Are U.S. Banks Safer?
Reading the Fed’s New Dashboard

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The Fed Board’s New Dashboard

**Accounting Signals**
- Book value of equity to assets
- Bank profitability, loan quality, and asset growth

**Market Signals**
- Market value of equity to assets
- CDS and bond spreads and equity volatility—distance to default
Conflicting Signals

**Accounting Signals**

- Book value of equity to assets
- Bank profitability, loan quality, and asset growth

**Market Signals**

- Market value of equity to assets
- CDS and bond spreads and equity volatility

How to interpret these signals for:

- regulators and U.S. Taxpayers
- holders of bank equity and bank bonds
Today’s Talk

Unified model of banks’ accounting and market signals
- Sarin and Summers (2016)
- Atkeson, d’Avernas, Eisfeldt, and Weill (2019)

Market signals of size of crisis shock to bank assets
- Begenau, Bigio, Majerovitz, and Vieyra (2019)
- Begenau, Piazzesi, Schneider (2015)

Interpret changes in average signals pre- to post-crisis

Interpret accounting and market signals in the cross-section

Bailout expectations in bond spreads
- Berndt, Duffie, Zhu (2019)
Outline

1. Fed Dashboard and Stress Test Framework

2. Market Signals of Size of Crisis Shock

3. Unified Model of Banks’ Accounting and Market Signals

4. Interpret Accounting and Market Signals

5. Conclusion
Fed Dashboard and Stress Test Framework
Accounting Data: Book Equity Up, Small Drop in 2007-2008

5. Capital Adequacy and Asset Growth

Note: CET1, tier 1 and total capital is reported instead of the components of tier 1 common equity and tier 1 and total risk-based capital by advanced approaches firms starting in 2014:Q1, and by all other firms starting in 2015:Q1, causing series breaks in some capital ratios in those quarters. Changes in the measurement of RWA starting in 2013:Q1 and 2015:Q1 also affect measurement of risk-weighted capital ratios and the ratio of RWA to total assets starting in those quarters. See 'Caveats and Limitations' for details. See data notes for definition of tier 1 common equity.
Accounting Data: Profitability Improving

Return on Equity

Annualized net income as % of equity


-20 -10 0 10 20

-20 -10 0 10 20


All Institutions
BHCs >$500bn
BHCs $50bn-500bn
Banks and BHCs <$50bn
3. Loan Performance

Note: Non-performing loans include loans that are (1) 90 days or more past due and still accruing or (2) non-accrual.
Market Data: Market Equity Down, Big Drop in 2007-2008
Market Data: CDS Spreads Up
Stress Test Framework and Results

Stress test framework can be summarized as:

\[
\frac{CET_1\t+1}{RWA_{t+1}} = \frac{1}{(1 + g_{At})^{1/4}} \frac{CET_1\t+1}{RWA_t}
\]

\[
\frac{CET_1\t+1}{RWA_t} = \frac{CET_1\t}{RWA_t} + \frac{PPNR_t}{RWA_t} - \frac{Provisions_t}{RWA_t} - \frac{Taxes_t}{RWA_t} - \frac{Dividends_t}{RWA_t}
\]

- model responses of income statement items to severe macro shock
- cumulative impact on accounting capital over a fixed horizon

Results:

- aggregate drop in \(CET1/RWA\) of about 6 percentage points
- much larger (smaller) than the loss of book (market) capital
Market Signals of Size of Crisis Shock

- observed drop in market value of equity
- Merton’s distance-to-default
- crisis losses on corporate bond portfolios
Observed losses on market value of bank equity

- Banks lost about $1 Trillion in market cap 2006-2009
- Drop in $ME/RWA$ of 20 percentage points
- Compared to drop in $BE/RWA$ of less than 2 percentage points
- Compared to stress test drop in $BE/RWA$ of 6 percentage points
- Lower bound on the drop in bank value
Distance-to-Default: Equity Volatility and Market Leverage

Merton’s distance-to-default

- Moody’s expected default frequency
- Atkeson, Eisfeldt, and Weill (2017)

Problem: volatility jumps in a crisis

- d’Avernas (2018)
- Nagel and Purnanandam (forthcoming)

▷ Have to model the probability of a jump in volatility
Bond returns as a measure of crisis losses

Begenau, Piazzesi, Schneider (2015);
Atkeson, d’Avernas, Eisfeldt, and Weill (2019)

- corporate bonds include MBS
- look at total returns on diversified bond portfolios

Have to match bank loan portfolios on maturity and credit risk

- maturity risk
- BBB credit risk
- High Yield credit risk

losses of 15-20 percent of portfolio value in 2 years or less frequent
can be as high as 40 percent
Unified Model of Banks’ Accounting and Market Signals

- bank franchise value and market value of government guarantees
- feed in crisis losses of 16% of bank value
- can match many accounting and market signals pre- and post-crisis
Gordon Growth Model for Accounting and Valuation

- Time period: time to reset book equity or close bank

- States $s \in S$ are i.i.d. under risk-neutral probability $q(s)$

- For calibration two states: $s \in \{n, c\}$ normal and crisis.
  - $q(c)$ risk-neutral crisis probability

- Constant risk-free rate $i$

- Assets: loans $L$

- Gov't guaranteed deposits $D$, sub. debt $B$, and book equity $BE$

- Assets and liabilities grow at the same rate $g(s)$
Franchise Value of Equity (FE)

- **Fair value** of a one-dollar loan
  
  PV of: interest - servicing costs + principal payments - default
  
  \[ v_L > \text{book value} = 1 \]

- **Fair value** of a one-dollar deposit
  
  PV of: interest + servicing costs + principal payments
  
  \[ v_D < \text{book value} = 1 \]

- **Franchise value** of equity per dollar of loans
  
  \[ \text{FE} = (v_L - 1) \times L - (v_D - 1) \times D \]
  
  lend at high rates, borrow at low rate
Market Value of Equity (ME)

- Market value of equity with default decision
  \[ ME = \frac{1}{1 + i} \sum_s q(s) \max \{0, \div_{E}(s) + (1 + g(s))ME\} \]

- What happens upon default?
  
  gov’t seizes the bank and injects cash to assist sale
  full recovery on deposits, loss \( \ell(s) \) on subordinated debt
  size of gov’t bailout depends on bank losses and leverage
Gov’t Guarantees and the Market Value of Equity

- Define the market value of gov’t guarantees
  
  \[ MG = \text{PV of all future cash injections} \]
  
  valuation multiple times expected bailout in a crisis
  
  \[
  MG = \frac{q(c)}{i - \bar{g}} T(c)
  \]

- Modigliani Miller with gov’t as negative stakeholder

  \[ ME = BE + FE + MG \]
Equity Valuation and Bond Spreads

- Market value of equity is multiple times dividend in normal time

\[ ME = \frac{q(n)}{(1 + i) - q(n)(1 + g(n))} \text{div}_E(n) \]

- Yield spread is risk neutral crisis probability times loss given crisis:

\[ y_B - i = q(c) \frac{\ell(c)}{v_B} \]
Accounting Profitability, Franchise Value, and Risk Taking

- Benchmark for accounting profitability

\[ q(n) \text{ROE}(n) + q(c) \text{ROE}(c) = i + (i - \bar{g}) \left( \frac{FE}{BE} \right) \]

- Profitability ROE(n) high either due to
  - high franchise value FE
  - risk-taking, that is low ROE(c)
Interpret Accounting and Market Signals
Identification: what drives the change in signals?

- yield spreads imply still have risk of default

- risk free rate \( i \) plus dashboard data
  
  and price-dividend or asset growth in normal times pin down
  risk to equity \( q(c) \) and sub. debt \( \ell(c) \)

  does not help with measuring risk to taxpayers

- Two strategies to identify risk to taxpayers \( MG \)
  
  measure franchise value directly
  
  calibrate risk in bank assets to infer franchise value
Risk-Taking, ROE, and ME in the cross-section

Meiselman, Nagel, and Purnanandam (2018)
- high ROE pre-crisis predicts high systematic tail risk in the crisis

Model implications: higher exposure to crisis shock goes with
- higher ROE in normal times
- higher market to book with gov't guarantees
- no impact on market to book without guarantees

In the data
- pre-crisis high ROE predicts high market to book ratio
- high market-to-book ratio of equity predicts high systematic tail risk
### Pre-Crisis Cross-Section BE = 9%

<table>
<thead>
<tr>
<th>$r_L(c)$</th>
<th>0.9</th>
<th>0.88</th>
<th>0.86</th>
<th>0.84</th>
<th>0.82</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ME/BE</strong></td>
<td>1.63</td>
<td>1.63</td>
<td>1.83</td>
<td>2.02</td>
<td>2.19</td>
</tr>
<tr>
<td><strong>ROE(n)</strong></td>
<td>0.14</td>
<td>0.15</td>
<td>0.16</td>
<td>0.17</td>
<td>0.19</td>
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### Post-Crisis Cross-Section BE = 13%

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<th>0.9</th>
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<td><strong>ME/BE</strong></td>
<td>1.06</td>
<td>1.06</td>
<td>1.09</td>
<td>1.19</td>
<td>1.32</td>
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<tr>
<td><strong>ROE(n)</strong></td>
<td>0.07</td>
<td>0.07</td>
<td>0.08</td>
<td>0.09</td>
<td>0.10</td>
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</table>
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<td>2.19</td>
</tr>
<tr>
<td>$ROE(n)$</td>
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<td>0.15</td>
<td>0.16</td>
<td>0.17</td>
<td>0.19</td>
</tr>
</tbody>
</table>

### Post-Crisis Cross-Section BE = 20%

<table>
<thead>
<tr>
<th>$r_L(c)$</th>
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</thead>
<tbody>
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<td>$ME/BE$</td>
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<td>1.04</td>
<td>1.04</td>
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<td>0.07</td>
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<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>$\log(ME/BE)$</td>
<td>0.534***</td>
<td>-0.413***</td>
<td>-0.171***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(14.25)</td>
<td>(-10.22)</td>
<td></td>
<td>(-3.94)</td>
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</tr>
<tr>
<td>$\log(ME/BE)$</td>
<td></td>
<td></td>
<td>-0.544***</td>
<td>-0.452***</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(-14.59)</td>
<td>(-10.40)</td>
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<td>Observations</td>
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<tr>
<td>$R^2$</td>
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<td>0.171</td>
<td>0.295</td>
<td>0.316</td>
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</table>

Standardized beta coefficients; $t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Bailout Expectations in Bond Spreads

In our model, bond spreads are given by:

\[ y_B - i = q(c) \frac{\ell(c)}{v_B} \]

- Berndt, Duffie, Zhu 2018
  - proxies for risk-neutral probability of default \( q(c) \)
  - infer changing expected loss on bonds \( \ell(c) \)

- model calibration of \( q(c) \) and \( \ell(c) \)

- interpret BDZ estimates in common units

\[ y_B - i = q(c) \times (1 - \pi) \times \hat{\ell}(c) \]
Small Change in Expected Default Losses

<table>
<thead>
<tr>
<th>Pre-Crisis</th>
<th>Post-Crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\pi$</td>
<td>$\pi$</td>
</tr>
<tr>
<td>$c(d)$</td>
<td>$c(d)$</td>
</tr>
<tr>
<td>$\ell(c)$</td>
<td>$\ell(c)$</td>
</tr>
<tr>
<td>$q(c)$</td>
<td>$q(c)$</td>
</tr>
<tr>
<td>0.51</td>
<td>0.30</td>
</tr>
<tr>
<td>75</td>
<td>158</td>
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<tr>
<td>0.29</td>
<td>0.42</td>
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<tr>
<td>2.55%</td>
<td>3.76%</td>
</tr>
<tr>
<td>0.46</td>
<td>0.20</td>
</tr>
<tr>
<td>75</td>
<td>158</td>
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<tr>
<td>0.32</td>
<td>0.48</td>
</tr>
<tr>
<td>2.31%</td>
<td>3.29%</td>
</tr>
<tr>
<td>0.43</td>
<td>0.10</td>
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<td>75</td>
<td>158</td>
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<tr>
<td>0.34</td>
<td>0.54</td>
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<td>2.19%</td>
<td>2.93%</td>
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<tr>
<td>0.39</td>
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<td>75</td>
<td>158</td>
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<tr>
<td>0.37</td>
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<tr>
<td>2.05%</td>
<td>2.63%</td>
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<tr>
<td>-</td>
<td>-</td>
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<tr>
<td>75</td>
<td>158</td>
</tr>
<tr>
<td>0.15</td>
<td>0.32</td>
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<tr>
<td>5.00%</td>
<td>5.00%</td>
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</table>
Conclusion
Main takeaways

- Model to interpret accounting and market signals
  feasible to develop a quantitatively plausible model
  useful for framing debates over the meaning of signals

- Faith in CCAR Stress Tests likely misplaced
  book capital is not the problem in a crisis
  should use market measures of crisis shocks to banks
  and try to measure bank franchise value

- What’s missing from our model?
  Duffie 2019: securities broker dealers were the problem in 2008
  Will derivatives be the next crisis?
Securities Broker Dealers Total Assets Have Shrunk
Bank Interest Rate Derivatives Have Shrunk
Bank Credit Derivatives Have Shrunk

Fair Values of Credit Derivatives Positive and Negative Protection
Bought and Sold

Percentage Points