The Financial Soundness of US Firms 1926-2012:

Financial Frictions and Business Cycles

Andrew Atkeson, Andrea Eisfeldt, and Pierre-Olivier Weill

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Finance and the Real Economy

- 2008 Financial Crisis and Great Recession

- New interest in old questions

  What is the role of financial frictions in business cycles?

  What is the relationship between recessions
  and financial soundness crises?

  How can we measure the financial soundness of firms?

- We propose a measure for the entire distribution of firms' financial soundness from 1926-2012.

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

  $\Rightarrow$ 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

  $\Rightarrow$ 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 $\Rightarrow$ likelihood of insolvency is high

  economic view: low distance $\Rightarrow$ 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

Theory: Firm's Financial Soundness

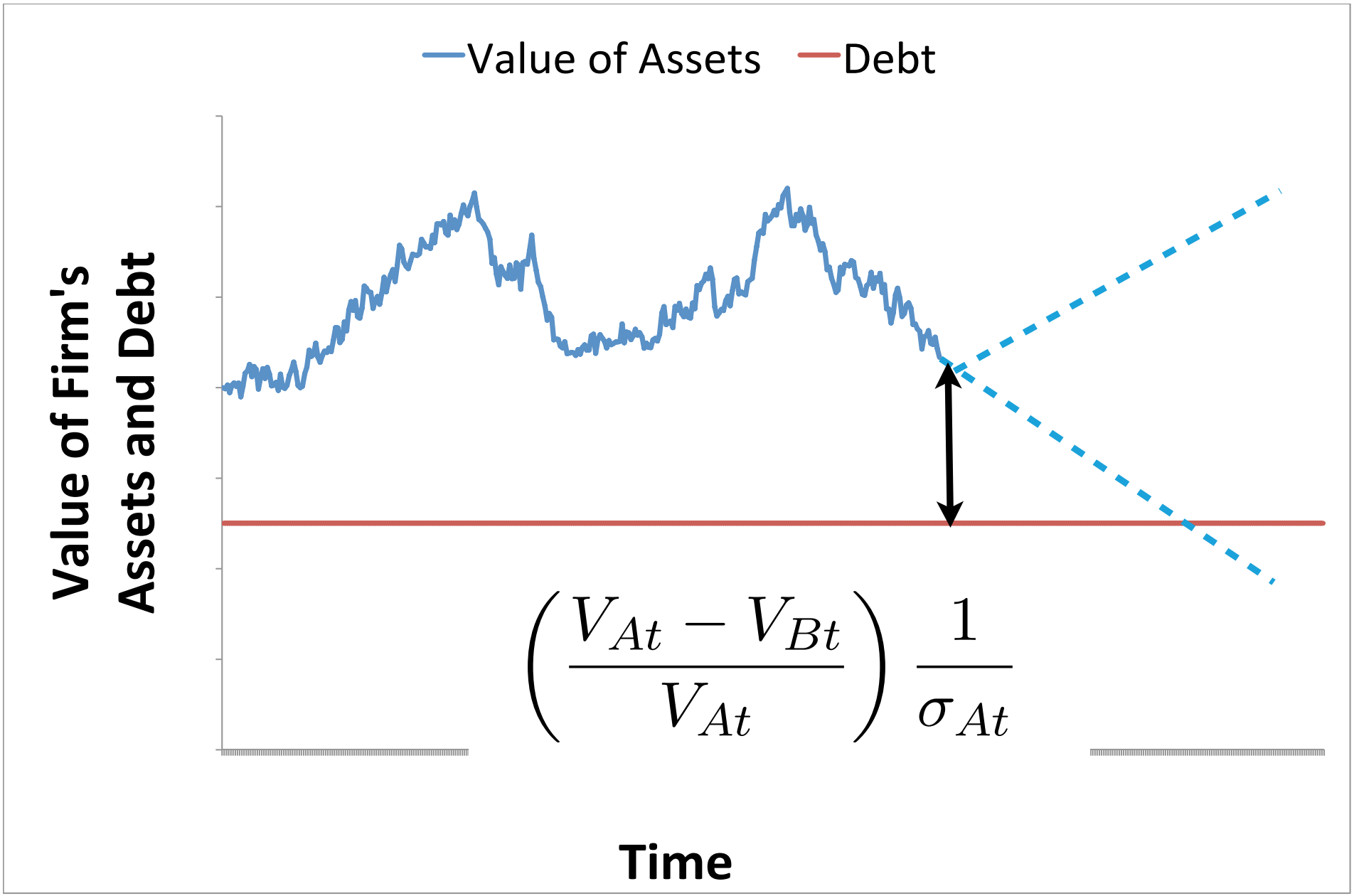
- *Firm Balance Sheet:* Assets and Liabilities

  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, $V_{At} < V_{Bt}$

Financial Soundness = Distance to Insolvency



Distance to Insolvency

- *Definition:* Leverage adjusted for asset volatility

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

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

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?

  Yes, with some theory! Key finding:

  Distance to Insolvency $\leq \frac{1}{\sigma_{\mathbf{E}}} \leq$ **Distance to Default**

Measurement with Unlimited Liability

- With unlimited liability

  Distance to insolvency $= \frac{\mathbf{1}}{\sigma_{\mathbf{E}}}$

- A simple proof

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

  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

Limited Liability:

- Our first result:

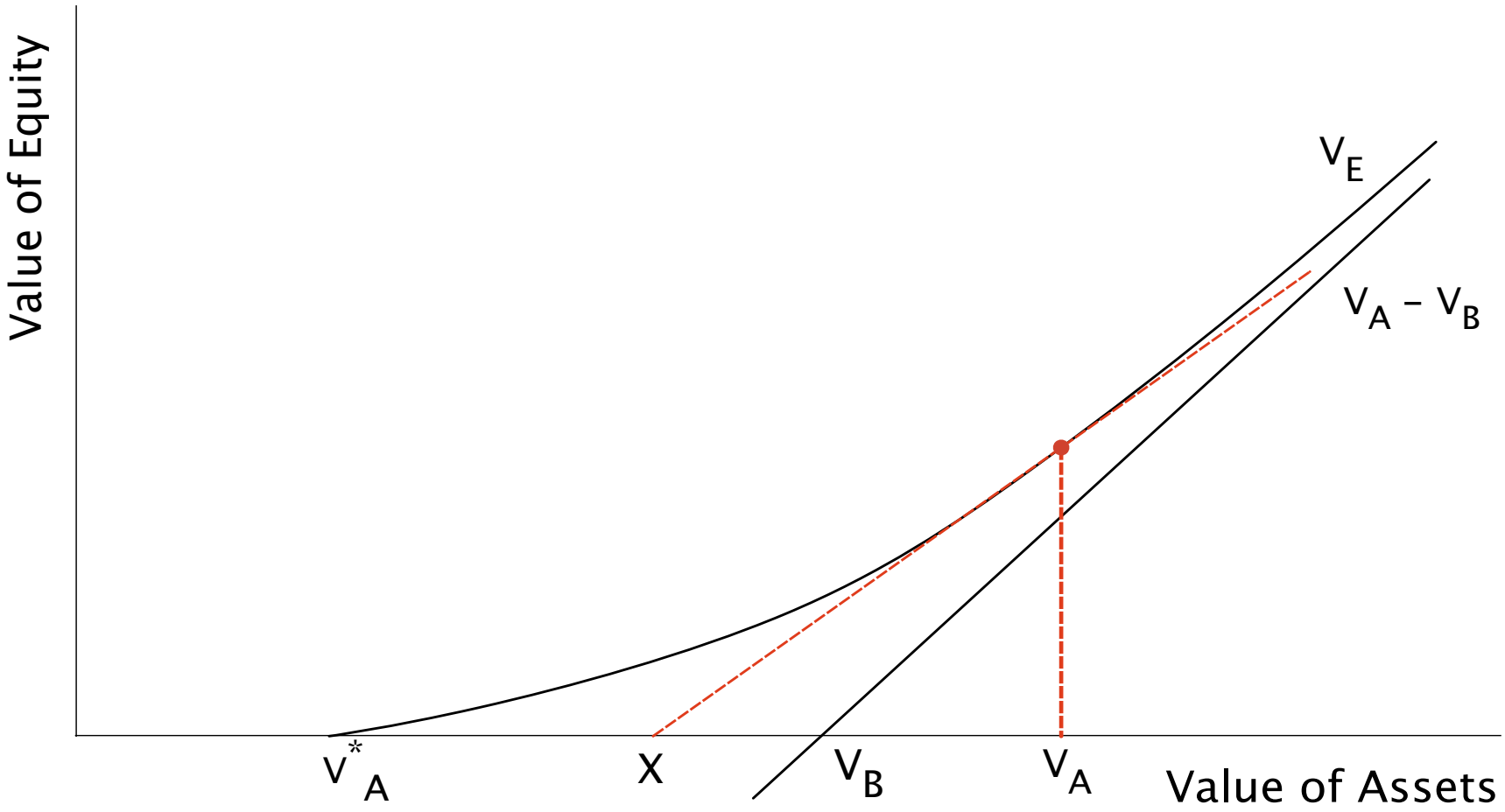
  Distance to Insolvency $\leq \frac{\mathbf{1}}{\sigma_{\mathbf{E}}}$

- Our second result:

  $\frac{\mathbf{1}}{\sigma_{\mathbf{E}}} \leq$ **Distance to Default**

- Thus **DI** $\leq \frac{\mathbf{1}}{\sigma_{\mathbf{E}}} \leq$ **DD**

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



Discussion of Bound

- How "close" are DI and DD?

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

  Equity grabs cash and/or gambles for resurrection

  Write bond covenants to take over firm at insolvency

  Aggressive creditors make insolvency and default close

- Why is the bound useful?

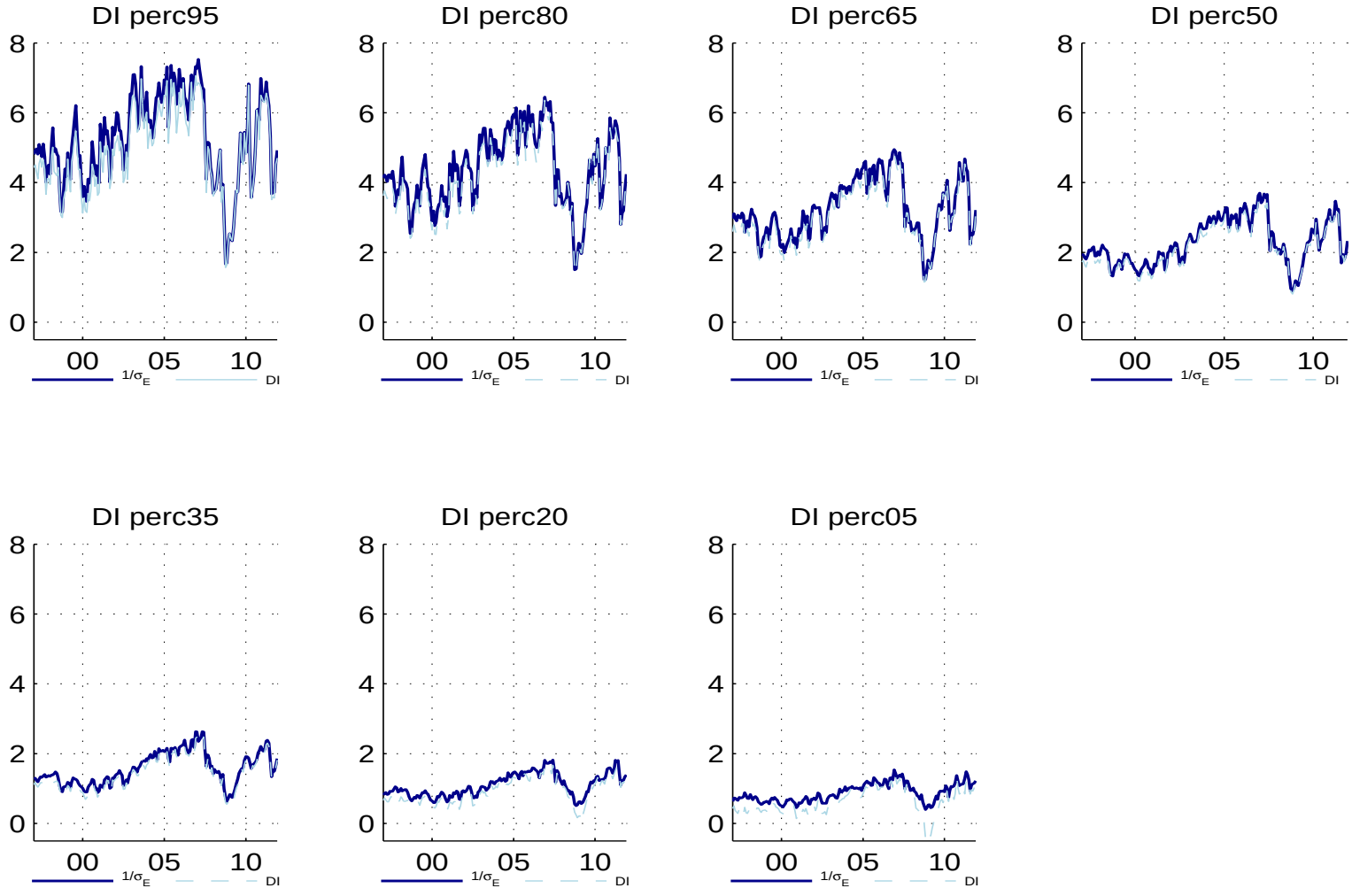
  Robust to model misspecification

  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 $\frac{1}{\sigma_{Et}}$ 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 $\frac{1}{\sigma_{Et}}$ for every month

  Start with several hundred firms per month

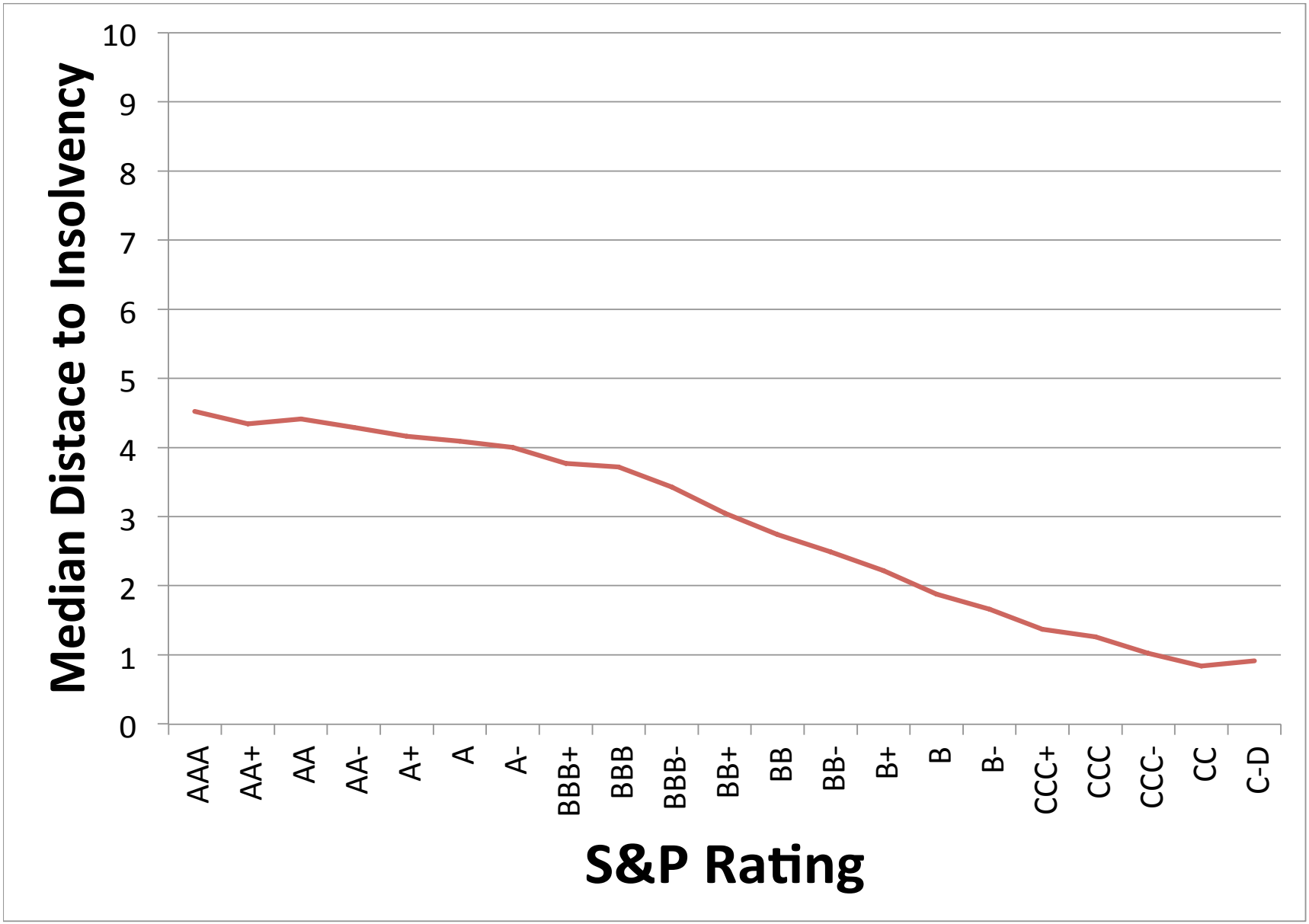
  End with several thousand

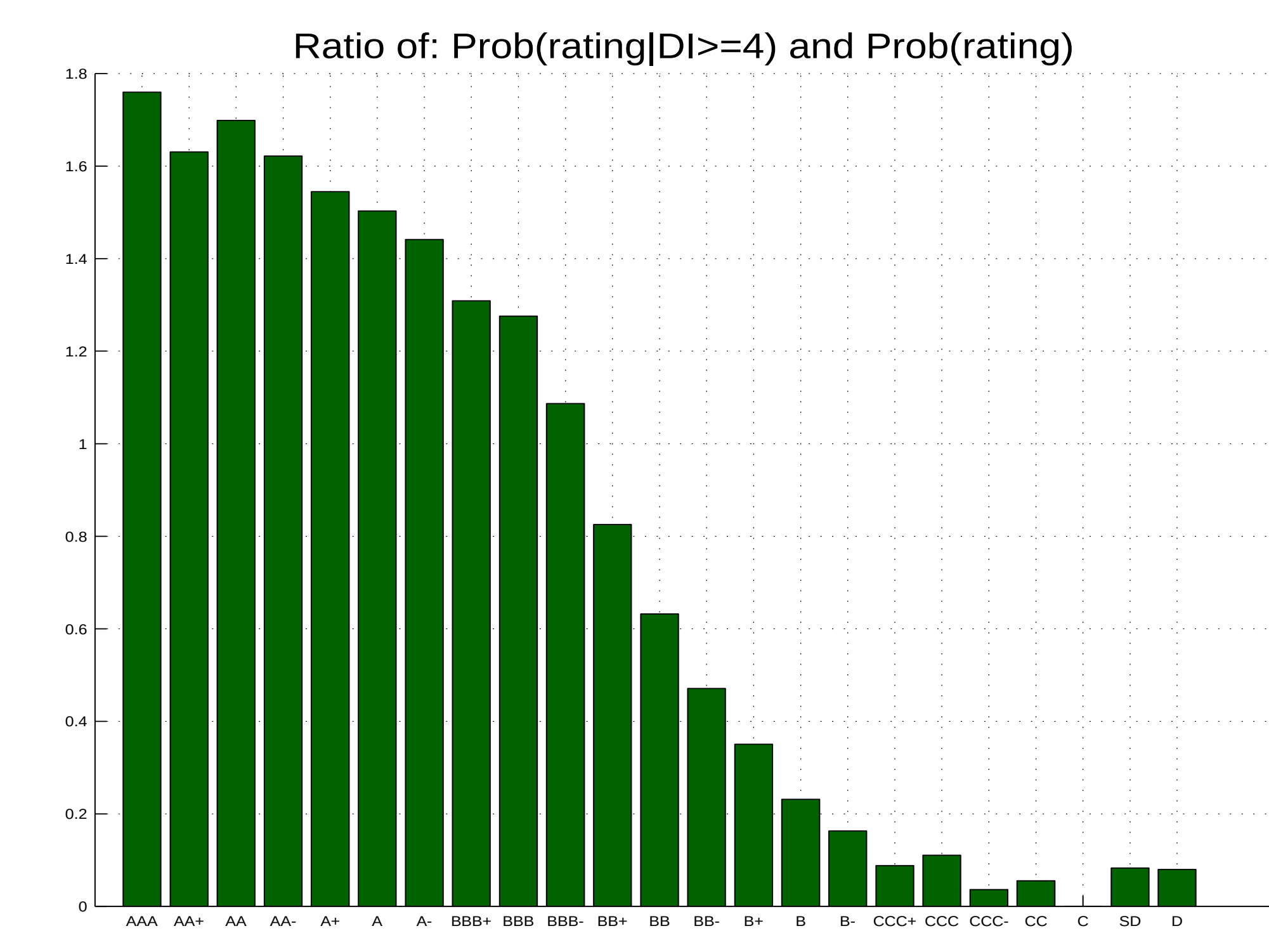
Calibrating our measuring stick

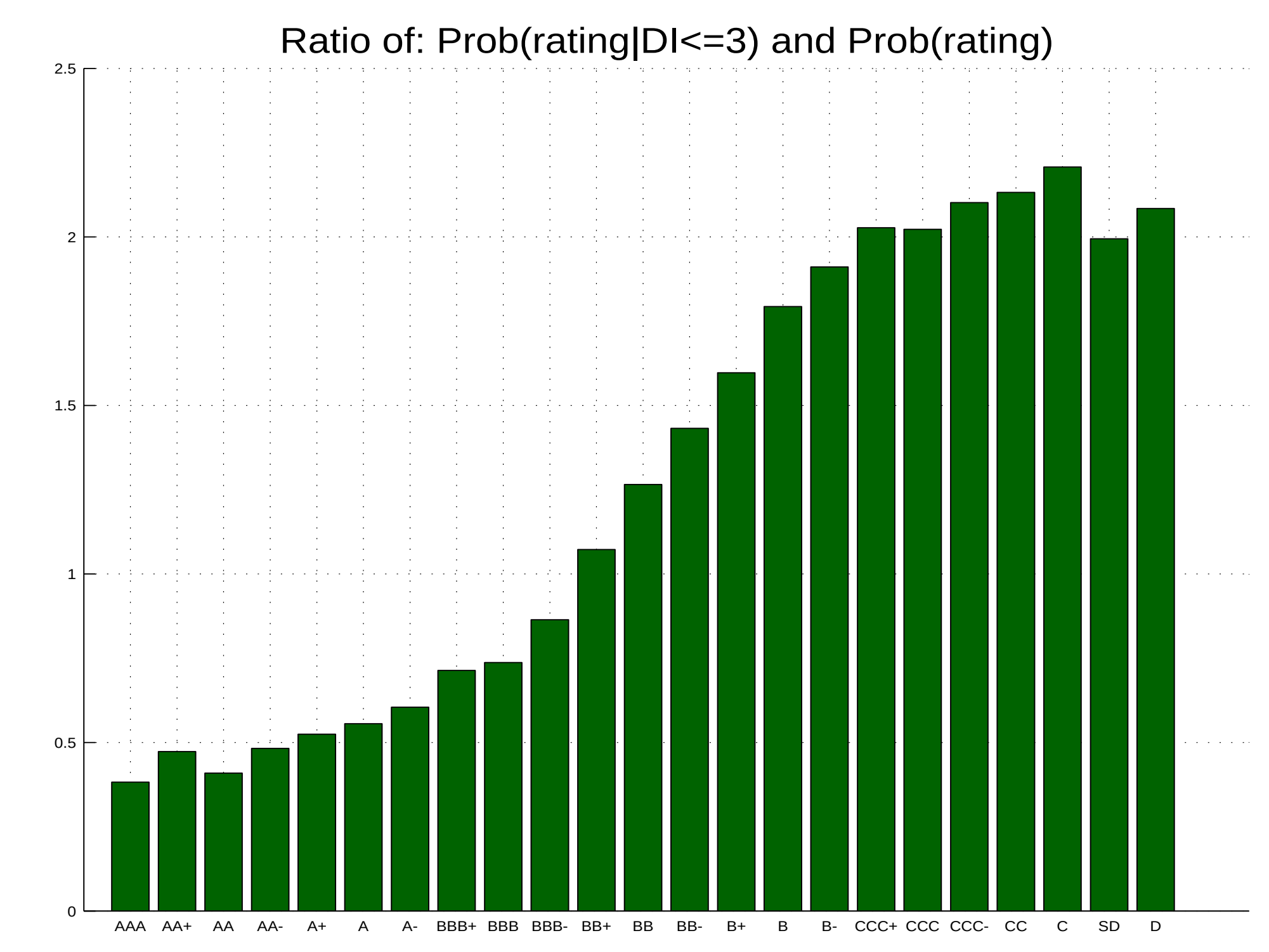
What is a low Distance to Insolvency?

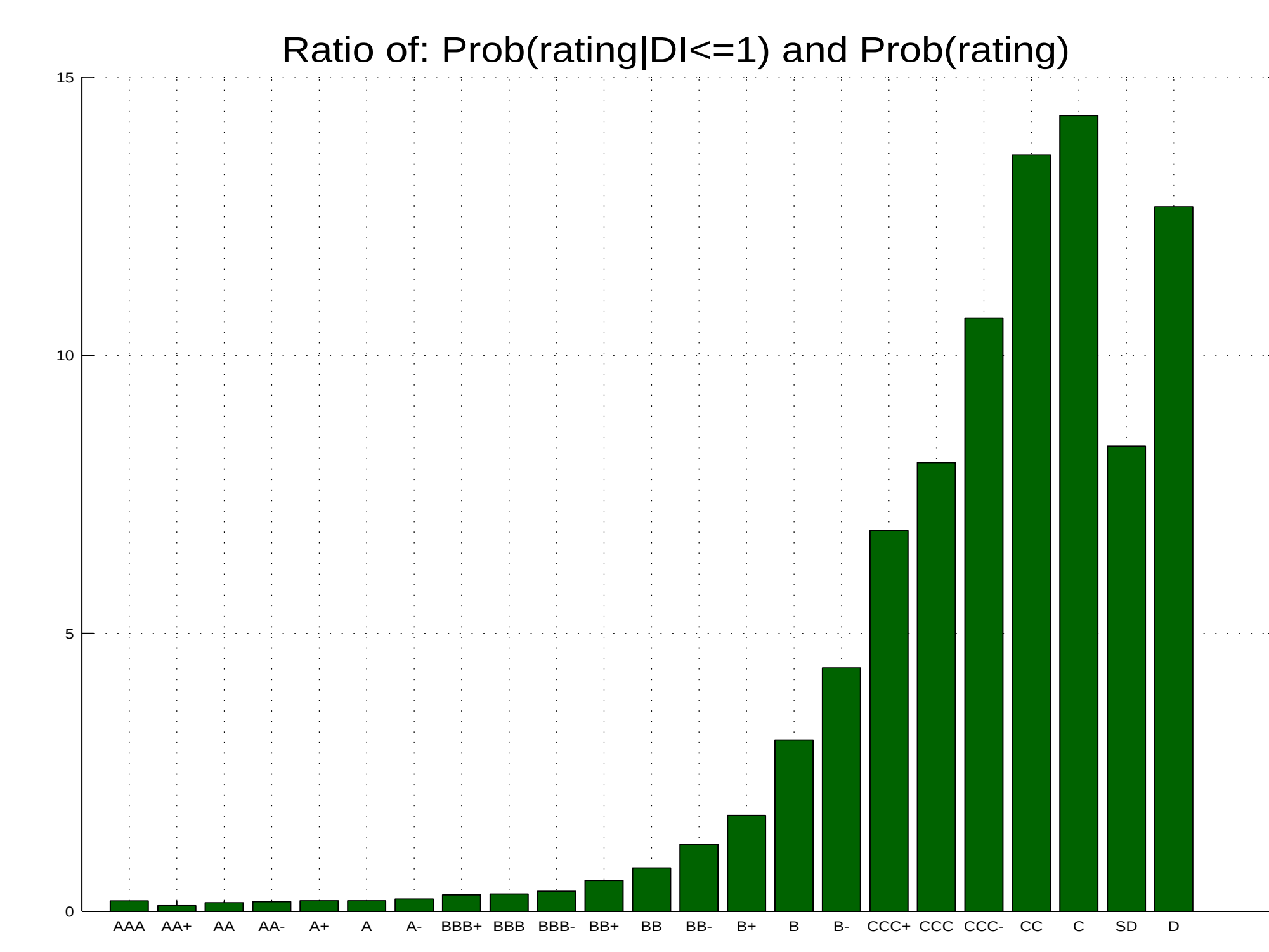
- Above 4: Good and safe
- At 3: Cutoff between Investment Grade and Speculative Grade
- Below 2: Not Investment Grade
- Below 1: Bankruptcy or default

$1/\sigma_E$ by Rating: All Firms

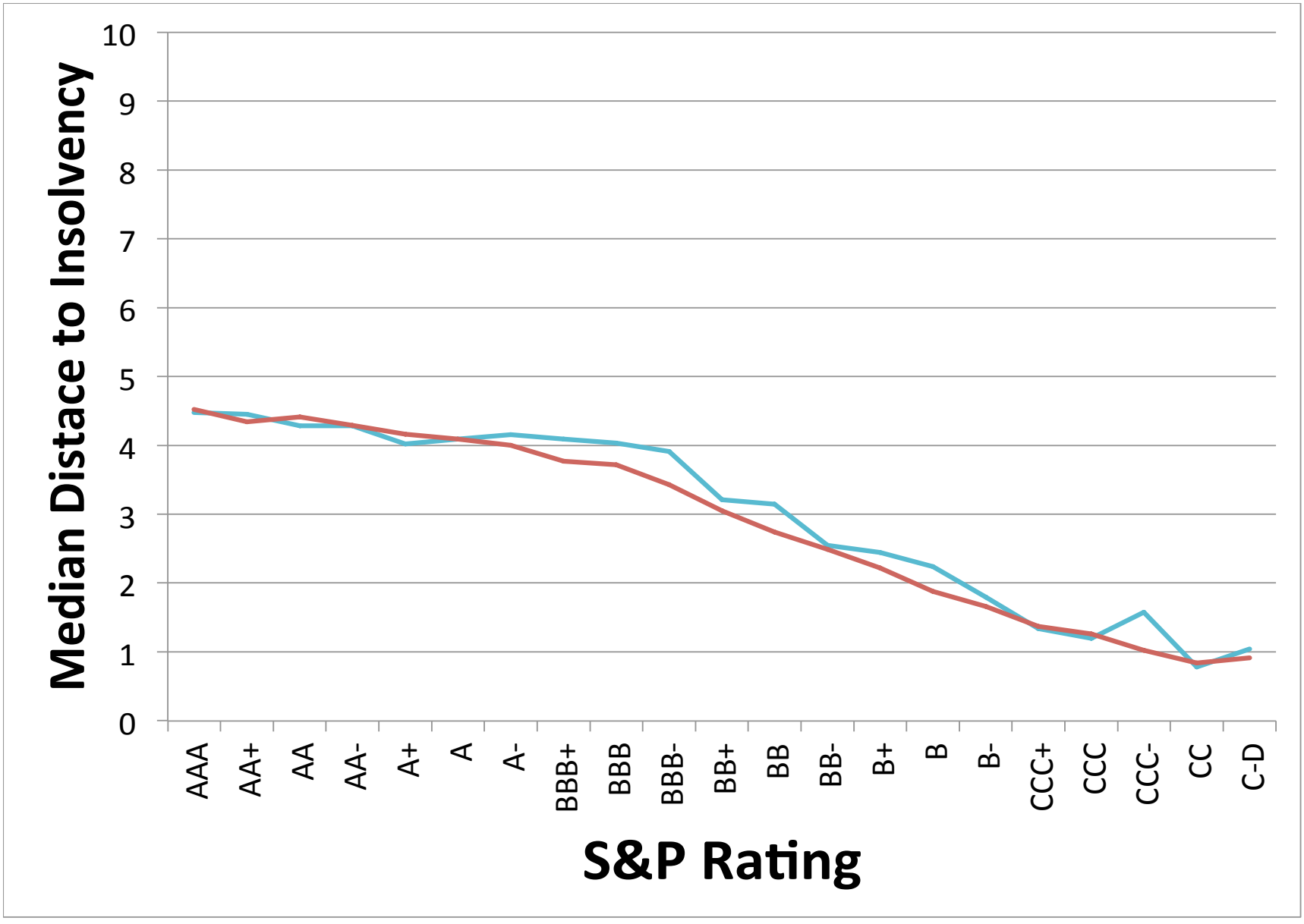



Ratio of: Prob(rating|DI>=4) and Prob(rating)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
AAA
AA+
AA
AA-
A+
A
A-
BBB+
BBB
BBB-
BB+
BB
BB-
B+
B
B-
CCC+
CCC
CCC-
CC
C
SD
D


Ratio of: Prob(rating|DI<=3) and Prob(rating)
2.5
2
1.5
1
0.5
0
AAA
AA+
AA
AA-
A+
A
A-
BBB+
BBB
BBB-
BB+
BB
BB-
B+
B
B-
CCC+
CCC
CCC-
CC
C
SD
D

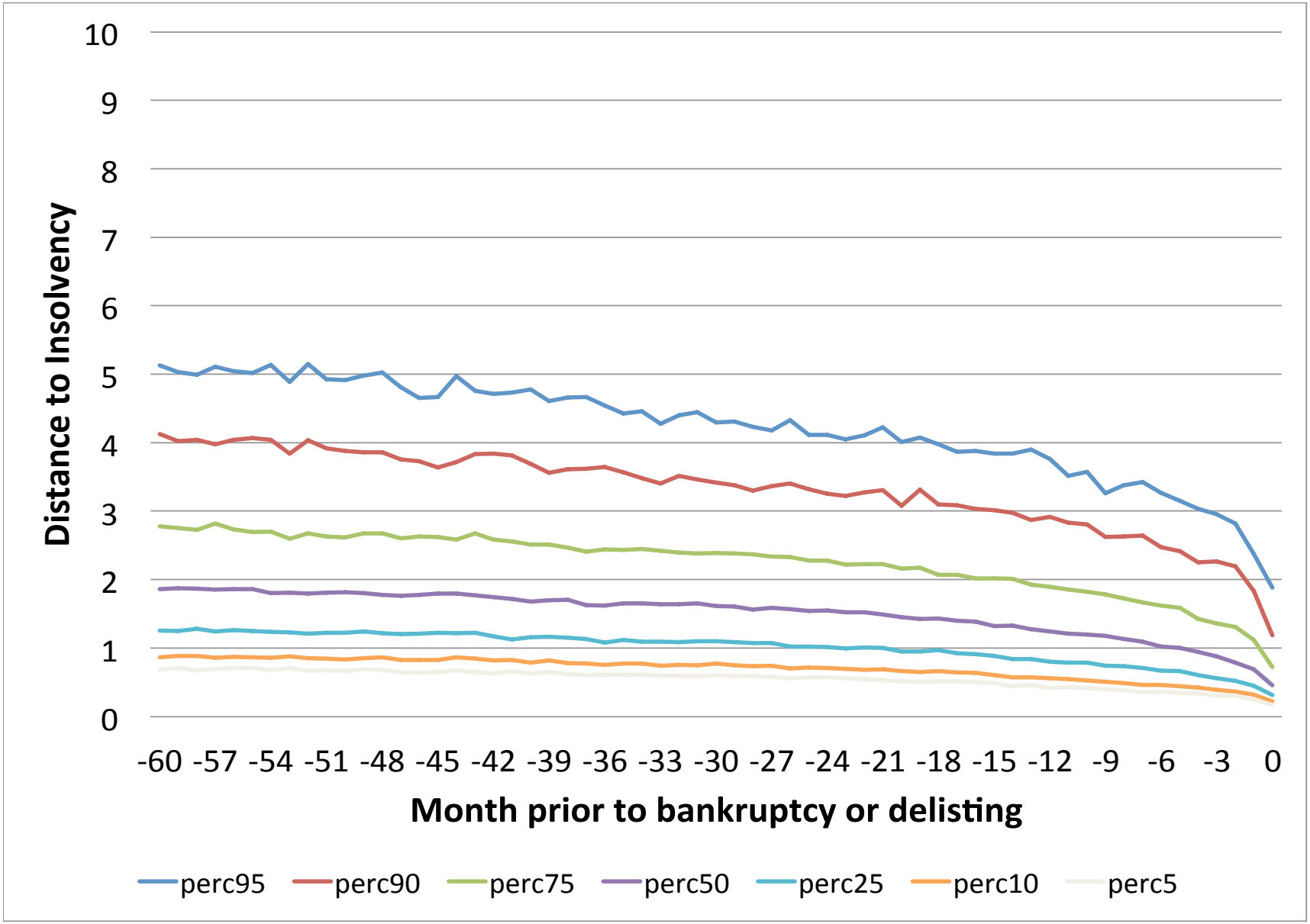

Ratio of: Prob(rating|DI<=1) and Prob(rating)
15
10
5
0
AAA
AA+
AA
AA-
A+
A
A-
BBB+
BBB
BBB-
BB+
BB
BB-
B+
B
B-
CCC+
CCC
CCC-
CC
C
SD
D

Financials Same as All Firms

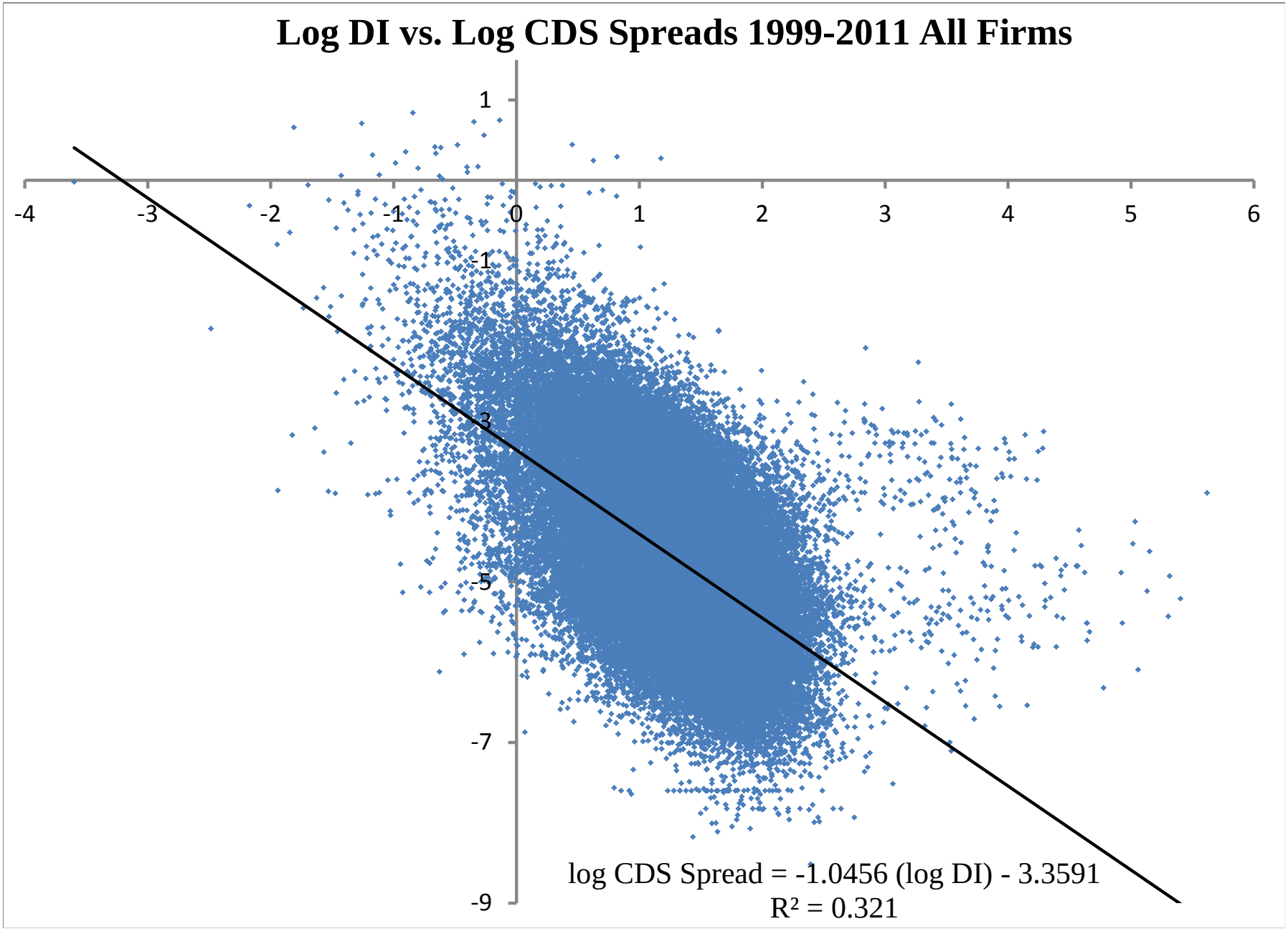


Red=All Firms, Blue=Financials

Further validation: $1/\sigma_E$ prior to bankruptcy



Further validation: $1/\sigma_E$ vs CDS spreads



Insolvency Crises and Recessions

- **A Crisis Definition:**

  A *broad* and *deep* deterioration in financial soundness.

  Broad: 95% of firms have Distance to Insolvency below 3.

  Deep: Average firm has Distance to Insolvency below 1.

- **3 Broad and Deep Insolvency Crises,**

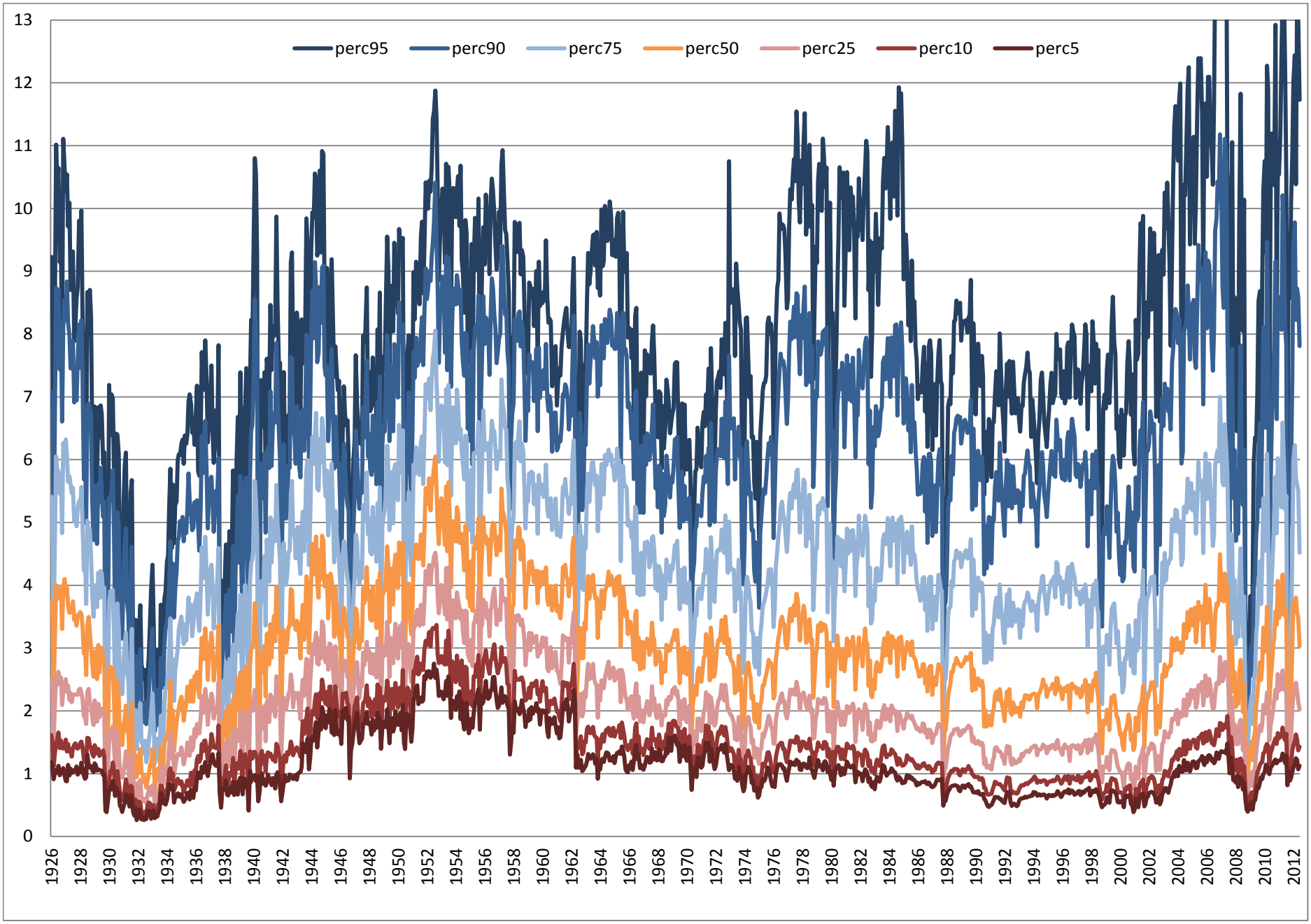
  1932-33

  1937

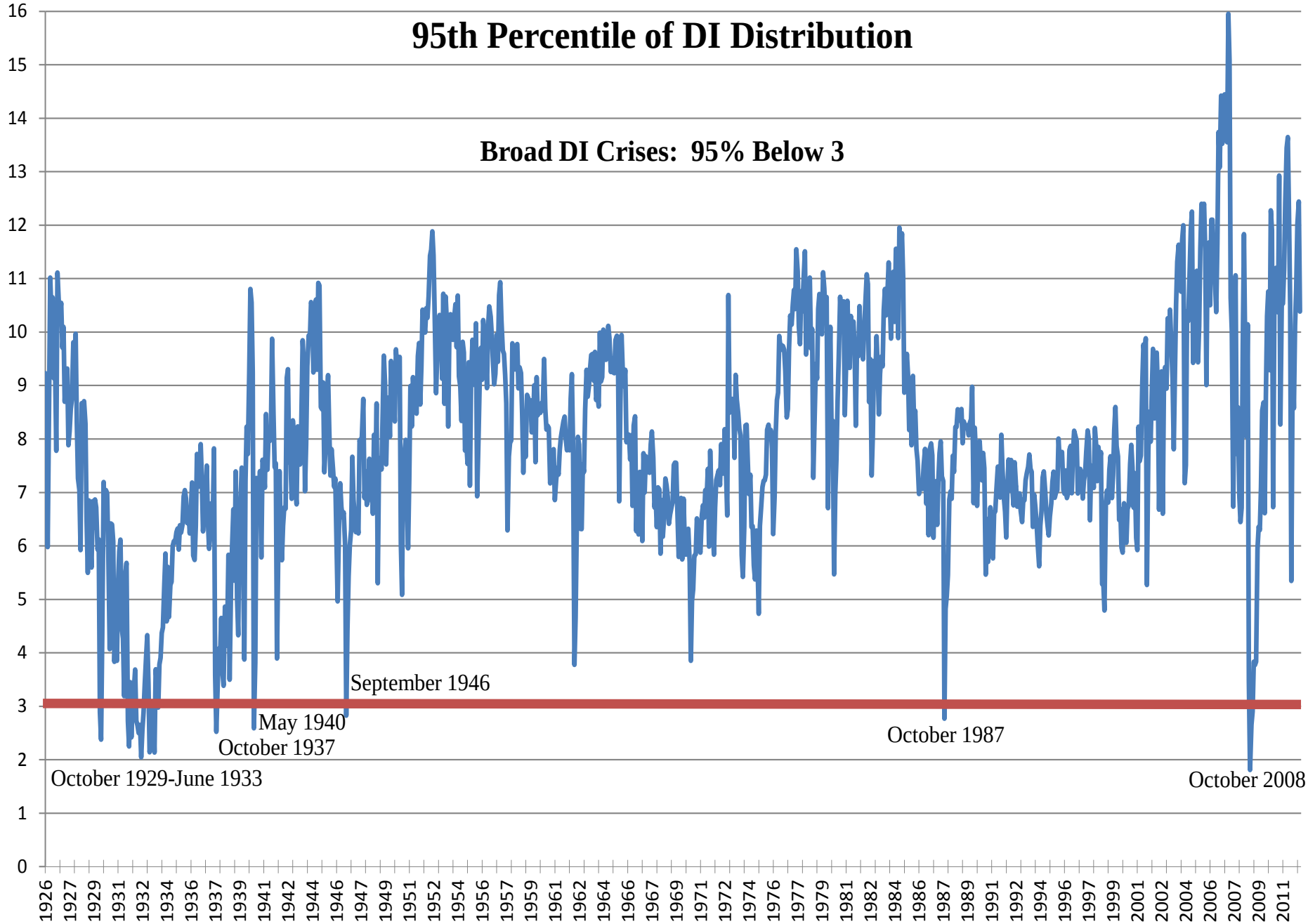
  2008

Coincide with 3 Big Recessions.

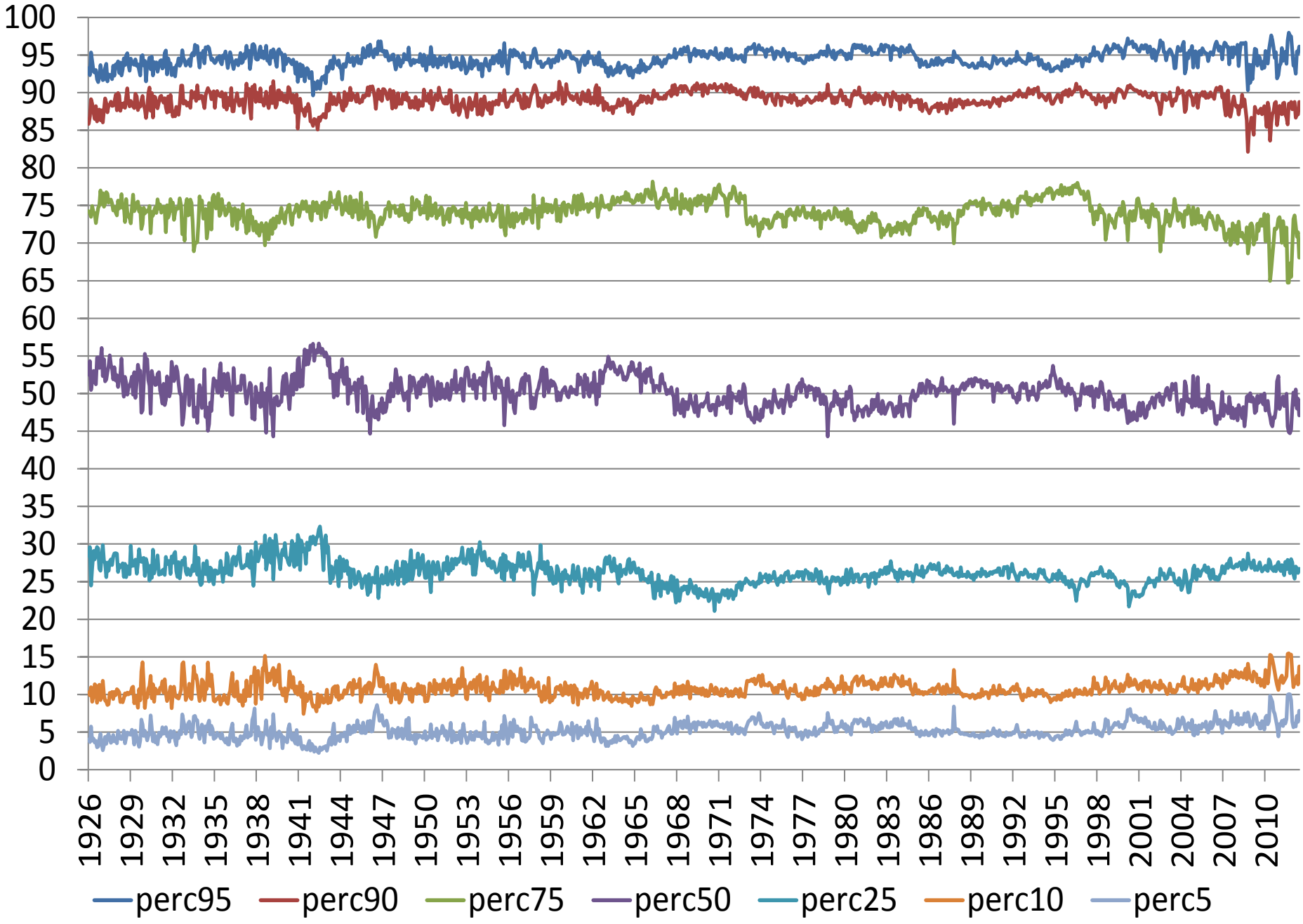
Distribution of DI 1926-2012



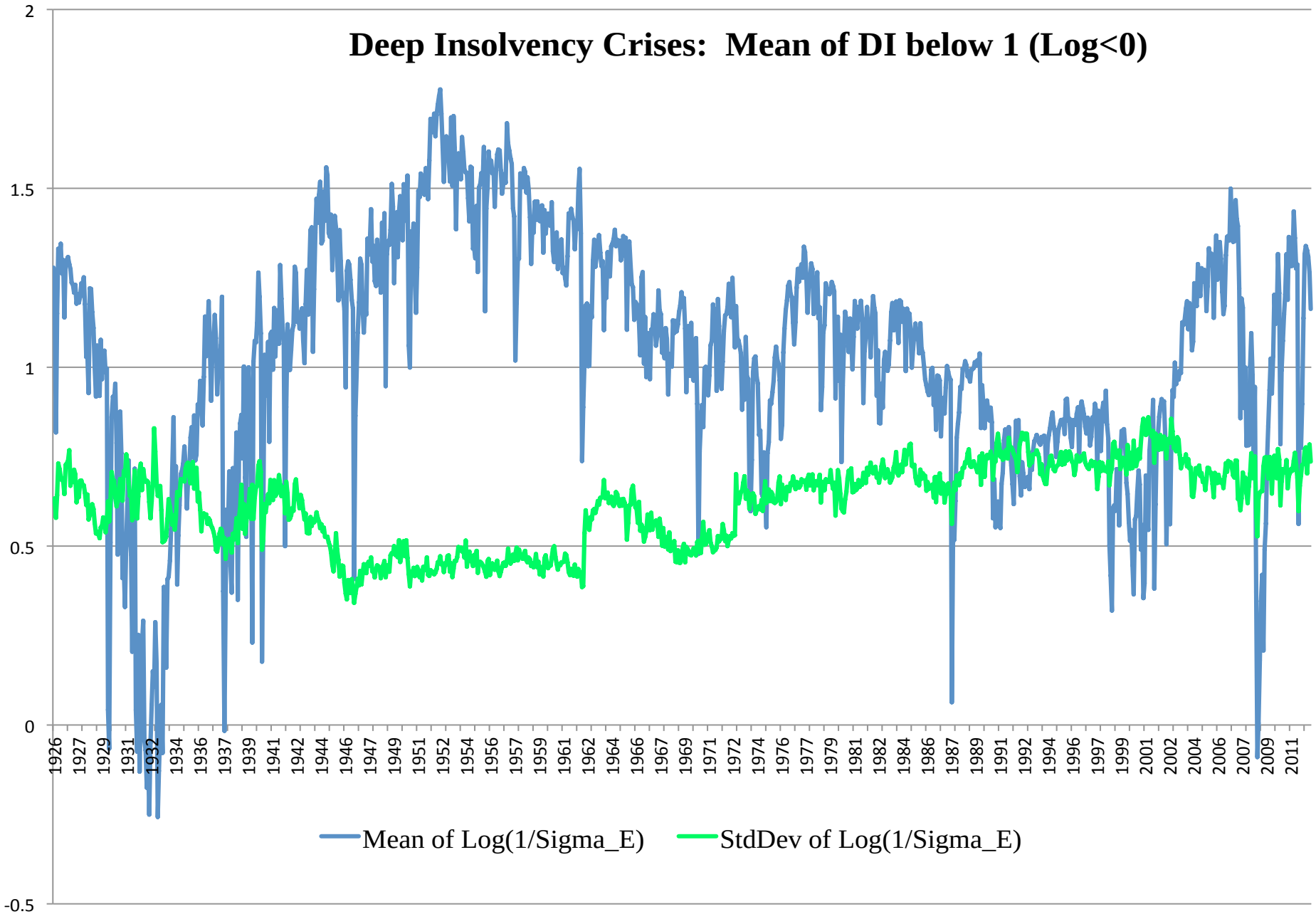
Broad Insolvency Crises 1926-2012



Distribution of DI 1926-2012: Lognormality



Deep Insolvency Crises 1926-2012



Recessions and Insolvency Crises

- *Three Insolvency Crises*: 1932-33, 1937, 2008

  Almost all Firms Become Unsound

  Average Firm Becomes Very Unsound

  Different from Other Recessions

Leverage vs. Asset volatility

Decomposing Distance to Insolvency

- Decompose Distance to Insolvency into:

  Leverage

  Asset Volatility

- Use unlimited liability benchmark:

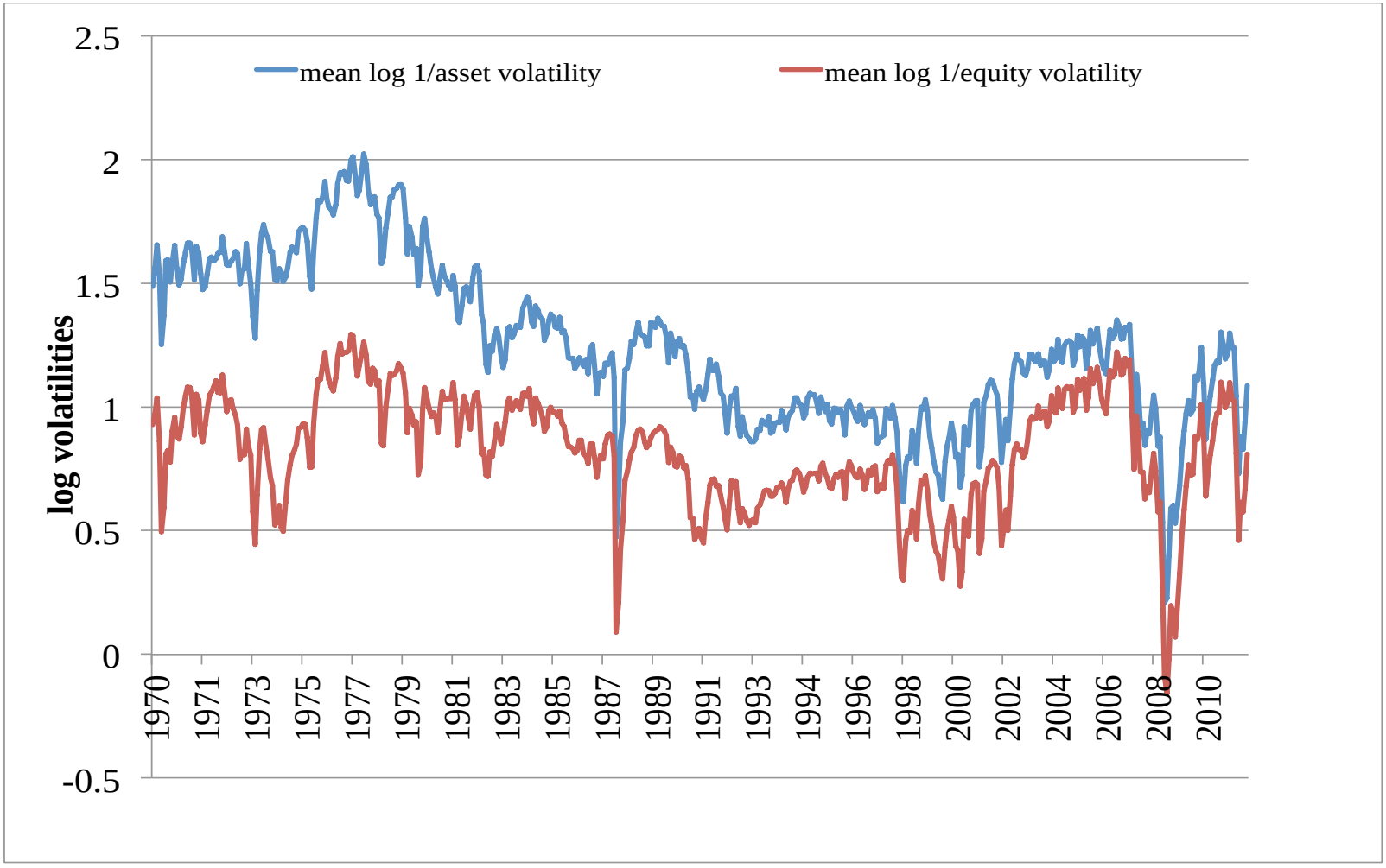
$$V_{At} = V_{Et} + V_{Bt}$$

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

- Need to use equity and accounting data

  COMPUSTAT data for value of liabilities V_{Bt}

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



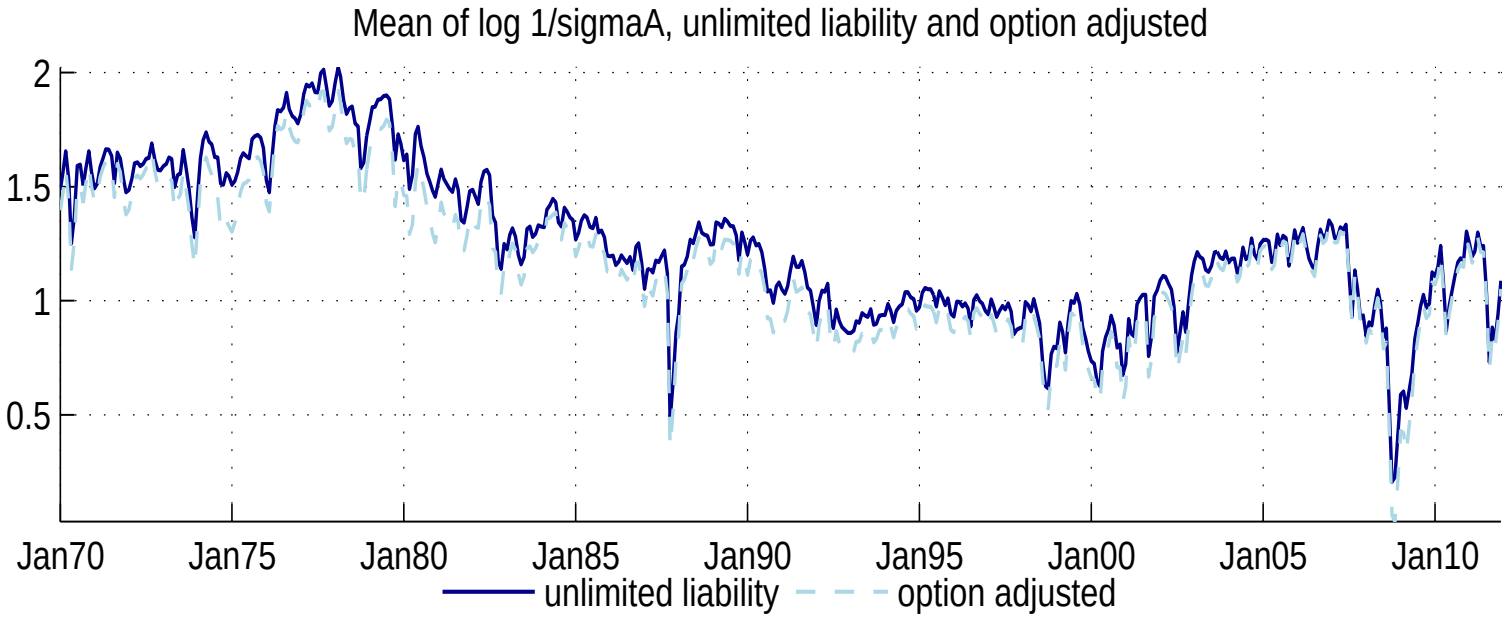
What happened in 2008?

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

  in which financial soundness deteriorates...

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

Measurement under limited vs unlimited liability

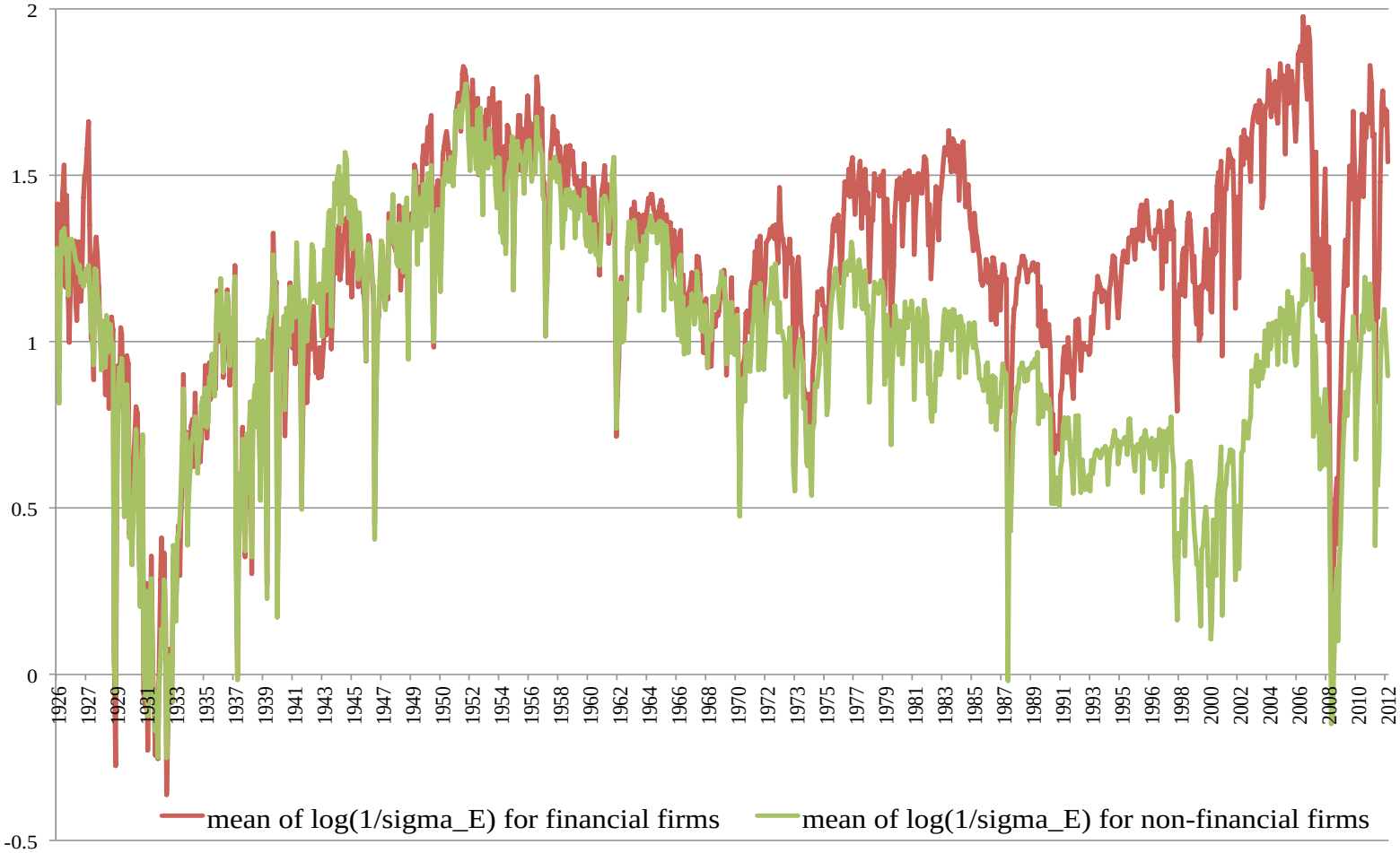


- We use Black and Scholes to calculate the option adjustment

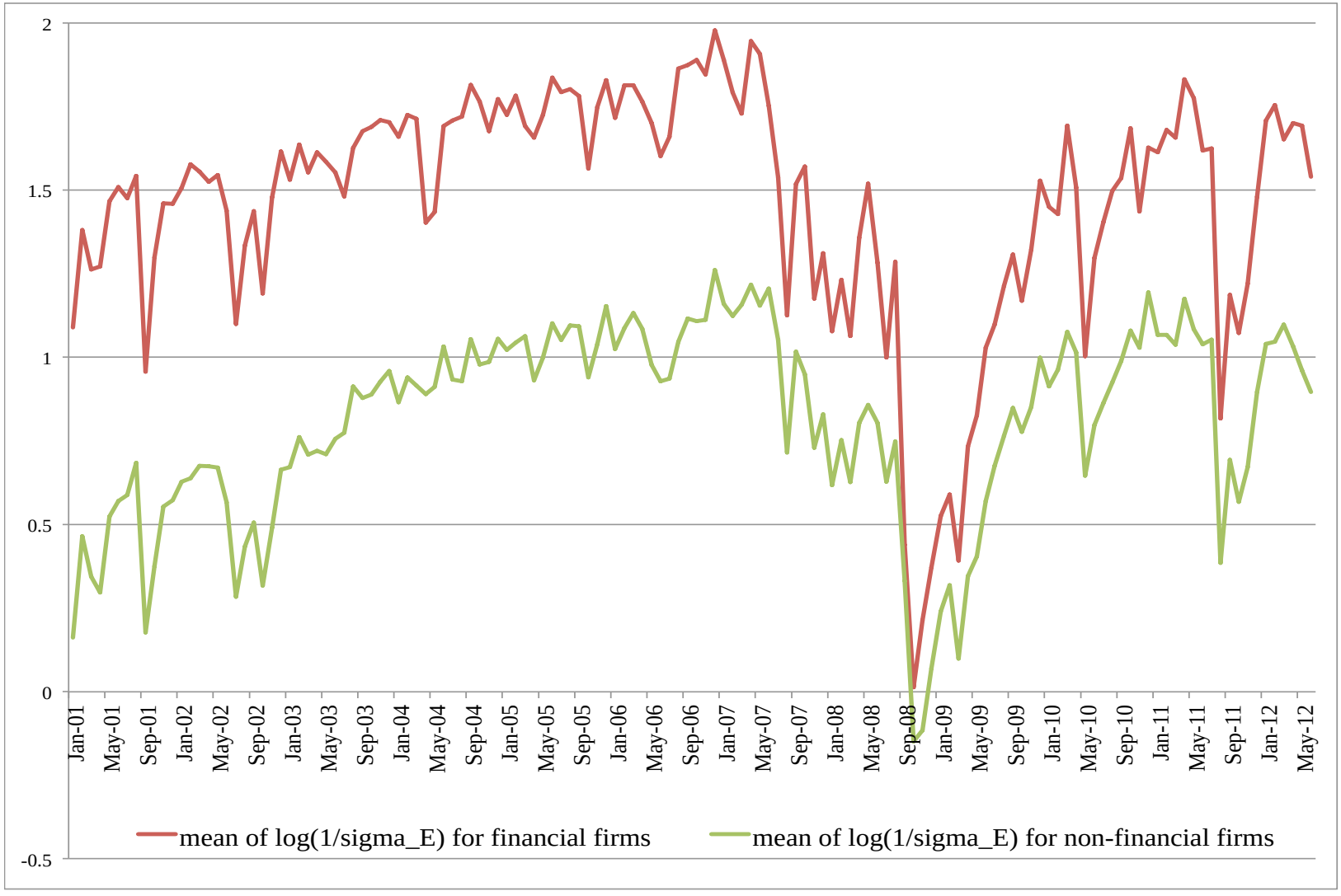
Are Some Firms Special?

- Financial firms
- Large Financial Firms (TBTF)
- Government-Backed Large Financial Intermediaries (GBLFIs)

Financials vs. Non-Financials DI 1926-2012



Financials vs. Non-Financials DI 2001-2012



Are Financial Firms Special?

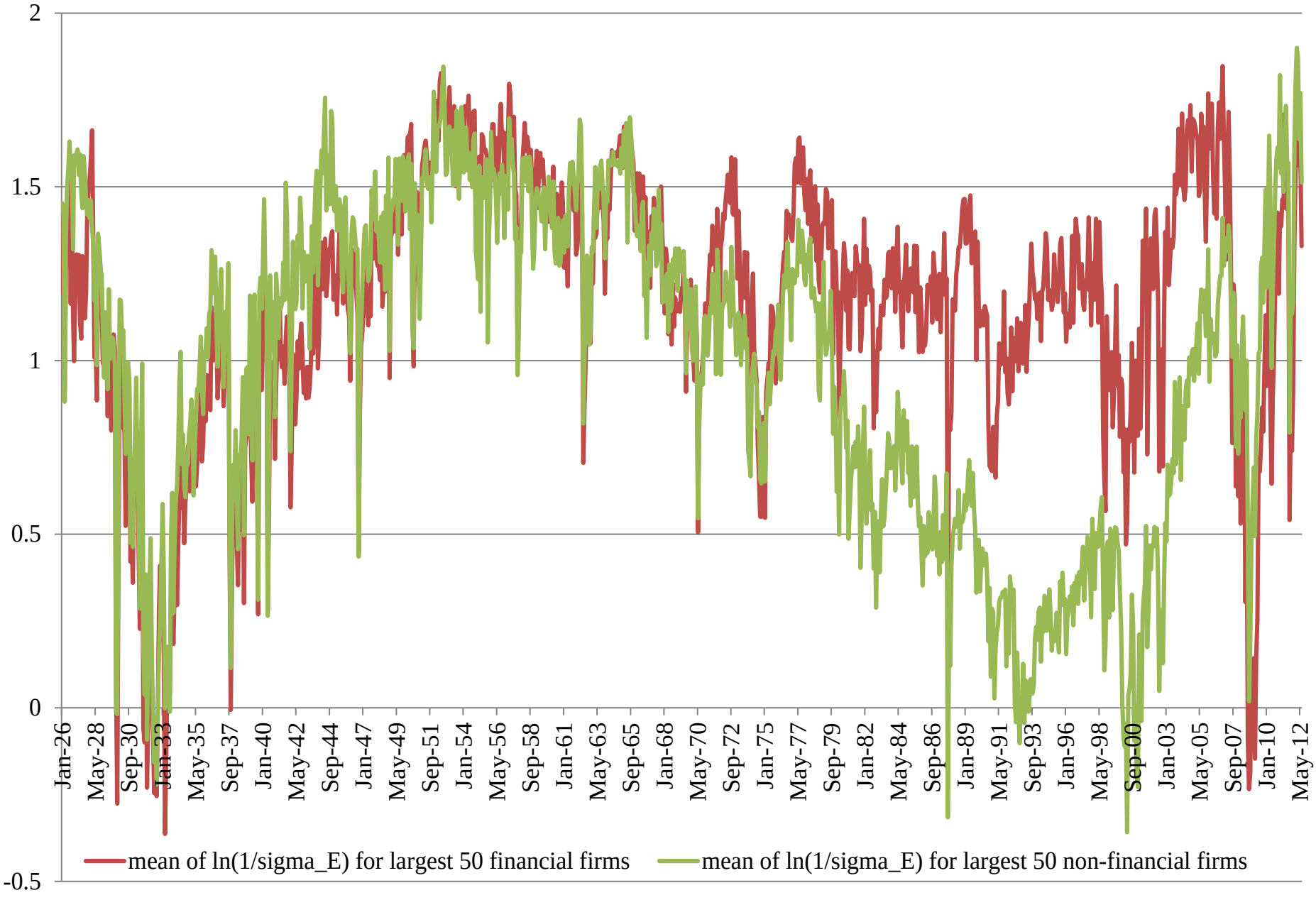
- DI for Financial Firms

  timing and magnitude of collapse of DI
  same as for all firms

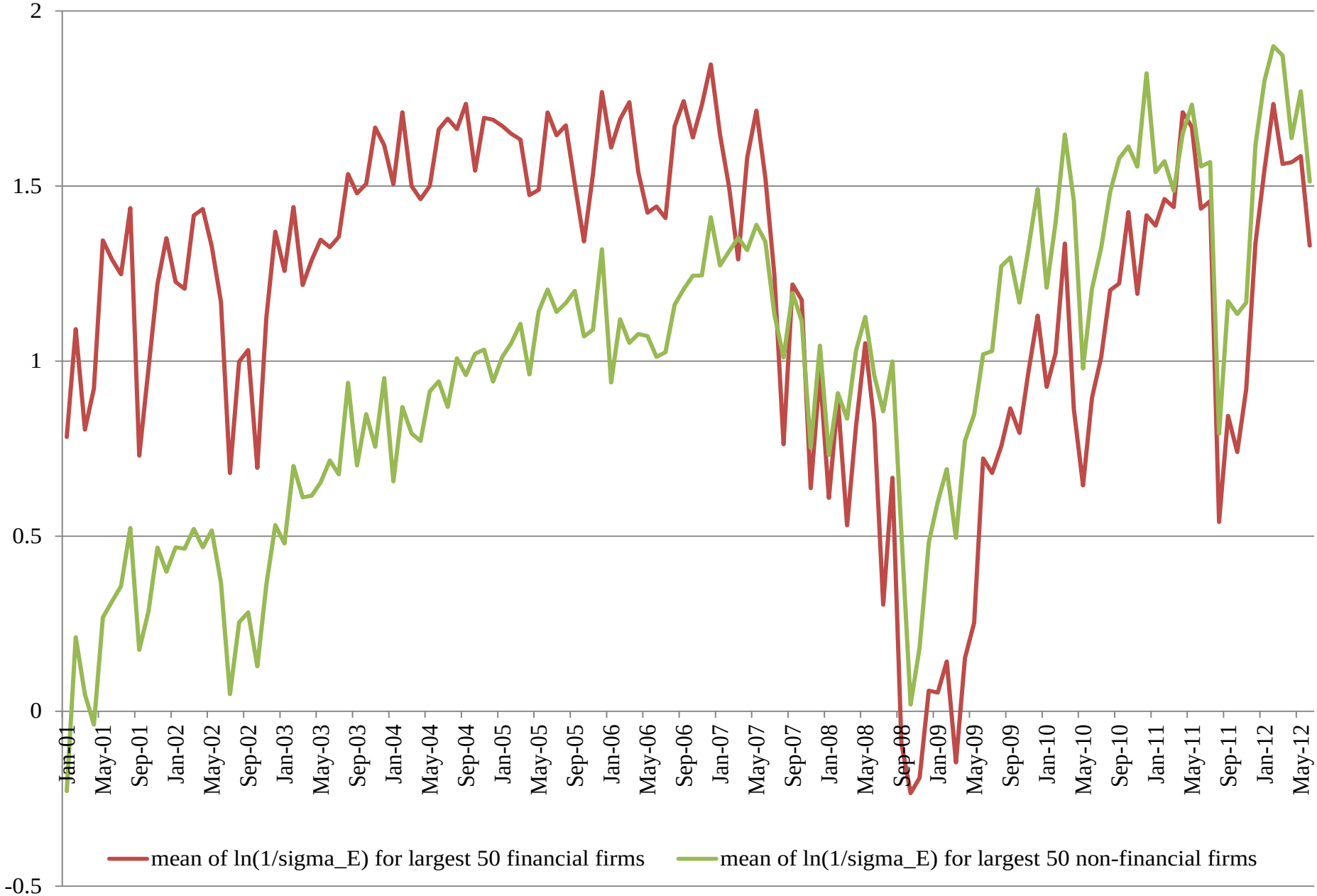
- No direct evidence for financials *leading* a crisis

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