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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.
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.
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: $m = e\beta\Omega(n')$.

- Market valuation of bank equity in equilibrium:
  \[
  \Omega(n) = z(n) + \beta [1 - e(n)] \Omega(n'(n)).
  \]

- Concave loan returns as a function of $y$: $n' = f(y)$. 
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.
Properties of Markov Perfect Equilibrium

**Generalized Euler Equation:**

\[ u_c = \frac{\chi (1 - \alpha) f_y}{1 + \alpha \beta \gamma \psi f_y z_n' - \alpha \beta f_y} u'_c. \]

- \( z_n' \equiv \frac{\partial z'}{\partial n'} \) 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 \( \Omega (f (y)) = -\psi \gamma z (f (y)) + f (y) \).

More \( y \) partially erodes \( \Omega' \) 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:

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<th>( \beta )</th>
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- Results: \( z_n' = 0.036 > 0 \). Thus, \( y^{CM} > y^{ME} \).

Commitment Equilibrium vs Markov Perfect Equilibrium

<table>
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<th>( z )</th>
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Introducing Loans under Uncertainty

- Loans are funded by deposit and capital: \( \ell = y + d \).

- Net loan return function generating \( n' \) exhibits DRS:

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

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

- The bank defaults when the shock, \( \eta' \), 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

\[ V(n; \Omega) = \max_{\{c,z,y,\ell,e,m\}} \left\{ u(c) + \chi \int_{\eta^*(\ell,y)} V(F(\ell,y,\eta'); \Omega) \, dG(\eta') \right. \]

\[ + \chi V(n) \left[ 1 - G(\eta^*(\ell,y)) \right] \}

subject to

\[ c + z + y = n + \alpha m \]

\[ m = \beta e \int_{\eta^*(\ell,y)} \Omega(F(\ell,y,\eta')) \, dG(\eta') \]

\[ c \leq \psi z \]

\[ e = \frac{m}{m + n - \gamma c - z} \]
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. $\ell$ 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, leverage^{ME} > leverage^{CM}.
Two State Example (Comparison with Social Planner)

- Marginal conditions w.r.t. $\ell$ and $y$ imply $d^{CM} > d^{SP}$ and $\ell^{CM} < \ell^{SP}$:
  
  \[
  d^{CM} = \frac{p^{-1}_1 [\chi (1 - \alpha) + \alpha \beta]^{-1} - R_d}{2\kappa} > \frac{\beta^{-1} - R_d}{2\kappa} = d^{SP},
  \]
  
  \[
  \ell^{CM} = \left[ [\chi (1 - \alpha) + \alpha \beta] p_1 (1 - \gamma) R \right]^{1/\gamma} < \left[ \beta p_1 (1 - \gamma) R \right]^{1/\gamma} = \ell^{SP}
  \]

- Moral hazard and impatience induce higher leverage for bankers.
  
  \[
  \text{leverage}^{CM} > \text{leverage}^{SP},
  \]
  
  \[
  y^{CM} < y^{SP}.
  \]
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.