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 ▷ better

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

Market Signals ▷ worse

- 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

- Meiselman, Nagel, and Purnanandam (2018)

Bailout expectations in bond spreads

- Berndt, Duffie, Zhu (2019)

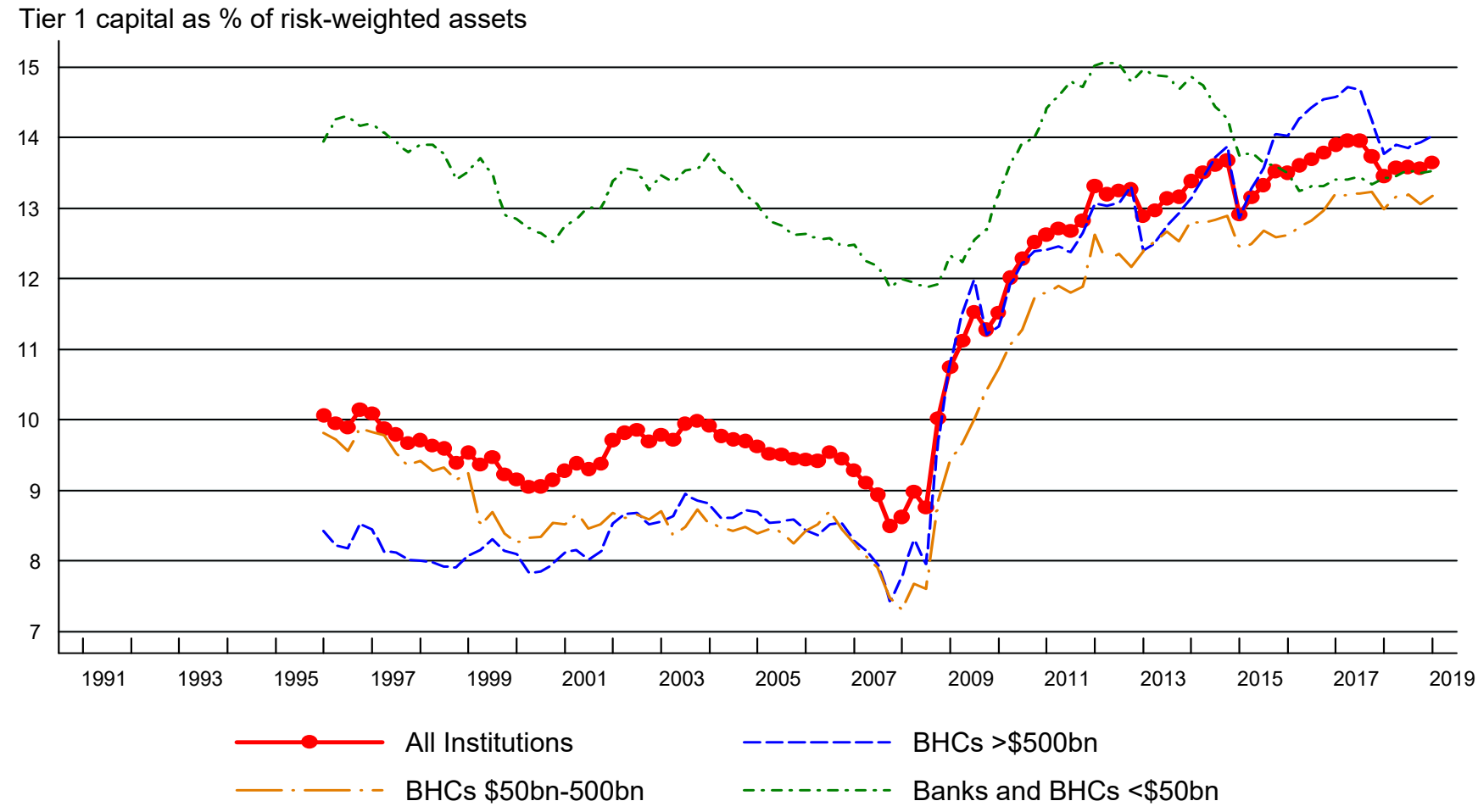
Outline

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

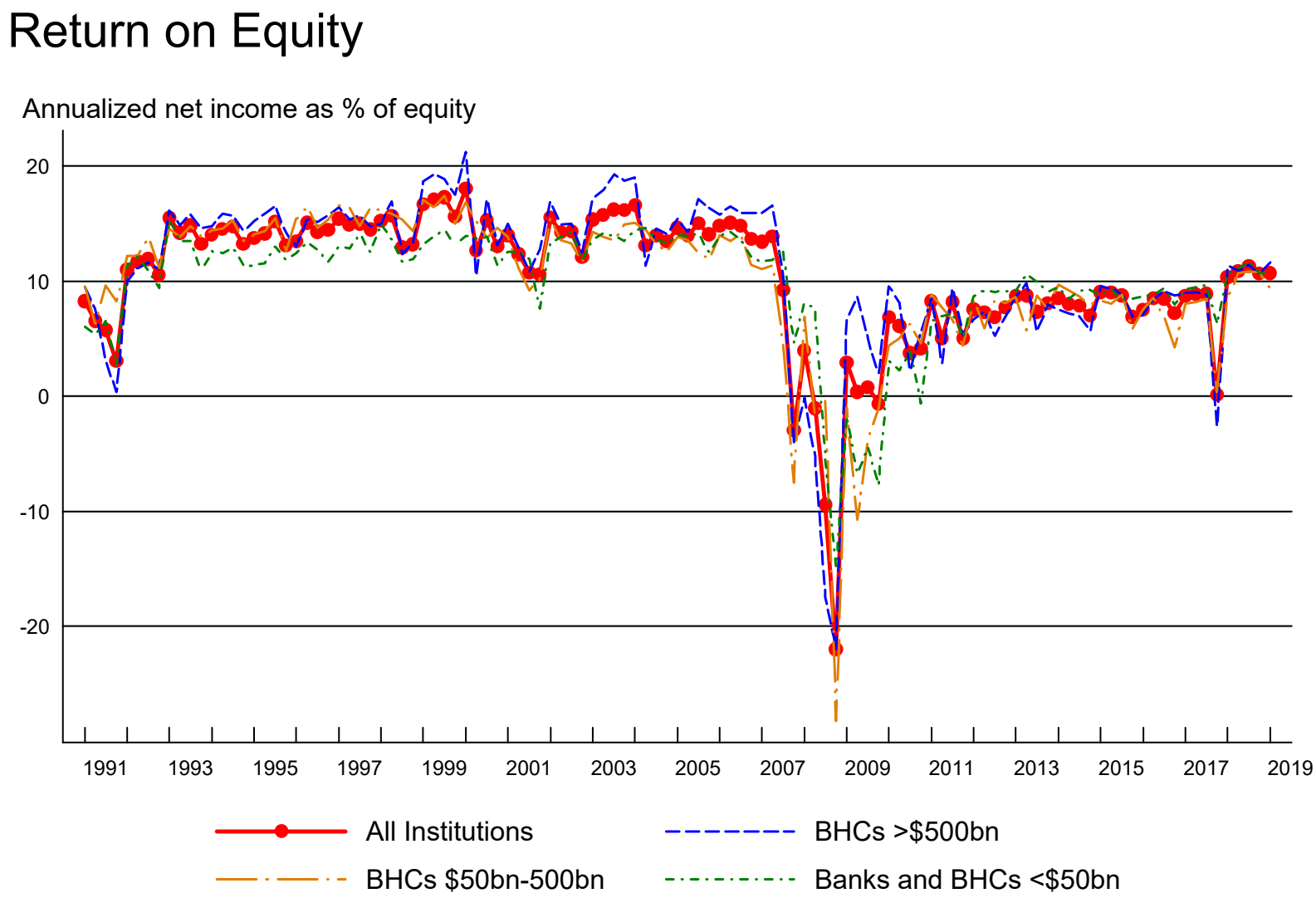
Fed Dashboard
and Stress Test Framework

Accounting Data: Book Equity Up, Small Drop in 2007-2008

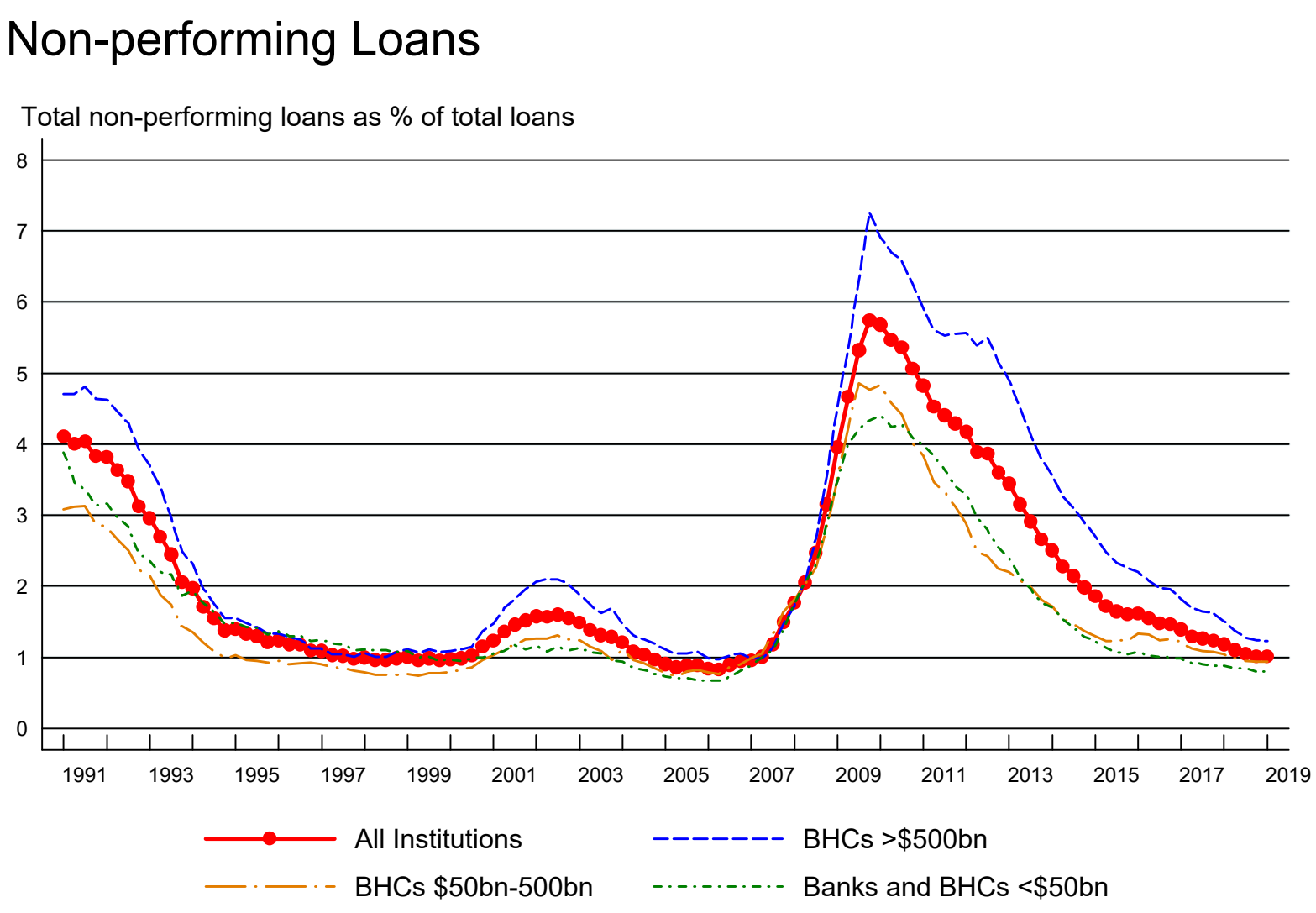
Tier 1 Capital Ratio



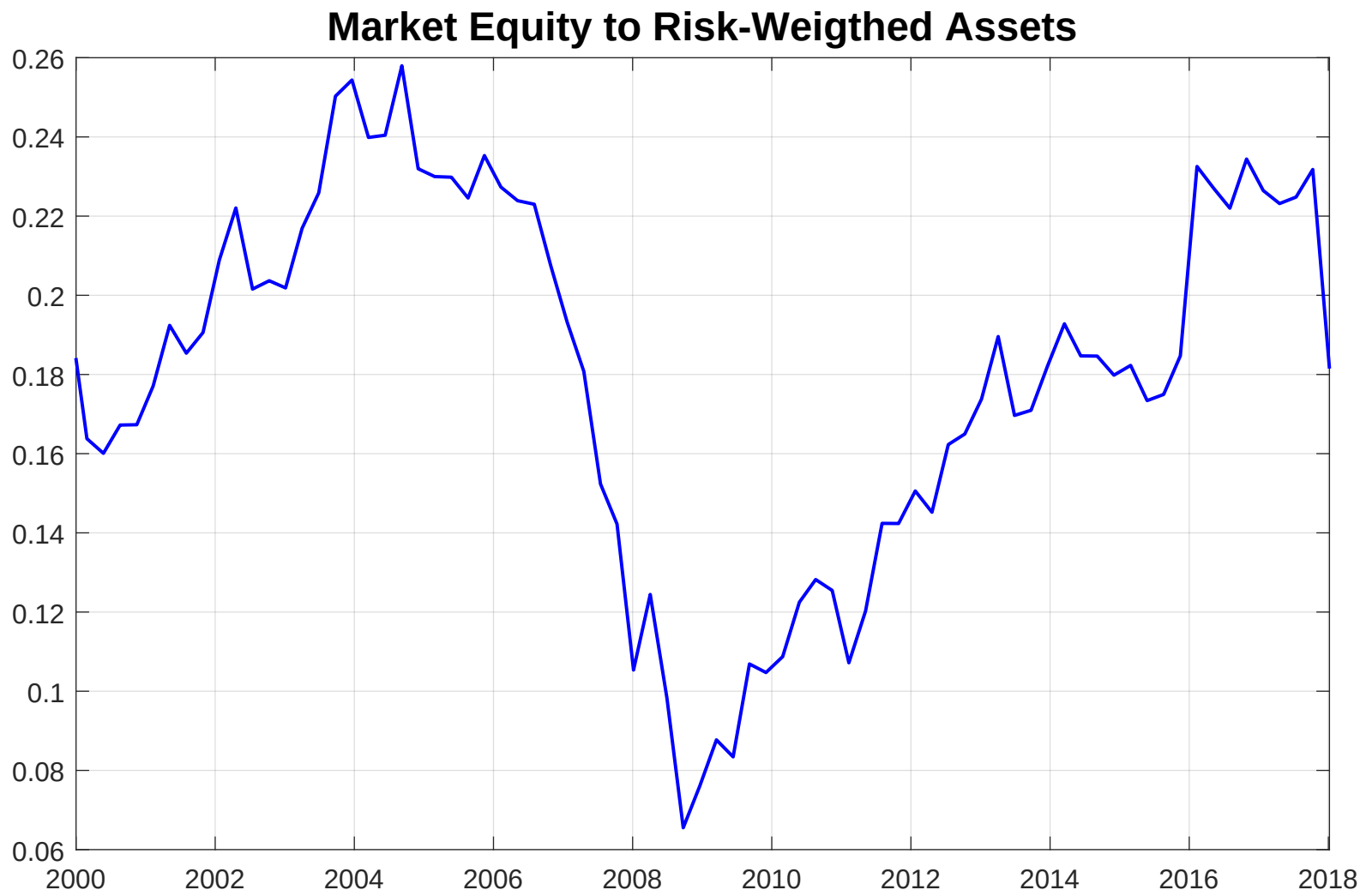
Accounting Data: Profitability Improving



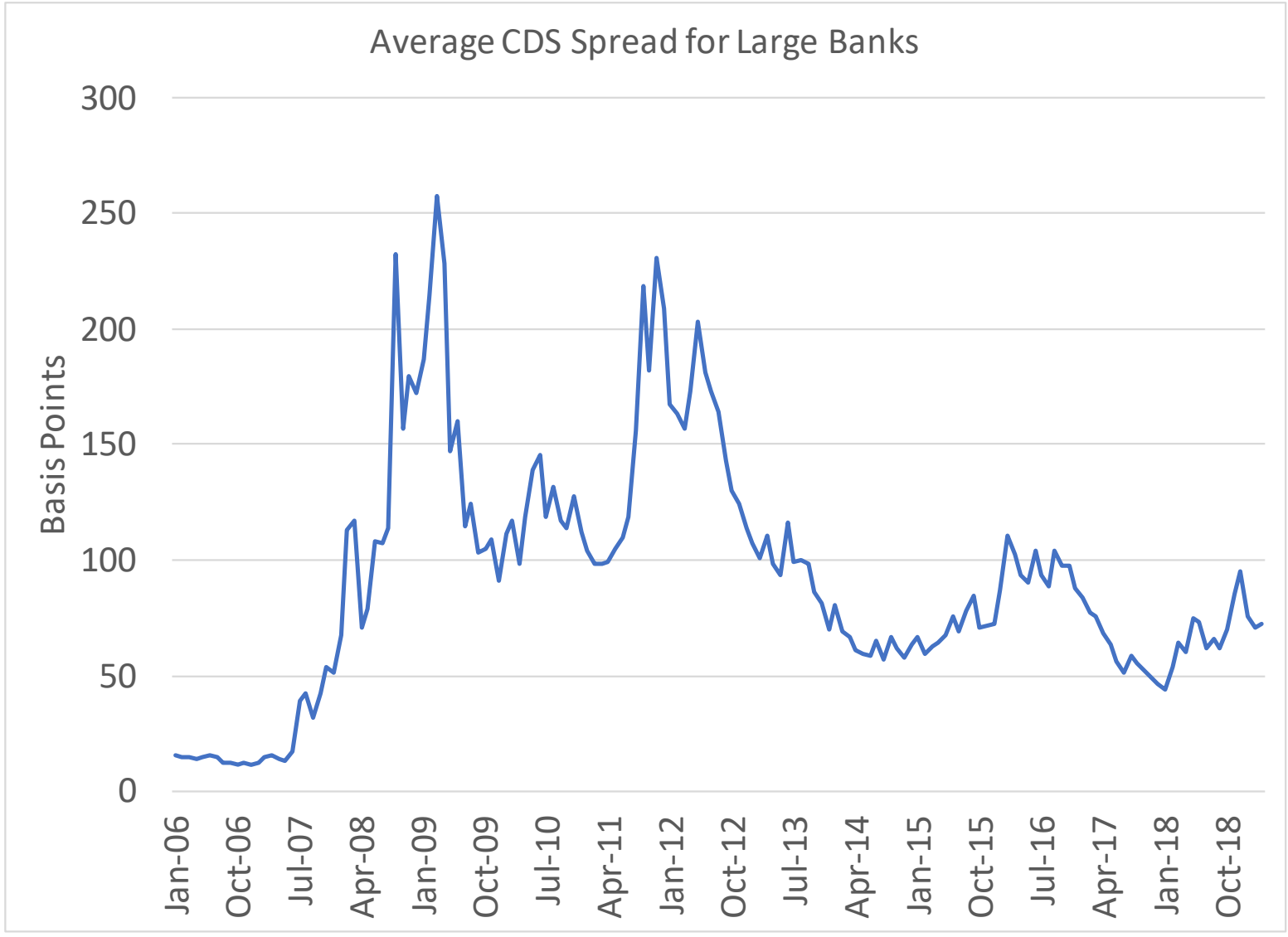
Accounting Data: Loan Quality Improving



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:

$$\frac{CET1_{t+1}}{RWA_{t+1}} = \frac{1}{(1+g_{At})^{1/4}} \frac{CET1_{t+1}}{RWA_t}$$

$$\frac{CET1_{t+1}}{RWA_t} = \frac{CET1_t}{RWA_t} + \frac{PPNR_t}{RWA_t} - \frac{Provisions_t}{RWA_t} - \frac{Taxes_t}{RWA_t} - \frac{Dividends_t}{RWA_t}$$

▷ 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
- Berndt, Douglas, Duffie, and Ferguson (2018)
- 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

  $v_L >$ book value $= 1$

- **Fair value** of a one-dollar deposit

  PV of: interest + servicing costs + principal payments

  $v_D <$ book value $= 1$

- **Franchise value** of equity per dollar of loans

  $\text{FE} = (v_L - 1) \times \text{L} - (v_D - 1) \times \text{D}$

  lend at high rates, borrow at low rate

Market Value of Equity (ME)

- Market value of equity with default decision

$$\mathsf{ME} = \frac{1}{1+i} \sum_s q(s) \max\left\{0, \mathsf{div}_E(s) + (1+g(s))\mathsf{ME}\right\}$$

- 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 = PV of all future cash injections

  valuation multiple times expected bailout in a crisis

$$\text{MG} = \frac{q(c)}{i - \bar{g}} T(c)$$

- Modigliani Miller with gov't as negative stakeholder

  $\text{ME} = \text{BE} + \text{FE} + \text{MG}$

Equity Valuation and Bond Spreads

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

$$ME = \frac{q(n)}{(1+i) - q(n)(1+g(n))} div_E(n)$$

- 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

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

- 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

$r_L(c)$	0.9	0.88	0.86	0.84	0.82
ME/BE	1.63	1.63	1.83	2.02	2.19
$ROE(n)$	0.14	0.15	0.16	0.17	0.19

Pre-Crisis Cross-Section BE = 9%

$r_L(c)$	0.9	0.88	0.86	0.84	0.82
ME/BE	1.06	1.06	1.09	1.19	1.32
$ROE(n)$	0.07	0.07	0.08	0.09	0.10

Post-Crisis Cross-Section BE = 13%

$r_L(c)$	0.9	0.88	0.86	0.84	0.82
ME/BE	1.63	1.63	1.83	2.02	2.19
$ROE(n)$	0.14	0.15	0.16	0.17	0.19

Pre-Crisis Cross-Section BE = 9%

$r_L(c)$	0.9	0.88	0.86	0.84	0.82
ME/BE	1.04	1.04	1.04	1.04	1.04
$ROE(n)$	0.05	0.06	0.06	0.07	0.07

Post-Crisis Cross-Section BE = 20%

	(1) $\log(ME/BE)$	(2) tail risk measure	(3) tail risk measure	(4) tail risk measure
$ROE(n)$	0.534***	-0.413***		-0.171***
	(14.25)	(-10.22)		(-3.94)
$\log(ME/BE)$			-0.544***	-0.452***
			(-14.59)	(-10.40)
Observations	510	510	510	510
R^2	0.286	0.171	0.295	0.316

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

$$y_B - i = q(c) \times (1 - \pi) \times \widehat{\ell}(c)$$

Small Change in Expected Default Losses

Pre-Crisis			
π	cds	$\ell(c)$	$q(c)$
0.51	75	0.29	2.55%
0.46	75	0.32	2.31%
0.43	75	0.34	2.19%
0.39	75	0.37	2.05%
-	75	0.15	5.00%

Post-Crisis			
π	cds	$\ell(c)$	$q(c)$
0.30	158	0.42	3.76%
0.20	158	0.48	3.29%
0.10	158	0.54	2.93%
0.00	158	0.60	2.63%
-	158	0.32	5.00%

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

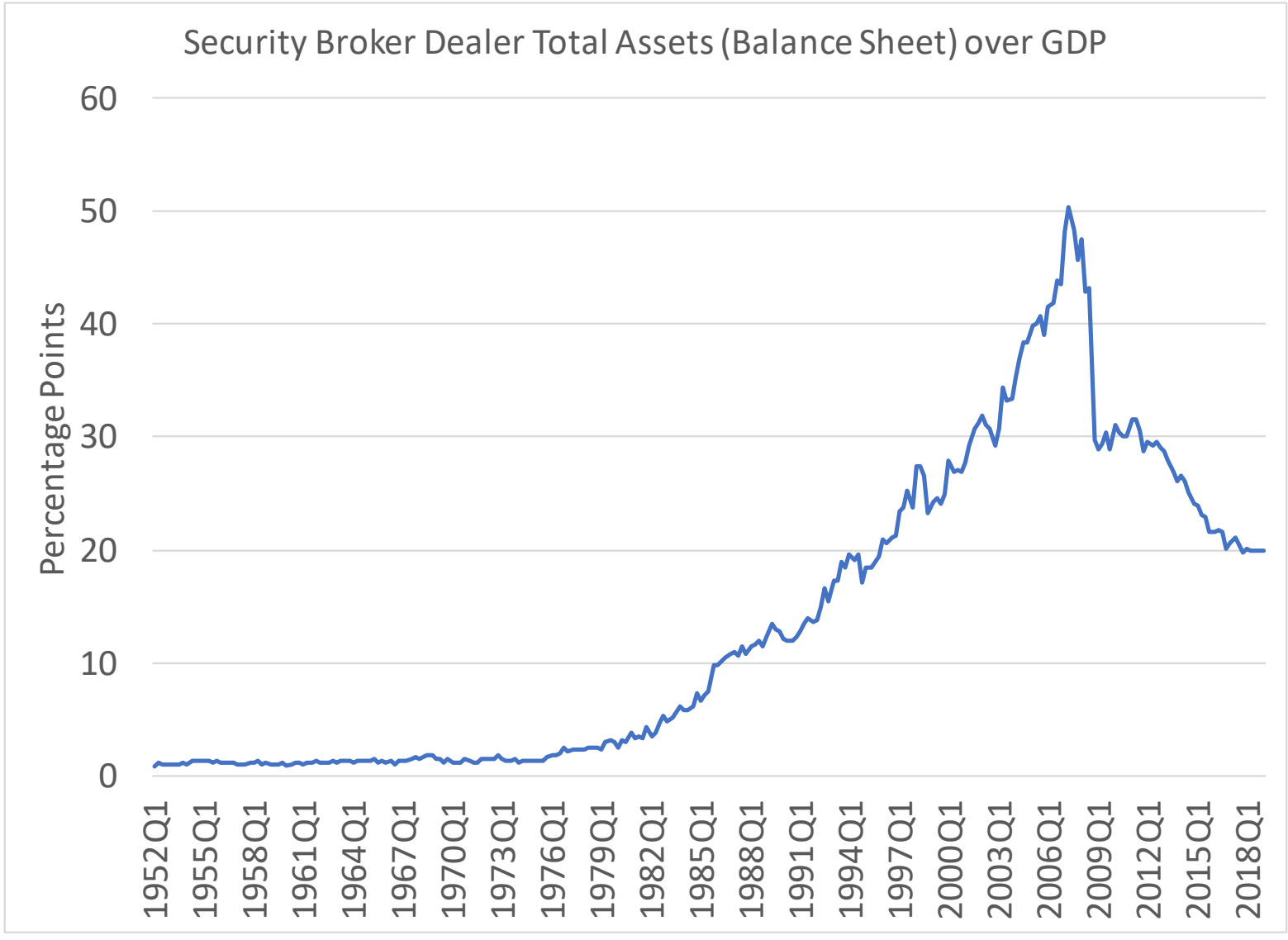
  and try to measure bank franchise value

- What's missing from our model?

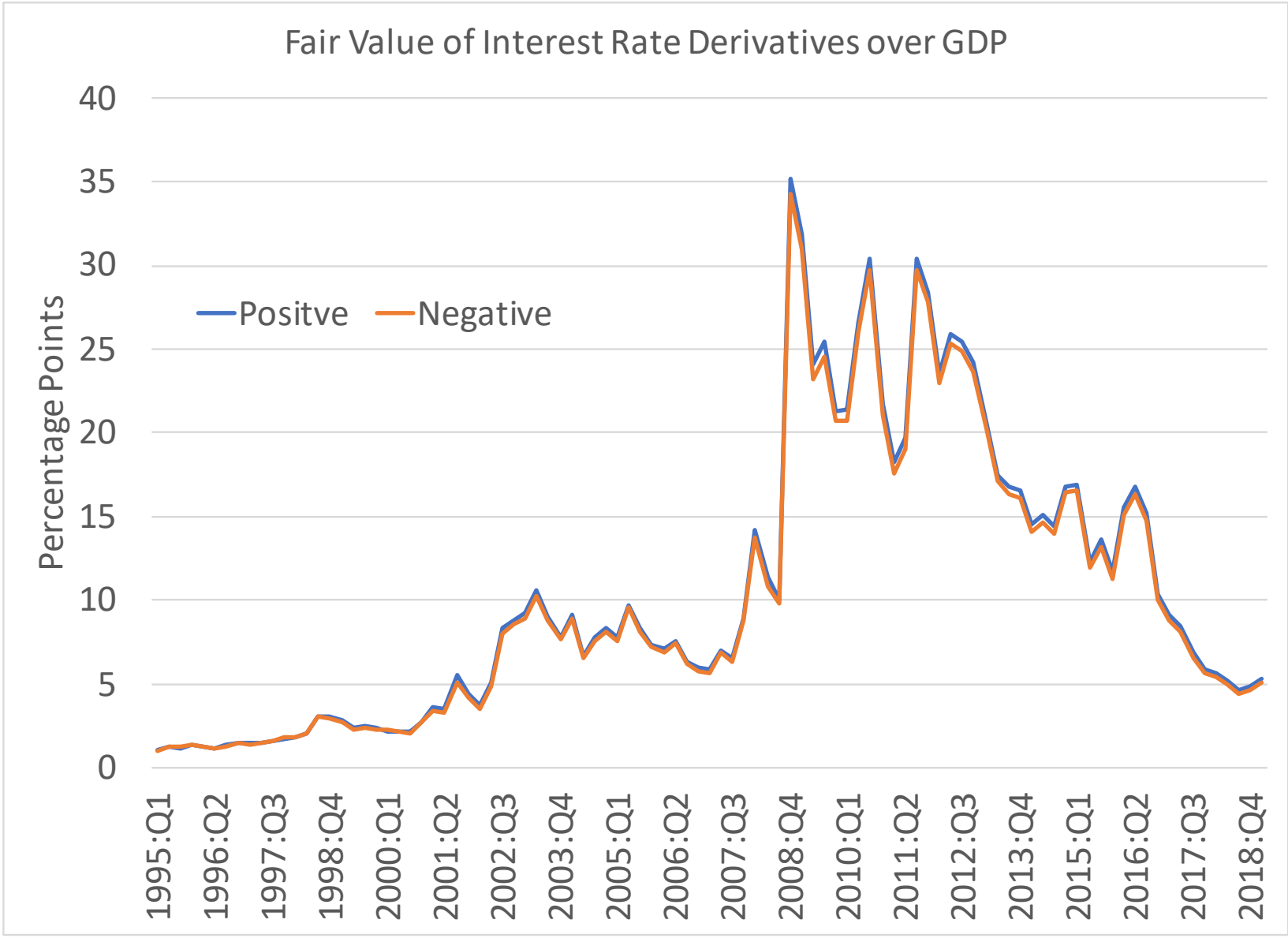
  Duffie 2019: securities broker dealers were the problem in 2008

  Will derivatives be the next crisis?

Securities Broker Dealers Total Assets Have Shrunk



Bank Interest Rate Derivatives Have Shrunk



Bank Credit Derivatives Have Shrunk