Financial Institution Dynamics and Capital Regulations

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Motivation

- Regulatory discussions during the financial crisis:
  - insufficient capitalization of banks;
  - bank dividend payouts (Acharya, Gujral, Kulkarni and Shin 2011);
  - executive compensation (Financial Stability Forum 2009).
- Basel III capital regulations include:
  - Capital conservation buffer (2.5%) + min. capital requirement (4.5%).
  - Distribution of earnings will be restricted if the buffer is drawn down.

Objective and 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 a model environment whereby over-payment of dividends and executive bonuses naturally arise.

- Existing macro-banking models typically have
  - no outside equity issuance, and/or
  - manager's incentive perfectly aligned with shareholders' interests.

- For today, focus on analyzing an equilibrium without capital regulations to discuss why they may be necessary.

Our Paper

- A macro-banking model featuring a manager who controls the bank and:
  1. issues outside equity and dividends (*time inconsistency* problem);
  2. is *impatient*; and
  3. faces *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, and
  - Dilution of existing equities.
- Excessive leverage by banks due to moral hazard.
- Need for both capital conservation buffer and minimum capital requirement.

Bank Manager's Problem with Implicit Loans

- Time-inconsistency issue

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

subject to

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

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

- In equilibrium,

$$\Omega(n) = z(n) + \beta[1 - e(n)]\ \Omega(f(y(n))).$$

- Bonus incentive

$$c \leq \psi z$$

- Anti-dulition protection

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

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Markov Perfect Equilibrium

Generalized Euler Equation:

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

- Knowing that tomorrow's manager will have his own interests, today's manager takes it into account through $z_n' \equiv \frac{\partial z'}{\partial n'}$.
- GEE collapses to a usual Euler equation when $\alpha = 0$: $u_c = \chi f_y u_c'$.
- The manager considers the "cost" of increasing y through

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

Under-Capitalization in MPE (Steady State)

- 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

Model with Loan, Deposit and Default

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

subject to

$c+z+y=n+\alpha m$	Budget Constraint
$\ell=d+y$	Balance Sheet
$m=e\,\beta\int_{\eta_*(d,y)}\Omega\left(F\left(\ell,y,\eta'\right)\right)dG\left(\eta'\right)$	Equity Issuance
$c\leq\psi z$	Compensation Constraint
$e=\dfrac{m}{(n-\gamma c-z)+m}$	Dilusion Constraint
$F(d,y,\eta')=R(d+y)^{1-\nu}\eta'-\left[R_d+h(d)\right]\cdot d$	Loan Return
$\eta_*\left(d,y\right)$ given by $F(d,y,\eta'=\eta_*)=0$	Default Threshold

The model simplifies to...

$$V(n) = \max_{z,y} \Big\{ u(\psi z) + \chi \int_{\eta_*(\widehat{d}(z,y,n),y)} V\left(F\left(\widehat{d}(z,y,n), y, \eta'\right)\right) G(d\eta') + \chi\, \underline{V}\, G\left(\eta_*(\widehat{d}(z,y,n),y)\right)\Big\}$$

- Deposit, $\widehat{d}$, is determined through the bud. const. given (z, y, n):

$$[1 + \psi - \alpha(1 + \gamma\psi)]\, z + y = (1 - \alpha)\, n + \alpha\beta \int_{\eta_*(\widehat{d},y)} F\left(\widehat{d}, y, \eta'\right) G\left(d\eta'\right) - \alpha\beta\gamma\psi \int_{\eta_*(\widehat{d},y)} z\left(F\left(\widehat{d}, y, \eta'\right)\right) G\left(d\eta'\right)$$

Optimality conditions

[z]

$$\psi u_c + \chi \left[\int_{\eta_*(\widehat{d},y)} V_n' F_d G(d\eta') + [\underline{V} - V(0)]\, G(\eta_*)\eta_{*d} \right] \widehat{d}_z = 0$$

[y]

$$\int_{\eta_*(\widehat{d},y)} V_n' \left(F_d \widehat{d}_y + F_y \right) G(d\eta') + [\underline{V} - V(0)]\, G(\eta_*) \left[\eta_{*d} \widehat{d}_y + \eta_{*y} \right] = 0$$

[envelope]

$$V_n(n) = \chi \left[\int_{\eta_*(\widehat{d},y)} V_n' F_d G\left(d\eta'\right) + [\underline{V} - V(0)]\, G(\eta_*)\, \eta_{*d} \right] \widehat{d}_n$$

Generalized Euler Equations

[y]

$$\psi u_c \frac{\widehat{d}_y}{\widehat{d}_z} = \chi \int_{\eta_*(\widehat{d},y)} \frac{\psi(1-\alpha)}{1+\psi-\alpha(1+\gamma\psi)} u_c' F_y G(d\eta') - \chi \left[\underline{V} - V(0)\right] G(\eta_*) \eta_{*y}$$

[z]

$$\psi u_c = \chi \left[- \int_{\eta_*(\widehat{d},y)} V_n' F_d G(d\eta' + \left[V(0) - \underline{V}\right] G(\eta_*) \eta_{*d} \right] \widehat{d}_z$$

GEEs continued

$[y]$

$$0 = \psi \, u_c \cdot \frac{1}{1+\psi-\alpha(1+\gamma\psi)} \Big\{$$

-1 direct loss in consumption from y↑

$+\alpha\beta \int_{\eta_*(\widehat{d},y)} (1-\gamma\psi z_n') F_y \, G(d\eta')$ gain in equity valuation from more loans

$+\alpha\beta\gamma\psi z(0) G(\eta_*)\eta_{*y} \Big\}$ gain in equity valuation from lower default

$+\chi \int_{\eta_*(\widehat{d},y)} \frac{\psi(1-\alpha)}{1+\psi-\alpha(1+\gamma\psi)} u_c' F_y \, G(d\eta')$ gain in future (consumption) from more loans

$+\chi \left[V(0) - \underline{V}\right] G(\eta_*)\eta_{*y}$ gain in continuation value from lower default

Two State Example

- Suppose $\eta' \in \{0, 1\}$ and $h = \kappa \cdot (\ell - y)$. Let $p_1 = \Pr(\eta' = 1)$.

- Long-surviving bankers' leverage and capital can be orderd as

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

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

Proof (Step 1)

- Compare a Markovian manager and a committed manager.

- Regardless of com. tech., $\ell(y)$ is the same under moral hazard.

$$D_\ell F(\ell(y), y, 1) = 0.$$

- DRS implies $d\ell(y)/dy < 1$ and leverage is decreasing in y.

- Again, $y^{ME} < y^{CM}$ due to time inconsistency. Hence,

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

Proof (Step 2)

- Compare a committed banker and the social planner.
- Only the banker is protected by limited liability.
- Solutions to d and ℓ satisfy $d^{CM} > d^{SP}$ and $\ell^{CM} < \ell^{SP}$:

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

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

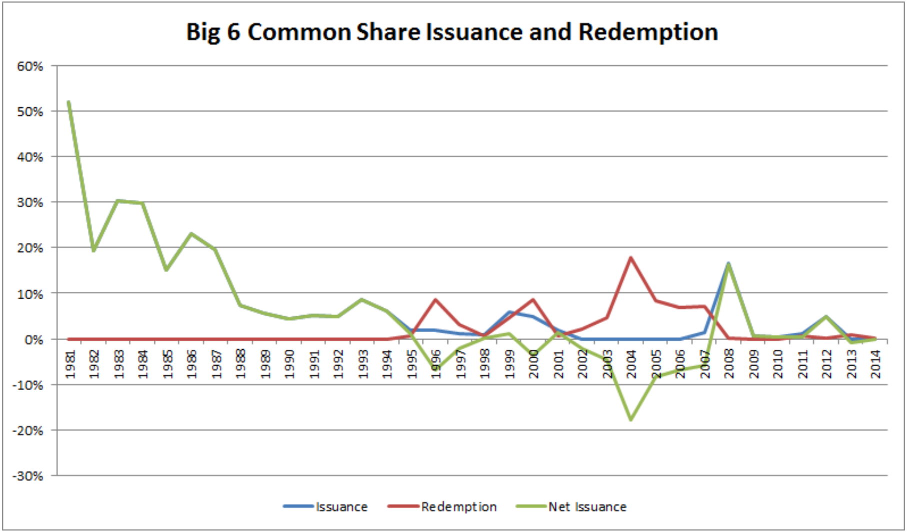
- This implies that $y^{CM} < y^{SP}$. As a result,

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

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 alone 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.

Equity Issuance by Banks in Canada



Dividend Payout by Banks in Canada