Intermediary Asset Pricing

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Motivation

- How to account for risk premia?

  - Standard models assume households determine risk premia
  - World is not so “risky” for households
  - Consumption $\equiv$ smooth and low correlation with stocks $\rightarrow$ Equity premium puzzle
Motivation

- How to account for risk premia?
  - Standard models assume households determine risk premia
  - World is not so “risky” for households
  - Consumption \equiv \text{smooth and low correlation with stocks} \rightarrow \text{Equity premium puzzle}

- Recent crisis pinpoints banks as crucial sector in the economy
  - Re-capitalizing the banking sector was a priority after the collapse of Lehmann
  - Banks capital matters!
**Contribution**

- Model in which banks determine risk premia
- Banks face an *equity capital constraint*
- Risk premia depends on banks capital
Contribution

- Model in which banks determine risk premia
- Banks face an **equity capital constraint**
- Risk premia depends on banks capital

- The model can account for the level & dynamics risk premia
- **Non-linearity:** when the equity constraint binds → “very tough times”
  - When banks hits the constraint, the economy enters in a crisis
  - A model of **endogenous banking crisis**
Environment

- Infinite-horizon, continuous-time Lucas tree economy
- Two groups of agents: **Households** and **Bankers**
  - Households: invest in equity of banks and risk-free bonds
  - Bankers: run banks, invest in stocks and bonds subject to equity constraint
The Model

Environment

- Infinite-horizon, continuous-time Lucas tree economy
- Two groups of agents: **Households** and **Bankers**
  - Households: invest in equity of banks and risk-free bonds
  - Bankers: run banks, invest in stocks and bonds subject to equity constraint
- Only Bankers can invest in stocks (exogenous mkt segmentation)
- Bankers’ stochastic discount factor determines risk premia
**Assets**

- **Stocks:** Price $p_t$ and yields flow of dividends

  \[
  \frac{dD_t}{D_t} = gt + \sigma dZ_t, \quad \text{given } D_0
  \]

- **Total Return Stocks:**

  \[
  dR_t = \frac{D_t dt + dP_t}{P_t}
  \]

- **Bonds:** zero net supply and yields the interest rate $r_t$
The Model

Banks

- Unit mass of infinitely-lived identical bankers who manage banks
- Bankers maximize $E \left[ \int_0^\infty e^{-\rho t} u(c_t) \, dt \right]$
- Each banker runs a bank
- Bankers are randomly matched to households (one-period link)
  - **Households** invest in $H_t$ equity of bank
  - **Bankers** invest their full wealth $w_t$ in the bank
  - Return on banks' capital: $d\tilde{R}_t = r_t \, dt + \alpha' (dR_t - r_t \, dt)$
  - $\alpha' > 1$, banks are levered and borrow $(\alpha' - 1) (w_t + H_t)$ in the bonds market
Capital Constraint

- Households can’t invest in stocks
- Households can’t invest more than $mw_t$ in the equity of banks
  \[ H_t \leq mw_t \]
- No constraint on debt positions. Banks can leverage as much as they want.
- Bankers budget constraint is
  \[ dw_t = -c_t dt + w_t r_t dt + \alpha' w_t (dR_t - r_t dt) \]
Households

- OLG of agents to keep simplicity
- Receives a labor income \( l \times D_t \)
- Invest a minimum \( \lambda \) of his wealth \( w_t^h \) in bonds
- Given log utility, the problem is

\[
\max_{\alpha^h_t \in [0,1]} \alpha^h_t \mathbb{E}_t \left[ d\tilde{R}_t - r_t dt \right] - \frac{1}{2} (\alpha^h_t)^2 \text{Var}_t \left[ d\tilde{R}_t - r_t dt \right]
\]

\[
\text{s.t. } \alpha^h_t (1 - \lambda) w_t^h \equiv H_t \leq mw_t
\]

\[
dw_t^h = (lD_t - \rho w_t^h) dt + w_t^h r_t dt + \alpha^h_t (1 - \lambda) w_t^h \left( d\tilde{R}_t - r_t dt \right)
\]
Equilibrium Risk Premium

- Risk premium when Bankers have log utility

\[ E_t [dR_t] - r_t dt = \gamma \text{Cov}_t \left[ \frac{dc_t}{ct}, dR_t \right] \]

\[ E_t [dR_t] - r_t dt = \alpha_t^l \text{Var}_t [dR_t] \]

- Given \( x_t = \frac{w_t}{P_t} \),

\[ \frac{\alpha_{t,\text{const}}^l}{\alpha_{t,\text{unconst}}^l} = \frac{1}{1 + m} \left( 1 + (1 - \lambda) \frac{1 - x_t}{x_t} \right) \]
## Calibration

### Panel A: Intermediation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$m$</td>
<td>Intermediation multiplier</td>
<td>4</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>Debt ratio</td>
<td>0.6</td>
</tr>
</tbody>
</table>

### Panel B: Preferences and Cashflows

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$g$</td>
<td>Dividend growth</td>
<td>2%</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Dividend volatility</td>
<td>9%</td>
</tr>
<tr>
<td>$\rho$</td>
<td>Time discount rate</td>
<td>4%</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>RRA of specialist</td>
<td>2</td>
</tr>
<tr>
<td>$l$</td>
<td>Labor income ratio</td>
<td>1.84</td>
</tr>
</tbody>
</table>

- Compensation of financial managers
- Debt/assets of intermediary sector
- Growth of economy
- Volatility of MBS portfolio
- Short-term interest rate
- Risk premium on MBS portfolio
- Share of labor income in total income
Risk Premium and Banks’ Capital

![Graph showing risk premium and banks' capital relationship]

- Constrained region
- Unconstrained region
Endogenous Crises
## Main Results

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>$\sigma = 6$</th>
<th>$\gamma = 1$</th>
<th>$m = 8$</th>
<th>$\lambda = .05$</th>
<th>$l = 1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Premium (%)</td>
<td>3.36</td>
<td>1.96</td>
<td>2.35</td>
<td>3.38</td>
<td>3.25</td>
<td>3.19</td>
</tr>
<tr>
<td>Sharpe Ratio (%)</td>
<td>36.46</td>
<td>32.62</td>
<td>27.34</td>
<td>37.11</td>
<td>35.72</td>
<td>34.81</td>
</tr>
<tr>
<td>Interest Rate (%)</td>
<td>0.06</td>
<td>1.42</td>
<td>0.95</td>
<td>0.02</td>
<td>0.14</td>
<td>0.83</td>
</tr>
<tr>
<td>Labor income ratio</td>
<td>0.64</td>
<td>0.52</td>
<td>0.54</td>
<td>0.62</td>
<td>0.55</td>
<td>0.61</td>
</tr>
<tr>
<td>Price/Dividend</td>
<td>70.50</td>
<td>70.02</td>
<td>71.00</td>
<td>71.00</td>
<td>70.22</td>
<td>49.50</td>
</tr>
<tr>
<td>Prob(Unconstrained) (%)</td>
<td>65.50</td>
<td>12.48</td>
<td>39.40</td>
<td>78.95</td>
<td>0.91</td>
<td>78.35</td>
</tr>
<tr>
<td>Debt/Assets Ratio</td>
<td>0.50</td>
<td>0.49</td>
<td>0.52</td>
<td>0.52</td>
<td>0.00</td>
<td>0.48</td>
</tr>
<tr>
<td>(Unconstrained)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob($RiskPremium &gt; 2 \times RiskPremium$)</td>
<td>0.87</td>
<td>1.99</td>
<td>3.49</td>
<td>0.55</td>
<td>1.43</td>
<td>0.57</td>
</tr>
<tr>
<td>E($RiskPremium</td>
<td>&gt; 2 \times RiskPremium$)</td>
<td>8.89</td>
<td>5.23</td>
<td>7.41</td>
<td>9.40</td>
<td>8.60</td>
</tr>
</tbody>
</table>
## Probability of Crisis

<table>
<thead>
<tr>
<th>Risk Premium ($RP^*$)</th>
<th>3.00%</th>
<th>6%</th>
<th>9%</th>
<th>12%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A: Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probability($Risk;Premium &gt; RP^*$)</td>
<td>89.77</td>
<td>1.33</td>
<td>0.22</td>
<td>0.07</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>32.31</td>
<td>66.26</td>
<td>103.59</td>
<td>144.04</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>0.48</td>
<td>-2.35</td>
<td>-5.47</td>
<td>-8.81</td>
</tr>
<tr>
<td>Debt/Assets</td>
<td>45.63</td>
<td>82.66</td>
<td>90.28</td>
<td>93.57</td>
</tr>
</tbody>
</table>
## Recovery

**Panel A: Baseline**

<table>
<thead>
<tr>
<th>Transit to</th>
<th>10</th>
<th>7.5</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit time from 12</td>
<td>0.18</td>
<td>0.65</td>
<td>1.42</td>
<td>2.67</td>
<td>5.56</td>
<td>9.34</td>
</tr>
<tr>
<td>Increment time</td>
<td>0.18</td>
<td>0.47</td>
<td>0.77</td>
<td>1.25</td>
<td>2.90</td>
<td>3.78</td>
</tr>
</tbody>
</table>
A model where banks capital determine risk premia

**Non-linearity:** when the equity constraint binds $\rightarrow$ “very tough times”

- When banks hits the constraint, the economy enters in a crisis
- A model of *endogenous banking crisis*

New strand of literature that focus on “special” role banks’ capital

New strand of literature that studies *Occasionally Binding Constraints*