“Intermediary Balance Sheets”

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**Objective:** Construct a general equilibrium model with two types of intermediaries:
- some with leverage constraints (banks)
- some with equity (skin-in-the-game) constraints (funds)

in order to determine the cyclicality of each type and of the overall financial sector.

**Result:** In the model and in the data:

- Banking sector: Pro-cyclical leverage
- Non-banking fin. sector: Acyclical leverage.
- Overall financial sector: Pro-cyclical leverage.

**Implication:** Among intermediary asset pricing models, those focusing on leverage constraints are more relevant that those focusing on intermediary wealth for understanding aggregate dynamics.
Background:

1) Why are models with financial intermediaries needed?
2) What is the essence of intermediary asset pricing models?
3) What other empirical evidence is there for/against either type of model?

Comments:

1) We’re not inherently interested in intermediary leverage. Add results on asset prices, real economic evidence and policy.
2) What’s achieved by combining the two types of models into one? How is this best done?
3) What is missing in the models with have so far?
Background I: Why do we need intermediary asset pricing models?

Risk premia increase much more following financial crises than recessions.

Muir (2014) uses data from 1870-2012 for 14 countries (180 non-financial recessions and 45 financial crisis)
This is hard to reconcile with consumption based models (consumption falls about the same in financial crisis and recessions and consumption volatility is similar).

Figure 1: This figure computes changes in risk premia, as measured by dividend yields (left axis) and credit spreads (right axis), in Panel A across financial crises, recessions, and wars. Panel B plots consumption state variables argued to capture variation in risk premia: the peak to trough decline in consumption (left axis) and consumption volatility (right axis).
Background 2: What is the essence of intermediary asset pricing models? From limited participation to intermediary asset pricing

It’s hard for households to figure out how to invest in risky assets.

Literature on limited stock market participation:

- Recognizes that many households don’t hold risky assets. Focuses on how this concentrates risk among stockholders.

- Shows empirically that consumption-based models do better when focusing on stockholders:

  Richest 1/3 of stockholders have beta of 3 on aggregate consumption → You can explain the equity premium with 1/3 the risk aversion.

  You can also get time-varying risk premia since wealth shares of stockholders fluctuate over time.
• How do intermediaries fit into this?

• The riskless asset is in zero net supply.
  In order for non-stockholders to do any saving in the riskless asset, stockholders issue riskless assets to non-stockholders.

• Financial intermediaries are not modelled explicitly. Implicitly, stockholders set up banks to issue riskless assets (deposits) to non-stockholders. Banks then holds risky assets on behalf of stockholders.

• So stockholders hold some risky asset directly and some indirectly via banks. **Stockholder leverage** via banks contributes further to increase the risk premium on risky assets (and on bank equity).
Literature on intermediary asset pricing, the “net worth” models (He and Krishnamurthy (2013)):

- Investing in risky assets is so hard that most is done via intermediaries and someone has to manage the intermediaries.

- **Constraint:** Intermediary managers’ wealth constrains size of intermediary’s overall equity, for moral hazard reasons.
  
  - **Stockholders Euler equation** is now non-standard: Sometimes they cannot invest more in intermediary equity even though exp returns look attractive.
  
  - When the constraint binds for stockholders, the risk premium is **higher** than in a standard limited participation setting and it’s time-varying.
  
  - Intermediary managers’ Euler equation is standard and always holds so you can use that to easily see the main points.
Risk premium based on manager’s Euler equation:

\[ E_t[dR_t] - r_t dt = \gamma Cov_t \left[ \frac{d_c t}{c_t}, dR_t \right] \]

\[ E_t[dR_t] - r_t dt = \alpha^I_t Var_t[dR_t] \quad \text{(in the log utility case)} \]

where \(\alpha^I_t\) is the risky asset share of the intermediary (risky assets/equity), which equals its leverage (since it doesn’t hold riskless asset as an asset).

Constraint: \(H_t \leq mw_t\)

Risky asset market clearing when constraint binds: \(\alpha^I_{t,\text{const}}(w_t + mw_t) = P_t\)

**Dynamics:** Less manager wealth, \(w_t\), relative to the value of the risky asset \(P_t\) → Larger intermediary risky asset share (leverage) needed to clear the risky asset market → Higher risk premium to induce bank manager to do this.

**Important:** In a crisis, \(w_t/P_t\) falls because the manager is invested 100% in intermediary equity which is a leveraged position in the risky asset.
Intermediary’s Position in Risky Asset ($\alpha^1$)

Constrained region

Unconstrained region
Which part of the financial sector is this a realistic model of? Banks.

- He and Krishnamurthy (2013) argue that if you want to think about the cyclicality of risk premia, you have to think about the intermediary in their model as a **bank**:

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  Importantly for the present analysis, in accord with our model the intermediaries that are the buyers during the crisis (i.e. banks) do so by borrowing and increasing leverage. Our model does not capture the other aspect of this process, as reflected in the behavior of the hedge fund sector, that some parts of the financial sector reduce asset holdings and deleverage”.
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He and Krishnamurthy discuss Ang, Gorovyy, Van-Inwegen (2010)'s evidence on market value leverage:

- Banks increase market value leverage in crisis. That fits the HK model.
- Hedge funds reduce market value leverage in crisis. That doesn’t fit the HK model.
Now, why do Adrian and Boyarchenko (and Shin and Moench) think this type of model is the wrong way to think about crisis and the financial sector?

- They agree that financial sector market leverage is counter-cyclical, but think we should focus on book leverage and the financial sector’s book leverage is pro-cyclical:

In bad times volatility increases, therefore banks delever and shrink, and the reduced risk-bearing capacity of banks is what drives up risk premia.
A graph from Adrian, Moench and Shin (2013) to illustrate how book and market leverage of banks (and of the overall US financial sector) have completely different cyclicalities:

Figure 1: Book Leverage and Market Leverage

The left panel shows the scatter chart of the asset-weighted growth in book leverage and total assets for the eight largest US dealers and banks. The right panel is the scatter chart for the asset-weighted growth in enterprise value leverage and enterprise value. Enterprise value is the sum of market capitalization and debt, and enterprise value leverage is the ratio of enterprise value to market capitalization. The dark dots are for 2007 - 2009. The eight institutions are Bank of America, Citibank, JP Morgan, Bear Stearns, Goldman Sachs, Lehman Brothers, Merrill Lynch and Morgan Stanley (Source: SEC 10Q filings).
Why do they think we should focus on book leverage?

- Essentially start from the idea that: **Someone has to regulate the intermediary (bank)**. The key constraint on intermediaries is a regulatory constraint on leverage (Basel), which is based on book leverage.

- Regulatory constraint on book leverage ($\theta_t=$book assets/book equity) (=market value leverage in the model but that’s not the point):

$$\theta_t \leq \frac{1}{\alpha \sqrt{\sigma_{ka,t}^2 + \sigma_{k\xi,t}^2}}$$

where

$$dR_{kt} = \frac{A_t k_{ht}}{k_{ht} p_{kt} A_t} dt + \frac{d \left( k_{ht} p_{kt} A_t \right)}{k_{ht} p_{kt} A_t} = \mu_{R_{kt}} dt + \sigma_{ka,t} dZ_{at} + \sigma_{k\xi,t} dZ_{\xi t}$$

- **dividend–price ratio**
- **capital gains**
• Earlier Adrian and Boyarchenko paper: Bank’s constraint is assumed to always bind (bank manager risk aversion is assumed close to zero).

Bank managers’ Euler equation is therefore not standard. The risk premia on bank stock and on risky capital becomes a function of the Lagrange multiplier on the bank’s leverage constraint.

• This Lagrange multiplier is increasing in how fun it is to be a bank, i.e. a function of the expected excess return on the risky asset over bank debt and the sensitivities of capital returns and bank debt returns to the underlying two shocks (productivity, preferences).

Risk premia are linear function of the sensitivities of the capital returns to the underlying shocks and of the state variables which are bank leverage and the share of wealth owned by bank managers (as opposed to households).
This is not a closed form solution, but graphically the equity excess return is negatively related to leverage growth and leverage growth is negatively related to (endogenously) increased risk (shock sensitivities).

Figure 5: Excess Returns and Intermediary Leverage

![Figure 5: Excess Returns and Intermediary Leverage](image)

Figure 3: Intermediary Leverage and Lagged Volatility Growth

![Figure 3: Intermediary Leverage and Lagged Volatility Growth](image)

(Why no t-stats…?) (Why lag sometimes?) (R2 is low in both model and data – this doesn’t explain much of actual fluctuations in leverage).
Background 3: What other empirical evidence is there for/against either type of model?

- **Adrian, Moench and Shin (2013)** perform time-series and cross-sectional asset pricing tests and argue that book equity-based measures work best.

  1975-2012.
  AR(1) innovations of growth rates of equity as pricing factor
  Lagged growth rates as predictors.

  Consider:
  - book vs. market equity,
  - leverage vs. equity
  - broker-dealers vs. banks.

  Find that broker-dealer **book leverage works best**.

- But in favor of net worth and market value models, **Muir (2014)** shows that **intermediary market equity/GDP** works well for predicting stock excess returns. And intermediary mkt. equity works in cross-sect asset pricing tests.
  1948-2012. Intermediary=SIC code 6 (finance, insurance, real estate).
• He and Krishnamurthy argue that it’s incorrect to think about the banking sector as shrinking during the worst part of the crisis. (From Arvind’s comments on Adrian and Shin, NBER MA).

<table>
<thead>
<tr>
<th>Table C1</th>
<th>U.S. Commercial Bank Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q4 2007</td>
</tr>
<tr>
<td>Cash and Reserves</td>
<td>76</td>
</tr>
<tr>
<td>Securities</td>
<td>2,253</td>
</tr>
<tr>
<td>Loans and Leases</td>
<td>6,807</td>
</tr>
<tr>
<td>All Other Assets</td>
<td>243</td>
</tr>
<tr>
<td>Total Financial Assets</td>
<td>9,379</td>
</tr>
</tbody>
</table>

Why did banks not shrink?
- Firms and securitization conduits drawdowns of pre-committed credit lines.
- Banks purchased MBS from others.
Comment 1: We’re not inherently interested in intermediary leverage. Add results on asset prices, real activity and policy.

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Modeling the equilibrium dynamics of He and Krishnamurthy [2012b, 2013] and Adrian and Boyarchenko [2012] within the same economy is relevant, as both banks and funds are important financial intermediaries, though their balance sheet behavior is very different. The empirical evidence presented here suggests that both bank sector dynamics and fund sector dynamics co-exist, and that bank sector dynamics are particularly important in understanding the evolution of pricing, volatility, and real activity.”

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In general equilibrium, the dynamic properties of the two sectors interact in such a way that the bank sector exhibits endogenously procyclical leverage, while the fund sector is acyclical. The dynamic properties of the nonbank sector are markedly different from He and Krishnamurthy [2013], as household allocate optimally between the bank and nonbank sectors in our setting. These findings matter for normative questions, as the cyclicality of leverage matters for policy conclusions.”
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- So it seems like the paper wants to be about:
  - Intermediary leverage
  - Asset pricing
  - Real activity
  - Optimal policy

- Currently it is mainly about intermediation leverage:
  - There's no matching of asset prices from the model and asset prices in the data
    - What is the level and dynamics of risk premia?
    - How volatile are prices on bank’s long-term debt?
  - There’s no assessment about real activity:
    - How much do leverage constrained banks affect output and consumption volatility relative to skin-in-the game constrained funds?
There’s no policy analysis

He and Krishnamurthy considered which policies are most effective at quickly reducing risk premia, standing in a financial crisis:

a) Low short rates (standard monetary policy)
b) Asset purchases (unconventional monetary policy)
c) Equity injections

(a) and (c) are found to be more successful (theoretically).

Is that different here? Is something new going on here?

For example, should you inject equity only in banks, not in the fund sector?
Comment 2: What’s achieved by combining the two types of models into one? How should this be done?

- From Tobias’ perspective, **why not just ignore the He and Krishnamurthy model** and related intermediary net worth models?

  Because **not all parts of the financial sector face book leverage constraints**. Perhaps the He and Krishnamurthy model could be relevant for those who don’t?

- **As noted above, HK model cannot mainly be about hedge funds.** Consistent with that, the current paper doesn’t include hedge funds in the fund sector: In the Flow of Funds hedge funds are part of the household sector.

- **But then what is the fund sector? Is the HK model a plausible description of that? I think no.**
What is everything in Flow of Funds Table L.107 that’s not banks or broker-dealers?

<table>
<thead>
<tr>
<th>Description</th>
<th>Fin. assets, 2013 ($B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total financial business</td>
<td>82,199</td>
</tr>
<tr>
<td>L.108 Monetary authority</td>
<td>4,074</td>
</tr>
<tr>
<td>L.110 U.S.-chartered depository institutions, excluding credit unions</td>
<td>12,803</td>
</tr>
<tr>
<td>L.111 Foreign banking offices in U.S.</td>
<td>2,037</td>
</tr>
<tr>
<td>L.112 Banks in U.S.-affiliated areas</td>
<td>85</td>
</tr>
<tr>
<td>L.113 Credit unions</td>
<td>1,003</td>
</tr>
<tr>
<td>L.114 Property-casualty insurance companies</td>
<td>1,531</td>
</tr>
<tr>
<td>L.115 Life insurance companies</td>
<td>5,977</td>
</tr>
<tr>
<td>L.117.b Private pension funds, defined benefit</td>
<td>3,069</td>
</tr>
<tr>
<td>L.117.c Private pension funds, defined contribution</td>
<td>4,905</td>
</tr>
<tr>
<td>L.118 State and local government employee retirement funds</td>
<td>4,846</td>
</tr>
<tr>
<td>L.119 Federal government employee retirement funds</td>
<td>3,531</td>
</tr>
<tr>
<td>L.120 Money market mutual funds</td>
<td>2,678</td>
</tr>
<tr>
<td>L.121 Mutual Funds</td>
<td>11,545</td>
</tr>
<tr>
<td>L.122 Closed-end and exchange-traded funds</td>
<td>284</td>
</tr>
<tr>
<td>L.123 GSEs</td>
<td>6,361</td>
</tr>
<tr>
<td>L.124 Agency- and GSE-backed mortgage pools</td>
<td>1,569</td>
</tr>
<tr>
<td>L.125 Issuers of asset-backed securities</td>
<td>1,615</td>
</tr>
<tr>
<td>L.126 Finance companies</td>
<td>1,473</td>
</tr>
<tr>
<td>L.127 Real estate investment trusts</td>
<td>507</td>
</tr>
<tr>
<td>L.128 Security brokers and dealers</td>
<td>3,408</td>
</tr>
<tr>
<td>L.129 Holding companies</td>
<td>4,276</td>
</tr>
<tr>
<td>L.130 Funding corporations</td>
<td>2,023</td>
</tr>
<tr>
<td>Not included: Hedge funds (I used data from FSOC (2014))</td>
<td>2,600</td>
</tr>
</tbody>
</table>
The Fed: Surely not what HK tried to model. The Fed’s equity is not determined by a moral hazard constraint to make Yellen put in high effort...

Pension/retirement funds/mutual funds: They have no leverage. Cannot be the focus of a discussion about the cyclicality of the non-banking sector’s leverage.

Insurance companies: They have leverage. But is their constraint not closer to a regulatory constraint? (Ralph & Moto’s work).

GSEs? The rest? HK left that out of their table of the financial sector so clearly didn’t intend their model to apply to that.

So, if the HK-type sector ends up with acyclical leverage in the model, is that the reason non-banks have acyclical leverage in the data? I think no.

My suggestion: Have one financial sector with two constraints: Skin-in-the-game and leverage.
If they want to keep the current setup, then the results need clarification.

In particular, exactly why does the fund sector end up with acyclical leverage in the model in equilibrium?

- Either the fund’s net worth constraint is often not binding.

- Or w/P doesn’t fall in crisis so the risky asset can be held with no increase in fund leverage.

- Or the capital demand of the banking sector picks up in crisis, but we know that’s not the case since the banking sector is procyclical in the model.

One cannot figure this out from the paper:

- It’s not shown how frequently the fund sector’s constraint binds nor how frequently the bank sector’s constraint binds.

- It’s not shown whether funds in equilibrium have a positive or negative weight on the riskless asset. Remember that this is the key determinant of whether w/P drops in crisis.
Also, I’m not a big fan of how they model bank debt:

- In reality, here is how I would think of the need for leverage regulation:
  - Depositors (non-stockholders) want riskless deposits
  - The bank equity holders (managers and other stockholders) would like to commit ex ante to keeping deposits riskless, but cannot.
  - Role for deposit insurance. Then need for regulation to limit bank risk taking.

- That’s not what’s going on in paper: Banks issue floating rate long bonds.

- A sequence of short-term deposits is not the same as a floating-rate long-term bond:
  - Households cannot reduce their bond investments when they want. The coupon has to adjust instead of the quantity.
  - And banks don’t earn a “safety-premium” on issuing ultra-safe debt. That interacts with the last issue I want to mention: Treasuries.
Comment 3: What’s still missing in these intermediary asset pricing models? The government: Treasury supply, reserve supply

- Fluctuations in Treasury supply are large relative to the size of the financial sector. Also substantial movement in Fed supply of reserves backed by MBS (or gold).

In crisis (financial crisis/recession/war), government supply/gdp goes up a lot. So does the fin. sectors holdings of govt. supplied assets.

- Regression: Fin. sector Govt. holdings/GDP on Treasuries/GDP, beta=0.5.
- Regression: Fin. sector lending/GDP on Treasuries/GDP, beta=-0.5.

- Interesting to think about this with a leverage constrained bank:

  - Govt. holdings have low risk-weights so become attractive exactly when the constraint is tight. And that’s exactly when the govt. adds supply.

  - So adding Treasuries may make the overall financial sector size less procyclical, but its lending more procyclical.
Figure 3. Impact of government supply on financial sector balance sheet, 1914-2011
Panel A. Impact on short, long, and equity net categories
Figure 2. Financial sector balance sheet, 1914-2011
Panel A. Instruments that are net assets on average across years