Capital Requirements and Banks' Behavior: Evidence from Bank Stress Tests

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Outline

Motivation

- The systematic risks of the financial system are the major focus of a macroprudential supervision *(Hanson, Kashyap, and Stein (2011))*.
- By contrast, a microprudential approach to financial regulation examines insolvency of individual institutions regardless of the spillover effects in the economy *(Kashyap and Stein (2004), Kashyap, Rajan and Stein (2008))*.
- After the great recession of 2008, regulatory reforms moved in a macroprudential direction to prevent fire-sales and credit-crunches *(Diamond and Rajan (2011)*, *Stein (2012))*.

Motivation

- New bank examinations—so called *stress tests*—represent one of the most important regulatory responses to the 2008 financial crisis, linking the micro and macroprudential supervisions *(Hirtle, Schuermann, and Stiroh (2009))*.
- Stress tests require a subset of banks to have higher regulatory capital ratios to absorb losses and to mitigate moral hazard problems.
- How banks meet higher capital requirements—whether through raising fresh capital or shrinking assets—determines the financial stability of the economy *(Admati, Demarzo, Hellwig, and Pfleiderer (2018))*.

Motivation

This paper examines how banks respond to the higher regulatory capital requirements of *stress tests* and adjust their capital and lending actions to pass these tests. I also analyze how these credit shocks disseminate to the real economy.

Mechanism

Banks can meet higher capital ratio requirements in three ways:

1. Banks can *recapitalize* their balance sheets by issuing equity and repurchasing debt while keeping assets intact.
2. Banks may issue new equity to expand their assets *(asset expansion)*.
3. They may also sell assets to buy back existing debt *(assets sales)*.

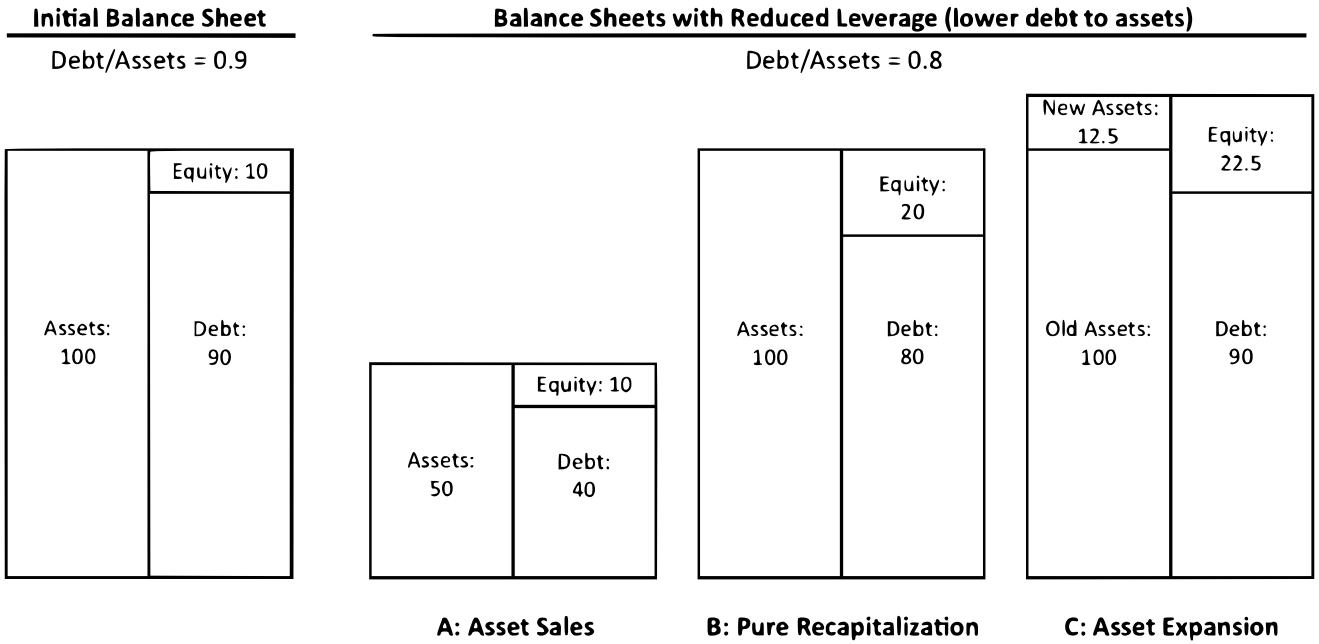


Figure Reference: Admati, Demarzo, Hellwig, and Pfleiderer, JF (2018)

Mechanism

- In both recapitalization and asset expansion mechanisms, banks increase capital ratios by issuing equity.
- That is, banks have discretion to decide whether to increase capital ratios by asset sales or equity issuance.
- Phrased differently, banks may raise the numerator of capital ratio through issuing equity or decrease the denominator by selling assets.
- Whether banks acquire or sell high versus low-quality assets affects the systematic risks in the economy. A bank's strategy may also affect financial decisions of borrowing firms via the lending channel.

Empirical Challenges

1. Historically, capital requirements rarely change over time, and typically, all banks must comply with these requirements at the same time. This makes it difficult to find a subset of banks that must comply with higher capital ratios.
   - To address this issue, I use the U.S. Federal Reserve's selection rule in choosing banks that undergo stress testing after the 2008 financial crisis in the United States.
2. It is important to determine how banks credit shock transmits to the real economy and eliminate the impact of the demand channel of borrowers on bank lending.
   - To control for changes in credit demand, I compare the same firm borrowing from two banks, where the banks differ on eligibility for stress tests. Following *Khwaja and Mian (2008)*, I use multiple bank-firm relationships in the syndicated loans market to control for credit demand.

Main Findings

This paper shows that in response to the regulatory reform,

- Stress-tested banks increase the total capital ratio by 11.7 percent compared to the non-tested group.
- To do this, stress-tested banks increase both the level of capital *(numerator)* and risk-weighted assets *(denominator)* of capital ratio. In particular, the numerator of the capital ratio exceeds the denominator.
- Stress-tested banks achieve this target by issuing equity to expand assets and reduce leverage as a form of *asset expansion* and *recapitalization*.
- At the *loan-level*, stress-tested banks originate new syndicated loans more than the non-tested matched group by 29 percentage points.
- At the *extensive margin*, stress-tested banks keep lending to existing borrowers and start lending to new ones, but they exclude small borrowers.

Main Findings - Continue

- Stress tests connect capital to loan portfolios of banks and induce banks to rebalance their loan portfolio towards safer lending.
- Stress tests induce banks to increase lending to large and safer borrowers while reducing credit supply to small and riskier firms by 28 percentage points relative to the large ones.
- The higher regulatory capital requirements influence banks to incorporate the borrower's risk in designing their loan contracts. Stress-tested banks effectively adopt stricter standards towards small borrowers that violate more covenants than large borrowers.

Main Findings - Continue

The transmission of bank credit supply shocks to the real economy depends on whether borrowers can mitigate bank-specific credit loss by borrowing from all available lenders in the market. If firms cannot smooth out any liquidity shortages induced by stress testing, this leads to adverse economic effects.

- The results show that higher capital requirements of stress tests sharply alter lending behavior, harming dependent borrowers that cannot find other sources of external financing.
- Firms reliant on borrowing from stress-tested banks cannot compensate for bank credit loss by borrowing from alternative lenders.
- As a result, they significantly reduce assets and investments by 26 and 28 percentage points relative to less dependent borrowers.

Background of Stress Tests

The 2008 recession highlighted critical deficiencies in the risk management practices and resiliency of financial institutions.

- On October 18, 2008, US regulators devised the *supervisory capital assessment program (SCAP)*, known as stress tests, to determine the vulnerability of financial institutions.
- This regulation requires a subset of selected banks to have at least 6% Tier1 capital ratio and 4% Tier1 common capital ratio by the end of year 2010 *(Hirtle, et al. (2009))*.
- Regulators have conducted stress tests regularly since then through *comprehensive capital analysis and review (CCAR)* and *Dodd-Frank Act stress test (DFAST)*. The goal of stress tests is to ensure that banks have enough capital to continue lending even in adverse economic conditions.

Regular Bank Examinations and Stress Tests

Unlike regular banking examinations,

1. Stress tests are *simultaneous* and *forward-looking* assessments of banks' capital adequacy under a variety of stressful scenarios.
2. These tests are unusually transparent in inputs, process, and outputs of models, and banks must *disclose* their results to the public.

I exploit the Federal Reserve's criterion that selects a subset of banks to include in stress tests based on a determined asset threshold. Only banks with at least $100 billion in assets in the last quarter of 2008 were subject to testing.

Data

The main data sources include,

- The FRB Y-9C (Consolidated Financial Statements for Bank Holding Companies in the United States) filings quarterly with the Federal Reserve System
- The Thomson Reuters LPCs Dealscan on syndicated loans
- The Compustat and Bloomberg quarterly data

Identification Strategy

- As an identification strategy, I compare banks before and after the policy change using a difference-in-differences matching method. The cross-sectional variation of banks allows uncovering the causal impact of higher capital requirements on banks' credit supply.
- I choose banks with assets above $20 billion but below $100 billion in the last quarter of 2008 as a control group during the sample periods of 2005q1 to 2013q4. I matched treated banks with the control group using median characteristics of banks between 2006q3 to 2007q2 (bias-corrected matching method, *Abadie and Imbens (2011)*).

Pre-Treatment Median Test of Banks

The total regulatory capital consists of core capital (Tier1) and supplementary capital (Tier2), adjusted by risk-weighted assets to create a capital ratio.

- Tier1 capital consists of common stockholder's equity, qualifying perpetual preferred stocks, and minority interests of subsidiaries minus intangible assets.
- Tier2 capital includes an allowance for loan and lease losses, perpetual preferred stocks, hybrid capital instruments, and subordinated debt.

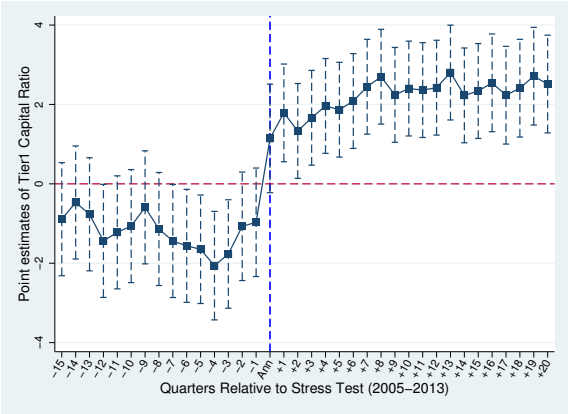
	Median-Unmatched Sample			Median-Matched Sample	
	Control	Treated	Difference	Control	Difference
Total Capital Ratio	12.15	12.27	-0.12	11.97	-0.30
Tier1 Capital Ratio	8.96	8.73	0.24	8.31	-0.42
Tier2 Capital Ratio	3.49	3.38	0.11	3.58	0.20
Tier1 Common Equity Ratio	8.96	8.62	0.35	7.88	-0.73
Cash Ratio	2.61	2.59	0.02	2.55	-0.04
Securities Ratio	12.47	10.75	1.72	10.90	0.15
Loan Ratio	73.99	63.37	10.62***	74.69	11.32
Deposit Ratio	68.59	60.26	8.33***	70.00	9.74
Fed Funds Purchased Ratio	6.26	3.76	2.51***	4.95	1.19
Leverage Ratio	89.32	90.80	-1.48**	90.22	-0.58
Common Ratio	0.46	0.30	0.16	0.55	0.25
Retained Earnings Ratio	5.70	5.39	0.32	6.37	0.99
Equity Ratio	10.64	9.10	1.54**	9.76	0.66
Interest Income Ratio	0.73	0.74	-0.01	0.75	0.01
Noninterest Income Ratio	-0.23	-0.03	-0.20***	-0.17	-0.14
Return on Equity	3.33	3.94	-0.62***	3.63	-0.31
Return on Assets	0.33	0.35	-0.02	0.36	0.00
LLR Ratio	1.04	1.05	-0.02	1.02	-0.03

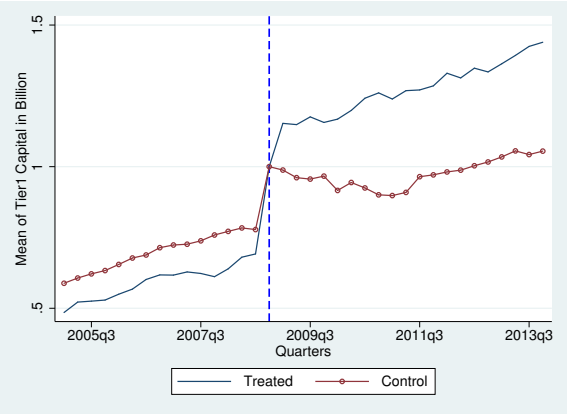
The Trend of Tier1 Capital Ratio

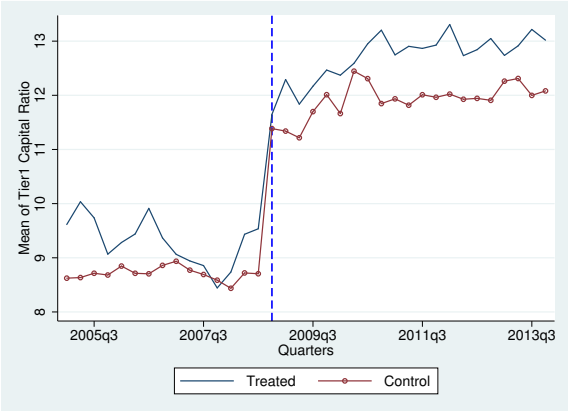
To verify that treated and control groups behave similarly in absence of the test,

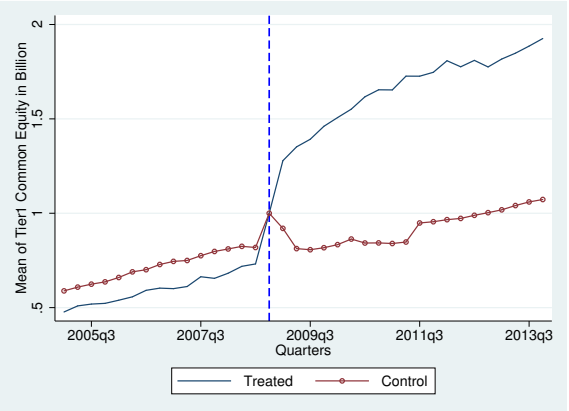
$$Y_{bt} = \alpha_b + \beta_1 Q_t^{-15} * Treated_b + \beta_2 Q_t^{-14} * Treated_b + \ldots + \beta_{34} Q_t^{+19} * Treated_b + \beta_{35} Q_t^{+20} * Treated_b + \varepsilon_{bt}$$

Y_{bt} are the outcome variables, $Treated_b$ are stress-tested banks, Q_t is a dummy variable with value of one in that quarter. Standard errors are clustered at the bank level.









Adjustment of Bank Behavior

The variable of interest is the interaction term between banks subject to stress tests after the tests' announcement. $Post_t$ is a dummy variable with value of one in 2008q4 and after.

$$Y_{bt} = \alpha_b + \tau_t + \nu_{bt} + \beta Treated_b * Post_t + \varepsilon_{bt}$$

Table:
Adjustment of Capital Ratios

	TCr	T1Cr	T1CEr	T1Lr	T2Cr	LnTC	LnRWA	LnT1C	LnT1CE	LnT2C	LnAT
Treated*Post	1.67**	2.09***	1.84**	1.05	-0.44*	0.49***	0.37***	0.57***	0.55***	0.21	0.34***
	(0.70)	(0.67)	(0.66)	(0.63)	(0.26)	(0.11)	(0.12)	(0.11)	(0.10)	(0.15)	(0.12)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dependent-mean	14.27	11.24	10.22	8.78	3.05	16.52	18.49	16.27	16.17	14.87	18.86
Dependent-sd	2.55	2.73	2.66	2.05	1.16	0.87	0.87	0.90	0.91	0.90	0.99
AdjR-squared	0.36	0.37	0.27	0.18	0.19	0.49	0.30	0.52	0.47	0.19	0.24
Observations	702	702	702	702	702	702	702	702	702	702	777

Table:
Adjustment of Balance Sheet

	EQr	CSr	PRr	RETr	LEVr	DPr	LNr	CASHr	SECr	MBSr	TSr
Treated*Post	1.54**	-0.15	0.45**	0.11	-1.56**	4.76*	-0.74	3.54*	3.57**	8.11***	-0.43
	(0.55)	(0.11)	(0.19)	(0.78)	(0.57)	(2.35)	(2.64)	(1.96)	(1.60)	(1.51)	(0.75)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dependent-mean	9.93	0.65	0.77	3.95	89.88	55.55	53.53	6.95	16.17	5.35	2.32
Dependent-sd	2.63	0.84	1.25	2.98	2.63	24.20	25.11	8.89	13.03	6.67	3.51
AdjR-squared	0.26	0.02	0.33	0.06	0.26	0.16	0.02	0.15	0.18	0.54	0.03
Observations	767	702	702	777	767	777	777	777	777	777	777

Lending and Risk Components

Stress-tested banks address risk by acting more conservatively than the non-tested matched banks, reporting higher non-performing loans and loan loss reserves.

Table:
Lending Behavior

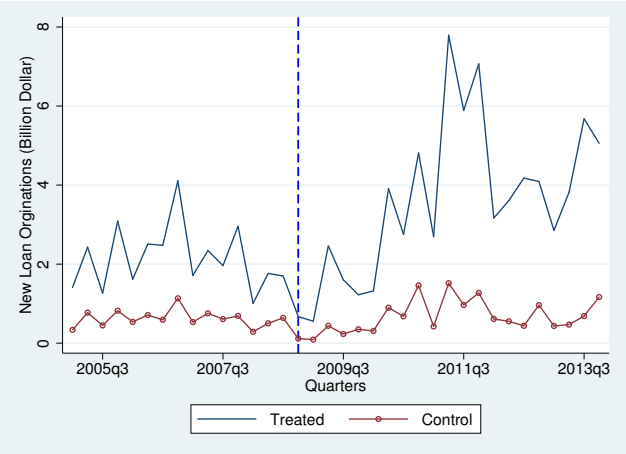
	RELr	CRELr	CILr	CLr	FRELr	RSLr	OREr	RENCOr	CINCOr	CNCOr
Treated*Post	-1.93	-1.76	2.39**	-0.41	-0.46	-0.09	0.04	0.01	0.00	0.05*
	(2.07)	(1.17)	(1.07)	(1.64)	(0.59)	(0.12)	(0.08)	(0.04)	(0.01)	(0.02)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dependent-mean	46.59	17.27	20.20	12.76	0.60	0.07	0.19	0.14	0.03	0.05
Dependent-sd	23.48	14.76	11.38	15.78	1.86	0.24	0.25	0.26	0.05	0.16
AdjR-squared	0.10	0.06	0.08	0.03	0.01	0.21	0.15	0.27	0.33	0.09
Observations	702	777	702	702	702	453	702	777	777	777

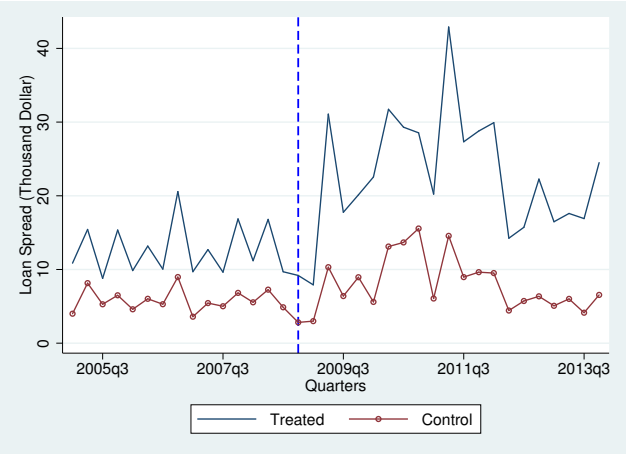
Table:
Risk Components

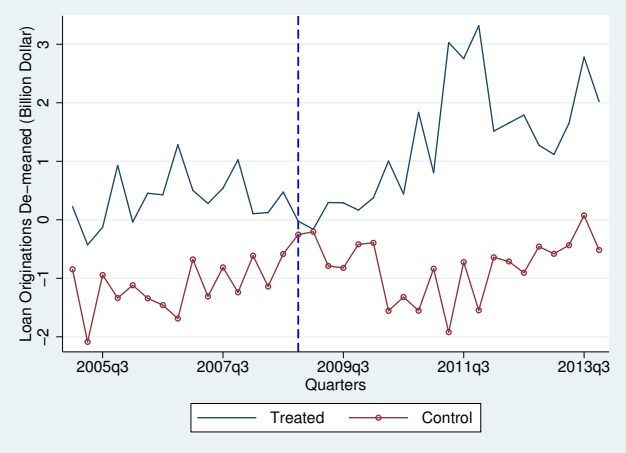
	NPLr	LLRr	NCOr	ROA	ROE	IIr	NIIr	IDPr	NIDPr	DIVr
Treated*Post	1.14***	0.41**	0.05	-0.09	-1.47**	-0.03	-0.11	6.67**	-1.91	-0.07***
	(0.29)	(0.18)	(0.05)	(0.06)	(0.66)	(0.03)	(0.07)	(2.78)	(3.00)	(0.02)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dependent-mean	1.96	1.71	0.26	0.20	2.08	0.67	-0.18	40.92	14.63	0.08
Dependent-sd	1.84	1.17	0.37	0.43	4.32	0.29	0.34	20.54	9.55	0.07
AdjR-squared	0.63	0.57	0.38	0.14	0.15	0.04	0.04	0.17	0.07	0.47
Observations	777	712	777	777	767	711	777	777	777	700

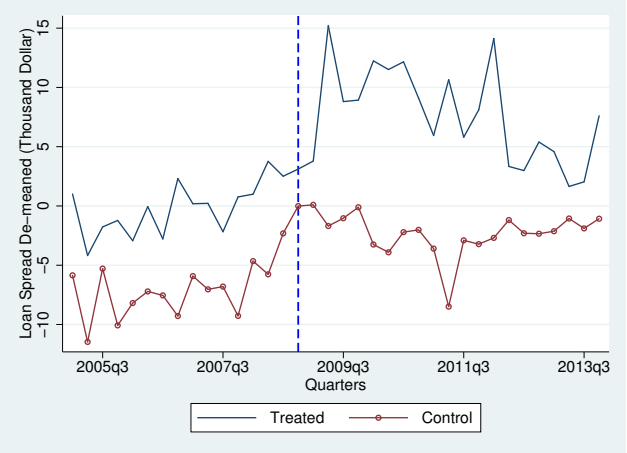
The Trend of New Loan Originations and Spread

To capture the credit supply channel, I restrict the sample to only firms that borrow from both types of banks before and after the test (intensive margin sample).









The Bank Lending Channel: Intensive Margin

At the loan-level, stress-tested banks increase loan originations and spread compared to the non-tested group. The results are robust using firm-quarter fixed-effects.

$$Y_{lbft} = \alpha_b + \beta Treated_b * Post_t + \sum_k^5 X_{b,t-1} + \eta_f + \tau_t + \mu_l + \nu_{ft} + \varepsilon_{lbft}$$

Table:
The Bank Lending Channel: Intensive Margin and Loan Prices

	Ln-Originations				Ln-Spread			
	Firms	Firms	Line-of-Credit	Term-Loan	Firms	Firms	Line-of-Credit	Term-Loan
Treated*Post	0.29***	0.35**	0.30***	0.28	0.20*	0.33**	0.19*	-0.02
	(0.09)	(0.13)	(0.08)	(0.17)	(0.11)	(0.14)	(0.11)	(0.08)
Treated*Small Firms*Post		-0.28**				-0.35**		
		(0.11)				(0.13)		
Treated*Small Firms		0.07				0.16*		
		(0.08)				(0.08)		
Small Firms*Post		0.20***				0.06		
		(0.06)				(0.12)		
Small Firms		-0.84***				-0.18**		
		(0.06)				(0.07)		
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan-Type Fixed Effects	Yes	Yes	No	No	Yes	Yes	No	No
Dependent-mean	16.65	16.76	16.67	16.55	4.99	5.16	4.89	5.64
Dependent-sd	0.92	1.00	0.87	1.15	0.84	0.97	0.80	0.79
AdjR-squared	0.51	0.51	0.52	0.64	0.72	0.74	0.72	0.82
Observations	4856	15523	4098	668	4479	13963	3809	622

Regression Discontinuity

The results are robust using a discontinuity around $100 billion asset threshold.

Table:
The Regression Discontinuity at the Loan-Level

	Δ(*Originations*)			Δ(*Spread*)			Δ(*Covenants*)			Δ(*Maturity*)		
Treated	0.10***	0.15***	0.17***	0.52***	0.36***	0.45***	-0.35***	-0.20*	-0.14	65.14***	51.17**	61.82**
	(0.01)	(0.03)	(0.03)	(0.05)	(0.08)	(0.11)	(0.11)	(0.10)	(0.10)	(5.69)	(20.86)	(24.90)
Treated*Asset Distance		0.00*	0.00		-0.01**	-0.01**		0.01	0.01		-0.44	-0.65
		(0.00)	(0.00)		(0.00)	(0.00)		(0.01)	(0.01)		(0.80)	(0.98)
Asset Distance		-0.00*	-0.00		0.01**	0.01**		-0.01	-0.01		0.44	0.65
		(0.00)	(0.00)		(0.00)	(0.00)		(0.01)	(0.01)		(0.80)	(0.97)
Treated*Small Firms			-0.11***			-0.49***			0.24*			-49.88**
			(0.02)			(0.13)			(0.14)			(21.72)
Small Firms*Asset Distance			0.00			0.00			0.00*			0.00
			(0.00)			(0.00)			(0.00)			(0.02)
Small Firms			0.02			-0.08			-0.94*			-34.25**
			(0.03)			(0.10)			(0.51)			(15.43)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dependent-mean	0.06	0.06	0.06	0.46	0.46	0.46	-0.44	-0.44	-0.44	33.38	33.38	33.38
Dependent-sd	0.19	0.19	0.19	0.94	0.94	0.94	3.81	3.81	3.81	191.07	191.07	191.07
AdjR-squared	0.27	0.27	0.30	0.49	0.49	0.51	0.65	0.65	0.65	0.46	0.45	0.46
Observations	786	786	786	786	786	786	786	786	786	786	786	786

The Bank Lending Channel: Extensive Margin

Extensive margin presents whether banks stop lending to existing borrowers (exit) or start lending to new borrowers (entry).

$$Y_{lbf} = \alpha_b + \beta Treated_b + \sum_{k}^{5} X_{b,pre-event} + \eta_f + \mu_l + \varepsilon_{lbf}$$

Stress-tested banks are 9 percentage points more likely than non-tested banks to maintain lending and start lending to new borrowers by 21 percentage points.

Table:
The Bank Lending Channel: Extensive Margin

	Exit				Entry			
	Firms	Firms	Line-of-Credit	Term-Loan	Firms	Firms	Line-of-Credit	Term-Loan
Treated	-0.09***	-0.08**	-0.13***	0.02	0.21***	0.20***	0.24***	0.11
	(0.03)	(0.03)	(0.04)	(0.06)	(0.03)	(0.03)	(0.05)	(0.08)
Treated*Small Firms		-0.03				0.03		
		(0.02)				(0.02)		
Small Firms		0.05**				-0.15***		
		(0.02)				(0.02)		
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan-Type Fixed Effects	Yes	Yes	No	No	Yes	Yes	No	No
Dependent-mean	0.28	0.28	0.26	0.32	0.51	0.51	0.51	0.52
Dependent-sd	0.45	0.45	0.44	0.47	0.50	0.50	0.50	0.50
AdjR-squared	0.62	0.62	0.61	0.72	0.50	0.50	0.48	0.59
Observations	17218	17218	12321	4357	17218	17218	12321	4357

Loan Pricing and Non-Pricing Attributes

Stress-tested banks require fewer covenants on the loan contract relative to the non-tested banks. They incorporate the borrower's risk in designing their loan contracts as small firms violate more covenants.

Table:
The Bank Lending Channel: Non-Price Attributes

	Covenants			Ln-Maturity		
	Firms	Firms	Line-of-Credit	Firms	Firms	Line-of-Credit
Treated*Post	-0.15**	-0.21	-0.15*	0.01	-0.03	-0.00
	(0.07)	(0.13)	(0.07)	(0.03)	(0.03)	(0.02)
Treated*Small Firms*Post		0.05			-0.01	
		(0.18)			(0.03)	
Treated*Small Firms		-0.07			-0.01	
		(0.06)			(0.03)	
Small Firms*Post		-0.21			-0.01	
		(0.17)			(0.01)	
Small Firms		-0.01			-0.31***	
		(0.05)			(0.03)	
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Loan-Type Fixed Effects	Yes	Yes	No	Yes	Yes	No
Dependent-mean	2.72	2.77	2.70	4.05	4.09	4.00
Dependent-sd	0.75	0.88	0.75	0.59	0.69	0.53
AdjR-squared	0.90	0.91	0.90	0.53	0.52	0.53
Observations	343	896	322	4837	15397	4086

Table:
Networth Covenants Violation

	Covenants-Violation	
Treated*Post	-0.09*	-0.01
	(0.04)	(0.02)
Treated*Small Firms*Post		1.59***
		(0.12)
Treated*Small Firms		0.02
		(0.02)
Small Firms		-0.02
		(0.02)
Bank Fixed Effects	Yes	Yes
Bank Controls	Yes	Yes
Quarter Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Dependent-mean	0.03	0.03
Dependent-sd	0.17	0.17
AdjR-squared	0.64	0.72
Observations	102	102

Borrowers Heterogeneity

Small firms are at the bottom 70% of total borrowings across all banks in each quarter.

$$Y_{lbft} = \alpha_b + \delta Small\ Firms_f + \beta Treated_b * Post_t + \xi Treated_b * Small\ Firms_f + \gamma Treated_b * Small\ Firms_f * Post_t + \sum_k^5 X_{b,t-1} + \eta_f + \mu_l + \tau_t + \varepsilon_{lbft}$$

Table:
Intensive Margin and Loan Prices

	Ln-Originations				Ln-Spread			
Treated*Post	0.23*	0.24*	0.31**	0.23*	0.27**	0.21	0.53**	0.24**
	(0.13)	(0.14)	(0.12)	(0.13)	(0.12)	(0.12)	(0.20)	(0.11)
Treated*Small Asset Firms*Post		-0.11				-0.24*		
		(0.11)				(0.12)		
Treated*Small Asset Firms		0.08				0.13**		
		(0.07)				(0.06)		
Small Asset Firms*Post		0.31***				0.16		
		(0.09)				(0.12)		
Small Asset Firms		-0.34***				-0.09		
		(0.04)				(0.06)		
Treated*Speculative*Post			-0.21***				-0.52**	
			(0.07)				(0.19)	
Treated*Speculative			0.09**				0.28**	
			(0.04)				(0.10)	
Speculative*Post			0.30***				-0.05	
			(0.07)				(0.19)	
Speculative			-0.71***				1.51***	
			(0.09)				(0.15)	
Treated*Z-Score*Post				-0.09				-0.16*
				(0.07)				(0.08)
Treated*Z-Score				0.02				0.10**
				(0.06)				(0.04)
Z-Score*Post				0.24***				0.36***
				(0.04)				(0.07)
Z-Score				-0.23***				-0.43***
				(0.06)				(0.05)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan-Type Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dependent-mean	16.76	16.76	16.83	16.82	5.16	5.16	4.98	4.98
Dependent-sd	1.00	1.00	0.96	0.95	0.97	0.97	0.93	0.93
AdjR-squared	0.44	0.44	0.45	0.45	0.73	0.73	0.75	0.75
Observations	15523	15523	10151	9273	13963	13963	9507	8690

Borrowers Heterogeneity - Continue

Stress-tested banks effectively adopt stricter standards towards small borrowers by demanding more covenants and shorter maturity on their loan contracts.

Table:
Non-Price Attributes

	Covenants				Ln-Maturity			
Treated*Post	-0.26**	-0.34**	-0.35***	0.13**	-0.03	-0.03	0.10*	0.02
	(0.11)	(0.14)	(0.11)	(0.06)	(0.04)	(0.04)	(0.05)	(0.04)
Treated*Small Asset Firms*Post		0.35**				-0.03		
		(0.14)				(0.04)		
Treated*Small Asset Firms		-0.22**				0.02		
		(0.08)				(0.03)		
Small Asset Firms*Post		-0.46***				0.11***		
		(0.11)				(0.02)		
Small Asset Firms		0.10				-0.11***		
		(0.08)				(0.04)		
Treated*Speculative*Post			0.34**				-0.18***	
			(0.12)				(0.04)	
Treated*Speculative			-0.11**				0.09***	
			(0.05)				(0.02)	
Speculative*Post			-0.51***				0.19***	
			(0.09)				(0.04)	
Speculative			1.71***				0.56**	
			(0.06)				(0.22)	
Treated*Z-Score*Post				-0.13**				-0.05*
				(0.04)				(0.03)
Treated*Z-Score				0.02*				0.01
				(0.01)				(0.02)
Z-Score*Post				0.15*				0.12***
				(0.07)				(0.02)
Z-Score				-0.14				-0.08**
				(0.10)				(0.03)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan-Type Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dependent-mean	2.77	2.77	2.76	2.76	4.09	4.09	4.09	4.09
Dependent-sd	0.88	0.88	0.88	0.91	0.69	0.69	0.62	0.62
AdjR-squared	0.90	0.91	0.92	0.94	0.50	0.50	0.46	0.48
Observations	896	896	787	705	15397	15397	10115	9240

The Firm Borrowing Channel

The reduction in credit supply of stress-tested banks would not necessarily yield effects at the firm level, if other banks, not subject to the tests pick up the slack.

$$Borrowing\ Share_f = \frac{\sum_{b=1}^{B} Stress\text{-}Tested_b \sum_{l=1}^{L} Loan\ Amount_{bfl,prior}}{Loan\ Amount_{f,prior}}$$

$$Y_{ft} = \alpha + \beta Borrowing\ Share_f * Post_t + \eta Borrowing\ Share_f + \sum_{k}^{5} X_{b,q-1} + \mu_b + \tau_t + \varepsilon_{ft}$$

Table:
The Borrowing Channel: Loan-Level

	All-Banks		Existing-Banks		New-Banks	
	Ln Total Borrowing	Ln Total Borrowing	Ln Total Borrowing	Ln Total Borrowing	Ln Total Borrowing	Ln Total Borrowing
Borrowing Share*Post	1.13***	0.36***	0.19	0.09	0.81***	0.07*
	(0.39)	(0.13)	(0.13)	(0.09)	(0.06)	(0.03)
Borrowing Share	-0.50	-0.39**	-0.70	-0.47**		
	(0.47)	(0.14)	(0.46)	(0.18)		
Borrowing Share*Small Firms*Post		0.08		-0.03		0.31***
		(0.17)		(0.13)		(0.06)
Borrowing Share*Small Firms		0.27		0.35*		
		(0.19)		(0.19)		
Small Firms*Post		0.14*		0.12**		-2.03***
		(0.08)		(0.05)		(0.03)
Small Firms		-2.20***		-2.11***		
		(0.08)		(0.05)		
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Dependent-mean	18.34	18.34	18.69	18.69	18.17	18.17
Dependent-sd	1.31	1.31	1.23	1.23	1.28	1.28
AdjR-squared	0.03	0.64	0.05	0.63	0.04	0.63
Observations	115048	115048	47629	47629	44452	44452

Firm Financial Outcomes

	Median-Unmatched Sample			Median-Matched Sample	
	Control	Treated	Difference	Control	Difference
Ln Total Assets	3.37	3.41	-0.05**	3.39	-0.02
Tangibility	23.79	26.03	-2.24***	24.52	-1.50
Net Worth	34.60	36.20	-1.61	35.93	-0.27
EBITDA/Total Assets	3.18	3.44	-0.25***	3.29	-0.14
Leverage Ratio	59.99	56.32	3.68***	57.34	1.03
Cash Flow/Total Assets	3.92	4.69	-0.77***	4.37	-0.33

Table:
Firm Financial Outcomes

	Ln-Assets		Ln-Sales		Ln-Fixed-Assets		Ln-Capital-Exp.	
Treated Firms*Borrowing-Share*Post	-0.26***	0.01	-0.22***	-0.03	-0.22***	0.01	-0.28***	0.01
	(0.05)	(0.06)	(0.06)	(0.06)	(0.04)	(0.06)	(0.06)	(0.08)
Borrowing-Share	-0.32**	-0.68**	-0.23**	-0.52*	-0.37***	-0.68**	-0.38***	-0.70**
	(0.12)	(0.27)	(0.10)	(0.26)	(0.12)	(0.27)	(0.11)	(0.28)
Treated Firms*Borrowing-Share*Small Firms*Post		-0.12**		-0.04		-0.12**		-0.15*
		(0.06)		(0.05)		(0.06)		(0.07)
Borrowing-Share*Small Firms		0.69**		0.58**		0.69**		0.65**
		(0.27)		(0.28)		(0.27)		(0.29)
Small Firms		-1.08***		-0.96***		-1.08***		-1.06***
		(0.07)		(0.07)		(0.07)		(0.07)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Cluster Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dependent-mean	3.61	3.61	2.89	2.89	2.95	3.61	1.80	1.80
Dependent-sd	0.73	0.73	0.69	0.69	0.93	0.73	0.91	0.91
AdjR-squared	0.32	0.65	0.26	0.55	0.56	0.65	0.45	0.65
Observations	30944	30944	30913	30913	30905	30944	30873	30873

Conclusion

- Stress-tested banks increase capital ratios and lending compared to the non-tested group. They increase lending to large borrowers while decrease lending to small firms.
- Firms reliant on borrowing from stress-tested banks significantly reduce assets and investments compared to less dependent borrowers.
- Using the medium-sized banks as part of the Dodd-Frank Act (2014) stress tests, I find the similar behavior to the large banks in capital adjustments and lending behavior.

Policy Implications

- From a macroprudential perspective, it is reasonable for regulators to require higher common equity to ensure the quality of banks' capital *(Hanson et al. (2011))*.
- The results of the U.S. bank stress tests can guide policymakers to assess higher capital requirements under the Basel III process and the expansion of the shadow banking system.