The Procyclical Effects of Bank Capital Regulation

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CEMFI

Third Unicredit Group Conference on Banking and Finance

Rome, 18 December 2009
“The IMF, the expanded FSF, and other regulators and bodies should develop recommendations to mitigate procyclicality, including the review of how valuation and leverage, bank capital, executive compensation, and provisioning practices may exacerbate cyclical trends.”

G20 Washington Summit
November 2008
“We call on our Finance Ministers and Central Bank Governors to reach agreement on an international framework of reform in the following critical areas:

(1) Building high quality capital and mitigating pro-cyclicality
(2) Reforming compensation practices
(3) Improving over-the-counter derivatives markets
(4) Addressing systemically important financial institutions.”

G20 Pittsburgh Summit
September 2009
Purpose of this paper

• Assess the extent to which bank capital regulation can lead to amplification of business cycle fluctuations

• Assess the impact of risk-sensitive capital requirements
  → Will Basel II make things worse?
  → What would be the appropriate policy response?
What is bank capital?

• (Equity) capital is a liability: funds provided by shareholders
• Sources of capital: equity issues + retained earnings
• Simplified balance sheet

<table>
<thead>
<tr>
<th>assets</th>
<th>liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>loans → $l$</td>
<td>$d ←$ deposits</td>
</tr>
<tr>
<td></td>
<td>$k ←$ capital</td>
</tr>
</tbody>
</table>
Capital requirements

• Minimum ratio $\gamma$ of capital to risky assets
  
  $\rightarrow$ In Basel I: $\gamma = 8\%$
  
  $\rightarrow$ In Basel II: $\gamma$ determined by value-at-risk calculation

• Given $k$, requirement sets upper limit on lending capacity

  \[ k \geq \gamma l \iff l \leq \frac{k}{\gamma} \quad (= 12.5k \text{ in Basel I}) \]

  $\rightarrow$ Upper limit varies with business cycle

  $\rightarrow$ Bank capital amplification channel
Bank capital amplification channel

- Contraction in loan supply in downturns due to
  - Lower bank capital due to higher default rates
  - Possibly higher capital requirements (Basel II)

- Two conditions are necessary for this effect
  - Banks should find it difficult to issue equity in downturns
  - Firms should find it difficult to switch financing source

- However, these conditions are not sufficient
  - With high capital buffers constraint would not be binding
Key question

• Will endogenous capital buffers neutralize the procyclicality of bank capital regulation?

• Answer (under realistic parameterization)
  → With Basel I: YES
  → With Basel II: NO
Outline

• Model setup
• Analytical results
• Numerical results
• Policy analysis
• Repullo, Saurina and Trucharte (2009)
Model setup

• Infinite horizon, discrete time, Markov switching model
• At each date \( t \) continuum of entrepreneurs enters the market
• They live for two periods → OLG structure
• Relationship banking
  → Entrepreneurs become dependent on initial lenders
  → Perfect competition ex-ante & monopoly rents ex-post
• Banks with ongoing relationships cannot issue equity
  → Banks can only raise capital every other date
• Loan losses as in single risk factor of Basel II
Notation (i)

• State of the economy $s_t \in \{h, l\}$ follows a Markov chain with
  
  $$q_h = \Pr(s_{t+1} = h | s_t = h)$$
  $$q_l = \Pr(s_{t+1} = h | s_t = l)$$

• State $s_t$ determines probability of default
  
  $$p_t = \begin{cases} 
  p_h & \text{if } s_t = h \\
  p_l & \text{if } s_t = l
  \end{cases} \quad \text{with } p_h > p_l$$

• Interpretation
  
  → State $h$: high business failure (recession)
  → State $l$: low business failure (expansion)
Notation (ii)

- Cost of (insured) deposits normalized to 0
- Cost of capital $\delta > 0$
- Initial loan rates $r_l$ and $r_h$ (depending on state)
- Initial capital (of banks that can issue equity) $k_l$ and $k_h$
- Capital requirements
  - Basel I: $\gamma_l = \gamma_h = 8\%$
  - Basel II: $\gamma_l < \gamma_h$
- Capital buffers $\Delta_l = k_l - \gamma_l$ and $\Delta_h = k_h - \gamma_h$
Equilibrium

• Sequence of state-contingent pairs \((k_s^*, r_s^*)_{s=h,l}\) that satisfy
  
  – Banks’ optimization
    
    \[ k_s^* = \arg\max_{k_s \in [\gamma_s, 1]} v_s(k_s, r_s^*) \]

  – Banks’ zero net present value condition
    
    \[ v_s(k_s^*, r_s^*) = 0 \]
Analytical results

• Optimal size of capital buffers depends on simple trade-off
  → Cost of holding excess capital
  → Benefit of being able to support profitable future lending

• In interior equilibrium
  → Positive probability of excess lending capacity in $s' = l$
  → Positive probability of credit rationing in $s' = h$
Comparative statics

• Higher capital requirements
  → Higher equilibrium loan rates
  → Ambiguous effect on total capital

• Two effects
  → Precautionary: Higher prospects of insufficient capital
  → Profitability: Lower profitability of future lending

• Focus on numerical solutions
Parameterization (i)

- Transition probabilities (for annual frequency)
  \[ q_h = \Pr(s_t = h | s_{t-1} = h) = 0.64 \]
  \[ 1 - q_l = \Pr(s_t = l | s_{t-1} = l) = 0.80 \]
  → Expected duration of high default state: 2.8 years
  → Expected duration of low default state: 5 years
Parameterization (ii)

• State-contingent probabilities of default (PDs)
  → Focus presentation on medium volatility of PDs scenario
    \[ p_l = 1.1\% \quad \rightarrow \quad \text{Basel II} \quad \gamma_l = 6.6\% \]
    \[ p_h = 3.3\% \quad \rightarrow \quad \text{Basel II} \quad \gamma_l = 10.5\% \]
  → Paper also considers high and low volatility scenarios
  → PDs chosen so that average capital requirement is 8%

• Other parameters
  → Loss given default (LGD) \( \lambda = 45\% \)
  → Cost of bank capital \( \delta = 4\% \)
## Initial loan rates and capital buffers

<table>
<thead>
<tr>
<th>Rates (°%)</th>
<th>Capital (°%)</th>
<th>Buffers (°%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_l$</td>
<td>$r_h$</td>
<td>$k_l$</td>
</tr>
<tr>
<td>Basel I</td>
<td>1.2</td>
<td>2.7</td>
</tr>
<tr>
<td>Basel II</td>
<td>1.2</td>
<td>2.8</td>
</tr>
</tbody>
</table>

- Small loan rate effects
- Sizable buffers
  - Slightly countercyclical in Basel I
  - Strongly procyclical in Basel II
Credit rationing

Expected % of second period projects not funded (because of banks’ insufficient lending capacity)

Credit rationing (%) in state $s'$ conditional on $s \rightarrow s'$

<table>
<thead>
<tr>
<th></th>
<th>$l \rightarrow l$</th>
<th>$l \rightarrow h$</th>
<th>$h \rightarrow h$</th>
<th>$h \rightarrow l$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basel I</td>
<td>1.4</td>
<td>1.4</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Basel II</td>
<td>0.3</td>
<td><strong>10.7</strong></td>
<td>4.5</td>
<td>0.6</td>
</tr>
</tbody>
</table>

• Basel II is more procyclical
  
  $\rightarrow$ Increases rationing in state $s' = h$, especially after $s = l$
  
  $\rightarrow$ Reduces rationing in state $s' = l$, especially after $s = h$
## Banks’ solvency

Probabilities of bank failure (%)

<table>
<thead>
<tr>
<th></th>
<th>1st period banks</th>
<th>2nd period banks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$s = l$</td>
<td>0.022</td>
<td>0.115</td>
</tr>
<tr>
<td>$s = h$</td>
<td>0.014</td>
<td>0.054</td>
</tr>
</tbody>
</table>

- Basel II increases solvency (unconditionally)
- Risk of failure is much lower than 0.1% targeted by Basel II
  - Due to capital buffers and net interest income
**Effect of parameter changes (i)**

Higher loss given default (LGD)

Results under Basel II

<table>
<thead>
<tr>
<th>Rates (%)</th>
<th>Buffers (%)</th>
<th>Rationing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_l$</td>
<td>$r_h$</td>
<td>$\Delta_l$</td>
</tr>
<tr>
<td>$\lambda = 45%$</td>
<td>1.2</td>
<td>2.8</td>
</tr>
<tr>
<td>$\lambda = 50%$</td>
<td>1.4</td>
<td>3.2</td>
</tr>
</tbody>
</table>

→ Higher rates, lower buffers, and much more credit rationing
**Effect of parameter changes (ii)**

Higher cost of bank capital

Results under Basel II

<table>
<thead>
<tr>
<th>Rates (%)</th>
<th>Buffers (%)</th>
<th>Rationing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_l$</td>
<td>$r_h$</td>
<td>$\Delta_l$</td>
</tr>
<tr>
<td>$\delta = 4%$</td>
<td>1.2</td>
<td>2.8</td>
</tr>
<tr>
<td>$\delta = 5%$</td>
<td>1.4</td>
<td>3.0</td>
</tr>
</tbody>
</table>

→ Higher rates, lower buffers, and much more credit rationing
Effect of parameter changes (iii)

Longer expected duration of low default state (expansions)

Results under Basel II

<table>
<thead>
<tr>
<th>Rates (%)</th>
<th>Buffers (%)</th>
<th>Rationing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_l$</td>
<td>$r_h$</td>
<td>$\Delta_l$</td>
</tr>
<tr>
<td>1.2</td>
<td>2.8</td>
<td>5.1</td>
</tr>
<tr>
<td>1.1</td>
<td>2.8</td>
<td>4.4</td>
</tr>
</tbody>
</table>

→ No change in rates and buffers in high default state $h$

→ Lower rates and buffers in low default state $l$

→ Much more rationing in state $h$ after state $l$
Effect of parameter changes (iv)

Higher cyclical variation of PDs

From $p_l = 1.1\%$ and $p_h = 3.3\%$ to $p_l = 1.0\%$ and $p_h = 3.6\%$

Results under Basel II

<table>
<thead>
<tr>
<th>Rates (%)</th>
<th>Buffers (%)</th>
<th>Rationing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_l$</td>
<td>$r_h$</td>
<td>$\Delta_l$</td>
</tr>
<tr>
<td>Benchmark</td>
<td>1.2</td>
<td>2.8</td>
</tr>
<tr>
<td>Higher vol.</td>
<td>1.1</td>
<td>3.1</td>
</tr>
</tbody>
</table>

→ Lower buffers and much more credit rationing
Summary of effects of parameter changes

• Qualitative results are robust to changes in parameters
• Rationing when entering recession is greater in economies with
  – Higher LGDs
  – Higher cost of bank capital
  – Lower probability of going into recession
  – Higher cyclical variation of PDs
Policy responses (i)

• Objective: Reduce incidence of credit rationing
  → without major costs in terms of banks’ solvency

• Policy 1: Reduce confidence level to 99.8% in state $h$
  + Increase conf. level in state $l$ to keep average at 99.9%

• Policy 2: Lower confidence level to 99.8% in state $h$ after $l$
  + Increase conf. level in state $l$ to keep average at 99.9%
Policy responses (ii)

Credit rationing (%) in state $s'$ conditional on $s \rightarrow s'$

<table>
<thead>
<tr>
<th></th>
<th>$l \rightarrow l$</th>
<th>$l \rightarrow h$</th>
<th>$h \rightarrow h$</th>
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<tr>
<td>Basel II</td>
<td>0.3</td>
<td>10.7</td>
<td>4.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Policy 1</td>
<td>0.8</td>
<td>3.7</td>
<td>3.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Policy 2</td>
<td>0.5</td>
<td>4.4</td>
<td>4.4</td>
<td>0.6</td>
</tr>
</tbody>
</table>

- Both policies achieve significant reductions in credit rationing
- Small effect on banks’ solvency
  - Probability of failure below 0.08% in all sequences.
Summing up (i)

• Paper evaluates procyclicality of bank capital regulation
  → Taking into account endogenous capital buffers

• Paper focuses on supply side of bank lending market
  → Demand side and feedback effects ignored
  → How much procyclicality comes from the supply side?
  → How this will be affected by Basel II?
Summing up (ii)

• Results on the effect of Basel II
  → Procyclical capital buffers (banks take precautions)
  → Risk of credit crunch when economy goes into a recession

• Policy response
  → Cyclical adjustment in capital requirements
Mitigating the Procyclicality of Basel II

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CEMFI             Bank of Spain     Bank of Spain

The views expressed in this paper are those of the authors and should not be attributed to the Banco de España or the Eurosystem
Introduction

• How should cyclical adjustment of Basel II be made?
  → The devil is in the details

• Gordy and Howells (2006): Two basic alternatives
  – Smooth the inputs of the Basel II formula
    → Through-the-cycle (TTC) ratings
  – Smooth the output (with point-in-time ratings)
    → Using aggregate or individual bank information
Strategy of paper

• Estimate model of probabilities of default (PDs)
  → Data on Spanish firms’ loans for the period 1984-2008
  → Credit Register of Bank of Spain
• Compute corresponding Basel II capital requirements
• Smooth cyclical behavior using Hodrick-Prescott (HP) filter
• Compare different smoothing procedures
  → Using root mean square deviations from HP benchmark
Capital requirements and GDP growth
Summary of results

Root mean square deviations (RMSD) from HP benchmark

<table>
<thead>
<tr>
<th></th>
<th>RMSD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTC ratings</td>
<td>0.55</td>
</tr>
<tr>
<td>GDP growth multiplier</td>
<td>0.54</td>
</tr>
<tr>
<td>Credit growth multiplier</td>
<td>0.66</td>
</tr>
<tr>
<td>Stock market multiplier</td>
<td>0.81</td>
</tr>
<tr>
<td>Autoregressive adjustment</td>
<td>0.54</td>
</tr>
</tbody>
</table>
Discussion (i)

• Autoregressive adjustment
  
  → Follows original series with lag

  → Undesirable in downturns
Discussion (ii)

• Smoothing the inputs with TTC ratings
  → No consensus on what TTC exactly means
  → Risks of unlevel playing field
  → TTC ratings not useful for pricing and risk management

  “Internal ratings and default and loss estimates must play an essential role in the credit approval, risk management, internal capital allocations, and corporate governance functions of banks using the IRB approach.”

  (BCBS, 2006, par. 444)
Discussion (iii)

- Best procedure: smooth output with GDP growth multiplier
  \[ \rightarrow 6.5\% \text{ surcharge for each standard deviation in GDP growth} \]

- Second best: smooth output with credit growth multiplier
Extensions

• Adjustment using individual bank credit growth
  → Dominated by GDP growth multiplier

• Cyclically varying LGDs
  → Does not affect relative performance of procedures
  → Value of multipliers is higher

• Adjustment of expected losses
  → Rationale for dynamic provisioning mechanism
Postscript

Basel Committee Consultative Document, 17 December 2009

→ Strengthening the resilience of the banking sector
Postscript

Section 4(a) Cyclicality of the minimum requirement

“The Basel II framework has increased the risk sensitivity of the regulatory capital requirement.”

“However, it is not possible to achieve greater risk sensitivity across institutions at a given point in time without introducing a certain degree of cyclicality in minimum capital requirements over time.”

“The Committee was aware of this trade-off during the design of the Basel II framework and introduced a number of safeguards to address excess cyclicality of the minimum requirement.”
Postscript

Section 4(a) Cyclicality of the minimum requirement

“The Committee has reviewed a number of additional measures that supervisors could take to achieve a better balance between risk sensitivity and the stability of capital requirements, should this be viewed as necessary.”

“The Committee is conducting an impact study on two specific proposals. The first is based on the use of the highest average PD estimate applied by a bank historically to each of its exposure classes as a proxy for a downturn PD; the second is based on the use of an average of historic PD estimates for each exposure class.”