Stressed Banks

Diane Pierret

HEC Lausanne & Swiss Finance Institute

Roberto Steri

HEC Lausanne & Swiss Finance Institute

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The Effect of Stress Test Supervision on Bank Risk Taking

Dodd-Frank Act (DFA) has brought major changes in the regulation of large banks:

- regulatory stress tests: higher capital requirements, additional regulatory scrutiny of banks' investments and processes (supervision)

Do regulatory stress tests reduce bank risk taking?

- Yes, but...

- To assess their effectiveness it is essential to disentangle **supervision** (stress tests) from **regulation** (capital requirements)

Stress Tests are Criticized by Politicians, and Academics...

- Stress test are an intrusive form of bank supervision
- Stress test are expensive
  - 2017 Fed budget for supervision and regulation is \$1,533 mn out of \$5,057 mn, with a large share of it devoted to "continue to implement expanded responsibilities mandated by the Dodd-Frank Act"
- "Market information provide little support for the view that major institutions are significantly safer than they were before the crisis" (Sarin and Summers, 2016)
  - the equity beta of the six largest U.S. banks was 1.23 in 2015, compared with a pre-crisis value of 1.18

...Stress Tests are Criticized by Bankers

Deutsche Bank hires Oliver Wyman consultancy to help pass US stress test

German lender failed exam in June after regulators found 'widespread' deficiencies

Fed to ease rules for smaller US banks

Regional lenders will get relief on stress tests and liquidity coverage ratio

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Kiran Stacey in Washington OCTOBER 31, 2018

Some of the largest regional banks in the US will no longer have to undergo annual stress tests under plans by regulators to reduce the industry's red tape, but which critics say could make another crisis more likely.

Companies such as BB&T and SunTrust will have their balance sheets tested only every two years under proposals unveiled on Wednesday by the US Federal Reserve.

There will also be regulatory relief for larger banks, such as US Bancorp and PNC, which will face lower liquidity requirements.

Jay Powell, the chairman of the Fed, said: "The proposals before us would prescribe materially less stringent requirements on firms with less risk, while maintaining the most stringent requirements for firms that pose the greatest risks to the financial system and our economy."

> **This increases the risk that the taxpayers will again be on the hook**

Randal Quarles, the Fed's vice-chairman for supervision, added: "The character of regulation should match the character of the firm."

Bank capital: silly old buffer

Stress tests should remain the primary way of keeping lenders on a tight leash

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AUGUST 29, 2018 8

Debates over bank capital resemble one of those epic but interminable tennis rallies between a pair of baseline sluggers. On one side of the net you have the big global banks. They say they have plenty of capital and that forcing them to operate with more is a restraint on trade. Pow! On the other side are the regulators, who say more capital is better because you never know what losses you may have to absorb. Thwack!

The current argument in the US over an extra layer of protection dreamt up by the Basel Committee — the countercyclical buffer — has played out in much the same way. Some sympathy for the banks is due. They are already subject to a dizzying array of ratios and buffers, from Basel and beyond. The benefits of adding another layer of bubble wrap are unclear.

But the discussion is really a sideshow. The more important point is that the Federal Reserve, the most powerful US banking regulator, already has a lot of latitude to tighten restraints on banks through annual stress tests. If the Fed feels that a frothy stock market poses extra risks, it can simply imagine a bigger swing in prices in its Armageddon scenario. Banks would then be forced to prepare for it by limiting cash distributions to shareholders.

This Paper: Risk Taking, Regulation and Supervision

Theoretical framework: **two channels** can affect banks' risk taking

1. **Capital requirements** (regulation): stress tests increase capital requirements for stressed banks $\longrightarrow$ risk-taking?
   - **More risk taking**: profit-maximizing banks could rationally respond to a higher cost of funding by increasing the expected profitability of their portfolios by investing in riskier assets (Koehn and Santomero, 1980; Kim and Santomero, 1988; Rochet, 1992; Baker and Wurgler, 2015; Gale, 2017)
   - **Less risk taking**: shareholders' skin in the game (Cooper and Ross, 2002; Admati, DeMarzo, Hellwig, and Pfleiderer, 2013)
   - **Non-monotonicity**: Bahaj and Malherbe (2018), Harris, Opp and Opp (2017)

2. **Regulatory scrutiny** (supervision): all additional regulatory exercises that do not affect the level of the capital requirement
   - qualitative exercise challenging bank risk management and capital planning processes

This Paper: Empirical Analyses

To assess the effect of stress tests on banks' risk taking, we study

1. **Yield on the bank portfolio of new loans**: comparing stressed banks to "non-stressed banks" in a differences-in-differences analysis, controlling for the bank-specific capital requirement
   - holding the capital requirement constant, the differential response of stressed banks to DFA plausibly captures the effect of enhanced **supervision**

2. **How banks allocate their portfolios of new loans to firms with a given level of risk**:
   Identification with a saturated model (Khwaja and Mian (2008), Jimenez et al. (2012, 2014), etc.)
   - given a set of fixed effects (firm*time and/or bank*time FE), how banks subject to more stringent capital requirements reallocate their loan portfolios?
   - diff-in-diff analysis: holding the capital requirement constant, what is the **differential response** of stressed banks after DFA?

This Paper: Summary of Main Results

Banks differ in their sensitivity to capital requirements

- The sensitivity of risk-taking to higher capital requirements decreases for all banks after DFA, but less for stressed banks
- Important control in order to highlight the other channels of risk-taking of stressed banks

1. **Stress Test Supervision**
   Holding the capital requirement constant,
   - the average yield increased for all banks after DFA, but by 186 to 197 bps less for stressed banks
   - stressed banks tilt their portfolio towards risky firms less after DFA: relative improvement of the average borrower rating by 0.7 classes

2. **Dissecting the effect of the capital requirement from stress tests**
   - the correction to the capital requirement resulting from the stress test induces banks to reallocate their loan portfolio towards safe borrowers

Our results highlight the effectiveness of stress test supervision in encouraging prudent lending.

Outline

1. Risk-Sensitive Capital Requirements
2. Bank, Firm, and Loan Data
3. Stress Test Supervision
4. Dissecting the Effect of Capital Requirements

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Capital Requirements

Banks in the U.S. have to comply with 4 regulatory capital requirements

$$
\begin{aligned}
CET1R: &\quad \frac{CET1_b}{RWA_b} \geq k_1 \\
T1R: &\quad \frac{T1_b}{RWA_b} \geq k_2 \\
TotalR: &\quad \frac{Total_b}{RWA_b} \geq k_3 \\
LVGR: &\quad \frac{T1_b}{Assets_b} \geq k_4
\end{aligned}
$$

where $CET1_b$ is the common equity Tier 1 capital, $T1_b$ is the Tier 1 capital, $Total_b$ is the Total regulatory capital, RWA_b are the risk-weighted assets, and $Assets_b$ are the average total assets of bank b.

Typically, $CET1_b \leq T1_b \leq Total_b$ and $RWA_b \leq Assets_b$.

Capital Requirements

4 regulatory capital requirements

Panel A: CCAR regulatory thresholds (%)

	T1CR (k_1)	CET1R (k_1)	T1R (k_2)	TotalR (k_3)	LVGR (k_4)
2016	-	4.5	6	8	4
2015	5	4 to 4.5	5.5 to 6	8	3 to 4
2014	5	4 to 4.5	4 to 6	8	3 to 4
2013	5	-	4	8	3 to 4
2012	5	-	4	8	3

Stress Tests Increase Capital Requirements

In stress tests, **the increase in capital requirement of a bank is related to the sensitivity of bank's assets to the stress scenario**

$$CET1R_{b,stress} = \frac{CET1_b - Loss(stress\,scenario)_b}{RWA_b + Risk(stress\,scenario)_b}$$

such that $CET1R_{b,stress} \leq CET1R_b$, and the capital requirement in the stress test is

$$CET1R_{b,stress} \geq k_1$$

Stress Tests Increase Capital Requirements

4 bank-specific capital requirements from stress tests

$$k_{1b}^{s} = \frac{k_1}{1 + \frac{CET1R_{b,stress} - CET1R_b}{CET1R_b}}$$

$$k_{2b}^{s} = \frac{k_2}{1 + \frac{T1R_{b,stress} - T1R_b}{T1R_b}}$$

$$k_{3b}^{s} = \frac{k_3}{1 + \frac{TotalR_{b,stress} - TotalR_b}{TotalR_b}}$$

$$k_{4b}^{s} = \frac{k_4}{1 + \frac{LVGR_{b,stress} - LVGR_b}{LVGR_b}}$$

Stress Tests Increase Capital Requirements

Comprehensive Capital Analysis and Review 2012
Table C.7: Federal Reserve Estimates in the Supervisory Stress Scenario
Citigroup Inc.

These projections represent hypothetical estimates that involve an economic outcome that is more adverse than expected. These estimates are not forecasts of expected losses, revenues, net income before taxes or capital ratios. The two minimum capital ratios presented below are for the period Q4 2011 through Q4 2013 and do not necessarily occur in the same quarter.

The Federal Reserve made changes to this table on March 16, 2012, to correct computation errors for some loss rates and levels. The corrections do not impact other figures, including capital ratios.

Projected Capital Ratios through Q4 2013
Under the Hypothetical Supervisory Stress Scenario

11.7% → 4.9% = 60% decline
5.0% requirement → 11.9% *effective*

16.9% → 9.9% = 59% decline
8% requirement → 13.7% *effective*

	Actual	Stressed ratios with all proposed capital actions through Q4 2013		Stressed ratios assuming no capital actions after Q1 2012 (1)
	Q3 2011	Q4 2013	Minimum	Minimum
Tier 1 Common Capital Ratio (%)	11.7	4.9	4.9	5.9
Tier 1 Capital Ratio (%)	13.4	6.0	6.0	6.8
Total Risk-Based Capital Ratio (%)	16.9	9.9	9.9	10.8
Tier 1 Leverage Ratio (%)	7.0	2.9	2.9	3.2

Source: Discussion by Daniel Green, 2018 Federal Reserve Stress Testing Research Conference

Capital Requirements are Risk-Sensitive for All Banks

Most stringent Tier 1 capital requirement (in % of total assets)

$$\frac{T1_b}{Assets_b} \geq Cap\,req_b$$

where

$$Cap\,req_b = \max(k_{1b}, k_{2b}, k_{3b}, k_4),$$

after expressing all capital requirements in the "same units"

$$CET1R: \quad \left[\frac{CET1_b}{RWA_b} - \frac{CET1_b - T1_b}{RWA_b}\right]\frac{RWA_b}{Assets_b} \geq \left[k_1 - \frac{CET1_b - T1_b}{RWA_b}\right]\frac{RWA_b}{Assets_b} = k_{1b}$$

$$T1R: \quad \frac{T1_b}{RWA_b}\frac{RWA_b}{Assets_b} \geq k_2\frac{RWA_b}{Assets_b} = k_{2b}$$

$$TotalR: \quad \left[\frac{Total_b}{RWA_b} - \frac{Total_b - T1_b}{RWA_b}\right]\frac{RWA_b}{Assets_b} \geq \left[k_3 - \frac{Total_b - T1_b}{RWA_b}\right]\frac{RWA_b}{Assets_b} = k_{3b}$$

$$LVGR: \quad \frac{T1_b}{Assets_b} \geq k_4$$

Capital Requirement of Stressed Banks

Most stringent Tier 1 capital requirement (in % of total assets)

$$\frac{T1_b}{Assets_b} \geq Cap\,req_b$$

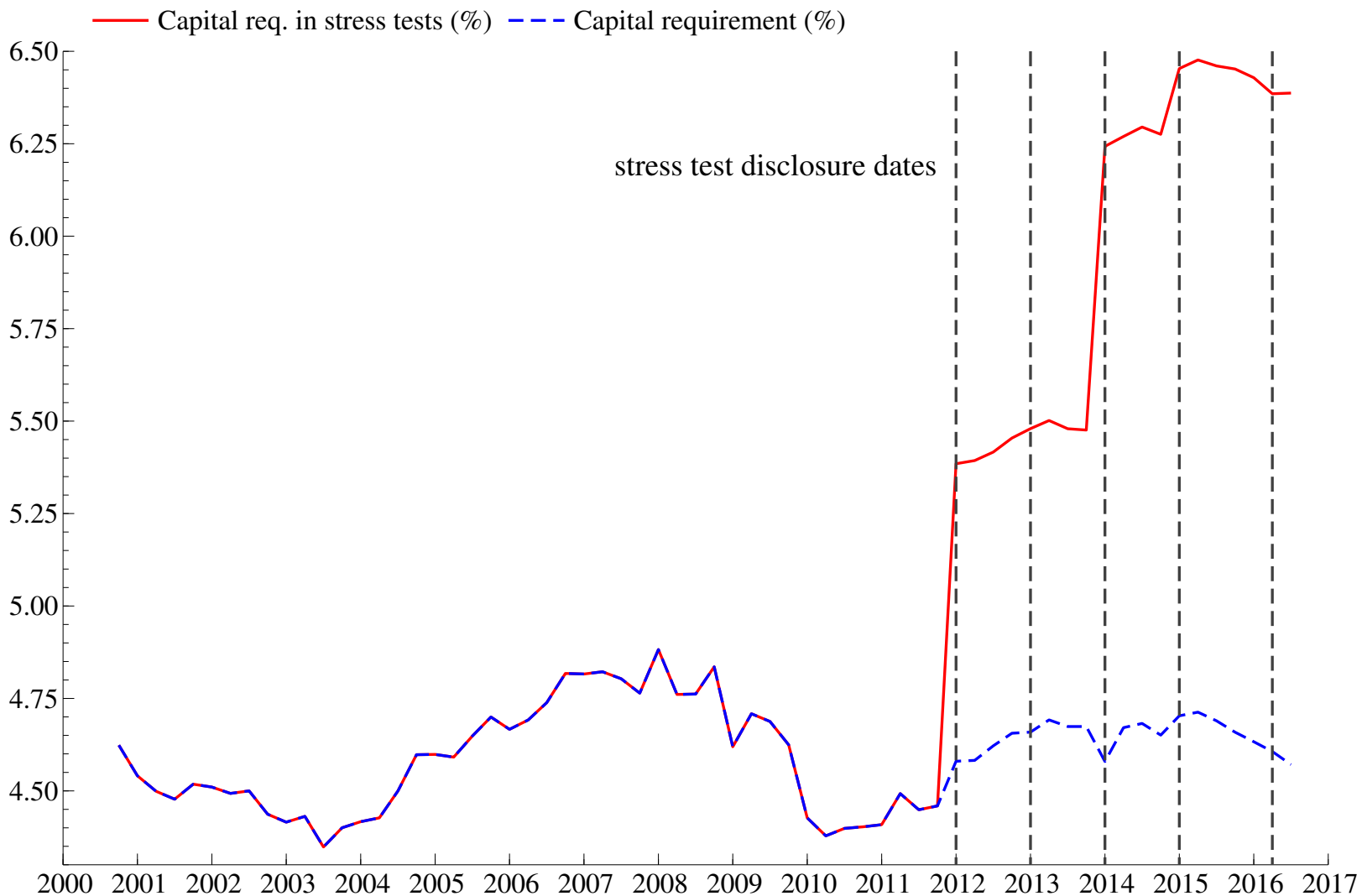
where

$$Cap\,req_b = \max(k_{1b}, k_{2b}, k_{3b}, k_4, k'_{1b}, k'_{2b}, k'_{3b}, k'_{4b}),$$

and $k_{1b} = \left[k_1 - \frac{CET1_b - T1_b}{RWA_b}\right] \frac{RWA_b}{Assets_b}$, $k_{2b} = k_2 \frac{RWA_b}{Assets_b}$,
$k_{3b} = \left[k_3 - \frac{Total_b - T1_b}{RWA_b}\right] \frac{RWA_b}{Assets_b}$, $k'_{1b} = \left[k^s_{1b} - \frac{CET1_b - T1_b}{RWA_b}\right] \frac{RWA_b}{Assets_b}$,
$k'_{2b} = k^s_{2b} \frac{RWA_b}{Assets_b}$, $k'_{3b} = \left[k^s_{3b} - \frac{Total_b - T1_b}{RWA_b}\right] \frac{RWA_b}{Assets_b}$, $k'_{4b} = k^s_{4b}$.

Capital Requirements

Two reasons for risk-sensitive capital requirements: risk-weighted assets (all banks) and stress tests (stressed banks)



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3. Stress Test Supervision
4. Dissecting the Effect of Capital Requirements

Sample of Banks

1. 33 stressed banks that participated in the CCAR 2016
   - 18 BHCs have been subject to the CCAR every year since 2011
   - 15 "new entrants" (with consolidated assets $\geq$ \$50 bn)

2. 21 non-stressed banks: U.S. BHCs with consolidated assets $\geq$ \$10 bn that have never been subject to a regulatory stress test

Matching SNL-DealScan

For each bank (BHC) and each quarter,

- list of controlled subsidiaries from the National Information Center (NIC): 48,113 unique lending companies
- 19,291 unique lending companies in DealScan
- manually matched on name, time, location

DealScan contains information on syndicated loans, which have a unique borrower but can have multiple lenders.

- unlike previous studies (e.g., Bharath, Dahiya, Saunders, and Srinivasan, 2011), **we do not restrict our sample to lead arrangers only**:
  a bank can engage in risky lending both by originating a syndicated loan as the lead arranger and by participating to it as a member bank

Exclude not completed deals and deals syndicated outside the U.S.: 227,074 lender-borrower relationships.

Matching SNL-DealScan-Compustat

- We match DealScan to the Compustat Quarterly Industrial Files (using the DealScan-Compustat Linking Database provided by Chava and Roberts (2008))
- We link every deal in the resulting merged dataset to the most recent S&P long-term credit ratings available for the borrower from Compustat Ratings
- Resulting sample: 119,383 lender-borrower relationships.

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Differences-in-differences Analysis

Supervision versus capital requirements

$$\begin{aligned} portfolio\,yield_{bt} = \; & \alpha_b + \delta_t + \beta_1 stressed_b * DFA_t \\ & + \beta_2 stressed_b * DFA_t * Cap\,req_{bt} + \beta_3 Cap\,req_{bt} \\ & + \beta_4 stressed_b * Cap\,req_{bt} + \beta_5 DFA_t * Cap\,req_{bt} \\ & + \gamma' controls_{bt} + \varepsilon_{bt} \end{aligned}$$

where

- α_b and δ_t are bank and time FE
- $Cap\,req_{bt}$ is the capital requirement
- $stressed_b = 1$ if stressed bank
- $DFA_t = 1$ after Dodd-Frank Act

The Effect of Supervision on Banks' Portfolio Yield

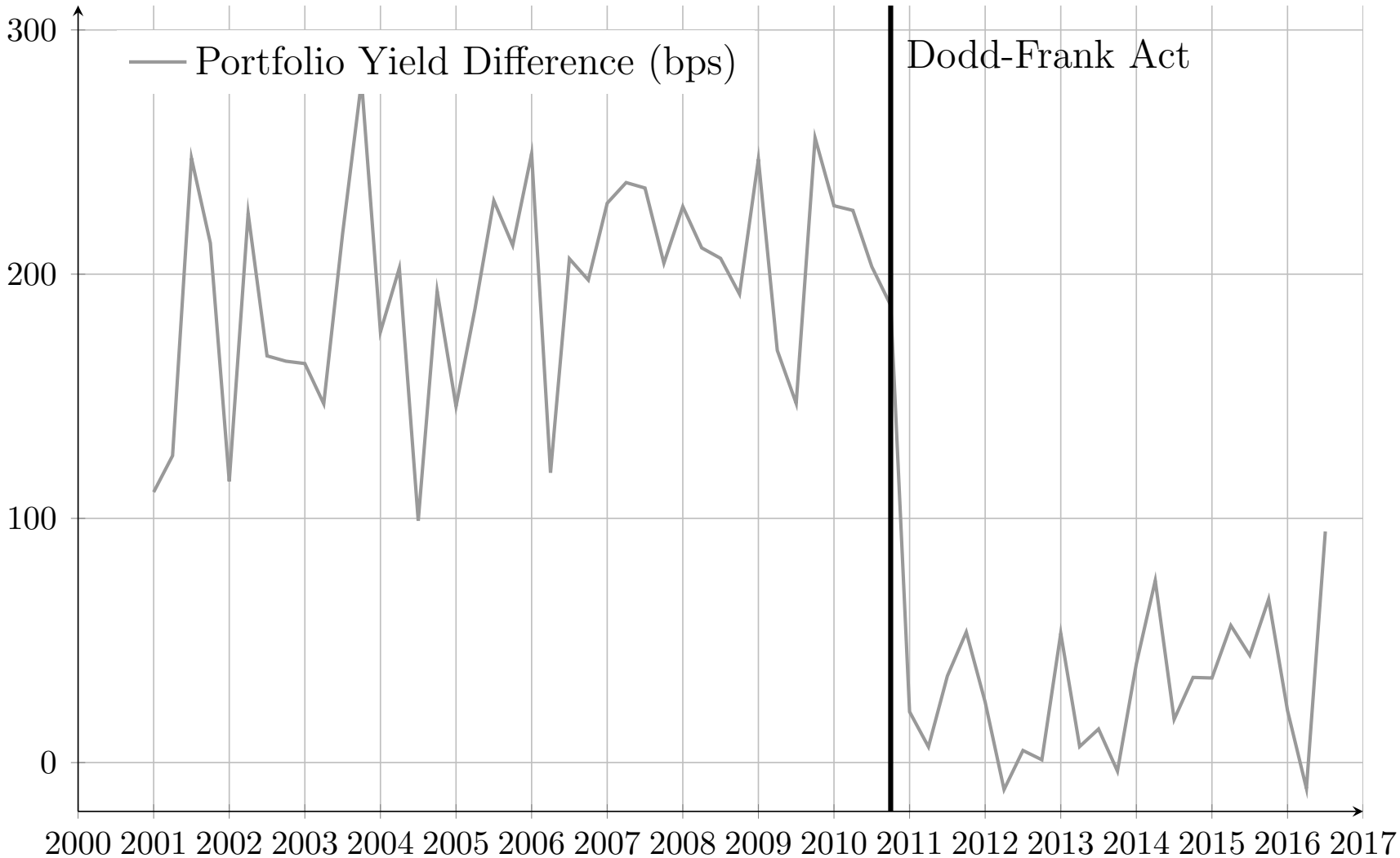
Holding the capital requirement constant, the change in the average portfolio yield after DFA is 197 bps lower compared to non-stressed banks.

The change in sensitivity to a 1 pp. capital requirement increase after DFA is 43 bps higher for stressed banks compared to non-stressed banks.

	Portfolio Yield				
$stressed_b * DFA_t$	9.70	8.31	**-196.75**	**-192.77**	**-185.60**
	(1.15)	(1.16)	(-4.16)	(-3.69)	(-3.67)
$\triangle \mathrm{E}(portfolio\,yield_{bt} \mid stressed_b = 0, \overline{Capreq_{bt}})$	39.43	39.43	51.37	50.08	45.95
$\triangle \mathrm{E}(portfolio\,yield_{bt} \mid stressed_b = 1, \overline{Capreq_{bt}})$	21.37	21.37	21.54	21.53	21.50
$stressed_b * DFA_t * Capreq_{bt}$			**42.96**	**42.22**	**41.05**
			(4.18)	(3.60)	(3.58)
Controls	N	Y	N	Y	Y
Bank and Time FE	Y	Y	Y	Y	Y
$stressed_b * DFA_t * portfolio\,yield_{bt-1}$	N	N	N	N	Y
R^2 (%)	69.49	72.23	71.17	73.63	73.78
Adjusted R^2 (%)	66.89	69.68	68.59	71.09	71.14
Observations	1,084	1,084	1,084	1,084	1,084
Banks	29	29	29	29	29

Portfolio Yield: Supervision Effect

The difference in the average residual portfolio yield (removing the effect of capital requirements) of stressed banks compared to non-stressed banks reduces after DFA



The Effect of Supervision on Loan Portfolio Composition

Supervision versus capital requirements

$$\begin{aligned}\log(amount_{fbt}) = \; & \alpha_{bt} + \alpha_{ft} + \beta_1 stressed_b * DFA_t * Firm\,risk_{ft} \\ & + \beta_2 stressed_b * DFA_t * Cap\,req_{bt} * Firm\,risk_{ft} \\ & + \beta_3 Cap\,req_{bt} * Firm\,risk_{ft} \\ & + \beta_4 stressed_b * Cap\,req_{bt} * Firm\,risk_{ft} \\ & + \beta_5 DFA_t * Cap\,req_{bt} * Firm\,risk_{ft} \\ & + \beta_6 stressed_b * Firm\,risk_{ft} + \gamma' controls_{fbt} + \varepsilon_{fbt}\end{aligned}$$

where

- $amount_{fbt} = bankallocation_{bft} * facilityamount_{ft} * exchangerate_{ft}$
- α_{bt} and α_{ft} are bank*time and firm*time FE
- $Firm\,risk_{ft}$ is the firm's numerical rating (1 is AAA; 23 is D)
- The double interaction of $Firm\,risk_{ft}$ and bank $Cap\,req_{bt}$ can capture changes in the **composition** of credit
- $controls_{fbt}$ are contemporaneous loan-level control variables, and lagged bank-level control variables interacted with firm risk

The Effect of Supervision on Banks' Portfolio Composition

Relatively to non-stressed banks, stressed banks lend roughly 70% more to firms in one better rating class after DFA.

	log(amount)			
$stressed_b * DFA_t * Firm\,risk_{ft}$	-0.09	-0.05	**-1.47**	**-0.69**
	(-1.31)	(-0.95)	(-4.72)	(-3.16)
$\triangle \mathrm{E}(amount_{fbt} \mid stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$	0.06	0.05	-0.67	-0.97
$\triangle \mathrm{E}(amount_{fbt} \mid stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$	0.96	0.32	0.98	6.36
$stressed_b * DFA_t * Capreq_{bt} * Firm\,risk_{ft}$			**0.30**	**0.14**
			(4.56)	(3.01)
Loan-Level Controls	N	Y	N	Y
Bank-Level Controls*Firm risk	N	Y	N	Y
Firm*Time FE	Y	Y	Y	Y
Bank*Time FE	Y	Y	Y	Y
Loan Characteristics FE	N	Y	N	Y
R^2 (%)	73.04	74.50	73.25	73.32
Adjusted R^2 (%)	66.92	68.64	67.17	67.26
Observations	21,174	21,174	21,174	21,174
Bank*Time	894	894	894	894
Firm*Time	3,018	3,018	3,018	3,018

Additional Analyses and Robustness

- Non-random assigment:
  - Parallel trend assumption: no differential trend in risk taking of stressed vs. non-stressed banks before DFA
  - Altonji, Elder, and Taber (2005) and Oster (2017)
  - Excluding the largest and smallest banks
  - Placebo test on different size cutoff (average bank size)
- External validity: bank asset income as an indicator of risk taking in good times (Meiselman, Nagel, and Purnanandam (2018))
- Supervision effect decomposed by year
- Advanced approach
- Capital requirement versus average rating on previous loans
- Bank capitalization and distance from capital requirement
- Other robustness tests:
  - Loans to new borrowers
  - Loans syndicated outside the U.S.
  - Excluding crisis observations
  - Including new entrants
  - Alternative firm risk measures

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Dissecting the Capital Requirements of Stressed Banks

The correction to the capital requirement resulting from the stress test

$$Correction_{bt} = Cap\,req_{bt} / Cap\,req^{*}_{bt}$$

where

- $Cap\,req_{bt} = \max(k_{1bt}, k_{2bt}, k_{3bt}, k_{4t}, k'_{1bt}, k'_{2bt}, k'_{3bt}, k'_{4bt})$, the capital requirement of stressed banks
- $Cap\,req^{*}_{bt} = \max(k_{1bt}, k_{2bt}, k_{3bt}, k_{4t})$, the capital requirement without the effect of stress tests
- $Correction_{bt} > 1$ for stressed banks after DFA

Risk Taking and Capital Requirements: the Effect of Stress Tests

Holding $Cap\,req_{bt}$ constant, a bank decreases by 3.5% to 6.6% its share of lending to a firm that has a rating in the next worse class when $Correction_{bt}$ increases by 1 pp.

Panel B: log(amount)				
$Cap\,req_{bt} * Firm\,risk_{ft}$	**0.013**	**0.007**	**0.019**	**0.013**
	(4.38)	(2.23)	(5.93)	(2.60)
$Correction_{bt} * Firm\,risk_{ft}$			**-0.066**	**-0.035**
			(-4.32)	(-1.96)
Loan-Level Controls	N	Y	N	Y
Bank-Level Controls*Firm risk	N	Y	N	Y
Firm*Time FE	Y	Y	Y	Y
Bank*Time FE	Y	Y	Y	Y
Loan Characteristics FE	N	Y	N	Y
R^2 (%)	73.12	74.50	73.18	74.52
Adjusted R^2 (%)	67.03	68.65	67.10	68.67
Observations	21174	21174	21174	21174
Bank*Time	894	894	894	894
Firm*Time	3018	3018	3018	3018

Risk Taking and Capital Requirements: the Effect of Stress Tests

Controlling for $Capreq_{bt}$ and $Correction_{bt}$, the remaining variation between stressed and non-stressed banks could be attributed to other forms of supervision (qualitative exercise) embedded in the CCAR.

Panel C: log(amount) (diff-in-diff)		
$stressed_b * DFA_t * Firm\,risk_{ft}$	**-1.496**	**-0.694**
	(-4.99)	(-3.17)
$\triangle$E$(amount_{fbt} \mid stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}}, Stress_{bt} = 1)$	-0.86	-1.10
$\triangle$E$(amount_{fbt} \mid stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}}, Stress_{bt} = 1)$	2.31	9.92
$Correction_{bt} * Firm\,risk_{ft}$	**-0.054**	-0.024
	(-3.88)	(-1.43)
$stressed_b * DFA_t * Capreq_{bt} * Firm\,risk_{ft}$	**0.309**	**0.139**
	(4.85)	(3.05)
Loan-Level Controls	N	Y
Bank-Level Controls*Firm risk	N	Y
Firm*Time FE	Y	Y
Bank*Time FE	Y	Y
Loan Characteristics FE	N	Y
R^2 (%)	73.27	74.54
Adjusted R^2 (%)	67.21	68.68
Observations	21174	21174

Summary

"The calculation of equity requirements will always be evolving, **regulators playing a catch-up game with regulated institutions**. Because **leverage is key to return on equity**, the latter have an incentive to minimize their use of capital an thereby to enjoy greater freedom" (Tirole, 2010).

Banks differ in their sensitivity to capital requirements: important control in order to highlight the effect stress test supervision (this is the omitted variable in Acharya et al. (2018))

1. **Stress Test Supervision**
   Holding the capital requirement constant,
   - the average yield increased for all banks after DFA, but by 186 to 197 bps less for stressed banks
   - stressed banks tilt their portfolio towards risky firms less after DFA: relative improvement of the average borrower rating by 0.7 classes

2. **Dissecting the effect of the capital requirement from stress tests**
   - the correction to the capital requirement resulting from the stress test induces banks to reallocate their loan portfolio towards safe borrowers

Higher capital requirements are not a substitute to enhanced bank supervision: stress test supervision can significantly reduce the risk-taking incentives of large banks.