The Procyclical Effects of Basel II

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Presented at the 9th Jacques Polak Annual Research Conference
Hosted by the International Monetary Fund
Washington, DC—November 13-14, 2008

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“Supervisors will assess the cyclicality of the Basel II framework and take additional measures as appropriate.”

*Financial Stability Forum, April 2008*

“We should critically examine capital regulations, provisioning policies, and other rules applied to financial institutions to determine whether, collectively, they increase the procyclicality of credit extension.”

*Ben Bernanke, Jackson Hole, August 2008*
“In implementing the new (Basel II) framework, banking supervisors will monitor the potential procyclical effects of the new regulation and assess whether remedial measures are needed.”

_Council of the European Union, October 2008_
Purpose of this paper

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

• Assess the impact of the new risk-based 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
  → In Basel I: $\gamma = 8\%$
  → In Basel II: $\gamma$ determined by value-at-risk calculation

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

  \[ k \geq \gamma l \iff l \leq \frac{k}{\gamma} \quad (= 12.5k \text{ in Basel I}) \]
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
• Concluding remarks
• Future research
Model setup

• Infinite horizon, discrete time, Markov switching model
• At each date $t$ continuum of entrepreneurs enters the market
• They live for two periods $\rightarrow$ OLG structure
• Relationship banking
  $\rightarrow$ Entrepreneurs become dependent on initial lenders
  $\rightarrow$ Perfect competition ex-ante & monopoly rents ex-post
• Banks with ongoing relationships cannot issue equity
  $\rightarrow$ 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
  \[
  q_h = \Pr(s_t = h \mid s_{t-1} = h) \\
  q_l = \Pr(s_t = h \mid s_{t-1} = l)
  \]

• 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
  \[ 
  \rightarrow \text{State } h: \text{ high business failure (recession)} \\
  \rightarrow \text{State } l: \text{ low business failure (expansion)}
  \]
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

- State-contingent pair \((k_s^*, r_s^*)\)\( s = h, l \) that satisfies
  - Banks’ optimization
    \[
    k_s^* = \arg \max_{k_s \in [\gamma_s, 1]} \nu_s(k_s, r_s^*)
    \]
  - Banks’ zero net present value condition
    \[
    \nu_s(k_s^*, r_s^*) = 0
    \]
Analytical results

• Banks’ objective function is neither concave nor convex
  – There may be corner or interior solutions
  – We derive comparative statics for interior solutions
• Higher capital requirements \(\rightarrow\) Higher equilibrium loan rates
• Higher capital requirements \(\rightarrow\) Ambiguous effect on capital
  – Higher prospects of ending with insufficient capital
  – 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></th>
<th>Rates (%)</th>
<th>Capital (%)</th>
<th>Buffers (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r_l$</td>
<td>$k_l$</td>
<td>$\Delta_l$</td>
</tr>
<tr>
<td>Basel I</td>
<td>1.2</td>
<td>11.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Basel II</td>
<td>1.2</td>
<td>11.7</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>$r_h$</td>
<td>$k_h$</td>
<td>$\Delta_h$</td>
</tr>
<tr>
<td>Basel I</td>
<td>2.7</td>
<td>11.2</td>
<td>3.2</td>
</tr>
<tr>
<td>Basel II</td>
<td>2.8</td>
<td>12.5</td>
<td>1.9</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
  - Increases rationing in state $s' = h$, especially after $s = l$
  - 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>( s = l )</td>
<td>( s = h )</td>
</tr>
<tr>
<td>Basel I</td>
<td>0.022</td>
<td>0.115</td>
</tr>
<tr>
<td>Basel II</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>$d_l = 5$ years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>2.8</td>
<td>4.4</td>
</tr>
<tr>
<td>$d_l = 6$ years</td>
<td></td>
<td></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>
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<tr>
<th>Rates (%)</th>
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<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 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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<tbody>
<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.
Concluding remarks (i)

• Two frequent misconceptions:
  – Buffers mean that capital requirements are “not binding”
    → Forward-looking banks take precautions!
  – Effect of Basel II can be predicted from Basel I evidence
    → Lucas’ critique!
Concluding remarks (ii)

• Paper evaluates potential procyclicality of capital requirements
• 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?
• Contribution is partly methodological and partly substantive
Concluding remarks (iii)

- Methodological contribution
  - Fully-fledged dynamic model of the credit market with
    - Relationship lending
    - Frictions in banks’ access to equity financing
  - Endogenous capital buffers and loan rates

- Numerical results on Basel II
  - Procyclical capital buffers
  - Risk of credit crunch when economy goes into a recession
  - Policy response: cyclical adjustment in cap. requirements
Future research

• How should the cyclical adjustment of Basel II be made?
  → The devil is in the details
• Two basic alternatives
  – Smooth the inputs of the Basel II formula
    → Through-the-cycle ratings
  – Smooth the output (with point-in-time ratings)
    → Using aggregate information
    → Using individual bank information
• Compare these alternatives with Spanish data