Optimal Capital Regulation

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*Any expressed views are our own and not necessarily those of the Bank of Canada, Bundesbank, or ECB.
What we do in this paper

• recent financial crisis has increased interest in regulation of financial intermediaries

• proposals for richer regulatory framework, for example BCBS (2010)

• number of regulatory tools already used and under consideration has increased

• our research questions:

  – which regulatory tools should necessarily augment market discipline?

  – what is the optimal interaction between those tools?
Optimal capital requirements

• dynamic stochastic production economy with financial intermediation

• exogenous shocks to bank assets, endogenous amplification (credit crises)

• What is new?
  – we model market discipline differently: market cares about bank’s incentive to default rather than just bank liquidation value
  – in the model banks have less incentive to default if they expect profits in future: a bank’s access to funding depends on both capital and future rents
  – creates pecuniary externality since rents depend on future asset prices: paper finds optimal capital requirements by focusing on constrained efficiency

• which regulatory tools necessary in addition to market discipline? optimal interaction?
Capital regulation in this paper and results

- **market-imposed capital requirements** are implicitly imposed by market discipline
  - those are endogenous no-default conditions which ensure solvency of banks
  - only binding occasionally:
    - because each bank engages in loan-loss provisioning

- define **macro-prudential regulation** as bank capital in constrained-efficient allocation
  - identify tools for implementation: ex-post capital relief and ex-ante capital buffers
    - capital relief mitigates large credit crises:
      - relax market-imposed requirement whenever it binds by increasing rents
    - do not rely exclusively on socially costly rents:
      - additional capital buffer whenever market-imposed requirement does not bind
Related literature

- credit crises are socially costly: Laeven-Valencia (2013)

- strong non-linearities due to occasionally binding constraints: Brunnermeier-Sannikov (2014), Boissay-Collard-Smets (2014)


- this paper: optimal usage of ex-ante and ex-post regulatory tools in small-scale DSGE model
Model ingredients

- time is discrete, $t = 0, 1, 2, \ldots$

- i.i.d. random variable with realizations $z_t \in Z = \{z_L, z_H\}$

- measure one of identical consumers

- measure one of identical banks

- each period there is a market for labor, wage $w$

- each period there is a market for non-contingent bonds, price $q$
Consumers

• consumers are risk-neutral, value consumption, discount factor $\beta \in (0, 1)$

• supply one unit of labor inelastically each period

• can trade non-contingent bonds
Banks

- banks are risk neutral, value dividends $d \geq 0$, discount factor $\gamma \in (0, \beta)$

- can trade non-contingent bond, hold quantity $b \in \mathbb{R}$

- have access to risky projects:
  can invest $k_{t+1}$ in period $t$ to receive $R_{t+1}(z_{t+1})k_{t+1}$ in period $t + 1$

- bank can misappropriate fraction $\theta \in (0, 1)$ of investment at end of period, but would lose bank capital and rents

- market discipline:
  bank can issue non-contingent bonds if it has incentive not to misappropriate

$$E_t \left[ \sum_{\tau=1}^{\infty} \gamma^{\tau} d_{t+\tau} \right] \geq \theta k_{t+1}$$
Competitive equilibrium

• a bank project generates cash flow $zk^\alpha l^{1-\alpha} + (1 - \delta)k - \omega l$, where $l$ denotes labor hired for a project, $\delta \in (0, 1)$ is depreciation rate

• let $K$ denote aggregate bank investment (loans to projects), $L = 1$ aggregate labor

• in a competitive equilibrium:
  
  – wage is given by $w_t = z_t (1 - \alpha) K_t^\alpha$
  
  – return on bank lending is given by $R_t = z_t \alpha K_t^{\alpha - 1} + 1 - \delta$
  
  – price of non-contingent bond is $q_t = \beta$
Market-imposed capital requirements

- define bank capital as common equity plus retained earnings: $A_t = R_t(z_t)k_t + b_t$

- define bank future rents:

$$\Pi_t = \sum_{\tau=1}^{\infty} \gamma^\tau E_t \left[ \left( R_{t+\tau}(z_{t+\tau}) - \frac{1}{\gamma} \right) k_{t+\tau} \right] + \sum_{\tau=1}^{\infty} \gamma^\tau E_t \left[ \frac{\gamma - \beta}{\gamma} b_{t+\tau} \right]$$

  - first term denotes profits from lending
  - second term denotes benefit from using external finance $b_{t+\tau} < 0$

- use bank balance sheet in $t = 0, 1, 2, \ldots$ to write $\sum_{\tau=0}^{\infty} \gamma^\tau E_t[d_{t+\tau}] = A_t + \Pi_t$

- condition for market discipline can be expressed as $E_t[A_{t+1}] \geq \frac{\theta}{\gamma} k_{t+1} - E_t[\Pi_{t+1}]$
• market-imposed capital requirement is given by

\[ E_t[A_{t+1}] \geq \frac{\theta}{\gamma} k_{t+1} - E_t[\Pi_{t+1}] \]

− it is lower during crises:
  negative shock to capital lowers lending and increases margins \( R \uparrow \) implies \( \Pi \uparrow \)

• market-imposed capital requirements bind only occasionally

  − because banks risk-weight income from lending:
    return on capital high when aggregate capital low (’last-bank-standing’ effect)

• is bank risk management induced by market discipline sufficient?
  would ’macro-prudential’ regulation require more or less loan loss provisioning?
Optimal capital requirements

- market-imposed capital requirements depend on future lending returns via $\Pi$

- introduces a pecuniary externality (in the sense of Greenwald-Stiglitz, 1986)

- constrained social planner can improve upon individual bank risk management

- assume planner maximizes expected present value of dividends and wages, common discount factor $\beta$ (bank pays dividends to consumers, run by impatient banker)
Numerical analysis

- compare competitive equilibrium to constrained-efficient allocation
  - identify tools which can implement constrained-efficient allocation
  - interpret those as necessary macro-prudential tools

- parameters:
  - $\beta = 0.95$, $\gamma = 0.94$, $\alpha = 0.35$, $\delta = 0.10$
  - $\theta = 0.10$ (long run leverage around 10)
  - $z_L = 0.8$, $E(z) = 1$, $Prob(z = z_L) = 0.2$ (shock to bank income, not TFP shock)
Bank capital, $A_t$

- percentage deviation from minimum capital required to lend First Best amount
- CE refers to competitive equilibrium: buffer due to loan loss provisioning
- SB shows constrained-efficient allocation: additional capital buffer
Bank lending, $K_t$

- percentage deviation from First Best lending
- smaller credit crises: buffers avoid significant drop in lending
- larger credit crises: lending drops up to 16 percent in CE, much less in SB

Why is there less amplification in SB? Why slower recovery after larger credit crises in SB?
Market-imposed capital requirement, \( \left( \frac{\theta}{\gamma} - \frac{E_t[\Pi_{t+1}]}{K_{t+1}} \right) \cdot 100 \)

- shows lower bound that market imposes on capital-asset ratio \( \frac{E_t[A_{t+1}]}{K_{t+1}} \)
- **capital relief** in large crisis for SB:
  - planner promises higher rents to banks, lowers market-imposed capital requirement
- reduces amplification, mitigates large crises
• SB promises higher rents when there is a large crisis to support capital relief: market allows banks to have a lower capital-asset ratio if rents higher
• rents are persistent in SB which slows down recovery
Additional slide on bank margins, $E_t [R_{t+1} - 1/\beta] \cdot 100$

- crises are less severe in SB, cost of credit increases less during crises in SB
- in SB rents are delivered via margins that are persistent
• the line $M$ shows realized margin $R_t - 1/\beta$ in CE
• the line $EM$ shows expected margin $E_t [R_{t+1} - 1/\beta] \cdot 100$ in CE
• note that $corr(M, EM) < 0$ in the model, see also Santos-Winton (2008)
• market-imposed capital requirement is counter-cyclical in CE (and in SB): market allows for higher leverage if future margins higher (when rents $\Pi$ positive)
What did we learn about optimal macro-prudential regulation?

- banks should be allowed to have higher leverage during severe crises: capital relief
  - supported by higher future rents to satisfy market imposed capital requirements
  - rents decrease gradually over time following a severe crisis:
    persistence in rents lowers overall distortion, but also slows down recovery

- avoid relying too much on rents: additional capital buffer
  - buffer is 'always on' in good times:
    do not wait until one bad shock occurs in order to turn it on due to non-linearities
Conclusion

- study competitive equilibrium in an economy with market-imposed capital requirements

- also study constrained-efficient allocation in such an economy

- interpret difference in bank capital between the two as due to macro-prudential concerns

- identify two macro-prudential tools necessary for efficiency:
  - ex-ante capital buffers:
    avoid smaller crises, always on during good times
  - ex-post capital relief:
    mitigate larger crises, persistent increase in future rents, slower recovery