Financial Institution Dynamics and Capital Regulations

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Motivation

- During the financial crisis, regulatory discussions included
  - insufficient capitalization of banks;
  - bank dividend payouts (Acharya, Gujral, Kulkarni and Shin 2011);
  - executive compensation (FSF 2009).
- Basel III
  - Capital conservation buffer (2.5%) + min. capital requirement (4.5%).
  - Distribution of earnings will be restricted if the buffer is drawn down.

Objective & Issues with Existing Macro-Banking Models

- Our goal: Analysis of macroeconomic implications of minimum capital requirement and conservation buffer in Basel III.
- To do so, we need model environment whereby over-payment of dividends and executive bonuses naturally arise.
- There is no off-the-shelf macro-banking models....
  - Manager's incentive perfectly aligned with shareholders' interests.
  - No equity issuance.

Our Paper

- Main ingredients of our dynamic macro-banking model:
  1. Outside equity
  2. An impatient manager controls the bank
  3. Moral hazard through limited liability
- These elements allow us to analyze capitalization and risk taking of banks simultaneously.

Main Results

- Under-capitalization due to time-inconsistency problem. Time inconsistency problems exist because of:
  - Reoptimization of dividend payment;
  - Dilution of existing equities.
- Excessive leverage by banks due to moral hazard.
- Need for both capital conservation buffer and minimum capital requirement.

The Model: Bank without Uncertainty

- An impatient manager runs the bank ($\chi < \beta$).
- Budget constraint: $c + z + y = n + \alpha m$.
- New equity issuance: $m = e\beta\Omega\left(n'\right)$.
- Market valuation of bank equity in equilibrium:

$$\Omega\left(n\right) = z\left(n\right) + \beta\left[1 - e\left(n\right)\right]\ \Omega\left(n'\left(n\right)\right).$$

- Concave loan returns as a function of y: $n' = f\left(y\right)$.

Time Inconsistency Problem and Incentive Alignment

The manager today wants to set $z = 0$ and $e = 1$. We assume that existing shareholders impose the following restrictions:

- Manager's bonus is tightly linked to dividends:

$$c \leq \psi z.$$

- Anti-dilution protection determines the fraction of new claims by an accounting rule:

$$e \leq \frac{m}{(n - \gamma c - z) + m}.$$

Banker without Commitment (Markov Perfect Equilibrium)

$$V(n) = \max_{\{c,z,y,e,m\}} \{u(c) + \chi V(f(y))\}$$

subject to

$$c + z + y = n + \alpha m$$

$$m = e\beta\Omega(f(y))$$

$$c \leq \psi z$$

$$e = \frac{m}{(n - \gamma c - z) + m}.$$

- MPE is time-consistent but not history-dependent.
- Tomorrow's manager will *not* take into account that tomorrow's dividend policy affects today's equity issuance. Manager knows this.

Generalized Euler Equation:

$$u_c = \frac{\chi\left(1-\alpha\right)f_y}{1+\alpha\beta\gamma\psi f_y z_n' - \alpha\beta f_y} u_c'.$$

- $z_n' \equiv \frac{\partial z'}{\partial n'}$ captures preemptive action of the banker.
- This collapses to a usual Euler equation when $\alpha = 0$: $u_c = \chi f_y u_c'$.
- $z_n' > 0$ reduces y as there is an extra cost of increasing y through

$$\Omega\left(f\left(y\right)\right) = -\psi\gamma z\left(f\left(y\right)\right) + f\left(y\right).$$

More y partially erodes Ω' as unproductive c will increase.

Steady State Comparison

- Markov Perfect Equilibrium:

$$f_y^{ME} = \frac{1}{\chi(1-\alpha) + \alpha\beta(-\gamma\psi z'_n + 1)}$$

- Commitment Equilibrium:

$$f_y^{CM} = \frac{1}{\chi(1-\alpha) + \alpha\beta}$$

- Social Planner

$$f_y^{SP} = \frac{1}{\beta}$$

- Insufficient capitalization if $z'_n > 0$.

$$y^{SP} > y^{CM} > y^{ME}.$$

Numerical Results (Steady State)

- Functional forms: $u(c) = \log(c)$, $f(y) = y^{\nu}$.
- Parameter values:

α	β	γ	χ	ψ	ν
0.98	0.99	0.5	0.9	1.0	0.9

- Results: $z_n' = 0.036 > 0$. Thus, $y^{CM} > y^{ME}$.

Commitment Equilibrium vs Markov Perfect Equilibrium

	y	z	Ω	z/Ω	m/Ω
Commitment	0.31	0.035	0.33	0.10	0.09
Markov Perfect	0.26	0.034	0.28	0.12	0.11

Introducing Loans under Uncertainty

- Loans are funded by deposit and capital: $\ell = y + d$.
- Net loan return function generating n' exhibits DRS:

$$n' = F(\ell, y, \eta') = R\ell^{1-\gamma}\eta' - \left[R_d + h\underbrace{(\ell - y)}_{=d}\right]\underbrace{(\ell - y)}_{=d},$$

where $h(d)$ is the internal cost of deposit.

- The bank defaults when the shock, η', is small.
- We want to show

$$\text{leverage}^{ME} > \text{leverage}^{CM} > \text{leverage}^{SP},$$

$$y^{ME} < y^{CM} < y^{SP}.$$

The Model with Loans under Uncertainty

$$V(n;\Omega) = \max_{\{c,z,y,\ell,e,m\}} \Big\{ u(c) + \chi \int_{\eta'_*(\ell,y)} V\left(F\left(\ell,y,\eta'\right);\Omega\right) dG\left(\eta'\right) + \chi V\left(\underline{n}\right)\left[1 - G\left(\eta'_*\left(\ell,y\right)\right)\right] \Big\}$$

subject to

$$c + z + y = n + \alpha m$$

$$m = \beta e \int_{\eta'_*(\ell,y)} \Omega\left(F\left(\ell,y,\eta'\right)\right) dG\left(\eta'\right)$$

$$c \leq \psi z$$

$$e = \frac{m}{m + n - \gamma c - z}.$$

Two State Example (Long-Surviving Bankers)

- $\eta' \in \{0, 1\}$ and $p_1 = \Pr(\eta' = 1)$. Default when $\eta' = 0$.
- Assume $h = \kappa \cdot (\ell - y)$.
- The marginal condition w.r.t. ℓ determines $\ell(y)$.

$$F_{\ell}^{\text{Banker}} = (1-\gamma) R\ell^{-\gamma} - [R_d + 2\kappa(\ell - y)] = 0.$$

- Due to DRS, $d\ell(y)/dy < 1$, implying leverage is decreasing in y.
- As before, $y^{ME} < y^{CM}$ due to time inconsistency. Hence,

$$\text{leverage}^{ME} > \text{leverage}^{CM}.$$

Two State Example (Comparison with Social Planner)

- Marginal conditions w.r.t. ℓ and y imply $d^{CM} > d^{SP}$ and $\ell^{CM} < \ell^{SP}$:

$$d^{CM} = \frac{p_1^{-1}\left[\chi\left(1-\alpha\right)+\alpha\beta\right]^{-1} - R_d}{2\kappa} > \frac{\beta^{-1} - R_d}{2\kappa} = d^{SP},$$

$$\ell^{CM} = \left[\left[\chi\left(1-\alpha\right)+\alpha\beta\right] p_1 \left(1-\gamma\right) R\right]^{1/\gamma} < \left[\beta p_1 \left(1-\gamma\right) R\right]^{1/\gamma} = \ell^{SP}$$

- Moral hazard and impatience induce higher leverage for bankers.

$$\text{leverage}^{CM} > \text{leverage}^{SP},$$

$$y^{CM} < y^{SP}.$$

Capital Regulations

- Markov perfect equilibrium exhibits insufficient capital accumulation and excessive leverage.
- Minimum capital requirement places a cap on banks' leverage.
  - This addresses over-borrowing but not necessarily under-capitalization.
- Basel III complements this by restricting dividend payouts and manager compensation of banks with low capital.
  - May be an effective policy to address issues arising from *both* time inconsistency and moral hazard.

Conclusion

- Time inconsistency problem regarding outside equity issuance leads bankers to pay excessive dividends and accumulate insufficient capital.
- Moral hazard problem leads to too much borrowing and thus excessive leverage of banks.
- Minimum capital requirement may not be adequate to promote capital accumulation. Capital conservation buffer may be an effective policy instrument.
- What's next?
  - Global solution (non-steady-state analysis).
  - Quantitative analysis of capital regulations.
  - Markovian evolution of banking industry.
  - Aggregate shocks.
  - General equilibrium.