

The Financial Soundness of US Firms 1926-2012:

Financial Frictions and Business Cycles

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December 2012

Financial crisis and Great recession

New interest in old questions

- What is the role of financial frictions in the business cycle?
- How to measure the state of financial frictions in the economy?

What we do

- A measurement exercise, going ahead of the following theory:
 - heterogeneous firms choose output, employment, investment
 - financial frictions impact activity of financially unsound firms
 - ⇒ aggregate state = *the cross-section of financial soundness*

What we do

- A measurement exercise, going ahead of the following theory:
 - heterogeneous firms choose output, employment, investment
 - financial frictions impact activity of financially unsound firms
 - ⇒ aggregate state = *the cross-section of financial soundness*
- Measure firms' financial soundness by **Distance to Insolvency**
 - leverage adjusted for asset volatility*
 - statistical view: low distance ⇒ likelihood of insolvency is high
 - economic view: low distance ⇒ financial frictions are high
 - e.g. bankruptcy cost, debt overhang, risk shifting

What we find

- Only three big recessions associated with insolvency crises
1929-1933, 1937, 2008
broad: 95% of firms junk
deep: Average firm well below junk cutoff
- The 2008 insolvency crisis: driven by an increase in asset volatility
leverage did not play a big role
- Are financial firms special?
financials resemble non-financials
but large and systemic financials
exhibited larger financial soundness declines and slower recoveries

Talk Outline

- Theory of firm's financial soundness

firm's state variable: Distance to Insolvency

- Measurement of Distance to Insolvency

- Calibrating our measuring stick

- Results

history of insolvency crises and recessions: 1926-2012

leverage vs. volatility

are financial firms special?

Theory

Financial Soundness = Distance to Insolvency

- *Firm Balance Sheet: Assets and Liabilities*

V_{At} : expected DPV of cash flows from the firm's assets

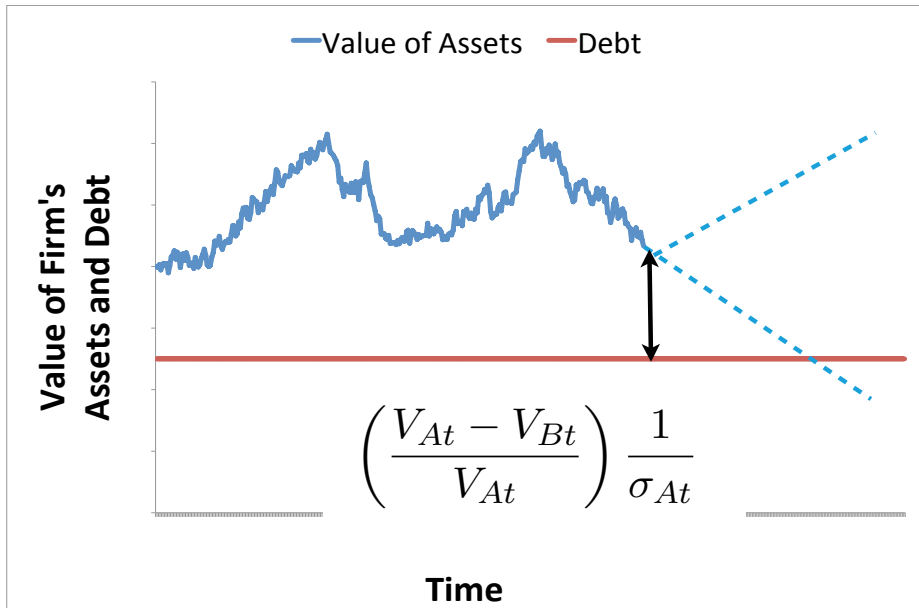
V_{Bt} : DPV of the promised cash flows on liabilities

- *Insolvency* = Assets worth less than Liabilities, $V_{At} < V_{Bt}$

- *Distance to Insolvency:* $\left(\frac{V_{At} - V_{Bt}}{V_{At}} \right) \frac{1}{\sigma_{At}}$

the percentage drop in asset value that renders the firm insolvent,
measured in units of the firm's asset standard deviation

Financial Soundness = Distance to Insolvency



Measurement

How to Measure Distance to Insolvency?

- What we get to see directly:
 - market values and volatilities of firms' equity
 - sometimes *accounting information* on firms' liabilities
- What we don't get to see directly:
 - values and volatilities of firms' assets
- Can we measure distance to insolvency in a simple way?

Measurement with Unlimited Liability

- With unlimited liability

$$\text{Distance to insolvency} = 1/\sigma_{Et}$$

- A simple proof

Value of equity: $V_{Et} = V_{At} - V_{Bt}$

Instantaneous volatility of equity: $\sigma_{Et} = \frac{V_{At}}{V_{Et}} \sigma_{At}$

Plug the first equation into the second one and take inverses:

$$\frac{1}{\sigma_{Et}} = \left(\frac{V_{At} - V_{Bt}}{V_{At}} \right) \frac{1}{\sigma_{At}}$$

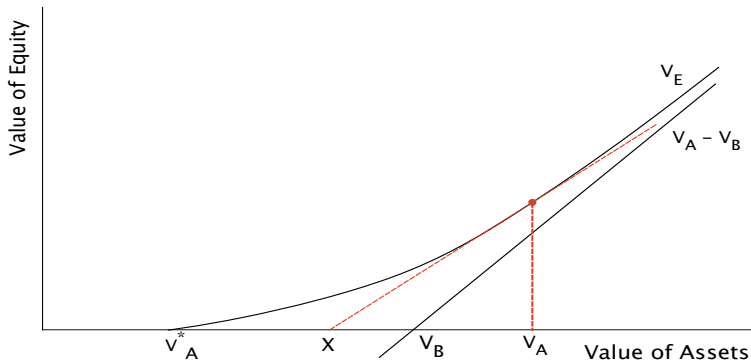
Measurement with Limited Liability

- Big literature in finance (Merton, Leland, etc.)
- Model equity's decision to exercise option of limited liability
- Academic empirical work: Duffie (2011) and many others
- Moody's Analytics (EDF) commercial application of methodology

Measurement with Limited Liability

Distance to Insolvency $\leq 1/\sigma_{Et} \leq$ Distance to Default

$$\left(\frac{V_A - V_B}{V_A} \right) \frac{1}{\sigma_A} \leq \frac{1}{\sigma_E} = \left(\frac{V_A - X}{V_A} \right) \frac{1}{\sigma_A} \leq \left(\frac{V_A - V_{A^*}}{V_A} \right) \frac{1}{\sigma_A}$$



Approximating DI by $1/\sigma_{Et}$

- How close are DI and $1/\sigma_{Et}$?

creditors lose if they let equity holders run V_{At} below V_{Bt}

aggressive creditors make insolvency and default close

aggressive creditors $\Rightarrow DI \simeq 1/\sigma_{Et}$

- Why is the approximation useful?

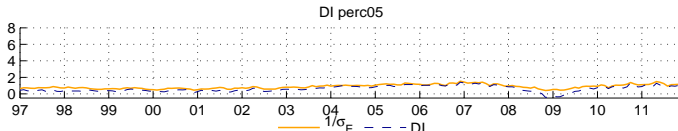
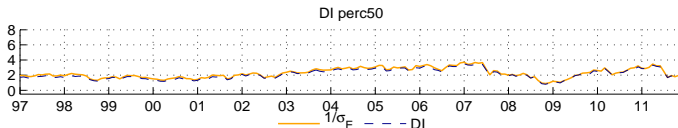
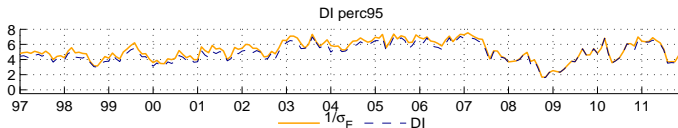
robust to model misspecification

does not require any accounting data

long time series available

Is the approximation any good?

Black and Scholes option adjustment, 1000 firms, 1997-2012

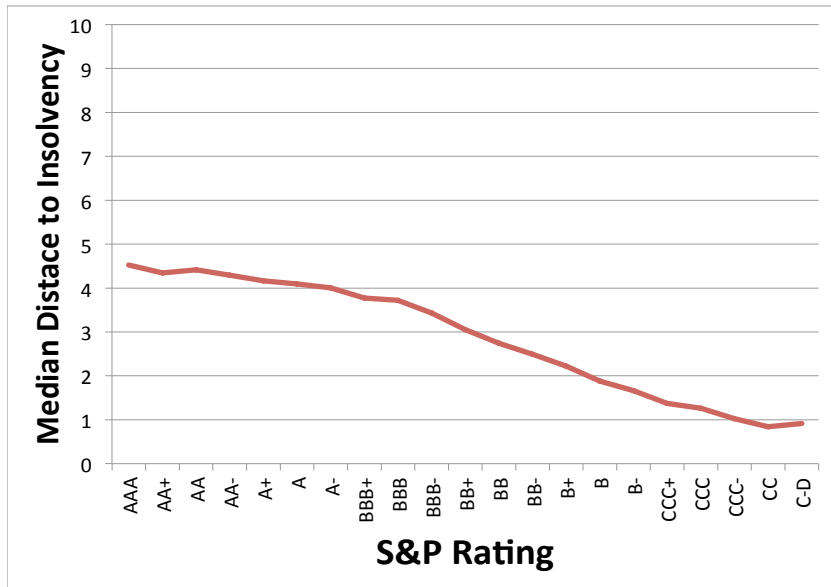


Measurement: 1926-2012

- Use $1/\sigma_{Et}$ to measure Distance to Insolvency monthly for each firm
- Calculate σ_{Et} = standard deviation of daily returns in month
Every NYSE, AMEX, and NASDAQ firm in CRSP
Every month, 1926 to 2011
- Construct cross-section distribution of $1/\sigma_{Et}$ for every month
Start with several hundred firms per month
End with several thousand

Calibrating our measuring stick

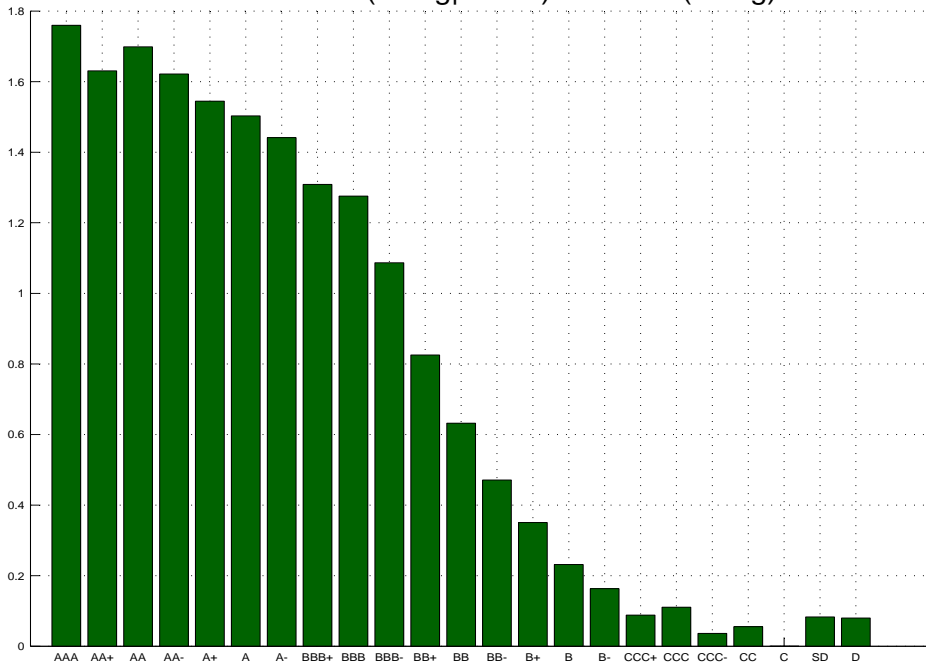
$1/\sigma_{Et}$ by rating: all firms



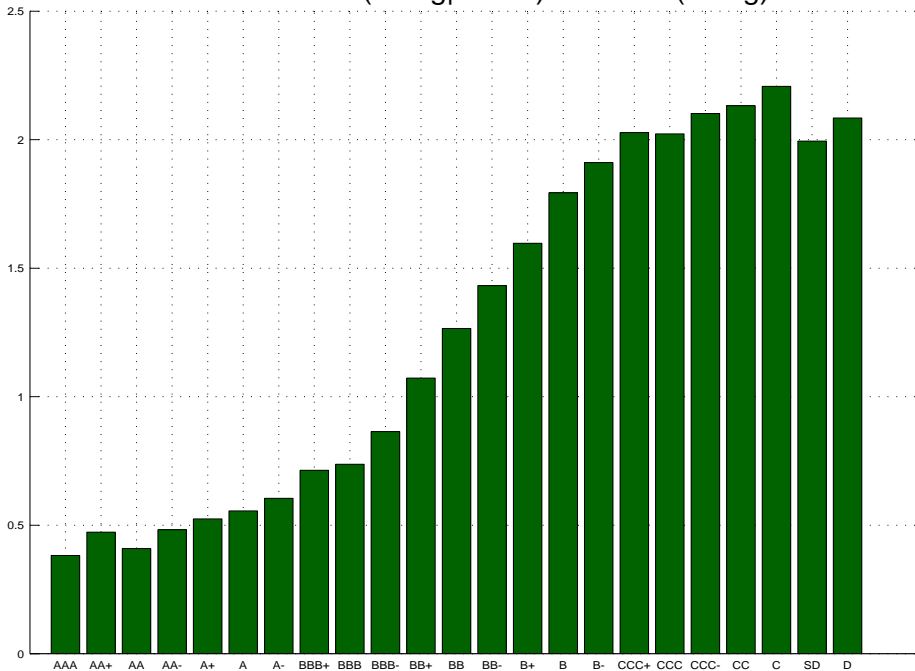
Summarizing

- Above 4: Good and safe
- At 3: Cutoff between Investment Grade and Speculative Grade
- Below 2: Not Investment Grade
- Below 1: Bankruptcy or default

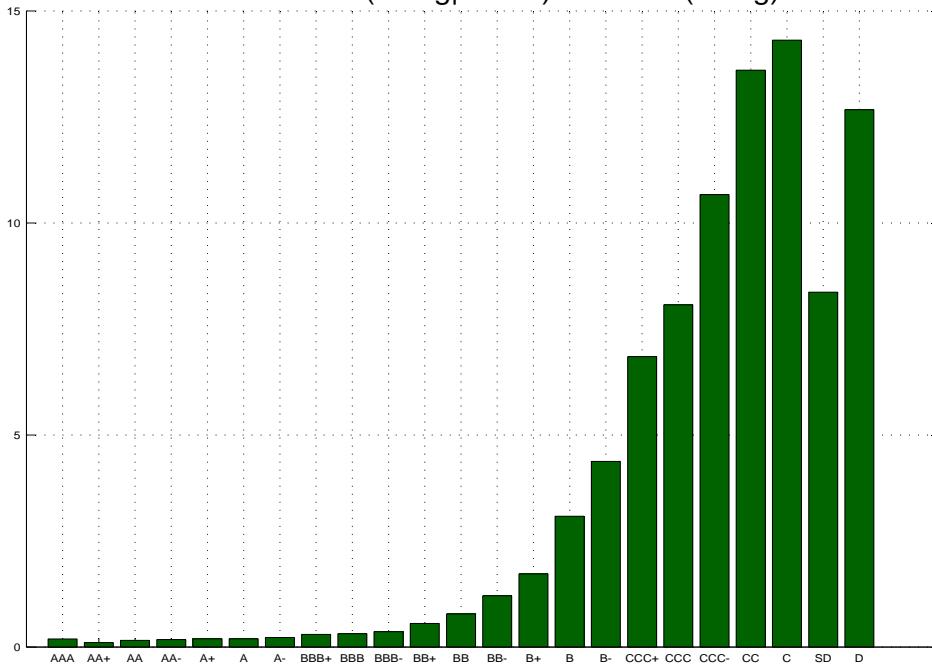
Ratio of: Prob(rating|DI \geq 4) and Prob(rating)



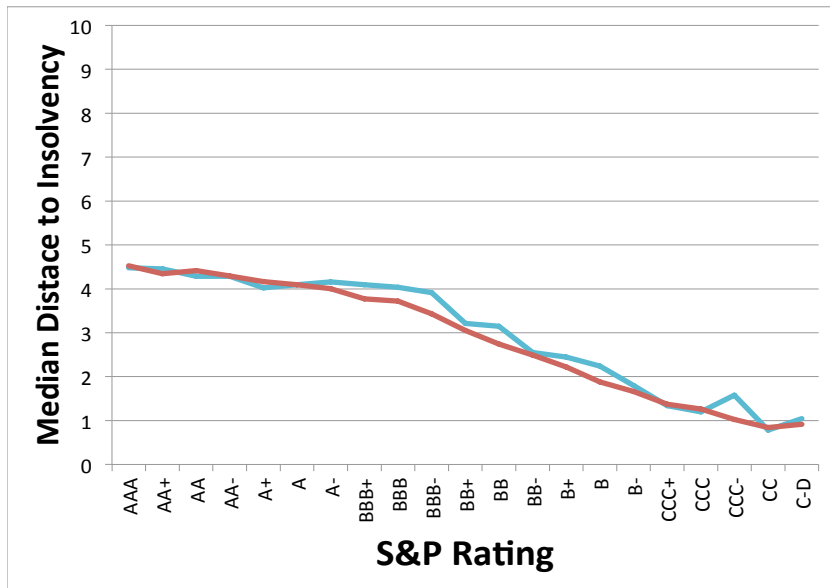
Ratio of: Prob(rating|DI<=3) and Prob(rating)



Ratio of: Prob(rating|DI<=1) and Prob(rating)

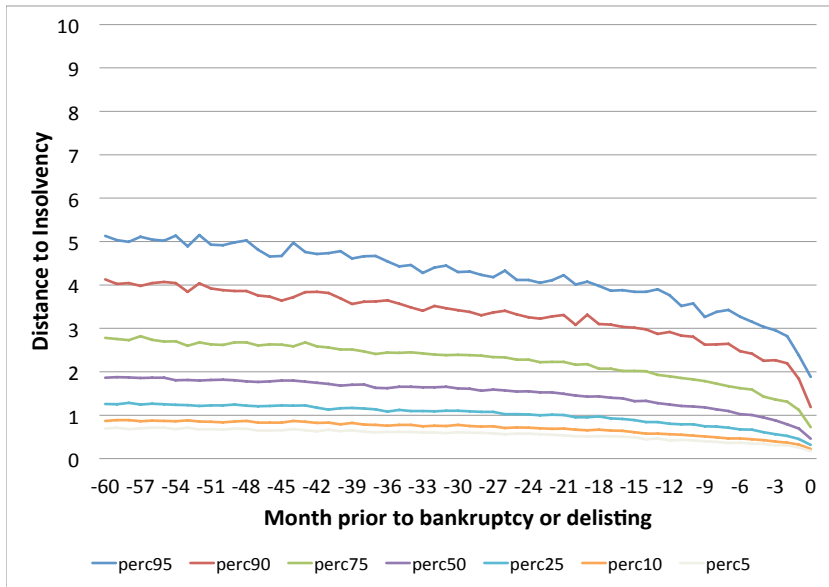


Financials Same as All Firms



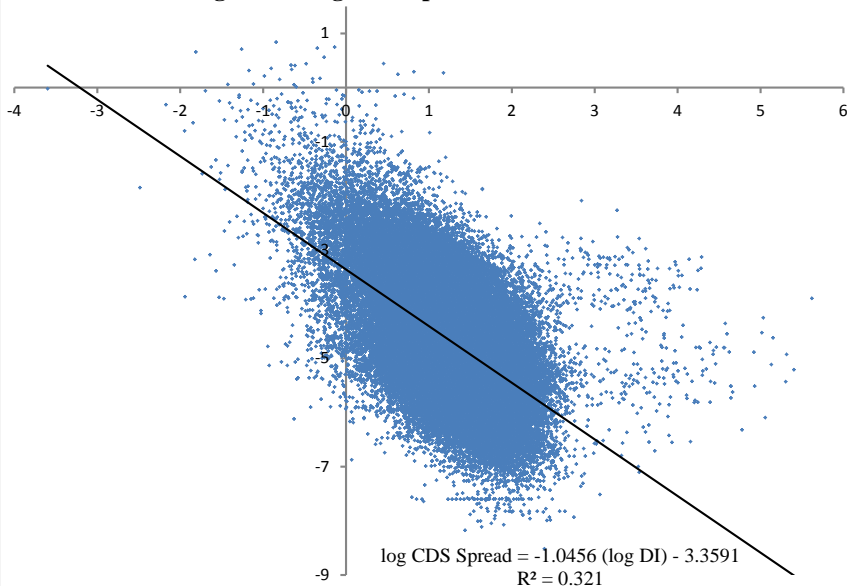
Red=All Firms, Blue=Financials

Further validation: $1/\sigma_{Et}$ prior to bankruptcy



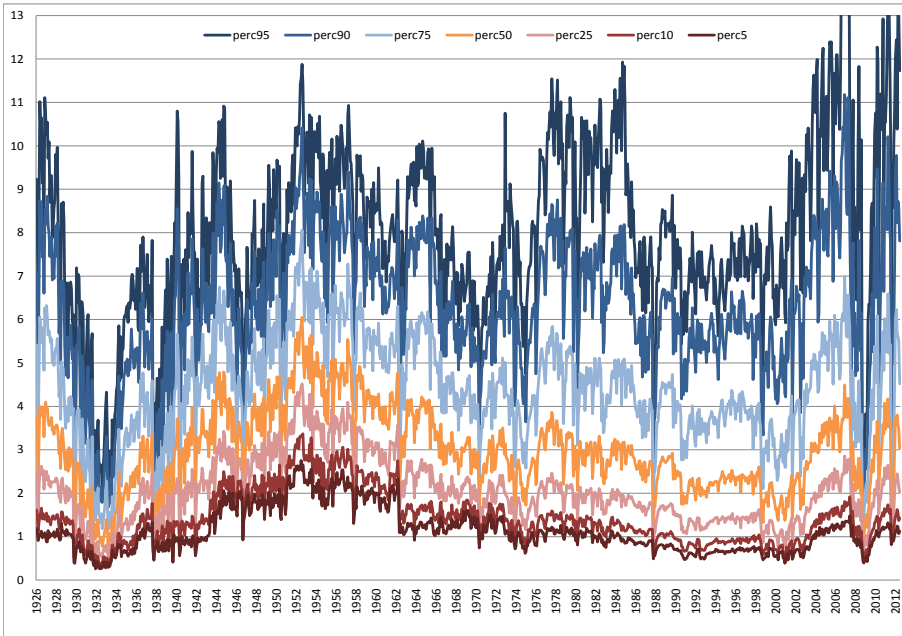
Further validation: $1/\sigma_{Et}$ vs CDS spreads

Log DI vs. Log CDS Spreads 1999-2011 All Firms



Financial soundness and recessions

Distribution of $1/\sigma_{Et} \simeq \text{DI}$, 1926-2012



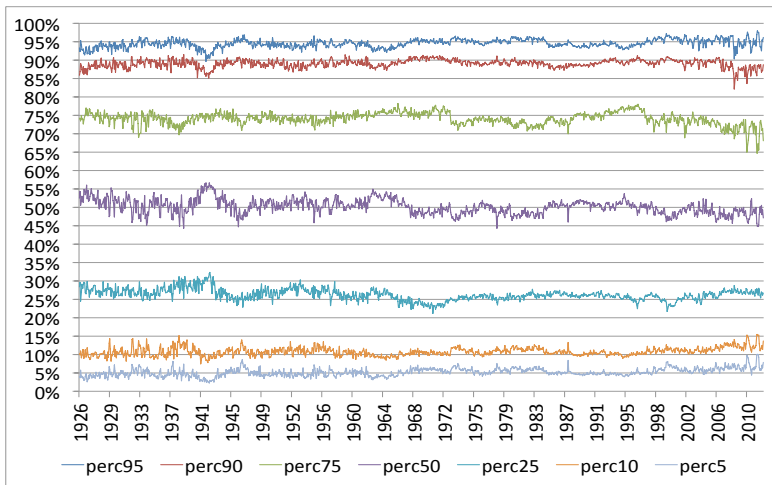
Summarizing the distribution of $1/\sigma_{Et} \simeq \text{DI}$

- The cross section of $1/\sigma_{Et}$ is approximately log normal
- A simple diagnostic check:

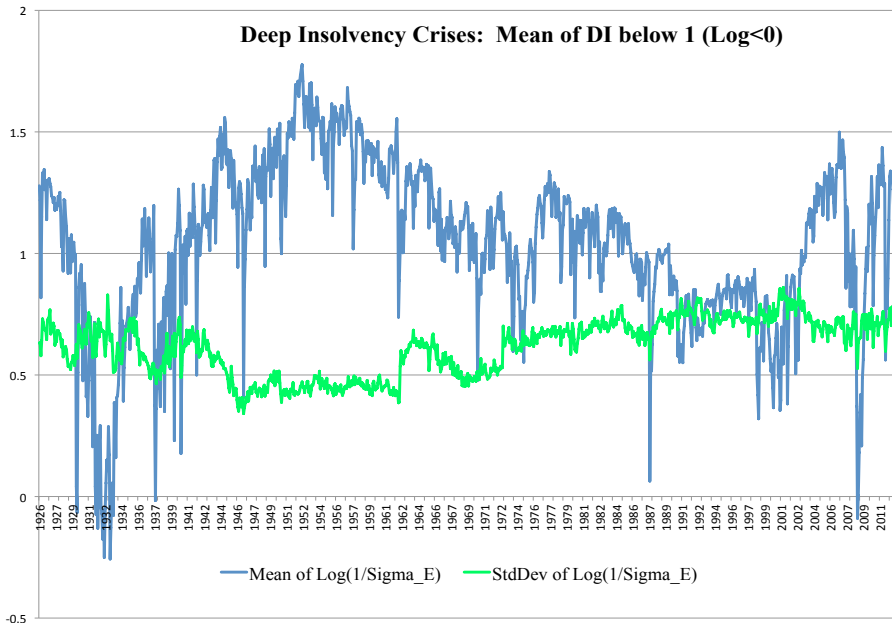
if it is so, $\Phi\left(\frac{\log(1/\sigma_{Et}) - \text{mean}}{\text{dispersion}}\right)$ should be uniform

where Φ = normal cdf

Diagnostic check for log normality



Three deep and broad insolvency crises



Leverage vs. Asset volatility

Decomposing Distance to Insolvency

- Decompose Distance to Insolvency into:

Leverage

Asset Volatility

- Use unlimited liability benchmark:

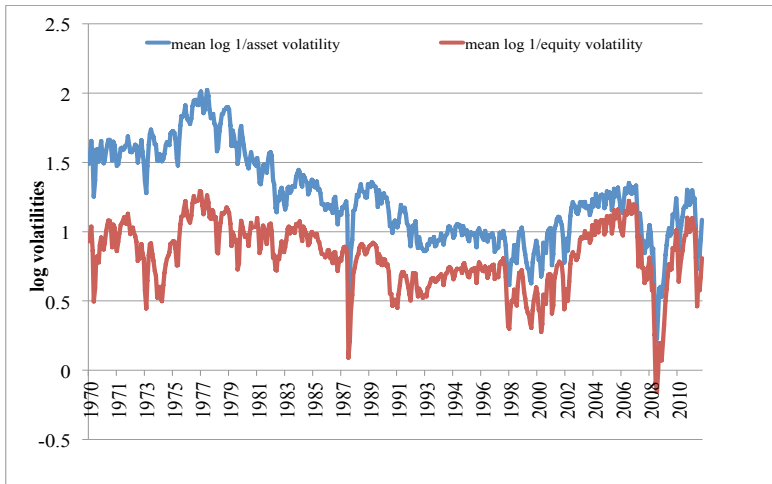
$$V_{At} = V_{Et} + V_{Bt}$$

$$\frac{1}{\sigma_{Et}} = \frac{V_{At} - V_{Bt}}{V_{At}} \times \frac{1}{\sigma_{At}}$$

- Need to use equity and accounting data

COMPUSTAT data for value of liabilities V_{Bt}

Decomposition of $\log\left(\frac{1}{\sigma_{Et}}\right)$



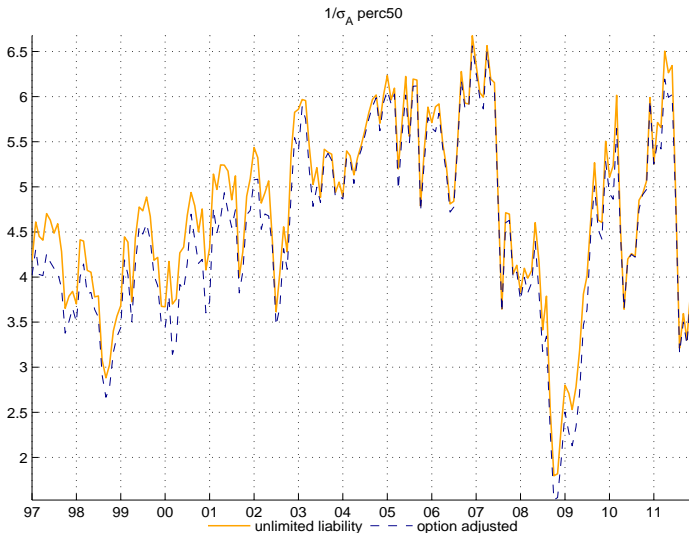
What happened in 2008?

- Much of the collapse in DI is due to a drop in asset volatility
- Not like in standard theories

where financial soundness deteriorate...

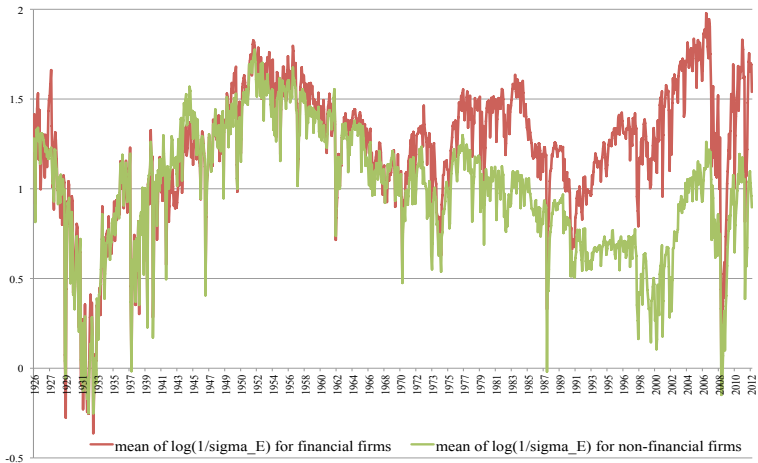
...because V_A , and hence $(V_A - V_B)/V_A$, drops

Measurement under limited vs unlimited liability



Are financial firms special?

Financials vs. Non-Financials DI 1926-2012



Financials vs. Non-Financials DI 2001-2012

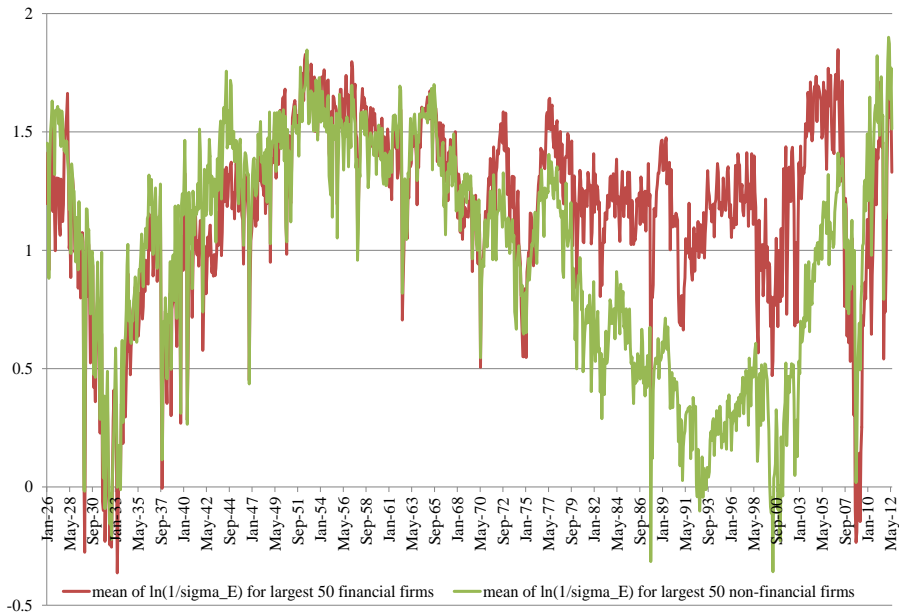


Are Financial Firms Special?

- DI for Financial Firms
 - timing and magnitude of collapse of DI
same as for all firms
- No direct evidence for financials *leading* a crisis

But, are *large* financial firms special?

Large Financials vs. Non-Financials DI 1926-2012



Large Financials vs. Non-Financials DI 2001-2012



Are Large Financial Firms Special?

- *DI for 50 Largest Financial Firms*

- timing similar to that for large non-financial firms

- magnitude greater than that for large non-financial firms

- No direct evidence for greater risk-taking ex-ante.

- DI ranking of large financials and non-financials switches in 2007

- large financials' recovery is weaker than large non-financials

Conclusions

Insolvency Crises in three big recessions

broad: 95% of firms junk

deep: Average firm well below junk cutoff

Asset volatility, not narrow “leverage” in 2008

DI for Financial Firms resembles that of Non-Financial Firms

but large financials

exhibited larger DI declines and slower DI recoveries