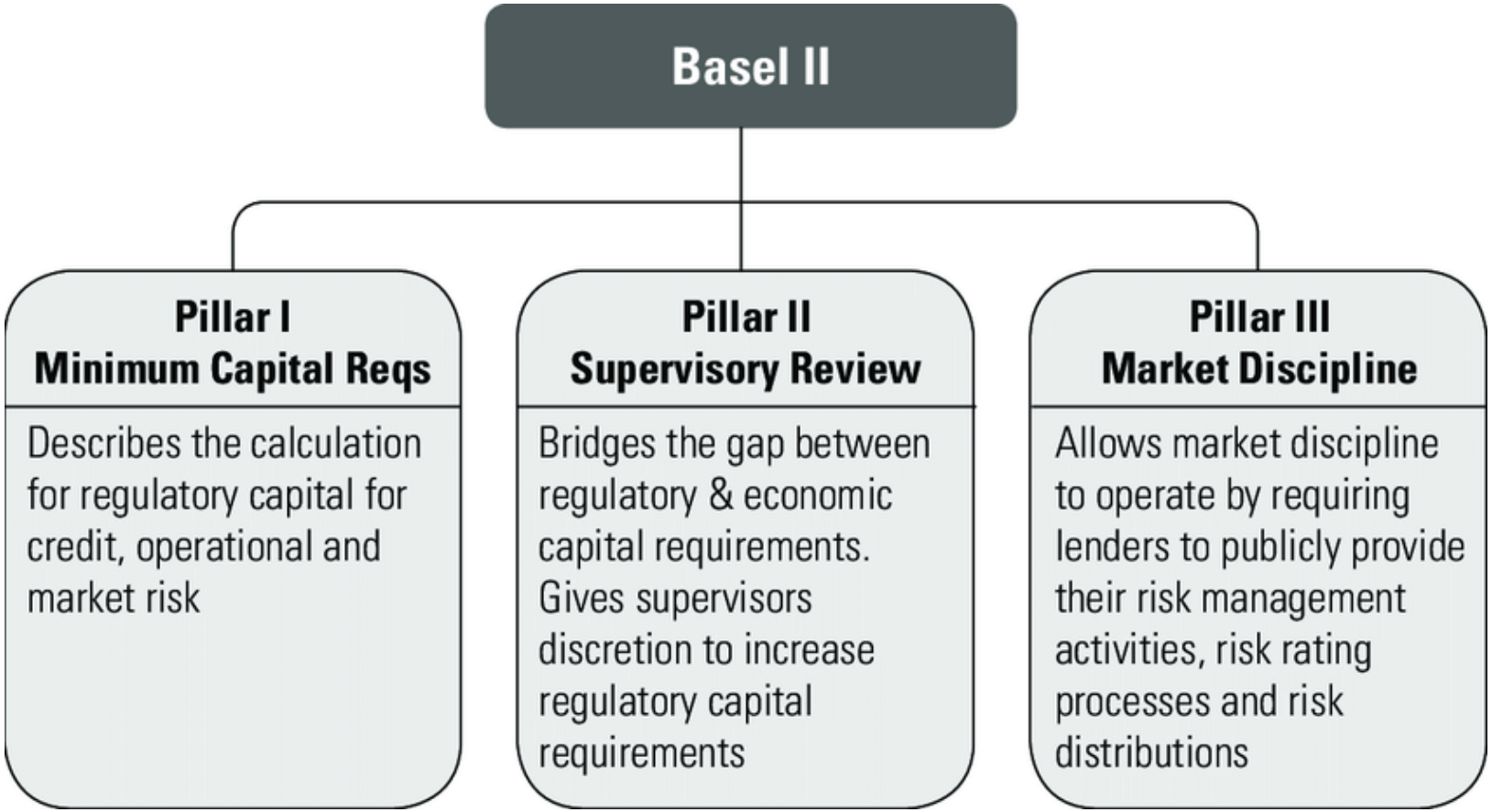
What do we mean by capital?

- Regulatory terms
  - Tier 1 and Tier 2
  - Common shares vs other instruments (even subordinated debt)
- Academic terms
  - Equity
- Why would subordinated debt be equity?

Basel Accords

- Capital regulation guidelines are international
  - Basel Accord sets the international standards
  - While national regulators have the right to adopt different rules
- Basel Accord has established international regulation on capital
  - Basel I (1988)- credit risk and market risk (1996)
  - Basel II (2004)- Risk weighted assets + supervision and market discipline (2 new pillars)
  - Basel III (2010)-
    - Stricter definition of capital + larger requirements
    - Better treatment of off-balance sheet & complex exposures
    - New regulatory buffers: CCB, CCyB, Systemic Risk Buffer
    - New leverage ratio requirement (flat)
    - New TLAC (& MREL) requirement

Basel Accords - Three pillars



Pilar I Minimum Capital Requirements

- Pillar 1 sets the foundation for capital adequacy by defining the minimum capital banks must hold against various types of risks.
- The objective is to ensure that banks maintain enough capital to cover potential losses, thereby enhancing resilience to financial shocks.
- Key components : Credit + Market + Operational risk
- Credit Risk:
  - Standardized Approach: This approach assigns fixed risk weights to different types of assets based on their risk profiles, as determined by external credit ratings. For instance, sovereign debt typically has lower risk weights than corporate loans.
  - Internal Ratings-Based (IRB) Approaches: Allows banks to use their own internal models to estimate key risk parameters (probability of default, loss given default, and exposure at default). This is subdivided into the Foundation IRB (F-IRB) and Advanced IRB (A-IRB) approaches, with A-IRB offering more flexibility but requiring rigorous validation.

Pilar I Minimum Capital Requirements

- Market Risk:
  - Market risk covers risks from changes in asset prices, such as interest rates, foreign exchange rates, and commodity prices.
  - Basel II originally allowed banks to use internal Value at Risk (VaR) models for market risk, which Basel III subsequently revised with the introduction of the "Fundamental Review of the Trading Book" (FRTB) to improve sensitivity to market conditions and reduce the tendency for banks to manipulate VaR models.
- Operational Risk:
  - Operational risk accounts for losses due to failures in internal processes, people, systems, or from external events (e.g., fraud, cyberattacks).

Pilar II Supervisory Review Process

- Pillar 2 emphasizes supervisory oversight. It requires regulators to evaluate the adequacy of banks' capital relative to their entire risk profile, not just minimum regulatory requirements.
- Supervisors can enforce capital surchages based on this pillar
- Key Components: ICAAP + SREP+Qualitative
- Internal Capital Adequacy Assessment Process (ICAAP):
  - Banks must develop an internal process to assess their capital needs in relation to their overall risk profiles, factoring in risks that might not be fully covered under Pillar 1, such as interest rate risk in the banking book (IRRBB) and concentration risk.
  - ICAAP encourages banks to adopt forward-looking risk assessments, including stress tests and scenario analysis, to capture potential vulnerabilities.

Pilar II Supervisory Review Process

- Supervisory Review and Evaluation Process (SREP):
  - Supervisors independently assess the ICAAP submissions and the broader capital adequacy and risk management practices of banks. This process enables supervisors to intervene if a bank's capital levels or risk management practices are deemed inadequate.
  - Regulators may require additional capital buffers, impose restrictions on business activities, or require improvements in risk management practices.
- Focus on Qualitative Risk Management:
  - Pillar 2 pushes banks to focus on qualitative aspects of risk management, including corporate governance, risk culture, and internal controls, which are often as critical as quantitative measures.
  - Regulators assess factors such as board oversight, risk appetite frameworks, and the integration of risk management within business processes.

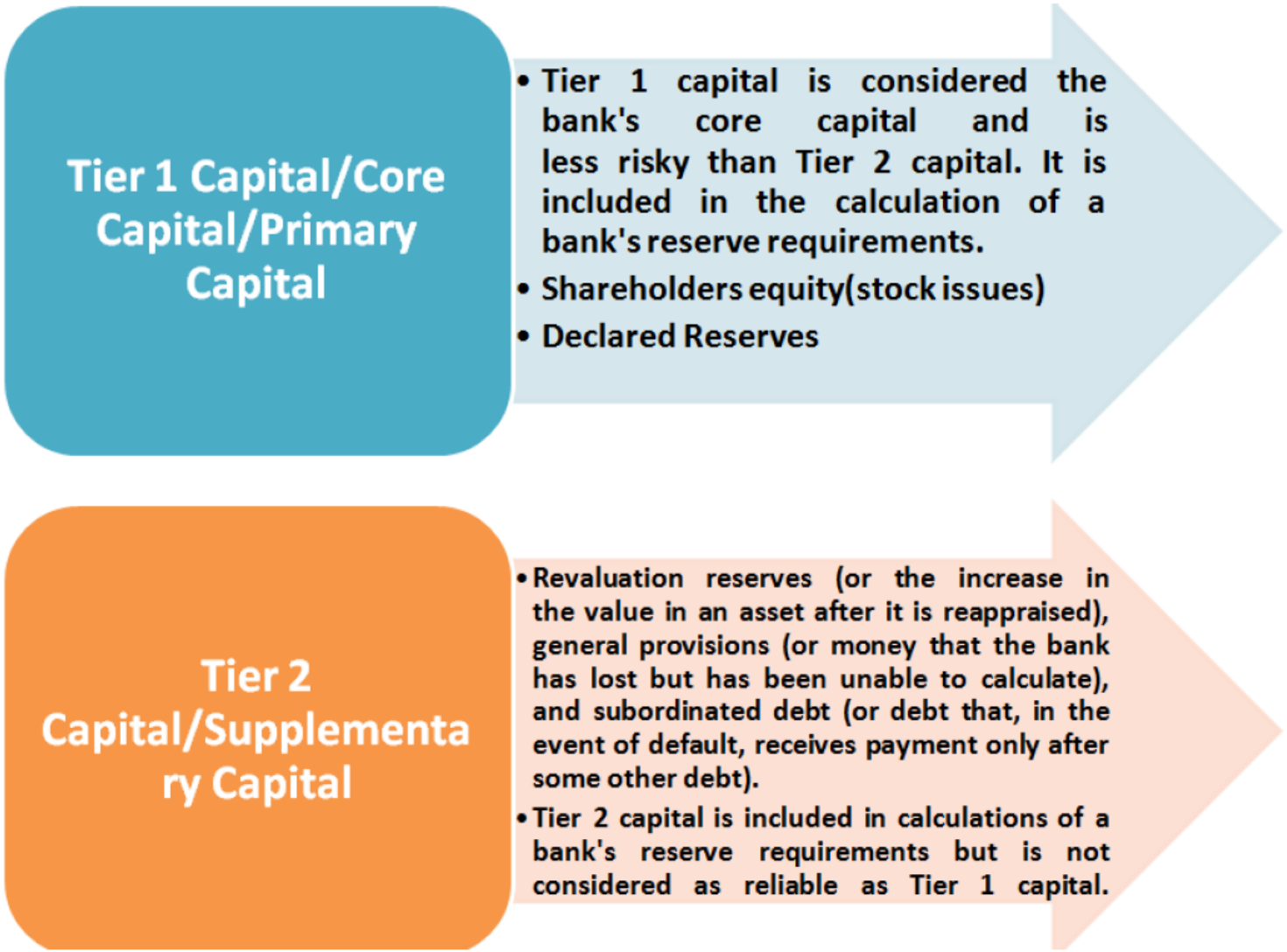
Pilar III Market Discipline

- Pillar 3 aims to enhance transparency in banks' risk exposures and capital, thereby leveraging market discipline as a regulatory tool.
- By requiring banks to disclose specific information, Pillar 3 allows market participants to better assess the risk profile of banks, which, in theory, should incentivize banks to maintain prudent levels of capital and manage risk effectively.
- Key Components: Disclosure + Frequency + Regulatory
- Disclosure Requirements:
  - Pillar 3 mandates banks to disclose detailed information about their capital structure, risk-weighted assets, risk exposures, and the models and approaches used to assess these risks.
- Frequency and Standardization of Disclosures:
  - Disclosures must be timely and standardized to allow comparability across institutions.
- Market Discipline as a Regulatory Mechanism:
  - Efficient market hypothesis and agency theory suggest that greater transparency can mitigate agency problems between shareholders,

Flat vs Risk Weighted

- Flat capital requirements
  - $k = \frac{E}{A} > \hat{k}$
  - E Equity, A Assets
- Risk Weighted approach
  - $k = \frac{E}{\gamma A} > \hat{k}$
  - γ estimation of risk of A
  - Standardized approach (use regulator estimations)
  - Internal Ratings Based (use bank estimations)
    - Foundation IRB - estimated defaullt probabilities (PD)
    - Advanced IRB - Estimated PD + Losses given default (LGD)
- Countercyclical/Macroprudential approach
  - $\hat{k}$ varies with the cycle
  - Lower in crisis periods

Tier 1 and Tier 2



Core Tier 1 Tier1 and Tier 2

Tier 1 capital

Common Equity Tier 1

- Common shares that meet the criteria for classification as common shares for regulatory purposes
- Stock surplus (share premium) resulting from the issue of instruments included Common Equity Tier 1
- Retained earnings
- Accumulated other comprehensive income and other disclosed reserves
- Common shares issued by consolidated subsidiaries and held by third parties (i.e. minority interest) that meet the criteria for inclusion in Common Equity Tier 1 capital
- Regulatory adjustments applied in the calculation of Common Equity Tier 1

Additional Tier 1 capital

- Instruments that meet the criteria for inclusion in Additional Tier 1 capital (and are not included in Common Equity Tier 1)
- Stock surplus (share premium) resulting from the issue of instruments included in Additional Tier 1 capital
- Instruments issued by consolidated subsidiaries and held by third parties that meet the criteria for inclusion in Additional Tier 1 capital and are not included in Common Equity Tier 1
- Regulatory adjustments applied in the calculation of Additional Tier 1 Capital

Tier 2 capital

- Instruments that meet the criteria for inclusion in Tier 2 capital (and are not included in Tier 1 Capital)
- Stock surplus (share premium) resulting from the issue of instruments included in Additional Tier 2 capital
- Instruments issued by consolidated subsidiaries and held by third parties that meet the criteria for inclusion in Tier 2 capital and are not included in Tier 1 capital
- Certain loan loss provisions
- Regulatory adjustments applied in the calculation of Tier 2 capital

Risk weights (with ratings)

TABLE J.2 Basel II Risk Weightings (%) Based on Ratings

	AAA to AA–	A+ to A–	BBB+ to BBB–	BB+ to BB–	B+ to B–	Below B–	Unrated
Corporates	20	50	100	100	150	150	100
Sovereign Entities	0	20	50	100	100	150	100
Banks	20	50	50	100	100	150	50
Residential Mortgages	35	35	35	35	35	35	35
Nonresidential Mortgages[a]	50–100	50–100	50–100	50–100	50–100	50–100	50–100

Basel II and Basel III

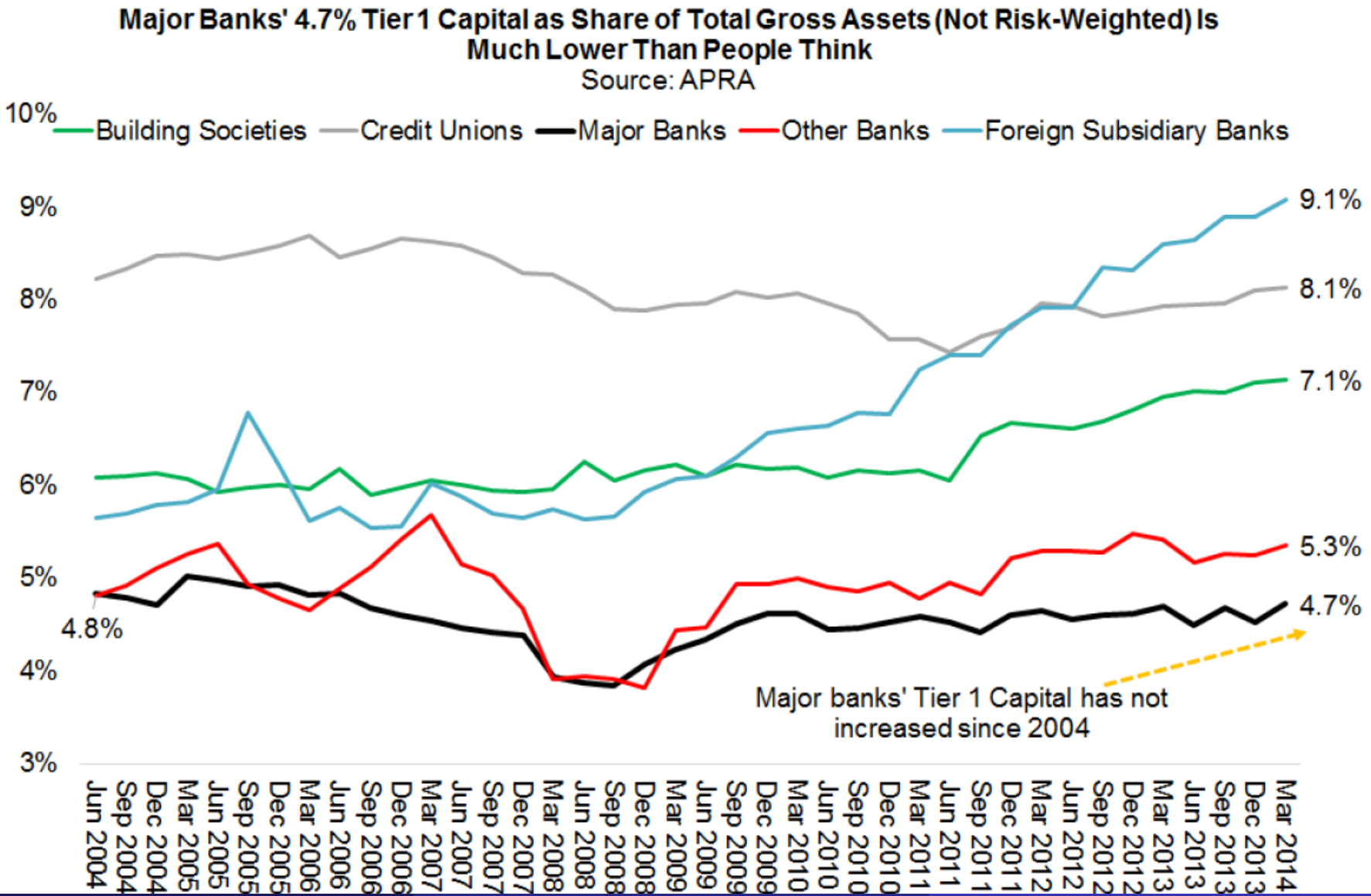
Capital Requirement Changes from Basel II to Basel III

Requirements	Basel II	Basel III
Total Capital	8%	8%
Core Tier 1	2%	4.50%
Tier 1	4%	6%
Core Tier 1 Implementation: 3.5% by Jan 1 st 2013, 4% by Jan 1 st 2013, and 4.5% by Jan 1 st 2015		

Basel III different buffers

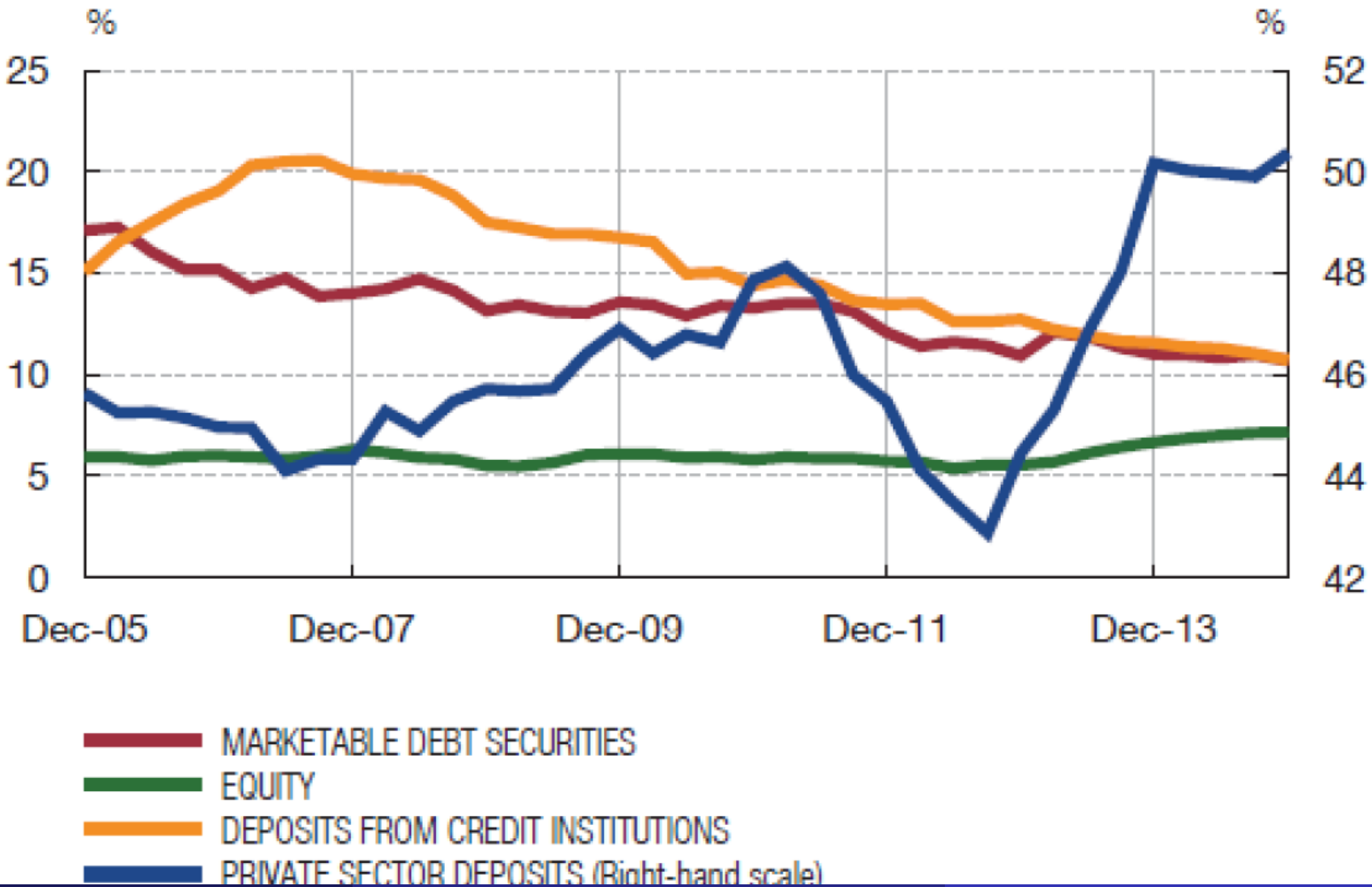
Calibration of the Capital Framework Capital requirements and buffers (all numbers in percent)			
	Common Equity (after deductions)	**Tier 1 Capital**	**Total Capital**
Minimum	4.5	6.0	8.0
Conservation buffer	2.5		
Minimum plus conservation buffer	7.0	8.5	10.5
Countercyclical buffer range*	0 – 2.5		

Post financial crisis situation

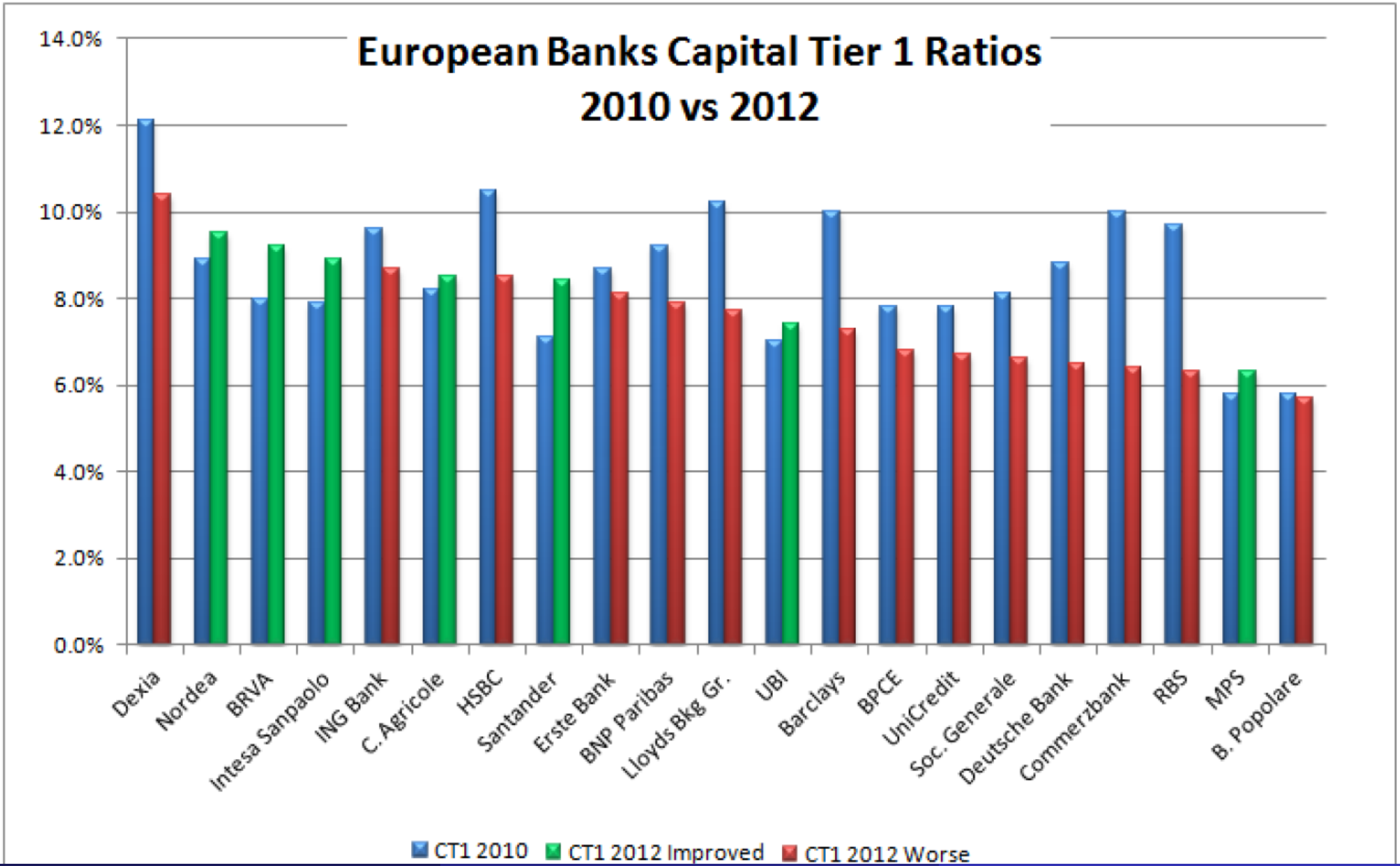


Situation in Europe

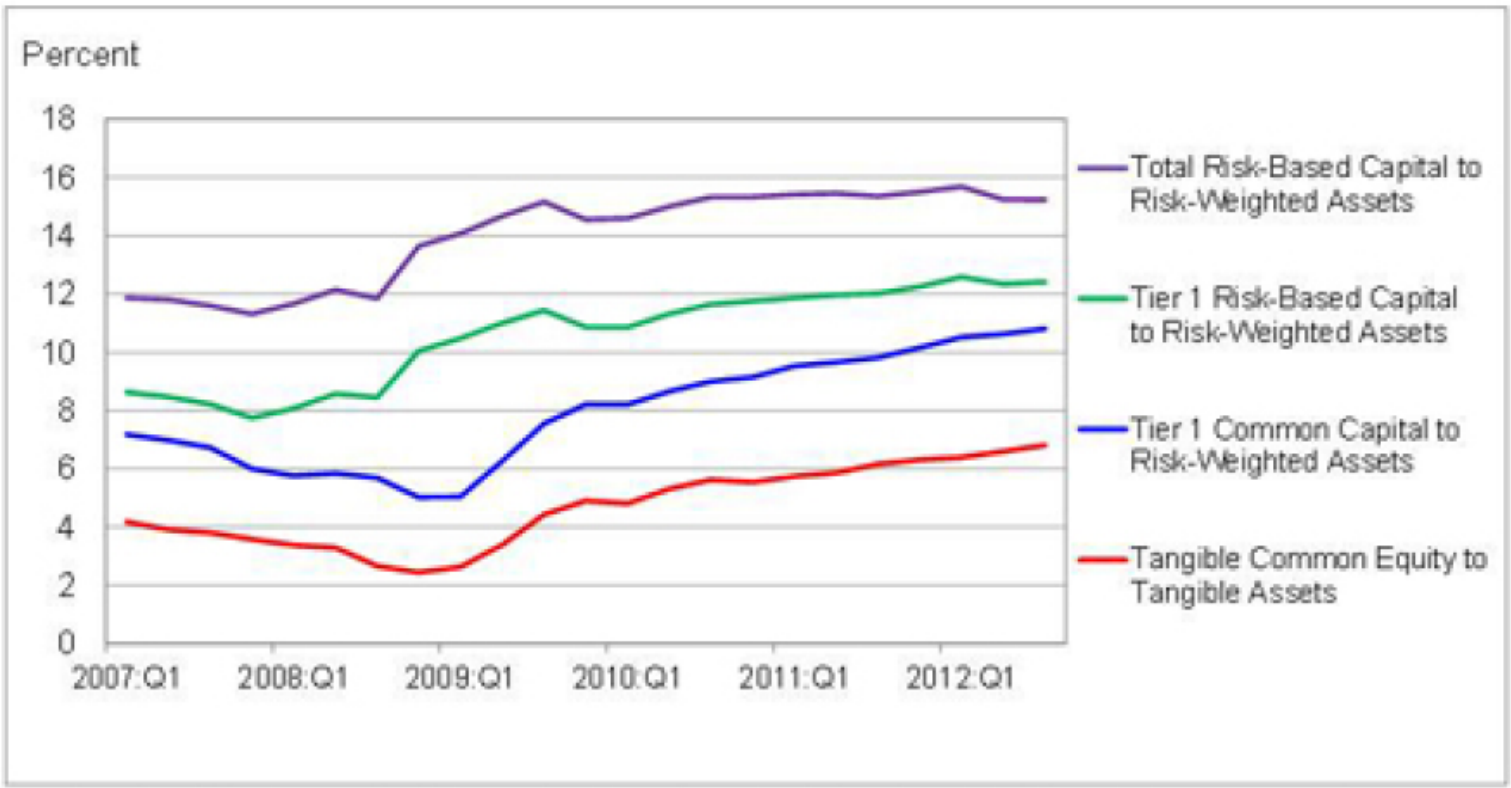
B. RELATIVE COMPOSITION OF LIABILITIES AND EQUITY AS A PERCENTAGE OF TOTAL ASSETS



Situation in Europe



Measures of Bank Capital in US



Note: Includes 15 large banking organizations that filed the FR Y-9C throughout the six-year period
Source: Consolidated Financial Statements for Bank Holding Companies (FR Y-9C)

Two different "approaches" to capital

- Capital as a "buffer" to absorb loses
  - Related to Value at Risk approaches
  - Bank incentives do not matter
  - Changes in capital does not change the underlying asset
- Capital as an "incentive" mechanism
  - Banks' risk decisions are crucial
  - Changes in capital change the underlying asset
  - No focus on loss absorption capacity
- Reality?
  - A bit of both things...

The "buffer" approach

- Assume that banks invest in an asset with stochastic returns
  - $R \sim F(.)$
  - $F(.)$ is the c.d.f. totally differentiable in the range $(0, \infty)$
  - The asset could be the portfolio of loans of the bank
- Assume that the bank has an amount of debt with total face value D
  - For now we assume no capital
- When does a bank fail?
  - $R < D$
  - $pr(R < D) = F(D)$

The "buffer" approach

- What happens if we include some capital?
  - Let us assume that the bank issues some amount of capital K
  - With that capital the bank buys back some debt $D' = D - K$
    - Same as assuming that $K + D' = D = I$
    - where I is the investment needed to invest in the asset
- When does a bank fail?
  - $R < D' = D - K$
  - $pr(R < D') = F(D') = F(D') < F(D)$
- The probability of bank failure has been reduced

The "buffer" approach- v2

- What happens if we include some capital?
  - Let us assume that the bank issues some amount of capital K
  - That capital stays as cash in the bank
    - The bank has final cash equal to $R + K$
- When does a bank fail?
  - $R + K < D$
  - $R < D - K = D'$
  - $pr(R < D') = F(D') = F(D') < F(D)$
- The probability of bank failure has been reduced
- Hence higher capital K would reduce the probability of bank failure

The "buffer" approach- Example

- Assume that a bank can invest 100 in a loan portfolio
- The bank issues debt D to fund that investment
- The return of the loan portfolio follows a uniform
  - $R \sim U[0, 250]$
- The probability of bank failure is
  - $\Pr(R < D) = \frac{D}{250}$
- Note that if debt is uninsured
  - $D \rightarrow D\left(1 - \frac{D}{250}\right) + \int_0^D R\frac{1}{250}dR \rightarrow D\left(1 - \frac{D}{250}\right) + \frac{D^2}{500}$
  - $D - \frac{D^2}{250} + \frac{D^2}{500} \rightarrow D - \frac{D^2}{500}$
  - $D - \frac{D^2}{500} = 100 \rightarrow -D^2 + 500D - 50000 \rightarrow \frac{-500+\sqrt{500^2-4*50000}}{-2} = 138$
- Note that if debt is insured (deposit insurance) $D_{IN} = 100$

The "buffer" approach- Example

- Probability of bank failure with uninsured debt
  - $F(D_{UN}) = \frac{138}{250}$
- Probability of bank failure with insured debt
  - $F(D_{IN}) = \frac{100}{250} < \frac{138}{250}$
- In a buffer approach deposit insurance reduces probability of bank failure!

The "buffer" approach- Subordinated debt

- Note how subordinated debt is a "buffer" for senior debt
- Would not prevent failure but would reduce costs to tax payers
  - Maybe not other costs related to bank failure

The "buffer" + "incentive" approach

- Assume that a bank can invest 100 in a loan portfolio
- The bank issues debt D and equity E to fund that investment
  - For simplicity assume debt is insured and its expected return $=1$
- There are two types of loans high and low risk
- The return of the low risk loan portfolio follows a uniform
  - $R_l \sim U[90, 120]$
- The return of the high risk loan portfolio follows a uniform
  - $R_l \sim U[0, 200]$
- $E(R_l) > E(R_h)$

The "buffer" + "incentive" approach

- Assume that a bank has 10 units of equity (90 Debt)
  - The final returns of a bank without subtracting the equity cost
  - $\pi(R_h) = \int_{90}^{200}(R-90)\frac{1}{200} = 30,25$
  - $\pi(R_l) = \int_{90}^{120}(R-90)\frac{1}{30} = 30$
- With 10% of capital bank shareholders would choose R_h
  - Their default probability would be $\frac{90}{200}$
- Assume that a bank has 20 units of equity (90 Debt)
  - $\pi(R_h) = \int_{80}^{200}(R-80)\frac{1}{200} = 36$
  - $\pi(R_l) = \int_{90}^{120}(R-80)\frac{1}{30} = 40$
- With 20% of capital bank shareholders would choose R_l
  - Their default probability would be $\frac{80}{200}$ if they had not´changed (buffer approach)
  - But it is $\frac{0}{30} = 0$ as they have changed project (incentive approach)
- Why? Recall limited liability and deconvexificaton of profits

The "incentive" approach

- We now turn to a pure incentive approach
  - more common if you don´not want to calibrate
- We assume that deposits are insured and the rate $(1 + r_d)$
- Banks choose p

$$\begin{aligned} & \max_p (1-p)(1+\alpha(p)-(1+r_d)) \\ foc &= -(\alpha(p)-r_d)+(1-p)\alpha'(p)=0 \\ soc &= -2\alpha'(p)+(1-p)\acute{\alpha}(p)<0 \end{aligned}$$

- FOC implicitly defines the optimal choice of risk of banks p^*
- This choice of risk is socially unoptimal

The "incentive" approach

- Assume that the bank has some capital K and insured deposits
  - Uses that capital to buy back debt
  - The ratio of capital to total liabilities $\frac{K}{D+K} = k$
- Banks choose p

$$\max_p (1-p)(1+\alpha(p)-(1-k)(1+r_d))-k(1+\delta)$$

$$foc - (1+\alpha(p)-(1-k)(1+r_d))+(1-p)\alpha'(p)=0$$

$$soc - 2\alpha'(p)+(1-p)\acute{\alpha}(p)<0$$

- How does p vary with k?
  - Use the implicit function theorem

The "incentive" approach

- $\frac{dp}{dk}$?
  - Totally differentiate the FOC

$$\begin{aligned} 0 &= \left(-2\alpha'(p) + (1-p)\acute{\alpha}(p)\right) dp - (1+r_d)\, dk \\ \frac{dp}{dk} &= \frac{(1+r_d)}{\left(-2\alpha'(p) + (1-p)\acute{\alpha}(p)\right)} < 0 \end{aligned}$$

- Higher capital means lower choice of risk by the banks
  - Note that with $k = 1$ social and bank choice of risk are equal
  - Why?

The "incentive" approach

- How much capital would a bank have?
  - Check its profit function

$$\max_k (1-p)(1+\alpha(p)-(1-k)(1+r_d))-k(1+\delta)$$

$$foc = (1-p)(1+r_d))-(1+\delta)$$

- With insured deposits $k = 0\,(r_d < \delta)$
  - Banks would not want to hold any (extra) capital

The "incentive" approach - signaling + uninsured debt

- Assume that bank debt is uninsured. Price of debt satisfies

$$(1-p)B = 1$$

- How much capital would a bank have?
  - Assume that choice of risk is unobservable
  - But the choice of k is observable

$$\max_{p,k}(1-p)(1+\alpha(p)-(1-k)B)-k(1+\delta)$$

$$s.t. B = \frac{1}{1-p}$$

- Ifk is chosen before p we can state

$$B(k) = \frac{1}{1-p(k)}$$

The "incentive" approach - signaling + uninsured debt

- FOC p (once k *and* B are set)

$$\begin{aligned} -(1+\alpha(p)-(1-k)B)+(1-p)\alpha'(p) &= 0 \\ \text{and recall (implicit function theorem} \frac{dp}{dk} &> 0 \end{aligned}$$

- FOC k
  - takes into account the signaling effect

$$(1-p)B-(1-p)(1-k)\frac{dB}{dk}-(1+\delta)$$

- Note $\frac{dB}{dk}<0$
  - More capital reduces the moral hazard and therefore signals lower ex-post risk
  - This makes debt cheaper and gives banks a higher incentive to have capital

The "incentive" approach - dynamic effects

- Extreme simlpification of Blum (1999) Hellman et al (2000) or Repullo (2004)
- Assume an infinitely lived bank(er)
  - Discounts future with discount factor β

$$V = \beta\left[-k(1+\delta)+(1-p)(1+\alpha(p)-(1-k)(1+r_d))\right]+\beta(1-p)V$$

$$V = \frac{\beta\left[-k(1+\delta)+(1-p)(1+\alpha(p)-(1-k)(1+r_d))\right]}{1-\beta(1-p)}$$

- Assume the existence of bank capital regulation and $k=\widehat{k}$
  - i.e. bank capital requirements are binding
  - Hence, $\frac{dV}{dk}<0$ (envelope theorem)

The "incentive" approach - dynamic effects

- How does the probability of failure vary with k
- Assume the existence of bank capital regulation and $k = \widehat{k}$
  - i.e. bank capital requirements are binding

$$\max_p \beta\left[-k(1+\delta)+(1-p)(1+\alpha(p)-(1-k)(1+r_d))\right]+\beta(1-p)V$$

$$foc = -\beta\left[(1+\alpha(p)-(1-k)(1+r_d))\right]+\beta(1-p)\alpha'(p)-\beta V = 0$$

- Applying the implicit function theorem $\frac{dp}{dk}$

$$-\frac{dp}{dk} = \frac{-(1+r_d)-\frac{dV}{dk}}{-2\alpha'(p)+(1-p)\alpha''(p)}$$

- In general undefined
  - Leverage effect vs charter value effect

The "incentive" approach- Subordinated debt

- Note how subordinated debt does not help incentives
  - Would not prevent unoptimal actions being taken
  - Equity would prevent unoptimal actions being taken
- It is not a substitute for equity

Can capital requirements increase risk?

- Yes
- Blum (1999) - see dynamic example done before -
  - If they are costly they reduce charter value of a bank
  - Higher cost means lower future rents of the bank
  - In a dynamic setup this decreases incentives to monitor
  - Trade-off higher static incentives vs lower dynamic incentives
  - Not clear which one prevails
- Martinez-Miera (2009)
  - Higher capital increases cost of banks and hence loan rates
  - Firms choose riskier loans and hence banks are riskier
  - But they also increase buffers (if imperfect correlated loans)
  - Overall effect in Martinez-Miera (2009) a U-shape

Inside vs outside equity

- Up till now we have assumed no conflict of interest between managers and shareholders
  - No informational assymetry between the one that takes the action (manager) and the one the shareholder
- One posibility is to think of equity as inside equity
  - It is provided by the banker-manager
- Is this true in reality?
  - Not necesarily
  - Bank managers do not hold the majority of bank shares
  - Shareholders might be dispersed and not always well informed

Does outrside equity affect the role of bank capital?

- Not in the "buffer" approach
  - Recall ther is no role of info assymetries in such view
  - Equity absorbs losses independently of who provides it
- Yes in the incentive approach
  - The incentives that matter are those of the agent that takes the decisions
  - In our case the bank manager

Outside equity

- Assume a peniless bank manager - owner
  - Has to raise 1 unit of funds to run the bank
  - Raises $1-k$ units of debt k units of outside equity
  - For simplicity deposits are insured
- Debt holders require an expected return equal to $1+r_d$
- Equity holders require an expected return equal to $1+r_e$
  - $r_e \geq r_d$
- Bank-manager keeps all returns after paying debtholders and shareholders
- Return of the project is $1+\alpha$ with probablity e
- Choice e is unobservable for all (also equity holders)
  - effort choice $c'(e) > 0$, $c''(e) < 0$

Outside equity

- What is the stake that the owner manager has in the bank?

$$\theta e(1+\alpha-(1-k)B)$$

- where

$$\begin{aligned}(1-\theta)e(1+\alpha-(1-k)B) &= k(1+r_e)\\ eB &= (1+r_d)\end{aligned}$$

- Bank-manager optimal choice of risk

$$\max \theta e(1+\alpha-(1-k)B)-c(e)$$

$$foc\ \theta(1+\alpha-(1-k)B)=c'(e)$$

- Direct to show $\frac{de}{d\theta}>0$

Outside equity

- How does e vary with k?
- Assume $k = 0 \rightarrow \theta = 1 \rightarrow B = \frac{1+r_d}{e}$

$$\max e(1 + \alpha - B) - c(e)$$

$$foc\ (1 + \alpha - \frac{1 + r_d}{e}) = c'(e)$$

- Assume $k = 1 \rightarrow \theta < 1 \rightarrow \theta = 1 - \frac{(1+r_e)}{(1+\alpha)e}$

$$\max \theta e(1 + \alpha) - c(e)$$

$$\begin{aligned} foc\ \theta(1 + \alpha) &= c'(e) \\ \left(1 - \frac{(1 + r_e)}{(1 + \alpha)e}\right)(1 + \alpha) &= c'(e) \end{aligned}$$

- e is not the social optimal value

Basic Macro trade-offs

- Bank equity can be scarce
  - Specially in downturns
  - Not infinite supply of equity (internal vs external)
- Firms need bank loans to produce
  - With capital requirements
  - Lower equity means lower loans
- "Balance sheet effect"
  - What if capital is costly or scarce?
- Rationale for interior capital requirements
  - Also for pro or countercyclical capital requirements

Capital requirements and investment

- Can capital requirements increase investment?
  - Normally no as they are a higher cost for the bank
  - Counter argument Bahaj and Malherbe (2017)
- In the presence of debt overhang issues
  - as well as risk shifting incentives
  - Higher capital requirements sometimes increases bank investment
  - As it reduces debt overhang problems

Basic Risk Weight trade-offs

- Riskier investments should have higher capital
  - Who determines the riskiness of an investment?
  - Do banks have incentives to misreport?
  - Crucial role for regulators and supervisors