

Stressed Banks*

Diane Pierret[†] Roberto Steri[‡]

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Abstract

We investigate the risk taking incentives of stressed banks — the banks that are subject to annual regulatory stress tests in the U.S. since 2011. We document that stringent capital requirements give both stressed and non-stressed banks motives to invest in risky assets, whose expected returns offset banks' increased cost of funding, which originates from the use of costly equity capital. Regulatory monitoring through stress tests effectively encourages prudent investment from stressed banks, but also provides them with steeper risk-taking incentives through tighter capital requirements. Our results highlight the importance of regulatory monitoring of banks portfolios in parallel to setting more stringent capital requirements.

Keywords: Capital Regulation, Dodd-Frank Act, Monitoring, Stress Tests.

JEL Classification Numbers: G01, G21, G28.

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[†]Faculty of Business and Economics at the University of Lausanne and Swiss Finance Institute. E-mail: diane.pierret@unil.ch.

[‡]Faculty of Business and Economics at the University of Lausanne and Swiss Finance Institute. E-mail: roberto.steri@unil.ch.

1 Introduction

The Great Recession has sparked renewed attention on undertaking regulatory and monitoring initiatives to design a safe and sound banking system. As a response, in July 2010 US Congress approved the Dodd-Frank Wall Street Reform and Consumer Protection Act, which contains a variety of provisions to overcome extant regulatory oversight. Two essential provisions in such extensive list are more stringent regulatory capital requirements and regulatory stress tests. For a given portfolio of investments, stringent capital requirements create a capital buffer that increases banks' capacity to absorb losses, and ultimately reduce the exposure of the deposit insurance fund, which is liable for fewer deposits in the event of a loss. Regulatory stress tests (as part of the Comprehensive Capital Analysis and Review) monitor the investment portfolios of a group of large banks whose collective costs of financial distress could harm the real economy, and enforce corrective actions for banks that are deemed deficient. The Dodd-Frank Act induces a strict link between capital requirements and stress tests, in that banks that are subject to regulatory monitoring through stress tests face individual capital requirements whose tightness is determined on the basis of the assessed risk of their individual portfolios.

Despite the major regulatory changes directed at reducing the risk of large financial institutions and the significant increase in banks' regulatory capital, Sarin and Summers (2016) observe that they did not translate into a decline of financial market measures of risk. For example, Sarin and Summers document that the equity beta of the six largest U.S. banks was 1.23 in 2015, compared with a pre-crisis value of 1.18, while their CDS spreads sharply surged. Motivated by the current regulatory framework, this paper examines how capital requirements and stress test monitoring influence the riskiness of banks' investments. Because banks respond to changes in the regulatory method through their portfolio decisions, to determine its effectiveness it is crucial to ascertain whether and how bank risk-taking behavior changes in response to more stringent capital requirements and to regulatory monitoring through stress tests. From a theoretical perspective, several studies, including Koehn and Santomero (1980), Kim and Santomero (1988), Rochet (1992) and more recently Gale (2010) and Harris, Opp, and Opp (2017), highlight the possibility that tighter capital requirements increase banks' cost of funding because equity is more expensive than debt, especially in the presence of deposit insurance and other debt guarantees. Thus, profit-maximizing banks could rationally

respond to a higher cost of funding by increasing the expected profitability of their portfolios by taking on more risk, for example by financing riskier firms and projects or by aggressively trading in derivatives and other financial securities. Regulatory stress tests potentially alleviate this problem by monitoring large bank investments and reducing their incentives to undertake risky investments. Interestingly, the current implementation of stress tests in the Dodd-Frank Act increases the cost of funding precisely through tighter capital requirements. Such a feedback effect could in turn put pressure on banks to invest in ex-ante profitable, hence risky, assets. On average, stressed banks face more stringent capital requirements than non-stressed banks, namely 6.8% versus 3% of assets. Do banks invest in riskier assets when they are subject to tighter capital requirements? Are stress tests effective monitoring devices to prevent excessive risk-taking? Does the strict link between capital requirements and stress tests induced by the Dodd-Frank Act influence banks' investment decisions? This work attempts at providing an empirical answer to these questions.

A challenge in empirically identifying the effects of capital requirement and monitoring on bank risk taking is that changes in capital requirements are rarely observed. Even when regulatory changes in capital requirements are implemented, they affect all banks in the economy, complicating the identification of a treatment and a control group. However, regulatory stress tests effectively impose bank-specific capital requirements to stressed banks on the basis of the assessed riskiness on their assets. Using the bank data disclosed in the regulatory stress tests, we back out such bank-specific capital requirements. The capital requirement of a bank subject to the regulatory stress test — a “stressed bank” — is more stringent if the difference between its actual capital ratio and its capital ratio projected in the stress scenario is large. Therefore, bank-specific capital requirements depend on the sensitivity of the bank's portfolio to the supervisory stress scenario.

To capture the riskiness of banks' investments in a given quarter, we collect data on new loans banks grant to firms from LPC DealScan.¹ We construct a comprehensive dataset matching loan data with stress test data and quarterly financials from regulatory reports of banks (available from SNL) on one hand, and quarterly financials and ratings of firms from Compustat on the other hand. Our dataset covers all subsidiaries of the bank holding companies in our sample that participated

¹ Carey and Hrycay (1999), estimate that the share of corporate covered by Dealscan in the U.S. is between 50% and 75% of the value of all commercial loans during the early 1990s, although biased towards larger loans (Acharya, Almeida, Ippolito, and Perez-Orive (2016)). Chava and Roberts (2008b) suggest that such fraction has been increasing in the recent years.

in the syndicated loan market, leading to a total of 234,037 lender-borrower relationships. Because 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, unlike previous studies, we do not restrict our sample to lead arrangers only.

We investigate the effect of capital requirements and regulatory stress tests on (i) the yield on the portfolio of new loans of banks in a given quarter, and (ii) the dollar amount different banks lend to the same firm with a given level of risk in a given quarter. For the first, the ex-ante promised yield on a bank's portfolio of new loans is interpreted as a measure of riskiness in a given quarter. For the second, it is crucial to retain all members of the syndicate in our dataset in order to observe multiple banks lending to the same firm in a given period of time. This identification strategy (Kwaja and Mian (2008), Jimenez and Ongena (2012), Jimenez, Ongena, Peydro, and Saurina (2014)) allows to control of the variation in the credit demand of firms with different risk levels.

Our identification strategy relies on differences-in-differences estimates to gauge the differential effect of Dodd-Frank Act on stressed banks risk taking compared to a control group of “non-stressed banks”. The control group includes bank holding companies that are subject to internal stress tests under Dodd-Frank Act, but never participated in a regulatory stress test. Controlling for the risk taking response of stressed banks to more stringent capital requirements after Dodd-Frank Act, the differential response of stressed banks to the Dodd-Frank Act plausibly captures the effect of more invasive regulatory monitoring of stressed banks on their decisions to lend to risky firms.

We find that stressed banks are more prudent than non-stressed banks after controlling for their response to the more stringent capital requirements they face. Holding the capital requirement constant, we find that the average yield on the portfolio of new loans increased for all banks after Dodd-Frank Act, but by 171 to 197 bps less for stressed banks. This effect is significant only when we control for bank-specific capital requirements, showing that the two channels originating from stress tests — higher capital requirements triggering risky investments and regulatory monitoring of banks' investments — are at work.

Our results on loan amounts confirm the presence of two contrasting channels. First, holding the volume of credit demand and credit supply fixed, banks with a capital requirement one percentage point higher increase lending by 4% to speculative-grade firms. More generally, a bank increases its

portfolio share by an additional one percent to a firm in the next worse S&P rating class when the bank capital requirement increases by one percentage point. Second, holding the volume of credit demand and credit supply fixed and for a given level of capital requirement, stressed banks tilt their portfolios towards risky firms less than non-stressed banks after Dodd-Frank Act. Stressed banks do not increase more their supply of loans after Dodd-Frank Act compared to non-stressed banks, but rather reallocate their loan portfolio towards firms with better ratings after isolating the effect of a higher capital requirement.

The more stringent capital requirements of stressed banks should not necessarily result in additional risk taking because of the link between capital requirements and stress tests. After controlling for the capital requirement level, the increase in the capital requirement resulting from the stress test does not lead to increased risk taking, and even induces banks to increase loan amounts granted to safe borrowers. Our results suggest that capital requirements derived on the basis of effective regulatory monitoring of banks' portfolio can significantly dampen or offset the risk-taking channel, and possibly reconcile with the arguments that point to a reduction of risk taking incentives when shareholders have a larger equity stake ("skin in the game") in the bank (e.g., Cooper and Ross (2002), Admati, DeMarzo, Hellwig, and Pfleiderer (2013b)).

Importantly, our evidence should not be interpreted as against a better capitalization of the banking sector. Rather, our results highlight an empirically relevant risk-taking channel that should be taken into account in the design of new regulations to promote financial stability. Our findings suggest that higher capital requirements are not a substitute to monitoring, but instead might need to be accompanied with additional regulatory monitoring of banks' asset risk. To this end, tools like the Comprehensive Capital Analysis and Review, an extensive monitoring exercise by the regulator that includes both quantitative and qualitative tests, appears to be more effective than linking capital requirements to risk-weighted assets or resorting to internal stress tests only. For example, our results suggest that the proposal of an off-ramp from regulatory stress tests for banks with capital greater than 10% of their assets in the Financial CHOICE Act proposed by the House Financial Services Committee might not be an adequate rule to ensure financial stability, as Schnabl (2017) indicates.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 provides details on the institutional background, and the definition of bank-specific capital

requirements. Section 4 describes the data and the empirical strategy. Section 5 presents the empirical results. Section 6 concludes.

2 Related Literature

Our paper builds on the theoretical literature on bank risk-taking as a response to regulatory capital requirements. Admati (2014) states that “capital requirements do not constrain what banks can do with their funds. The pervasive confusion allows false claims, such as that higher capital requirements will prevent banks from making loans, to resonate and go unchallenged” and that “setting ROE targets for bank managers is dangerous. Shareholders too might be harmed by being exposed to excessive risk taken to achieve ROE targets”. From a theoretical perspective, the channel of tighter capital requirements possibly leading to an increase in risk taking is already present in the work of Koehn and Santomero (1980), Kim and Santomero (1988), Rochet (1992), and more recently in the general equilibrium models of Gale (2010) and Harris, Opp, and Opp (2017). Previous studies (Hellmann, Murdock, and Stiglitz (2000), Repullo and Suarez (2004)) show that banks’ incentives to tilt the composition of credit towards risky borrowers largely originates from deposit insurance and implicitly insured debt. These guarantees induce deviations from the Modigliani-Miller principle, allow banks to raise debt at attractive terms despite their high levels of leverage, and render equity a relative more expensive source of funding than deposits or wholesale debt.²

Risk-taking incentives create the need for additional bank regulation (Dewatripont, Tirole, et al. (1994)), which are considered in our empirical analysis. A first regulatory tool to mitigate the risk-taking problem are risk weights, which determine how much capital banks have to hold against various risk-sensitive assets. Kim and Santomero (1988) propose to derive “theoretically-correct” risk weights under risk-based capital regulation in order to restrict banks’ asset composition. Rochet (1992) proposes to make the “correct” risk-weights proportional to the systematic risks (the betas) of the assets. Glasserman and Kang (2013) propose optimal risk weights for the regulator

²These studies are not necessarily in contradiction with Admati, DeMarzo, Hellwig, and Pfleiderer (2013a), who conclude that bank equity is not *socially* expensive. Banks’ *private* funding costs, instead, depend on their funding mix because bank debt carries benefits from tax subsidies and government guarantees.

that are proportional to the profitability level of asset classes. The risk-based approach to capital requirements has been adopted by regulators around the world since the Basel Accords (1988).

However, several studies provide evidence that regulatory risk weights result in only imperfect monitoring of banks' investments. There is ample evidence of banks optimizing risk weights (Beltratti and Paladino (2013), Acharya, Engle, and Pierret (2014)) when deriving their regulatory risk weights and allocating their portfolios, indicating that external equity financing is costly for banks. The channel of risk taking due to more stringent capital requirements can then still subsist when there is the presence of regulatory arbitrage, because banks, conditional on a given level of risk weight, can choose to invest in riskier assets. In addition, the literature points to several reasons for which risk weights only imperfectly reflect actual asset risk. First, Basel I only features four coarse risk weight categories (0%, 20%, 50%, 100%). Second, banks can manipulate risk weights using their internal models in Basel II (Mariathasan and Merrouche (2013), Plosser and Santos (2016)). Third, potentially risky sovereign exposures are subject to preferential regulatory treatments (Acharya and Steffen (2015), Kirschenmann, Korte, and Steffen (2016)). A second regulatory monitoring device that complements risk weights are stress tests, on which this paper centers. In the U.S., the CCAR introduces additional quantitative monitoring of banks' assets and a qualitative assessment of their risk management practices by the regulator.

Our empirical analysis lies at the intersection of two branches of literature that have developed quickly, but separately, after the financial crisis. The first branch investigates the effect of increased capital requirements on bank lending. Groppe, Mosk, Ongena, and Wix (2016) find that European banks reduced credit supply to the real sector when they were forced to increase their regulatory capital ratios in the 2011 capital exercise of the European Banking Authority. Fraisse, Le, and Thesmar (2015) exploit the heterogeneity in capital requirements for different loans due to the use of internal risk models under Basel II, and find that a one percentage point increase in loan-specific capital requirement reduces lending by ten percent. As in this work, these papers also exploit bank-specific capital requirements, but focus on aggregate lending rather than on bank risk taking and credit composition.

The second branch focuses on stress tests and encompasses investor response to stress tests results (Greenlaw, Kashyap, Schoenholtz, and Shin (2012), Flannery, Hirtle, and Kovner (2017)),

information disclosure (Goldstein and Sapra (2012), Schuermann (2012), Petrella and Resti (2013)), stress scenario selection and stress testing methodologies (Breuer, Jandačka, Rheinberger, and Summer (2009), Glasserman, Kang, and Kang (2012), Hirtle, Kovner, and Bhanot (2016)). To the best of our knowledge, only Acharya, Berger, and Roman (2017) investigate the risk-taking behavior of banks subject to the CCAR since the Dodd-Frank Act. They find that the banks in their sample reduce their aggregate supply of credit, in particular to risky borrowers. Our works instead jointly consider two channels, namely increased capital requirements and monitoring through stress tests, that can influence the risk taking behavior of the banks subject to annual regulatory stress tests. While their results are also based on data on syndicated loans, our empirical strategy is based on data collected for all banks participating in syndicated loans, instead of for the lead banks only. This allows us to identify the effect of banks' characteristics of different banks lending to the same firm during one quarter.

More broadly, our paper relates to the large literature that links regulation and policy to banks' riskiness and lending activity. Recent contributions include Ellul and Yerramilli (2013), Jimenez and Ongena (2012), Jimenez, Ongena, Peydro, and Saurina (2014), Neuhann and Saidi (2017), Heider, Saidi, and Schepens (2017), Acharya, Eisert, Eufinger, and Hirsch (2016), Acharya, Eisert, Eufinger, and Hirsch (2017).

3 Institutional Background: Stress Tests and Capital Requirements

3.1 Dodd-Frank Act and CCAR

The Dodd-Frank Wall Street Reform and Consumer Protection Act (Pub.L. 111-203, H.R. 4173) or “Dodd-Frank Act” (DFA), signed into law on July 21, 2010, required enhanced prudential standards for bank holding companies “with total consolidated assets of \$50 billion or more and any nonbank financial firms that may be designated systemically important companies by the FSOC”. DFA requires banks to “develop annual capital plans, conduct stress tests, and maintain adequate capital, including a tier one common risk-based capital ratio greater than 5 percent, under both

expected and stressed conditions” (DFA Section 165(b)(1)(A)(i) and 165(j)).³ The act also features annual stress tests conducted by the regulator in addition to stress tests ran by the banks (DFA Section 165(i)). These annual stress tests, called Dodd-Frank Act Stress Test or “DFAST”, are part of a broader supervisory exercise called the Comprehensive Capital Analysis and Review (CCAR), which demands that banks also submit their capital plans for regulatory review. In their capital plans, bank holding companies describe all capital issuances and distributions (e.g., issuance of capital instruments, dividends payments, share repurchases) they would undertake under a baseline scenario defined by the banks for the next nine quarters. The Federal Reserve then assesses banks’ ability to pursue such capital plans and maintain post-stress capital ratios that are above the regulatory capital requirements in effect during each quarter of the planning horizon.⁴

The ultimate outcome of the CCAR exercise is a decision by the Federal Reserve concerning banks’ capital plans in light of the stress test results and a qualitative assessment. The decision is publicly disclosed in the CCAR summary report. Since 2013, the Federal Reserve can give an objection, a conditional non-objection, or a non-objection to a bank’s capital plans. In the Appendix, we report the number of banks failing stress tests, i.e., the banks that received an objection or a conditional non-objection to their capital plans. If banks do not meet the supervisory criteria (quantitative or qualitative), the objection to the their capital plans usually prevents the bank from making any capital distribution in the following quarters until the next CCAR.

3.2 Sample of Bank Holding Companies and Regulatory Data

The first CCAR was conducted in 2011 for the 19 bank holding companies that previously participated in the Supervisory Capital Assessment Program (SCAP) in 2009 under the Troubled Asset Relief Program (TARP). All domestic bank holding companies with year-end 2008 assets exceeding \$100 billion were required to participate in the SCAP. In 2014, the bank size threshold to be subject to the CCAR reduced to \$50 billion in consolidated assets.⁵ The number of participating

³<https://www.federalreserve.gov/news-events/press/bcreg/20111220a.htm>, visited on 11/02/2017.

⁴<https://www.federalreserve.gov/bankinforeg/stress-tests/CCAR/201503-comprehensive-capital-analysis-review-capital-plan-assessment-framework-and-factors.htm>, visited on 11/02/2017.

⁵Those banks were previously subject to the Capital Plan Review (CapPR). Under CapPR, banks were required to conduct internal stress tests based on the supervisory scenarios, but were not subject to a regulatory stress test (i.e., the Federal Reserve was not conducting its own stress test by projecting the supervisory scenarios on banks’ regulatory data).

banks increased to 30 bank holding companies in the 2014 CCAR (including U.S. subsidiaries of Canadian and European banks). Deutsche Bank Trust Corporation joined the CCAR in 2015, and BancWest Corporation and TD Group US Holdings LLC joined in 2016. In the Appendix, we provide the list of all participating banks — the “stressed banks” — in the SCAP, as well as in each annual CCAR.

For our analyses, we collect data on both stressed and non-stressed banks. In November 2011, the Federal Reserve proposed a rule to implement the DFA requirements specifying that a summary of the stress tests results should be made public. From 2012 to 2016, we collect the bank-specific stress test data disclosed in each annual CCAR summary report available from the Federal Reserve website.⁶ The sample of non-stressed banks includes public U.S. bank holding companies with consolidated assets of \$10 billion or more that have never been subject to a regulatory stress test (including CCAR 2017).⁷ For all banks in the sample, we obtain quarterly public regulatory accounting data on bank holding companies from SNL (originally collected from FR-Y9C reports), and market data from Bloomberg from December 2000 to September 2016. Our sample consists of 33 stressed banks that participated in the 2016 CCAR (see Table A1 in the Appendix) and 21 non-stressed banks. Out of the 33 stressed banks, 18 banks have been subject to the CCAR every year since 2011. The other stressed banks are referred to as “new entrants” in the paper throughout.⁸

3.3 Capital Requirements Under DFA

Capital Requirements of Bank Holding Companies. The capital requirements of U.S. bank holding companies are defined using four regulatory capital ratios

$$\begin{aligned}
 CET1R : \quad & \frac{CET1_b}{RWA_b} \geq k_1, \\
 T1R : \quad & \frac{T1_b}{RWA_b} \geq k_2, \\
 TotalR : \quad & \frac{Total_b}{RWA_b} \geq k_3, \\
 LVGR : \quad & \frac{T1_b}{Assets_b} \geq k_4,
 \end{aligned} \tag{1}$$

⁶Only for the 2011 CCAR, the Federal Reserve did not disclose any bank-specific result from the stress test.

⁷Under DFA, non-stressed banks are also required to conduct their own internal stress tests each year and to publicly disclose the results of these internal stress tests under the severely adverse scenario. However, they are not subject to the regulatory stress test (see <https://www.federalreserve.gov/bankinforeg/ccar-and-stress-testing-as-complementary-supervisory-tools.htm>).

⁸MetLife, Inc. is excluded from the sample. MetLife, Inc. was not considered as a bank holding company in 2013, and therefore got exempted from CCAR.

where, for bank b , $CET1_b$ is common equity Tier 1 capital, $T1_b$ is Tier 1 capital, $Total_b$ is Total regulatory capital, RWA_b denotes risk-weighted assets, and $Assets_b$ denotes average total assets (i.e., the time-series average of the bank’s total assets over the quarter).⁹ In Table 1 (Panel A), we report the four regulatory thresholds (k_1, k_2, k_3, k_4) for each capital ratio in each CCAR exercise. The thresholds are collected from annual CCAR summary reports available on the Federal Reserve website.

[INSERT TABLE 1 HERE]

Capital Requirements of Stressed Banks. Stressed banks generally face higher capital requirements than non-stressed banks. For all banks subject to the CCAR, the capital ratio that is used to assess capital adequacy is the minimum capital ratio over the nine quarters of the supervisory stress scenario. This minimum capital ratio is lower than the actual bank capital ratio because the bank’s capital is supposed to absorb the projected losses under the stress scenario.¹⁰ Specifically, under adverse economic conditions, the decline in value of bank’s assets translates into an hypothetical loss under stressed economic conditions. As a result, the buffer of post-stress capital reduces by this hypothetical loss for each quarter of the stress test horizon. In addition, the riskiness of the bank’s assets increases in the hypothetical stress scenario, resulting in higher “risk weights” assigned to risky exposures and lower post-stress capital ratios defined as a percentage of risk-weighted assets.¹¹

Therefore, when a bank is subject to the regulatory stress test, the thresholds that are applicable to its actual capital ratios become bank-specific and can be expressed as follows:

$$\begin{aligned} k_{1b}^s &= \frac{k_1}{1 + \frac{CET1R_{b,stress} - CET1R_b}{CET1R_b}}, \\ k_{2b}^s &= \frac{k_2}{1 + \frac{T1R_{b,stress} - T1R_b}{T1R_b}}, \end{aligned} \tag{2}$$

⁹Descriptive statistics for the four regulatory ratios of stressed banks participating in all stress tests, new entrants, and non-stressed banks are reported in the Appendix.

¹⁰In principle, it might be the case that the stress scenario loosens capital requirements, but this situation is never empirically observed.

¹¹In addition, bank’s capital ratios can also decrease when the bank has planned net capital distributions over the planning horizon.

$$k_{3b}^s = \frac{k_3}{1 + \frac{\text{Total}R_{b,\text{stress}} - \text{Total}R_b}{\text{Total}R_b}},$$

$$k_{4b}^s = \frac{k_4}{1 + \frac{\text{LVGR}_{b,\text{stress}} - \text{LVGR}_b}{\text{LVGR}_b}},$$

where $CET1R_{b,\text{stress}}$, $T1R_{b,\text{stress}}$, $\text{Total}R_{b,\text{stress}}$, $\text{LVGR}_{b,\text{stress}}$ are the minimum projected capital ratios of bank b under the supervisory stress scenario. Because $CET1R_{b,\text{stress}} \geq CET1R_b$, $T1R_{b,\text{stress}} \geq T1R_b$, $\text{Total}R_{b,\text{stress}} \geq \text{Total}R_b$, $\text{LVGR}_{b,\text{stress}} \geq \text{LVGR}_b$, the denominators used to define the thresholds of stressed banks in Equation (2) are expected to be lower than one, and the bank-specific post-stress thresholds of stressed banks are expected to be higher than the regulatory thresholds (k_1 , k_2 , k_3 , k_4). Importantly, the difference between post-stress thresholds and the regulatory thresholds is a function of the sensitivity of the bank assets to the supervisory stress scenario. The capital requirement of a stressed bank increases by the extent to which the bank is vulnerable to the supervisory stress scenario. A comparison of the regulatory thresholds in Panel A to the average post-stress thresholds in Panel B of Table 1 shows the more stringent capital requirements that stressed banks face.

Although some banks fail the regulatory stress test each year, the average actual capital ratios of stressed banks, reported in Panel C of Table 1, are always above the average post-stress thresholds. Indeed, most stressed banks maintain capital ratios well above the capital requirements imposed by stress tests.¹² While, after 2014, most banks did not fail the CCAR based on quantitative capital inadequacy,¹³ the distance between the actual capital ratios of the bank and its post-stress

¹²After the crisis, the average capital ratios have increased for all groups of banks, and especially for stressed banks (see descriptive statistics in the Appendix). The average Tier 1 capital ratio increased by 4% for stressed banks, compared to an increase of 2.1% for non-stressed banks. This difference is explained by the low level of capitalization of stressed banks before the crisis compared to non-stressed banks. In Figure A1 (in the Appendix), we observe an upward shift in banks' regulatory capital ratios during the fourth quarter of 2008, which coincides with the launch on October 14, 2008 of the Capital Purchase Program (CPP) and the Temporary Liquidity Guarantee Program (TLGP) under the TARP. Under the CPP, the Treasury Department injected \$205 billion capital into banks by buying warrants, common shares, and preferred shares. The SCAP stress test of February 2009 also led to a substantial recapitalization of the U.S. financial system by forcing 10 stressed banks to raise an additional \$75 billion capital buffer.

¹³Some banks failed the CCAR based on "qualitative reasons". In the qualitative assessment of the CCAR, the Federal Reserve "focus[es] on the internal practices a BHC [Bank Holding Company] uses to determine the amount and composition of capital it needs to continue to function throughout a period of severe stress." Source: <https://www.federalreserve.gov/bankinforeg/stress-tests/CCAR/201503-comprehensive-capital-analysis-review-capital-plan-assessment-framework-and-factors.htm>, visited on 11/02/2017.

regulatory capital requirements reflects the tightness of the regulatory capital constraint, as well as the probability of the bank of failing the stress test, and having to raise additional equity.

The Most Stringent Capital Requirement. To describe the capital requirements of non-stressed banks with a single measure, we re-write the capital requirement based on the four regulatory capital ratios of Equation (1) as a single Tier 1 leverage ratio requirement, i.e. a Tier 1 capital requirement as a percentage of average total assets. To do so, we recognize that the most stringent capital requirement can be written as

$$\frac{T1_b}{Assets_b} \geq Capreq_b,$$

where after some algebraic manipulation of regulatory capital requirements in Equation (1):

$$Capreq_b = \max(k_{1b}, k_{2b}, k_{3b}, k_4), \quad (3)$$

with $k_{1b} = \left[k_1 - \frac{CET1_b - T1_b}{RWA_b} \right] \frac{RWA_b}{Assets_b}$, $k_{2b} = k_2 \frac{RWA_b}{Assets_b}$, and $k_{3b} = \left[k_3 - \frac{Total_b - T1_b}{RWA_b} \right] \frac{RWA_b}{Assets_b}$. The capital shortfall or the amount of Tier 1 capital a bank needs to raise in order to meet the capital requirement of Equation (3) is $\max(0, Capreq_b * Assets_b - T1_b)$.

Similarly, the most stringent Tier 1 leverage ratio requirement for stressed banks is

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

where $k'_{1b} = \left[k_{1b}^s - \frac{CET1_b - T1_b}{RWA_b} \right] \frac{RWA_b}{Assets_b}$, $k'_{2b} = k_{2b}^s \frac{RWA_b}{Assets_b}$, $k'_{3b} = \left[k_{3b}^s - \frac{Total_b - T1_b}{RWA_b} \right] \frac{RWA_b}{Assets_b}$, and $k'_{4b} = k_{4b}^s$. In the last column of Panel B of Table 1, we report the cross-sectional average single Tier 1 leverage ratio requirement ($Capreq_b$) of stressed banks.¹⁴ This threshold is on average higher than k_{4b}^s , showing that the capital requirements based on risk-weighted assets can occasionally be more stringent for some of the banks participating in the CCARs.

¹⁴Note that given the change in the regulatory definition of the common equity Tier 1 ratio and the different resulting thresholds used in the CCARs, we do not consider k_{1b} and k'_{1b} when deriving the most stringent capital requirement in Equations (3) and (4).

Figure 1 shows the evolution of the average single capital requirement as defined in Equation (4) for our sample of banks (including both stressed and non-stressed banks), and how the average capital requirement changed after stressed banks became subject to DFA stress tests. The average capital requirement of all banks increases from 4.5 percent before the DFA to a maximum of 6.5 percent in 2015. The figure also shows that the average capital requirement in 2015 and 2016 would be roughly two percentage points lower if stressed banks were not required to use more equity to absorb potential losses under the stress scenario by DFA stress tests.

In the following sections, we attempt to shed light on the reaction of stressed banks in their investment decisions to being subject to higher capital requirements and more invasive monitoring under DFA.

[INSERT FIGURE 1 HERE]

3.4 Bank Asset Income and Capital Requirements

In this section, we provide a first crude set of descriptive evidence on how banks' asset income, as available from financial statements, is affected by how capital requirements evolve along the timeline of the regulatory stress testing process. While the type of investments that contribute to changes in banks' income are substantially heterogeneous, and increases in income that are realized (ex-post) after innovations to capital requirements can not necessarily be interpreted as the immediate outcome of risk taking, the evidence in this section is suggestive of the timing of events associated with the extant regulatory framework playing a role on banks' investment policy.

We measure asset income as the part of bank income that is not directly affected by the banks' funding costs. To compute asset income, we start from net income, defined as

$$\begin{aligned}
 \text{Net income} = & \text{ Interest income} - \text{Interest expenses} - \text{Provisions} \\
 & + \text{Noninterest income} + \text{Securities revenues} - \text{Noninterest expenses} \\
 & - \text{Taxes},
 \end{aligned}$$

and define asset income as (*Net income + Interest expenses*). We then relate changes in asset income to bank-specific capital requirements through the following regression

$$\Delta \text{asset income}_{bt} = \beta \text{Cap req}_{bt} + \gamma' \text{controls}_{bt} + \delta_t + \epsilon_{bt}, \quad (5)$$

where $\Delta \text{asset income}_{bt}$ is the change in asset income of bank b , Cap req_{bt} is the capital requirement of stressed bank b in the CCAR of year t as defined by Equation (4), controls_{bt} denotes bank-specific control variables, and δ_t are year fixed effects. The control variables include bank size (measured by the logarithm of bank's total assets), bank lending activity (ratio of loans to total assets), and bank capital structure (ratio of book equity to total assets). The dataset used in this regression is obtained by pooling cross-sections of stressed bank data for the five CCAR years.

The peculiar feature of this regression is that the timing of measurement of the banks' response to capital requirements is crucial. In Figure 2, we detail the stress test timeline of two consecutive CCARs. Chronologically, the stress scenario starts the day after the reporting date of bank data used by the Federal Reserve to project the stress scenario ("Scenario Start" in the figure). It is followed by the release of the supervisory stress scenario by the Federal Reserve ("Supervisory Scenario Release"). Banks usually submit their data, internal projections, and capital plans three months later ("Bank Submits To the Fed"), and a few months after banks' submission, the Federal Reserve publicly discloses the results of the stress test ("DFAST Disclosure") as well as its decision concerning banks' capital plans review in light of the stress test results ("CCAR Disclosure + Decision").

When a bank receives an objection to its capital plans, it can resubmit new capital plans before the next CCAR exercise ("Resubmission"). In this case, the banks cannot increase their capital distributions until a new capital plan is approved. Starting in 2013, The Federal Reserve also gave the possibility to stressed banks to adjust their planned capital distributions ("Adjusted Capital Actions") before the CCAR disclosure and after receiving the Federal Reserve's preliminary CCAR post-stress capital analysis.¹⁵

¹⁵"The only kind of adjustment permitted under this new procedure was a reduction of the planned capital

The change in bank asset income is measured between the release of the supervisory stress scenario and the disclosure of stress test results (“Risk Taking”). The underlying assumption is that banks can forecast their own capital requirement in the regulatory stress test ($Capreq_{bt}$) just after the stress scenario is released. Even though banks do not know the model used by the Federal Reserve to project the stress scenario on their data, banks have perfect knowledge of all their exposures and the sensitivity of these exposures to the stress scenario. Therefore, when they learn the supervisory stress scenario, banks can foresee whether they will need to use more equity in their capital structure and bear increasing funding costs in the quarters following the CCAR disclosure.

[INSERT FIGURE 2 HERE]

Table 2 reports the estimate of β for different components of $\Delta asset income_{bt}$.¹⁶ Panel A reports the ratio of asset income to total assets, Panel B reports the ratio of loan interest income to total loans, and Panel C the ratio of trading and securities revenues to total assets. We find that the estimate of β is positive and statistically significant at the 5% level when $\Delta asset income_{bt}$ is measured by the change in the ratio of asset income to total assets in Panel A. A positive estimate is consistent with bank asset profitability being affected in anticipation of more stringent capital requirements in the stress test. The results are similar when we replace $Capreq_{bt}$ with the individual bank-specific thresholds for each regulatory capital ratio (k_{1bt}^s , k_{2bt}^s , k_{3bt}^s , k_{4bt}^s), and when we replace the dependent variable by the change in the ratio of asset income to risk-weighted assets. The results in Panel B show less pronounced patterns that link banks’ loan portfolios to banks’ capital requirements in the stress test. The estimate of β is positive but only marginally significant in Panel B, in which the dependent variable is the change in the ratio of loan interest income to loans. Overall, the results in Table 2 show that banks’ asset income changes in response to innovations to bank-specific capital requirements according to systematic patterns that line up

distributions that were submitted by the BHCs in their January 2013 capital plans. These adjusted capital actions, if any, were then incorporated into the Federal Reserve’s projections to calculate the adjusted post-stress capital levels and ratios. For firms that submitted an adjusted capital distribution, the Federal Reserve is disclosing both the minimum projected capital ratios using the originally submitted planned capital actions and the adjusted planned capital actions.”

¹⁶We report descriptive statistics on different measures of asset income in the Appendix.

with the regulatory timing. The immediate reaction to the stress scenario is more pronounced for trading and security-related income (as shown in Panel C).

While the evidence in this section is not inconsistent with stressed banks actively reallocating their portfolios towards risky assets that generate on average higher income, especially by immediately trading in security markets, it is certainly not conclusive. In particular, several concerns arise when interpreting the asset income measures reported in quarterly income statements as proxies for risk taking behavior during that quarter. For example, asset income can decrease due to non-performing loans when existing borrowers do not pay interests in a timely fashion. When the quality of existing borrowers deteriorates, asset income measures might decrease because the bank fails at collecting interest payments.

[INSERT TABLE 2 HERE]

4 Data and Empirical Strategy

The asset income measures of the previous section might not capture the riskiness of banks' investments. In this section, we instead consider two measures that likely reflect the ex-ante risk of new loans granted after innovations in capital requirements, namely the average yield on the portfolio of new syndicated loans of a bank, and the amount that a bank lends to risky borrowers in a new syndicated loan.

4.1 Syndicated Loans: Data and Descriptive Statistics

To study the risk-taking behavior of stressed and non-stressed banks in our sample, we rely on loan data from the LPC DealScan dataset. For each bank and each quarter, we reconstruct the exhaustive list of, directly or indirectly, controlled subsidiaries using organization hierarchy data from the National Information Center (NIC), available at www.ffiec.gov/nicpubweb/nicweb/nichome.aspx.

This yields a total of 48,113 unique lending companies in our sample period. We manually match these lender names to DealScan lenders (19,291 unique lending companies in our sample period), to determine for each quarter all loans that the 54 bank holding companies in our sample include in their portfolios. DealScan contains information on syndicated loans, which have a unique borrower but can have multiple lenders. In DealScan, syndicated loans are also referred to as facilities. Because 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, unlike previous studies (e.g. Bharath, Dahiya, Saunders, and Srinivasan (2011)), we do not restrict our sample to lead arrangers only. We exclude all deals whose status is not completed or that are syndicated outside the United States, for a total of 234,037 lender-borrower relationships.

Some of the analyses in this section require accounting information regarding borrowers, that we ascertain by matching DealScan to the Compustat Quarterly Industrial Files. We link DealScan and Compustat using the DealScan-Compustat Linking Database provided by Chava and Roberts (2008a). Finally, 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. The sub-sample for which both borrower accounting and rating information is available consists of 121,773 lender-borrower relationships.

As a measure of borrower risk we use the spread, in basis points, paid by the borrower over the LIBOR rate (plus any annual, or facility-related, fee paid to the bank group) to the bank for each dollar drawn down, as reported by DealScan as “all-in-drawn” spread. Table 3 reports the average all-in-drawn spread across facilities from deals that banks originated or participated in before and after DFA, along with other characteristics of facilities reported in DealScan. The table reports averages for banks that participated in all stress tests (“All Stress Tests”), for banks that were subject to regulatory stress tests at a later stage (“New Entrants”), and for non-stressed banks (“Non-Stressed Banks”). The average all-in-drawn spread increased for all banks, but the increase in average borrower risk is less pronounced for the facilities of stressed banks (51 bps compared to 66 bps for non-stressed banks). At the same time, the average maturity increases for all banks after

DFA (between 8 and 11 months). The third row of the table reports the average facility amount committed by the lenders' pool in new syndicated loans. The average facility amount increases for deals of stressed banks and new entrants (resp. 129 and 177 USD mn), but decreases for non-stressed banks (-61 USD bn). However, the number of facilities banks participate in, that reflects an extensive margin, decreases for stressed banks and new entrants (respectively -13,478 and -3,757) after DFA, but increases for non-stressed banks (719 additional facilities).

The amount banks have committed to each facility is missing for around 75% of lender-borrower relationships. We have to rely on this restricted sample (56,523 lender-borrower relationships and 43,366 lender-borrower relationships for the database linked to Compustat) in our analysis of bank risk taking since the bank allocation is key to measure bank's exposure to risk.¹⁷ The average bank allocation is 14 percent for stressed banks, 10 percent for new entrants, 13 percent for non-stressed banks, and slightly decreases after DFA. The increase in the average amount stressed banks lend in these new facilities is the largest (21 USD mn), compared to new entrants and non-stressed banks (resp. 12 and 3 USD mn).

[INSERT TABLE 3 HERE]

4.2 Empirical Strategy

While banks might have incentives to take more risks when they expect their funding costs to raise, they might also have incentives to reduce asset risk before reporting to the Federal Reserve in order to reduce their risk-sensitive capital requirements in the CCAR. Indeed, the asset portfolios of stressed banks are more monitored by the regulator compared to other banks because their capital requirement depends on a regulatory assessment of the sensitivity of their portfolio to the stress scenario. In addition, stressed banks are subject to a qualitative assessment challenging the bank's

¹⁷Additional filters exclude observations for which the all-in-drawn spread is missing, the capital requirement is missing, the bank total assets reported in SNL are missing, and loan facilities starting before 2001, leaving 45,986 lender-borrower relationships. On the database linked to Compustat, the same additional filters restrict the sample to 34,866 lender-borrower relationships.

risk management team on the assumptions used to derive stressed projections, capital plans and regulatory risk weights. This “monitoring” effect of regulatory stress tests should induce banks to follow more prudential standards when making investment decisions.

In this section, we describe the empirical strategy we use to separate the effect of *higher capital requirements* from the effect of *more invasive monitoring* on the risk taking behavior of stressed banks.

4.2.1 Effect on Portfolio Yield

Two contrasting effects might influence the response of stressed banks to the CCAR, namely the increase in risk taking incentives because of more stringent capital requirements (“higher capital requirements”), and the prudential incentives induced by regulatory monitoring through stress tests (“monitoring”). We identify the effect of DFA on stressed banks compared to non-stressed banks using a differences-in-differences analysis on the yield on the portfolio of new loans banks issue during one quarter. The dependent variable $portfolio\ yield_{bt}$ is the weighted average all-in-drawn spread on the portfolio of new syndicated loans (new facilities) bank b participates to in a given quarter t , with weights given by the bank’s dollar loan amounts to each firm within the quarter. Formally, the portfolio yield on new loans of bank b in quarter t is defined as

$$portfolio\ yield_{bt} = \sum_{f, \tau \in t} \frac{bank\ allocation_{bf\tau} * facility\ amount_{f\tau} * exchange\ rate_{f\tau} * all\ in\ drawn_{f\tau}}{\sum_{f, \tau \in t} bank\ allocation_{bf\tau} * facility\ amount_{f\tau} * exchange\ rate_{f\tau}},$$

where, for all dates $\tau \in t$ (DealScan item “FacilityStartDate”), $bank\ allocation_{bf\tau}$ is the fraction of the loan amount allocated by bank b in the syndicated loan to firm f , $facility\ amount_{f\tau}$ is the total amount the syndicate lends to firm f at date τ , $exchange\ rate_{f\tau}$ is the exchange rate applied to the amount lent to firm f at date τ (equal to one if the loan is denominated in USD), and $all\ in\ drawn_{f\tau}$ is the all-in-drawn spread charged to firm f at date τ .

In order to separate the effect of monitoring from the effect of higher capital requirements in the CCAR, we implement a triple differences-in-differences analysis testing the differential effect of

DFA on the portfolio yield of stressed versus non-stressed banks, after controlling for the sensitivity of bank's portfolio yield to the level of bank-specific capital requirements:

$$\begin{aligned}
\text{portfolio yield}_{bt} = & \alpha_b + \delta_t + \beta_1 \text{stressed}_b * \text{DFA}_t + \beta_2 \text{stressed}_b * \text{DFA}_t * \text{Capreq}_{bt} \\
& + \beta_3 \text{Capreq}_{bt} + \beta_4 \text{stressed}_b * \text{Capreq}_{bt} \\
& + \beta_5 \text{DFA}_t * \text{Capreq}_{bt} + \gamma' \text{controls}_{bt} + \epsilon_{bt},
\end{aligned} \tag{6}$$

where α_b are bank fixed effects, δ_t are time (quarter) fixed effects, stressed_b is a dummy variable equal to one if bank b is subject to CCAR, DFA_t is a dummy variable equal to one if quarter t is after the fourth quarter of 2010, Capreq_{bt} is the capital requirement of bank b in quarter t as defined by Equation (3) and Equation (4) for stressed banks after DFA, and controls_{bt} are bank-specific control variables described below.

In the regression specification (6), we interpret β_1 as a monitoring effect for stressed banks subject to CCARs, after controlling for the effect of their regulatory capital requirement ($\text{Capreq}_{bt} * \text{stressed}_b * \text{DFA}_t$). The specification allows for different responses of the portfolio yield of stressed versus non-stressed banks to capital requirements before versus after DFA. Therefore, the estimate of β_2 can be interpreted as a differences-in-differences estimate that gauges the effect of DFA on the sensitivity of the portfolio yield to the bank-specific capital requirement of stressed banks compared to non-stressed banks. Our identification of a monitoring effect relies on the assumption that, after controlling for a different response of stressed banks to higher bank-specific capital requirement after DFA, the remaining differential response of stressed banks to DFA compared to non-stressed banks should come from more invasive monitoring of stressed banks by the regulator. Given that we do not explicitly measure monitoring at the bank level, regulatory monitoring could take different forms as it is the case in the CCAR (i.e., quantitative or qualitative assessments of banks' assets, capital adequacy, and risk management).

The panel dataset is composed of quarterly data of stressed and non-stressed banks. The post-stress bank-specific thresholds ($k_{1bt}^s, k_{2bt}^s, k_{3bt}^s, k_{4bt}^s$) of stressed banks after DFA are held constant between the quarter before the CCAR disclosure until the quarter before the next CCAR disclosure.

Importantly, all information used to derive the single bank-specific capital requirement $Capreq_{bt}$ in quarter t — average total assets, risk-weighted assets and the different measures of capital — is updated every quarter based on end of *previous* quarter ($t-1$) regulatory data. The control variables include bank-level variables measured in the previous quarter, namely bank size (measured by the logarithm of bank's total assets) and bank lending activity (ratio of loans to total assets), and contemporaneous portfolio-level variables, namely the weighted average portfolio maturity (weights given by the bank's loan amounts to each firm), and the percentage of secured loans of the bank in quarter t . Controlling for bank size and the relative importance of lending in different bank business models should mitigate additional concerns regarding the interpretation of the monitoring effect.

4.2.2 Effect on Loan Amounts

Along with the portfolio yield analysis, we consider the change in the composition of credit (intensive margin) for both stressed and non-stressed banks lending to risky firms after DFA. The dependent variable $\log(amount_{fbt})$ is the logarithm of the USD amount lent by bank b to firm f in a facility issued at date t , where $amount_{fbt} = bankallocation_{bft} * facilityamount_{ft} * exchangerate_{ft}$. We first consider a model saturated with bank*quarter and firm*quarter fixed effects, in which the amount a bank lends to firms and the amount a firm borrows from banks in a quarter are fixed. Similarly to Jimenez, Ongena, Peydro, and Saurina (2014), we look at the changes in the composition of credit flowing from banks to firms with the regression

$$\log(amount_{fbt}) = \alpha_{bt} + \alpha_{ft} + \beta Capreq_{bt} * Firm risk_{ft} + \epsilon_{fbt}, \quad (7)$$

where α_{bt} are bank*quarter fixed effects, α_{ft} are firm*quarter fixed effects, $Capreq_{bt}$ is the capital requirement of bank b at date t as defined by Equation (3) and Equation (4) for stressed banks after DFA, and $Firm risk_{ft}$ is a measure describing the risk of borrower f at date t (as described in detail in Section 5.2). The control variables include lagged bank-level variables and contemporaneous loan-level variables, namely bank size, bank lending activity, the maturity of the loan, and a dummy

variable equal to one if the loan is secured. The panel dataset is composed of firm*bank*time data of stressed and non-stressed banks. The capital requirement $Capreq_{bt}$ is derived as for the portfolio yield regressions.

In specification (7), we interpret β as a risk taking parameter indicating by how much a bank allocates more of its loan portfolio to risky firms. The bank*quarter and firm*quarter fixed effects absorb all bank and firm time-varying heterogeneity in loan amounts such that we control for the level of supply and demand for credit, and rather concentrate on the bank-firm matching process resulting in a different composition of credit. The remaining variation in amounts lent comes from the bank*firm dimension in a given quarter. Importantly, and differently from other studies using DealScan data (Acharya, Berger, and Roman (2017) for example), the fact that we do not focus on the lead arranger in syndicated loans allows us to adopt this identification strategy. While a bank lends to multiple firms in a quarter, we also have multiple banks lending to the same firm in a given loan syndicate. Our identification strategy relies on multiple banks lending to the same firm in a given quarter (and multiple firms borrowing from the same bank). Our data, collected for all banks participating in the syndicated loan market, therefore serves as a laboratory to address this question.

In order to separate the effect of monitoring from tighter capital requirements on loan amounts from stressed banks after DFA, we adopt a triple differences-in-differences regression similar to the one we use for the portfolio yield analysis:

$$\begin{aligned}
\log(amount_{fbt}) = & \alpha_{bt} + \alpha_{ft} + \beta_1 stressed_b * DFA_t * Firm risk_{ft} \\
& + \beta_2 stressed_b * DFA_t * Capreq_{bt} * Firm risk_{ft} + \beta_3 Capreq_{bt} * Firm risk_{ft} \\
& + \beta_4 stressed_b * Capreq_{bt} * Firm risk_{ft} + \beta_5 DFA_t * Capreq_{bt} * Firm risk_{ft} \\
& + \beta_6 stressed_b * Firm risk_{ft} + \gamma' controls_{fbt} + \epsilon_{fbt},
\end{aligned} \tag{8}$$

where $stressed_b$ is a dummy variable equal to one if bank b is subject to CCAR, and DFA_t is a dummy variable equal to one if the facility is issued after the fourth quarter of 2010, and $controls_{fbt}$

are contemporaneous loan-level control variables including loan maturity, a dummy variable indicating whether the loan is secured, and loan fixed effects.

The identification of the monitoring effect (β_1) relies on the same assumption described for the portfolio yield analyses. Controlling for the differential response of stressed banks to tighter capital requirements in the amount they lend to risky firms, the remaining differential effect of DFA on risky lending for stressed banks compared to non-stressed banks is attributed to more invasive regulatory monitoring of stressed banks. Including bank*time and firm*time fixed effects, the monitoring effect indicates a differential response of stressed banks to DFA compared to non-stressed banks in terms of the compositional change of their portfolios of new loans. We alternatively relax the bank*time fixed effects and replace them by bank and time fixed effects, and include bank-specific control variables like the logarithm of bank's total assets, and the ratio of bank loans to total assets measured in the previous quarter. In this case, we can interpret the monitoring effect as a differential response to DFA in the amount stressed banks lend to the same risky firm compared to non-stressed banks.

4.2.3 Two Decompositions of Capital Requirements

Risk Taking and Capital Requirements: the Effect of Stress Tests. Table 1 shows that, compared to non-stressed banks, stressed banks are subject to more stringent capital requirements, which might result in larger risk-taking incentives. In contrast, the additional equity capital that stressed banks are required to use might more closely track the riskiness of bank assets and, all else equal, dampen or offset the risk-taking effect of more stringent capital requirement. To gauge the empirical relevance of the two effects, we implement a test in which, holding the level of the capital requirement fixed, we investigate banks' response to the proportion of the capital requirement specifically related to the stress test. The larger this proportion, the higher the extent to which the capital requirement reflects the sensitivity of the bank's assets to the regulatory stress scenario. Thus, as Panel A of Figure 3 illustrates, we decompose the capital requirement of stressed banks in

the capital requirement without the effect of stress tests, and the increase in the capital requirement due to the stress test:

$$Capreq_{bt} = Capreq_{bt}^* + Stress_{bt}, \quad (9)$$

where $Capreq_{bt} = \max(k_{1b}, k_{2b}, k_{3b}, k_4, k'_{1b}, k'_{2b}, k'_{3b}, k'_{4b})$, $Capreq_{bt}^* = \max(k_{1b}, k_{2b}, k_{3b}, k_4)$. The variable $Stress_{bt} = Capreq_{bt} - Capreq_{bt}^*$ measures the difference between the capital requirement in stress tests and the standard capital requirement that bank b would be subject to if it were not stressed in quarter t . This variable is only different from zero for stressed banks after DFA.

[INSERT FIGURE 3 HERE]

Bank Capitalization and Distance from Capital Requirement. If banks comply to regulatory capital requirements, the latter are likely positively correlated to their observed capital ratios. Any risk-taking effect of higher capital requirements might then originate from the higher capital ratios that stressed banks maintained after the financial crisis. We investigate this possibility that risk taking is merely driven by the actual capitalization level with a second decomposition of the capital requirement, illustrated in Panel B of Figure 3. Specifically, we separate the *actual capitalization level* of the bank and its *distance to the capital requirement* as

$$Capreq_{bt} = LVGR_{bt} - Distance_{bt}, \quad (10)$$

where $Capreq_{bt} = \max(k_{1b}, k_{2b}, k_{3b}, k_4, k'_{1b}, k'_{2b}, k'_{3b}, k'_{4b})$. The variable $Distance_{bt} = LVGR_{bt} - Capreq_{bt}$ is the difference between the actual Tier 1 leverage ratio of the bank and the single Tier 1 leverage capital requirement. The decomposition allows to assess the effect of the actual capitalization level of the bank reflecting its cost of funding ($LVGR_{bt}$), and the effect of the probability of an increase of its cost of funding occurring whenever the bank capitalization level falls below the capital requirement ($Distance_{bt}$).

Based on these decompositions of capital requirements, we investigate alternative specifications

for the portfolio yield and the loan amounts in which we jointly assess the effect of $Capreq_{bt}$ and $Stress_{bt}$, and the effect of $LVGR_{bt}$ and $Distance_{bt}$, respectively.

5 Results

In this section, we present the results of our assessment of the two channels of risk taking — “higher capital requirements” and “monitoring” — on bank portfolio yields (Section 5.1), bank loan amounts (Section 5.2), and using two decompositions of capital requirements (Section 5.3). The results we present in the differences-in-differences analyses are based on a treatment group of banks that participated in all stress tests and a control group of banks that never participated in any regulatory stress test.¹⁸ The results on the portfolio yield analysis are based on 37,883 lender-borrower relationships aggregated at the bank-quarter level (1,087 observations). The results on the loan amount analysis are based on 28,726 lender-borrower relationships.¹⁹

5.1 Effect on Portfolio Yield

Table 4 reports the estimation results of regression (6). The parameter β_1 in this regression captures the differential change in the average portfolio yield of stressed banks compared to non-stressed banks after DFA. The first two columns of Table 4 report the estimate of β_1 in a restricted regression where $\beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$, in which the channel of risk-taking incentives originating from capital requirements is deliberately neglected. Comparing results in the two columns allows assessing the effect of including control variables in the regression.

[INSERT TABLE 4 HERE]

¹⁸Our results are qualitatively similar when we include the group of new entrant banks in the treatment group.

¹⁹Additional filters applied are due to missing values for some risk measures for some firms in Compustat.

The results show that the effect of stress tests is confounded when banks' heterogeneity in capital requirements is not taken into account. The estimates of β_1 suggest that the average portfolio yield spread increased by roughly 5 to 10 bps more for stressed banks after DFA, but these estimates are not statistically significant. These estimates correspond to an average increase in the portfolio all-in-drawn spread of respectively, 21 bps and 39 bps for stressed and non-stressed banks after DFA. The results are consistent with Figure 4, which shows an increase in the average portfolio yield of both stressed and non-stressed banks after DFA.

[INSERT FIGURE 4 HERE]

The three rightmost columns of Table 4 report the estimates of β_1 and β_2 of the unrestricted regression (6). In columns three and four, we report the results of our benchmark specifications, with the difference that we include control variables in column four. The results show that the monitoring effect becomes visible once controlling for the effect of bank-specific capital requirements. The estimate of β_1 is significant at the 1% level when we hold the bank-specific capital requirement constant, and while the corresponding average portfolio yield increased for all banks after DFA, it did by 171 to 197 bps less for stressed banks. The table also shows that setting the capital requirement at the average level before DFA and to the average level after DFA for all banks, the estimates imply an increase of the average portfolio yield of approximately 22 bps and 52 bps for stressed and non-stressed banks, respectively, after DFA.

In Figure 5, we report the differential average portfolio yield of stressed banks compared to non-stressed banks, after removing the effect of capital requirements on banks' portfolio yields. The portfolio yields we use in this figure are orthogonal to capital requirements in the sense they are based on residuals and fixed effects from regression (6). We interpret the fall in the average yield spread between stressed and non-stressed banks after DFA as a monitoring effect since the spread is uncorrelated to capital requirements.

[INSERT FIGURE 5 HERE]

The sensitivity of the portfolio yield to capital requirements is captured by the parameters β_2 , β_3 , β_4 and β_5 , which jointly describe the yield increase or decrease, expressed in basis points, resulting from an increase by one percentage point of the bank-specific capital requirement. The differential effect (β_2) of DFA on the sensitivity of stressed versus non-stressed banks portfolio yields is significant at the 1% level. The differential effect (β_2) indicates that the sensitivity of stressed banks' portfolio yield to capital requirements decreases by 37 to 43 bps less than non-stressed banks after DFA.

Finally, the last column of Table 4 checks the robustness of results to some persistence in banks' risk taking. More specifically, endogeneity could become a concern for the very reason that the definition of capital requirements might reflect a portion of banks' asset risk which not captured by controls *and fixed effects*. If banks are persistent in their level of risk taking — e.g. they overweight each quarter the same group of firms — the capital requirement reflecting asset risk in the previous quarter could be interpreted as an autoregressive term. In order to address this concern we test whether the capital requirement Granger-causes the yield on the portfolio of new loans of the bank. We find that the monitoring effect (β_1) remains significant at the 1% level. Holding the capital requirement and the persistence in risk taking constant, the average portfolio yield increased for all banks after DFA, but by 165 bps less for stressed banks. The differential effect of DFA on the sensitivity of stressed versus non-stressed banks portfolio yields (β_2) also remains significant at the 1% level.

In the Appendix, we replicate regression (6) on the sample of term loans and revolver loans only (as in Acharya, Berger, and Roman (2017)), on the sample of new borrowers only, and on a sample including loans syndicated outside the U.S. as well. New borrowers are firms to which a bank did not grant any loan in the previous quarter. Focusing on new borrowers also helps mitigate concerns related to relationship lending and persistence of risk taking. Including non-U.S. deals addresses concerns about the largest banks resorting to international loans as well to tilt their loan portfolio towards risky borrowers. Results are robust to the restricted samples based on loan and borrower types, and to the inclusion of international loans.

5.2 Effect on Loan Amounts

Table 5 reports the estimates of β from regression (7) for different measures of $Firm risk_{ft}$. We consider the numerical credit rating of the firm $rating_{ft}$ (where AAA=1; D=23), a dummy variable $rated_{ft}$ equal to one if the firm has a rating reported in Compustat, a dummy variable $speculative_{ft}$ equal to one if the firm's rating is worse than BBB, the 3-year rolling volatility of firm's cash flows ($cash flow vol_{ft}$), and the Whited-Wu Index capturing the importance of financial constraints of a firm ($WhitedWu_{ft}$).

[INSERT TABLE 5 HERE]

If higher capital requirements lead banks to lend to risky firms we expect the estimate of β to be positive for all measures except for the dummy variable $rated_{ft}$ that should indicate more transparent firms and carry a negative loading. Table 5 shows that the estimates of β have the expected sign. The estimates are significant at the 1% level for all measures of risk, except $cash flow vol_{ft}$. For example, holding the volume of credit demand and credit supply fixed, a bank increases its portfolio share by an additional 1% to a firm with a S&P rating in the next worse class when the bank capital requirement increases by 1 percentage point. Similarly, we find that banks with a capital requirement 1 pp. higher increase lending by 4% to speculative-grade firms (and decrease lending to investment-grade firms by 4%).

Table 6 reports the differences-in-differences estimates of regression (8), where $Firm risk_{ft}$ is the numerical rating ($rating_{ft}$) of the firm available from Compustat. The two leftmost columns report estimates of the saturated model, which include bank*time and firm*time fixed effects to respectively absorb the level of credit supply for a bank and the level of credit demand for a firm in a given quarter. In addition, the results reported in the second column are based on a regression that includes loan-level controls.

[INSERT TABLE 6 HERE]

For a given capital requirement, stressed banks tilt their portfolios towards risky firms less than non-stressed banks after DFA. The reported estimates imply different expected amounts a bank would lend to an investment grade firm depending on its capital requirement and on whether the bank is a stressed bank after DFA. To isolate the effect of monitoring on loan amounts granted to low risk firms after DFA, we derive the average amount a bank would lend to investment grade firms conditional on its capital requirement being equal to the average capital requirement of all banks before DFA in the pre-DFA period, and equal to the average capital requirement of all banks after DFA in the post-DFA period. We find that non-stressed banks would reduce the amount they lend to an investment grade firm by 0.65 to 1.56 USD million on average after DFA. Instead, stressed banks would increase the loan amount granted to an investment grade firm by 0.96 to 8.13 USD million on average.

The specifications in the third and fourth columns of Table 6 relax the bank*time fixed effect, and replace them by bank and time fixed effects. Thus, they describe a change in the credit supply to risky firms while the credit demand of firms is held constant in a given quarter. When the bank*time fixed effects are relaxed, the monitoring effect is still present but only marginally significant. Thus, a comparison of the estimates in columns one and two with those in column three and four suggest that stressed banks (respectively non-stressed banks) do not increase (respectively reduce) more their supply of loans due to monitoring, but rather reallocate their loan portfolio more to firm with better (respectively worse) ratings, holding their capital requirement constant.

5.3 Two Decompositions of Capital Requirements

5.3.1 Risk Taking and Capital Requirements: the Effect of Stress Tests

The results of this section indicate that, after controlling for the capital requirement level ($Capreq_{bt}$), the increase in the capital requirement resulting from the stress test ($Stress_{bt}$) does not lead to more risk taking, and even induces banks to increase loan amounts granted to safe borrowers. The more prudent behavior of stressed banks resulting from the effect of stress tests

on their capital requirements reconciles our empirical findings with a reduction of moral hazard at banks subject to higher capital requirements after controlling for banks' response to the increased cost of funding they generate.

Panel A of Table 7 reports the results of a differences-in-differences analysis on the bank's yield on the bank's portfolio of new loans (regression (6)) to assess the effect of the variables $Stress_{bt}$, holding the regulatory capital requirement ($Capreq_{bt}$) constant. Observe that, in a differences-in-differences analysis, it is not necessary to interact $Stress_{bt}$ with the treatment group and post-treatment dummies given that this variable is only different from zero for stressed banks after DFA. We do not find that this variable is significant in explaining the differential effect of DFA on stressed banks. The other estimates are similar to the results reported for our benchmark specification in Section 5.1.

[INSERT TABLE 7 HERE]

Panel B of Table 7 reports the effect of $Stress_{bt}$ and $Capreq_{bt}$ on the amount banks lend to risky firms (regression (7)). We find that, holding the volume of credit demand and credit supply fixed, as well as the level of capital requirement constant, banks tilt their loan portfolio towards safer firms when their capital requirement better reflects the sensitivity of bank's assets to the regulatory stress scenario. Holding the capital requirement ($Capreq_{bt}$) constant, a bank decreases by 2.2% its share of lending to a firm that has a rating in the next worse class when $Stress_{bt}$, the difference between the capital requirement in the CCAR and the capital requirement the bank would be subject to if it were not stressed, increases by one percentage point. Similarly, keeping the increase in the capital requirement resulting from the stress test fixed ($Stress_{bt}$ constant), a bank increases its lending to a firm in the next worse rating class by 2.2% to 2.3% when the bank capital requirement increases by one percentage point. To summarize, banks do not have additional incentives to take risk when the increase in their capital requirement results from being subject to the regulatory stress test. Results are robust to relaxing bank*time fixed effects and replacing them by bank and time fixed effects.

Panel C of Table 7 reports the results of a differences-in-differences analysis showing the effect of $Stress_{bt}$ on the amount banks lend to risky firms (regression (8)). This regression reports two different monitoring effects. First, after controlling for the capital requirement, $Stress_{bt}$ indicates the extent to which a bank reduces risk taking when its capital requirement reflects the sensitivity of the bank's assets to the regulatory stress scenario (quantitative assessment). Second, after controlling for the capital requirement and the composition of the capital requirement ($Stress_{bt}$), the remaining variation between stressed and non-stressed banks could be attributed to other forms of monitoring embedded in the regulatory CCAR exercise (e.g., qualitative assessment). The two estimates that capture the two different forms of regulatory monitoring in stress tests are significant at the 5% level in the saturated model. The results for the variable $Stress_{bt}$ are similar to those obtained in Panel B.

5.3.2 Bank Capitalization and Distance from Capital Requirement

In this section, we jointly consider the effect on risk taking of the actual bank capitalization level and its distance from the capital requirement. We show that both the actual cost of funding and the probability of an increase in the funding cost of the bank explain its portfolio yield in a differences-in-differences analysis. However, it is mainly the actual capitalization level of the bank (its actual cost of funding) that explains loan amounts granted to firms with a given level of risk.

Table 8 reports the estimates from regressions (6), (7), and (8), in which we replace $Capreq_{bt}$ with the variables $LVGR_{bt}$, and $Distance_{bt}$.

[INSERT TABLE 8 HERE]

Panel A of Table 8 shows the results of a differences-in-differences analysis on the bank's yield on its portfolio of new loans (regression (6)). We find a significant differential effect of DFA on the sensitivity of the portfolio yields of stressed banks to both their capitalization level and their distance to the capital requirement. The sensitivity of the banks' portfolio yield to a one percentage

point increase in the capital ratio decreases for both stressed and non-stressed banks after DFA, but by 33.93 to 40.80 bps less for stressed banks. Similarly, the sensitivity of the banks' portfolio yield to a one percentage point increase in the distance from the capital requirement increases for both stressed and non-stressed banks after DFA, but by 17.41 to 33.22 bps less for stressed banks.²⁰ The monitoring effect (β_1) remains significant at the 1% level when holding the capital ratio and the distance to the capital requirement constant in the portfolio yield regression. We find that the average portfolio yield increased for all banks after DFA, but by 210.07 to 222.58 bps less for stressed banks.

Panel B of Table 8 reports the effect of $LVGR_{bt}$ and $Distance_{bt}$ on the amount banks lend to risky firms (regression (7)). We find that, holding the volume of credit demand and credit supply fixed, banks tilt their loan portfolio towards riskier firms when their capitalization level increases and when the probability of an increase of their capitalization level increases. Holding $Distance_{bt}$ constant, a bank increases its portfolio share by an additional 1.6% to a firm in the next worse rating class when the bank capital ratio increases by one percentage point. Holding $LVGR_{bt}$ constant, a bank decreases its portfolio share by an additional 0.3% to a firm that has a rating one class lower when the distance to the bank capital requirement increases by one percentage point. The latter effect of the distance is however not significant at the 5% level. The results are robust to relaxing bank*time fixed effects and replacing them by bank and time fixed effects.

Panel C of Table 8 reports the results of a differences-in-differences analysis on the amount banks lend to risky firms (regression (8)), replacing $Capreq_{bt}$ with $LVGR_{bt}$ and $Distance_{bt}$. Similarly to the results in Panel B, we do not find a significant effect of the distance to the bank capital requirement on the amount a bank lends in a new loan to a risky firm. We find the monitoring effect to be significant at the 1% level. For a given level of the capital ratio of the bank, stressed banks tilt their portfolios towards risky firms less than non-stressed banks after DFA. When the

²⁰The latter differences-in-differences effect of the distance to the capital requirement on the portfolio yield is however not significant at the 5% level in the last specification, which could be interpreted as a Granger causality test.

bank*time fixed effects are relaxed, the monitoring effect remains significant but the differences-in-differences effect of the capital ratio is not significant at the 5% level.

6 Discussion and Conclusions

This paper investigates the risk taking incentives of “stressed banks” — the banks that are subject to annual regulatory stress tests in the U.S. since 2011. We document that stringent capital requirements give both stressed and non-stressed banks motives to invest in risky assets, but that stress tests are effective regulatory monitoring tools to encourage more prudent investments. The two economic channels, higher capital requirements triggering risky investments to offset the increased cost related to the use of costly equity capital, and regulatory monitoring of banks’ investment through stress tests, are intertwined. The Dodd-Frank Act precisely imposes tighter capital requirements to stressed banks to provide a capital buffer to absorb losses under adverse economic scenarios, and this feedback effect in turn puts pressure on banks to invest in ex-ante profitable, hence risky, assets. On average, stressed banks face more stringent capital requirements than non-stressed banks, namely 6.8% versus 3% of assets. Because the two economic channels have a contrasting effect of bank risk-taking, the joint effect of stress-test monitoring and increased capital requirements ultimately determines the riskiness of banks’ portfolios.

Our empirical evidence contributes to the academic and regulatory debate on the benefits and costs of requiring more equity funding of banks. In particular, our results highlight the importance of regulatory monitoring of banks’ portfolios in parallel to setting more stringent capital requirements. Some theoretical studies (e.g. Rochet (1992), Gale (2010), Harris, Opp, and Opp (2017)) highlight the possibility that tighter capital requirements translate in an increase in bank risk taking. Other scholars (e.g. Cooper and Ross (2002), Admati, DeMarzo, Hellwig, and Pfleiderer (2013b)), instead, point out that if shareholders have a larger equity stake in a bank (“skin in the game”), their incentives to engage in risky lending are reduced. On one hand, we document the empirical relevance of the channel that associates tighter capital requirements to bank risk taking. On the other hand,

our results also suggest that effective regulatory monitoring of banks' portfolio can significantly dampen or offset the risk-taking channel, and possibly reconcile with the arguments in Cooper and Ross (2002) and Admati, DeMarzo, Hellwig, and Pfleiderer (2013b).

Importantly, our results should not be interpreted as against a better capitalization of the banking sector. Rather, they highlight an empirically relevant risk-taking channel that should be taken into account in the design of new regulations to promote financial stability. Our findings suggest that higher capital requirements are not a substitute to monitoring, but instead might need to be accompanied with additional regulatory monitoring of banks' asset risk. To this end, tools like the Comprehensive Capital Analysis and Review, an extensive monitoring exercise by the regulator that includes both quantitative and qualitative tests, appears to be more effective than linking capital requirements to risk-weighted assets or resorting to internal stress tests only. For example, our results suggest that the proposal of an off-ramp from regulatory stress tests for banks with capital greater than 10% of their assets in the Financial CHOICE Act proposed by the House Financial Services Committee might not be an adequate rule to ensure financial stability, as Schnabl (2017) indicates.

Clearly, our results do not substitute full-blown quantitative or welfare analyses which, as Admati (2014) argues, are desirable in the design of new regulatory policies. Rather, this paper echoes Admati's clarion call for future research directed to develop quantitative banking models that capture the relevant economic tradeoffs that affect banks' decisions, and serve as laboratories to thoroughly evaluate (counterfactual) regulatory proposals in comparison to the status quo.

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Table 1
CAPITAL REQUIREMENTS OF STRESSED BANKS

The table reports regulatory thresholds used for each regulatory ratio in the CCAR (Panel A), the cross-sectional average bank-specific thresholds (Panel B), and the cross-sectional average actual capital ratios (Panel C). $Cap\ req_b$ is the bank-specific single capital requirement as defined in Equation (4). k_{1b}^s , k_{2b}^s , k_{3b}^s , k_{4b}^s are the bank-specific capital requirements for the CET1R, T1R, TotalR, and LVGR, respectively, as defined in Equation (2). T1CR is the ratio of common equity Tier 1 capital to risk-weighted assets (Basel I definition), CET1R is ratio of common equity Tier 1 capital to risk-weighted assets (Basel III definition), T1R is ratio of Tier 1 capital to risk-weighted assets, TotalR is the ratio of Total capital to risk-weighted assets, LVGR is the ratio of Tier 1 capital to average total assets. Our sample is selected as described in Section 3.2.

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

Panel B: Average Bank-Specific Thresholds (%)					
	T1CR (k_{1b}^s)	CET1R (k_{1b}^s)	T1R (k_{2b}^s)	TotalR (k_{3b}^s)	LVGR (k_{4b}^s)
2016	-	7.6	9.5	11.5	6.4
2015	7.8	-	9.9	12.1	6.2
2014	8.1	-	9.4	11.5	5.9
2013	9.1	-	6.8	12.2	5.3
2012	8.5	-	6.8	11.9	5.1

Panel C: Average Actual Capital Ratios (%)				
	T1CR	CET1R	T1R	TotalR
2016	-	12.5	13.6	15.8
2015	12.7	-	14.1	16.6
2014	11.7	-	13.1	15.7
2013	11.3	-	13.1	15.6
2012	10.4	-	12.7	15.6

Table 2
BANK ASSET INCOME AND CAPITAL REQUIREMENTS

The table reports estimates from the regression

$$\Delta asset\ income_{bt} = \beta Cap\ req_{bt} + \gamma' controls_{bt} + \delta_t + \epsilon_{bt},$$

where, for bank b in year t , $\Delta asset\ income_{bt}$ is the change between the supervisory stress test release date and the stress test result disclosure date in Asset Income/Assets (Panel A), Loan Interest Income/Loans (Panel B), Trading and Securities Revenues/Assets (Panel C), $Cap\ req_{bt}$ is the capital requirement in the CCAR of year t as defined by Equation (4), $controls_{bt}$ denotes bank-specific control variables, and δ_t are year fixed effects. The control variables include bank size (measured by the logarithm of bank's total assets), bank lending activity (ratio of loans to total assets), and bank capital structure (ratio of book equity to total assets). $Cap\ req_{bt}$ is the bank-specific single capital requirement as defined in Equation (4). k_{1bt}^s , k_{2bt}^s , k_{3bt}^s , k_{4bt}^s are the bank-specific capital requirements for the CET1R, T1R, TotalR, and LVGR, respectively, as defined in Equation (2). Control variables include the logarithm of bank's total assets, the ratio of loans to total assets, and the ratio of book equity to total assets. Our sample includes 18 stressed banks participating in all stress test (90 observations), as described in Section 3.2. T-statistics based on clustered standard errors at the bank level are in parentheses. Adj. R^2 is the adjusted R^2 .

Panel A: Change in Asset Income/Assets									
$Cap\ req_{bt}$	2.22	2.65							
	(3.13)	(3.12)							
CET1R Req. (k_{1bt}^s)		1.75	1.98						
		(2.85)	(3.52)						
T1R Req. (k_{2bt}^s)			2.25	2.51					
			(2.97)	(3.03)					
TotalR Req. (k_{3bt}^s)					1.95	2.15			
					(3.11)	(3.20)			
LVGR Req. (k_{4bt}^s)							3.72	4.01	
							(4.95)	(5.48)	
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y	N	Y	N
R^2 (%)	21.45	24.45	23.83	26.89	19.47	23.43	21.11	24.93	16.88
Adj. R^2 (%)	16.77	16.99	19.30	19.67	14.67	15.86	16.41	17.51	11.93
									20.56
									12.71

Panel B: Change in Loan Interest Income/Loans									
$Capreq_{bt}$	3.03	3.33							
	(1.58)	(1.62)							
CET1R Req. (k_{1bt}^s)		3.32	3.36						
		(1.84)	(1.91)						
T1R Req. (k_{2bt}^s)				2.46	2.50				
				(1.21)	(1.22)				
TotalR Req. (k_{3bt}^s)						2.01	2.03		
						(1.27)	(1.28)		
LVGR Req. (k_{4bt}^s)								6.32	6.31
								(1.99)	(2.03)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y	N	N	Y
R^2 (%)	22.60	26.66	36.59	39.80	14.85	19.73	14.72	19.55	29.34
Adj. R^2 (%)	17.99	19.42	32.82	33.85	9.78	11.80	9.64	11.60	25.14
									33.83

Panel C: Change in Trading and Securities Revenues/Assets									
$Capreq_{bt}$	0.31	1.22							
	(1.21)	(2.66)							
CET1R Req. (k_{1bt}^s)		1.18	0.94						
		(2.05)	(2.25)						
T1R Req. (k_{2bt}^s)				1.56	1.25				
				(3.14)	(3.14)				
TotalR Req. (k_{3bt}^s)						1.24	1.02		
						(2.96)	(3.21)		
LVGR Req. (k_{4bt}^s)								1.53	1.61
								(2.33)	(2.71)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y	N	N	Y
R^2 (%)	7.40	34.50	17.57	33.14	20.87	35.33	20.03	35.11	13.24
Adj. R^2 (%)	1.89	28.03	12.66	26.54	16.16	28.95	15.27	28.70	8.08
									33.38
									26.80

Table 3
DEALSCAN FACILITIES: BEFORE AND AFTER DODD-FRANK ACT

The table reports descriptive statistics of DealScan facilities characteristics of stressed banks compared to non-stressed banks before the crisis (“Before”) and after Dodd-Frank Act (“After”). Stressed banks are the banks subject to annual regulatory stress tests in the U.S. Stressed banks are separated between banks that participated in all stress tests and new entrants. All-in-Drawn Spread is the spread, in basis points, paid by the borrower over the LIBOR rate (plus any annual, or facility-related, fee paid to the bank group) to the bank holding each dollar drawn down. bank amount is 0.01*Bank allocation*Facility amount (in \$ mn). The sample includes stressed bank holding companies that participated in all CCARs and non-stressed banks participating in syndicated loans, as described in Sections 3.2 and 4.1

	DealScan Facilities			Stressed Banks			Non-Stressed Banks		
	Before	After	Change	Before	After	Change	Before	After	Change
All-in-Drawn Spread (bps)	233.02	283.96	50.94	193.29	256.55	63.26	250.88	316.67	65.79
Maturity (Months)	45.14	53.79	8.64	44.15	55.28	11.13	47.25	55.39	8.14
Facility Amount (USD mn)	293.49	422.84	129.34	397.51	574.97	177.46	288.18	226.78	-61.40
Number of Facilities	37,767	24,289	-13,478	13,659	9,902	-3,757	2,916	3,635	719
Bank Amount (USD mn)	52.90	73.45	20.55	33.78	45.67	11.89	14.43	17.10	2.67
Bank Allocation (%)	13.86	11.70	-2.16	9.96	7.15	-2.81	13.40	9.76	-3.64

Table 4

MONITORING VERSUS CAPITAL REQUIREMENTS: EFFECT ON PORTFOLIO YIELD

The table reports estimates from the regression:

$$\begin{aligned} \text{portfolio yield}_{bt} = & \alpha_b + \delta_t + \beta_1 \text{stressed}_b * \text{DFA}_t + \beta_2 \text{stressed}_b * \text{DFA}_t * \text{Capreq}_{bt} \\ & + \beta_3 \text{Capreq}_{bt} + \beta_4 \text{stressed}_b * \text{Capreq}_{bt} \\ & + \beta_5 \text{DFA}_t * \text{Capreq}_{bt} + \gamma' \text{controls}_{bt} + \epsilon_{bt}, \end{aligned}$$

where $\text{portfolio yield}_{bt}$ is the weighted average all-in-drawn spread on the portfolio of new syndicated loans (new facilities) bank b participates to in a given quarter t , with weights given by the bank's dollar loan amounts to each firm within the quarter, α_b are bank fixed effects, δ_t are time (quarter) fixed effects, stressed_b is a dummy variable equal to one if bank b is subject to CCAR, DFA_t is a dummy variable equal to one if quarter t is after the fourth quarter of 2010, Capreq_{bt} is the capital requirement of bank b in quarter t as defined by Equation (3) and Equation (4) for stressed banks after DFA, and controls_{bt} are bank-specific control variables. Control variables include the logarithm of bank's total assets, the ratio of bank loans to total assets, the weighted average portfolio maturity, and the percentage of secured loans of the bank in quarter t . $\Delta E(\text{portfolio yield}_{bt} | \text{stressed}_b = 0, \overline{\text{Capreq}_{bt}})$ and $\Delta E(\text{portfolio yield}_{bt} | \text{stressed}_b = 1, \overline{\text{Capreq}_{bt}})$ denote the change in the average portfolio yield for non-stressed and stressed banks, respectively, setting the capital requirement at the average level before DFA and at the average level after DFA for all banks in the sample. The sample includes stressed bank holding companies that participated in all CCARs and non-stressed banks participating in syndicated loans, as described in Sections 3.2 and 4.1. T-statistics based on clustered standard errors at the bank level are in parentheses. Adj. R^2 is the adjusted R^2 .

Portfolio Yield					
$\text{stressed}_b * \text{DFA}_t$	9.88 (1.17)	5.00 (0.73)	-197.00 (-4.15)	-170.54 (-3.51)	-164.71 (-3.70)
$\Delta E(\text{portfolio yield}_{bt} \text{stressed}_b = 0, \overline{\text{Capreq}_{bt}})$	39.43	39.43	51.09	51.04	46.91
$\Delta E(\text{portfolio yield}_{bt} \text{stressed}_b = 1, \overline{\text{Capreq}_{bt}})$	21.44	21.44	21.61	21.64	21.62
$\text{stressed}_b * \text{DFA}_t * \text{Capreq}_{bt}$			43.06 (4.18)	37.11 (3.40)	35.89 (3.32)
Controls	N	Y	N	Y	Y
Bank and Time FE	Y	Y	Y	Y	Y
$\text{stressed}_b * \text{DFA}_t * \text{portfolio yield}_{bt-1}$	N	N	N	N	Y
R^2 (%)	70.45	73.16	72.07	74.32	74.46
Adj. R^2 (%)	67.91	70.74	69.55	71.88	71.92
Observations	1,087	1,087	1,087	1,087	1,087
Banks	30	30	30	30	30

Table 5
CAPITAL REQUIREMENTS: EFFECT ON LOAN AMOUNT

The table reports estimates from the regression:

$$\log(amount_{fbt}) = \alpha_{bt} + \alpha_{ft} + \beta Capreq_{bt} * Firm risk_{ft} + \epsilon_{fbt},$$

where $\log(amount_{fbt})$ is the logarithm of the USD amount lent by bank b to firm f in a facility issued at date t , α_{bt} are bank*quarter fixed effects, α_{ft} are firm*quarter fixed effects, $Capreq_{bt}$ is the capital requirement of bank b at date t as defined by Equation (3) and Equation (4) for stressed banks after DFA, and $Firm risk_{ft}$ is a measure describing the risk of borrower f at date t (as described in detail in Section 5.2). $Firm risk_{ft}$ is measured as follows: $rating_{ft}$ is the firm's numerical rating (1 is AAA; 23 is D), $rated_{ft}$ is a dummy variable equal to one if the firm has a rating assigned in Compustat, $speculative_{ft}$ is a dummy variable if the firm's rating is worse than BBB, $cash flow vol_{ft}$ is the 3-year rolling volatility of firm's cash flows, $WhitedWu_{ft}$ is the Whited-Wu Index (index of financial constraints) in the quarter of day t . The control variables include lagged bank-level variables and contemporaneous loan-level variables, namely bank size, bank lending activity, the maturity of the loan, and a dummy variable equal to one if the loan is secured. All regressions are saturated with bank*time and firm*time fixed effects. The sample includes stressed bank holding companies that participated in all CCARs and non-stressed banks participating in syndicated loans, as described in Sections 3.2 and 4.1. T-statistics based on clustered standard errors at the bank*time and firm*time level are in parentheses. Adj. R^2 is the adjusted R^2 .

log(amount)					
$Capreq_{bt} * rating_{ft}$	0.01 (4.44)				
$Capreq_{bt} * rated_{ft}$		-0.08 (-7.10)			
$Capreq_{bt} * speculative_{ft}$			0.04 (3.46)		
$Capreq_{bt} * cash flow vol_{ft}$				0.68 (2.25)	
$Capreq_{bt} * WhitedWu_{ft}$					0.41 (6.54)
R^2 (%)	73.23	72.73	73.18	73.76	74.30
Adj. R^2 (%)	67.13	66.18	67.07	67.20	67.82
Observations	21,543	27,984	21,543	22,002	26,516
Bank*Time	914	1,001	914	949	971
Firm*Time	3,084	4,421	3,084	3,447	3,890

Table 6
MONITORING VERSUS CAPITAL REQUIREMENTS: EFFECT ON LOAN AMOUNT

The table reports estimates from the regression:

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

where $\log(amount_{fbt})$ is the logarithm of the USD amount lent by bank b to firm f in a facility issued at date t , α_{bt} are bank*quarter fixed effects, α_{ft} are firm*quarter fixed effects, $Capreq_{bt}$ is the capital requirement of bank b at date t as defined by Equation (3) and Equation (4) for stressed banks after DFA, and $Firm risk_{ft}$ is the firm's numerical rating (1 is AAA; 23 is D). The control variables include loan maturity, a dummy variable indicating whether the loan is secured, and loan fixed effects. Regressions are saturated with bank*quarter and firm*quarter fixed effects, or include bank, quarter and firm*quarter fixed effects. $\Delta E(amount_{fbt} | stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$ and $\Delta E(amount_{fbt} | stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$ denote the change in the average amount that non-stressed and stressed banks, respectively, would lend to investment grade firms, setting the capital requirement at the average level before DFA and at the average level after DFA for all banks in the sample. The sample includes stressed bank holding companies that participated in all CCARs and non-stressed banks participating in syndicated loans, as described in Sections 3.2 and 4.1. T-statistics based on clustered standard errors at the bank*quarter and firm*quarter level or, respectively, at the bank, quarter and firm*quarter level. Adj. R^2 is the adjusted R^2 .

	log(amount)			
$stressed_b * DFA_t * Firm risk_{ft}$	-1.47 (-4.70)	-0.64 (-2.93)	-0.14 (-1.71)	-0.07 (-1.24)
$\Delta E(amount_{fbt} stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$	-0.65	-1.56	0.01	0.55
$\Delta E(amount_{fbt} stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$	0.96	8.13	0.61	10.19
$stressed_b * DFA_t * Capreq_{bt} * Firm risk_{ft}$	0.30 (4.54)	0.13 (2.79)	0.03 (1.98)	0.01 (1.93)
$stressed_b * DFA_t$			0.40 (1.05)	0.06 (0.20)
Loan-Level Controls	N	Y	N	Y
Bank-Level Controls	-	-	N	Y
Firm*Time FE	Y	Y	Y	Y
Bank*Time FE	Y	Y	N	N
Bank and Time FE	-	-	Y	Y
Loan Characteristics FE	N	Y	N	Y
R^2 (%)	73.24	71.26	71.28	72.65
Adj. R^2 (%)	67.17	68.61	66.37	67.90
Observations	21,178	21,178	21,337	21,337
Banks	-	-	29	29
Bank*Time	895	895	-	-
Firm*Time	3,017	3,017	3,022	3,022

Table 7
RISK TAKING AND CAPITAL REQUIREMENTS: THE EFFECT OF STRESS TESTS

The table reports estimates from the regression described in Tables 4 (Panel A), 5 (Panel B), and 6 (Panel C), in which the capital requirement of stressed banks is decomposed into the capital requirement without the effect of stress tests and the increase in the capital requirement due to the stress test, as follows:

$$Capreq_{bt} = Capreq_{bt}^* + Stress_{bt},$$

where $Capreq_{bt} = \max(k_{1b}, k_{2b}, k_{3b}, k_4, k'_{1b}, k'_{2b}, k'_{3b}, k'_{4b})$, $Capreq_{bt}^* = \max(k_{1b}, k_{2b}, k_{3b}, k_4)$. The variable $Stress_{bt} = Capreq_{bt} - Capreq_{bt}^*$ measures the difference between the capital requirement in stress tests and the standard capital requirement that bank b would be subject to if it were not stressed in quarter t . All variables are defined as in Tables 4, 5, and 6. $\Delta E(portfolio\ yield_{bt} | stressed_b = 0, \overline{Capreq_{bt}}, Stress_{bt} = 0)$ and $\Delta E(portfolio\ yield_{bt} | stressed_b = 1, \overline{Capreq_{bt}}, Stress_{bt} = 0)$ denote the change in the average portfolio yield for non-stressed and stressed banks, respectively, setting the capital requirement at the average level before DFA and at the average level after DFA, and setting $Stress_{bt} = 0$ for all banks in the sample. $\Delta E(amount_{fbt} | stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}}, Stress_{bt} = 0)$ and $\Delta E(amount_{fbt} | stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}}, Stress_{bt} = 0)$ are defined analogously. The sample includes stressed bank holding companies that participated in all CCARs and non-stressed banks participating in syndicated loans, as described in Sections 3.2 and 4.1. T-statistics based on clustered standard errors at the bank level (Panel A), at the bank*quarter and firm*quarter level or, respectively, at the bank, quarter and firm*quarter level (Panels B and C) are in parentheses. Adj. R^2 is the adjusted R^2 .

Panel A: Portfolio Yield			
$stressed_b * DFA_t$	-203.85 (-4.06)	-175.90 (-3.41)	-169.30 (-3.64)
$\Delta E(portfolio\ yield_{bt} stressed_b = 0, \overline{Capreq_{bt}}, Stress_{bt} = 0)$	51.11	51.18	47.07
$\Delta E(portfolio\ yield_{bt} stressed_b = 1, \overline{Capreq_{bt}}, Stress_{bt} = 0)$	27.83	25.91	26.69
$Stress_{bt}$	-3.75 (-0.50)	-2.58 (-0.39)	-3.07 (-0.46)
$stressed_b * DFA_t * Capreq_{bt}$	44.86 (4.08)	38.49 (3.28)	37.40 (3.22)
Controls	N	Y	Y
Bank and Time FE	Y	Y	Y
$stressed_b * DFA_t * portfolio\ yield_{bt-1}$	N	N	Y
R^2 (%)	72.09	74.32	74.46
Adj. R^2 (%)	69.53	71.86	71.90
Observations	1,087	1,087	1,087
Banks	30	30	30

Panel B: log(amount)				
<i>Stress_{bt} * Firm risk_{ft}</i>	-0.022 (-4.42)	-0.022 (-4.53)	-0.023 (-3.41)	-0.023 (-3.49)
<i>Capreq_{bt} * Firm risk_{ft}</i>	0.022 (5.84)	0.023 (6.32)	0.023 (3.94)	0.024 (4.24)
<i>Stress_{bt}</i>			0.172 (2.84)	0.195 (3.20)
<i>Capreq_{bt}</i>			-0.194 (-3.46)	-0.219 (-4.00)
Loan-Level Controls	N	Y	N	Y
Bank-Level Controls	-	-	N	Y
Firm*Time FE	Y	Y	Y	Y
Bank*Time FE	Y	Y	N	N
Bank and Time FE	-	-	Y	Y
Loan Characteristics FE	N	Y	N	Y
<i>R</i> ² (%)	73.18	74.49	71.36	72.743
Adj. <i>R</i> ² (%)	67.10	68.64	66.47	68.01
Observations	21,178	21,178	21,337	21,337
Banks	-	-	29	29
Bank*Time	895	895	-	-
Firm*Time	3,017	3,017	3,022	3,022

Panel C: log(amount) diff-in-diff						
<i>stressed_b * DFA_t * Firmrisk_{ft}</i>	-1.526 (-4.99)	-0.728 (-3.45)	-0.143 (-1.72)	-0.065 (-1.19)		
$\Delta E(amount_{ftb} stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}}, Stress_{bt} = 0)$	-0.638	-1.568	-0.003	0.178		
$\Delta E(amount_{ftb} stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}}, Stress_{bt} = 0)$	2.248	18.378	0.635	8.910		
<i>Stress_{bt} * Firmrisk_{ft}</i>	-0.022 (-4.07)	-0.022 (-4.04)	-0.026 (-3.54)	-0.027 (-3.80)		
<i>stressed_b * DFA_t * Capreq_{bt} * Firmrisk_{ft}</i>	0.317 (4.88)	0.150 (3.40)	0.031 (2.45)	0.020 (2.78)		
<i>stressed_b * DFA_t</i>			0.187 (0.47)	-0.160 (-0.47)		
Loan-Level Controls	N	Y	N	Y		
Bank-Level Controls	-	-	N	Y		
Firm*Time FE	Y	Y	Y	Y		
Bank*Time FE	Y	Y	N	N		
Bank and Time FE	-	-	Y	Y		
Loan Characteristics FE	N	Y	N	Y		
<i>R</i> ² (%)	73.28	74.49	71.44	72.77		
Adj. <i>R</i> ² (%)	67.21	68.63	66.52	68.04		
Observations	21,178	21,178	21,337	21,337		
Banks	-	-	29	29		
Bank*Time	895	895	-	-		
Firm*Time	3,017	3,017	3,022	3,022		

Table 8
BANK CAPITALIZATION AND DISTANCE FROM CAPITAL REQUIREMENT

The table reports estimates from the regression described in Tables 4 (Panel A), 5 (Panel B), and 6 (Panel C), in which the capital requirement of stressed banks is decomposed into the actual Tier 1 leverage ratio and its distance to the capital requirement, as follows:

$$Capreq_{bt} = LVGR_{bt} - Distance_{bt},$$

where $Capreq_{bt} = \max(k_{1b}, k_{2b}, k_{3b}, k_4, k'_{1b}, k'_{2b}, k'_{3b}, k'_{4b})$, and $LVGR_{bt}$ is the bank's Tier 1 leverage ratio. The variable $Distance_{bt} = LVGR_{bt} - Capreq_{bt}$ is the difference between the actual Tier 1 leverage ratio of the bank and the single Tier 1 leverage capital requirement. All variables are defined as in Tables 4, 5, and 6. $\Delta E(portfolio\ yield_{bt} | stressed_b = 0, \overline{LVGR}_{bt}, \overline{Distance}_{bt})$ and $\Delta E(portfolio\ yield_{bt} | stressed_b = 1, \overline{LVGR}_{bt}, \overline{Distance}_{bt})$ denote the change in the average portfolio yield for non-stressed and stressed banks, respectively, setting the capital ratio and the distance from the capital requirement at the average level before DFA and at the average level after DFA for all banks in the sample. $\Delta E(amount_{fbt} | stressed_b = 0, speculative_{ft} = 0, \overline{LVGR}_{bt}, \overline{Distance}_{bt})$ and $\Delta E(amount_{fbt} | stressed_b = 1, speculative_{ft} = 0, \overline{LVGR}_{bt}, \overline{Distance}_{bt})$ are defined analogously. The sample includes stressed bank holding companies that participated in all CCARs and non-stressed banks participating in syndicated loans, as described in Sections 3.2 and 4.1. T-statistics based on clustered standard errors at the bank level (Panel A), at the bank*quarter and firm*quarter level or, respectively, at the bank, quarter and firm*quarter level (Panels B and C) are in parentheses. Adj. R^2 is the adjusted R^2 .

Panel A: Portfolio Yield			
<i>stressed_b * DFA_t</i>	-222.58 (-2.65)	-211.66 (-2.49)	-210.07 (-2.87)
$\Delta E(portfolio\ yield_{bt} stressed_b = 0, \overline{LVGR}_{bt}, \overline{Distance}_{bt})$	65.21	72.43	71.90
$\Delta E(portfolio\ yield_{bt} stressed_b = 1, \overline{LVGR}_{bt}, \overline{Distance}_{bt})$	22.09	21.38	21.72
<i>stressed_b * DFA_t * LVGR_{bt}</i>	40.80 (3.02)	34.76 (2.58)	33.93 (2.64)
<i>stressed_b * DFA_t * Distance_{bt}</i>	-33.22 (-2.86)	-23.52 (-2.01)	-17.41 (-1.52)
Controls	N	Y	Y
Bank and Time FE	Y	Y	Y
<i>stressed_b * DFA_t * portfolio\ yield_{bt-1}</i>	N	N	Y
<i>R</i> ² (%)	72.19	74.52	74.77
Adj. <i>R</i> ² (%)	69.56	72.00	72.16
Observations	1,087	1,087	1,087
Banks	30	30	30

Panel B: log(amount)				
$LVGR_{bt} * Firm\ risk_{ft}$	0.015 (5.43)	0.016 (6.04)	0.016 (4.02)	0.016 (4.46)
$Distance_{bt} * Firm\ risk_{ft}$	-0.003 (-0.97)	-0.003 (-1.09)	-0.004 (-1.53)	-0.004 (-1.68)
$LVGR_{bt}$			-0.157 (-4.13)	-0.163 (-4.78)
$Distance_{bt}$			0.047 (2.22)	0.052 (2.55)
Loan-Level Controls	N	Y	N	Y
Bank-Level Controls	-	-	N	Y
Firm*Time FE	Y	Y	Y	Y
Bank*Time FE	Y	Y	N	N
Bank and Time FE	-	-	Y	Y
Loan Characteristics FE	N	Y	N	Y
R^2 (%)	73.17	74.48	71.33	72.71
Adj. R^2 (%)	67.09	68.63	66.43	67.98
Observations	21,178	21,178	21,337	21,337
Banks	-	-	29	29
Bank*Time	895	895	-	-
Firm*Time	3,017	3,017	3,022	3,022

	Panel C: log(amount)			diff-in-dif	
<i>stressed_b * DFA_t * Firm risk_{ft}</i>	-1.666 (-6.53)	-0.846 (-4.21)	-0.193 (-2.03)	-0.113 (-2.09)	
$\frac{\Delta E(amount_{ft}) stressed_b = 0, speculative_{ft} = 0, LVGR_{bt}, Distance_{bt}}{\Delta E(amount_{ft}) stressed_b = 1, speculative_{ft} = 0, LVGR_{bt}, Distance_{bt}}$	0.482 1.292	11.126 11.454	0.063 0.500	1.348 9.607	
<i>stressed_b * DFA_t * LVGR_{bt} * Firm risk_{ft}</i>	0.214 (3.69)	0.069 (1.45)	0.023 (1.49)	0.014 (1.39)	
<i>stressed_b * DFA_t * Distance_{bt} * Firm risk_{ft}</i>	-0.059 (-0.65)	0.056 (0.70)	-0.010 (-0.59)	-0.003 (-0.20)	
<i>stressed_b * DFA_t</i>		0.380 (0.88)	0.020 (0.06)		
Loan-Level Controls	N	Y	N	Y	
Bank-Level Controls	-	-	N	Y	
Firm*Time FE	Y	Y	Y	Y	
Bank*Time FE	Y	Y	N	N	
Bank and Time FE	-	-	Y	Y	
Loan Characteristics FE	N	Y	N	Y	
<i>R</i> ² (%)	73.30	74.50	71.38	72.75	
Adj. <i>R</i> ² (%)	67.24	68.65	66.48	68.01	
Observations	21,178	21,178	21,337	21,337	
Banks	-	-	29	29	
Bank*Time	895	895	-	-	
Firm*Time	3,017	3,017	3,022	3,022	

Figure 1
EVOLUTION OF AVERAGE CAPITAL REQUIREMENTS

The figure shows the evolution of the bank-specific single capital requirement as defined in Equation (4). The solid thick line refers to the average capital requirement for the entire sample of banks, while the dashed line refers to the average regulatory capital requirement banks would not be subject to stress tests after Dodd-Frank Act. The vertical dotted lines indicate the stress-test disclosure dates. Our sample includes 18 stressed banks participating in all stress test, 15 new entrants, and 21 non-stressed banks and is selected as described in Section 3.2.

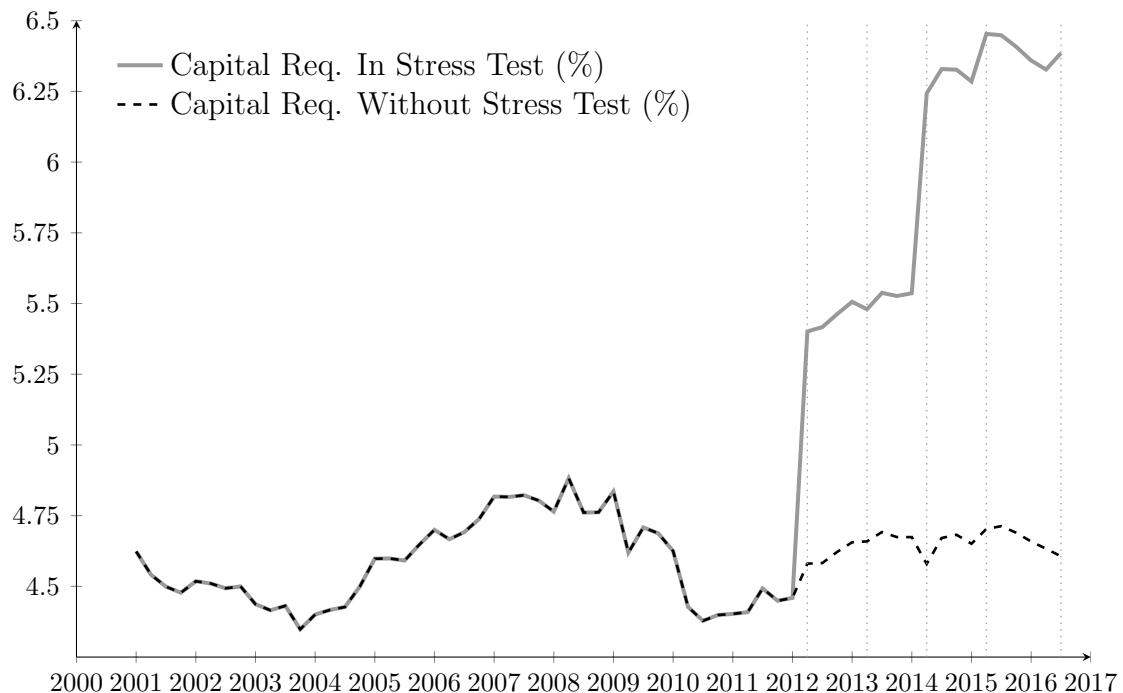


Figure 2
STRESS TEST TIMELINE

The figure illustrates the timeline imposed by the regulator on stressed banks between two consecutive years t and $t + 1$, as described in Section 3.4.

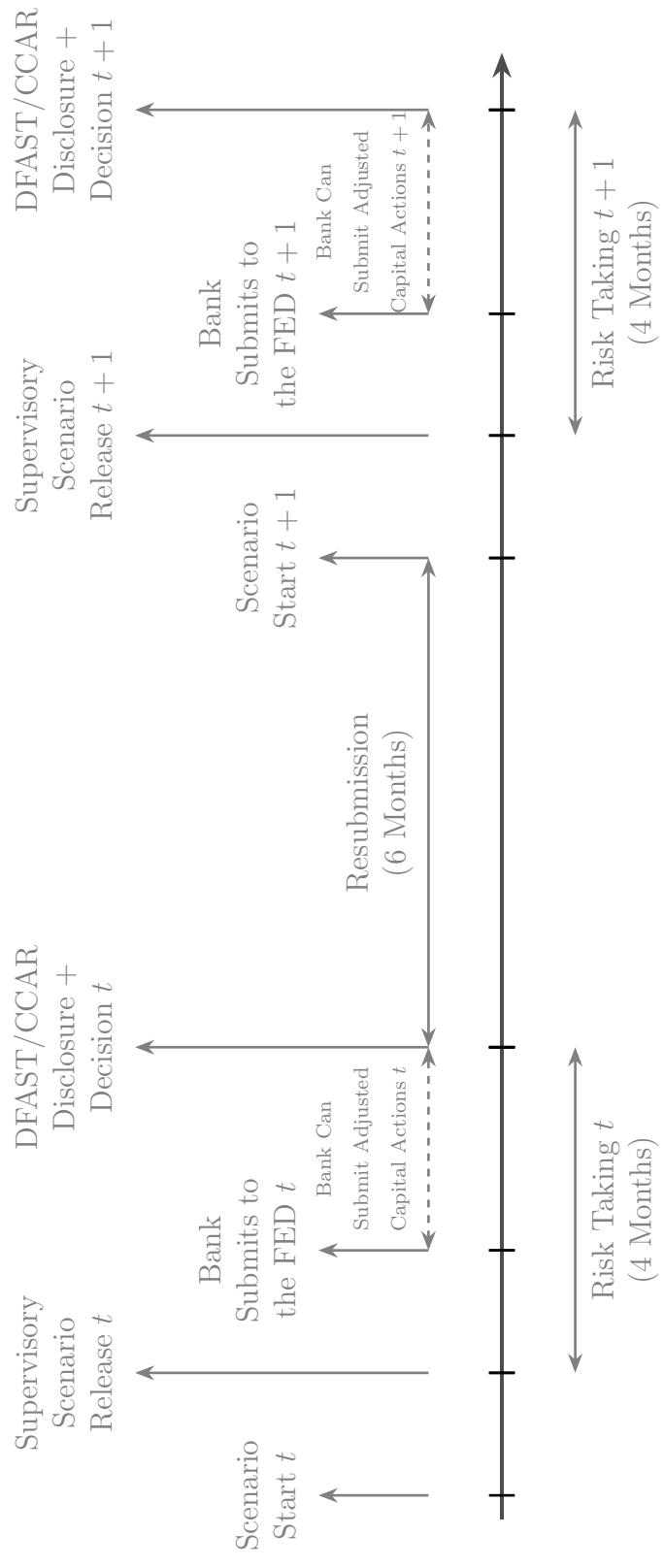
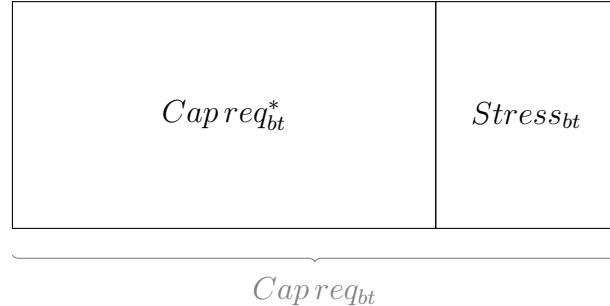


Figure 3
 TWO DECOMPOSITIONS OF CAPITAL REQUIREMENTS

The figure provides a graphical illustration of the two decompositions of capital requirements discussed in Section 4.2.3.

Panel A: Risk Taking and Capital Requirements: the Effect of Stress Tests



Panel B: Bank Capitalization and Distance from Capital Requirements

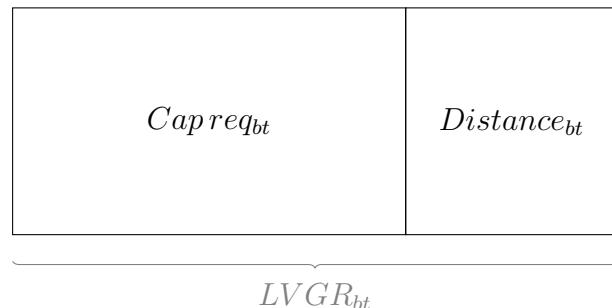


Figure 4
 AVERAGE PORTFOLIO YIELD OF STRESSED AND NON-STRESSED BANKS

The figure shows the evolution of the average portfolio yield on new syndicated loans of stressed banks and non-stressed banks. The solid line refers to the average yield for stressed banks, while the dashed line refers to the average yield for non-stressed banks. The vertical thick line is in correspondence of Dodd-Frank Act. Our sample is selected as described in Sections 3.2 and 4.1.

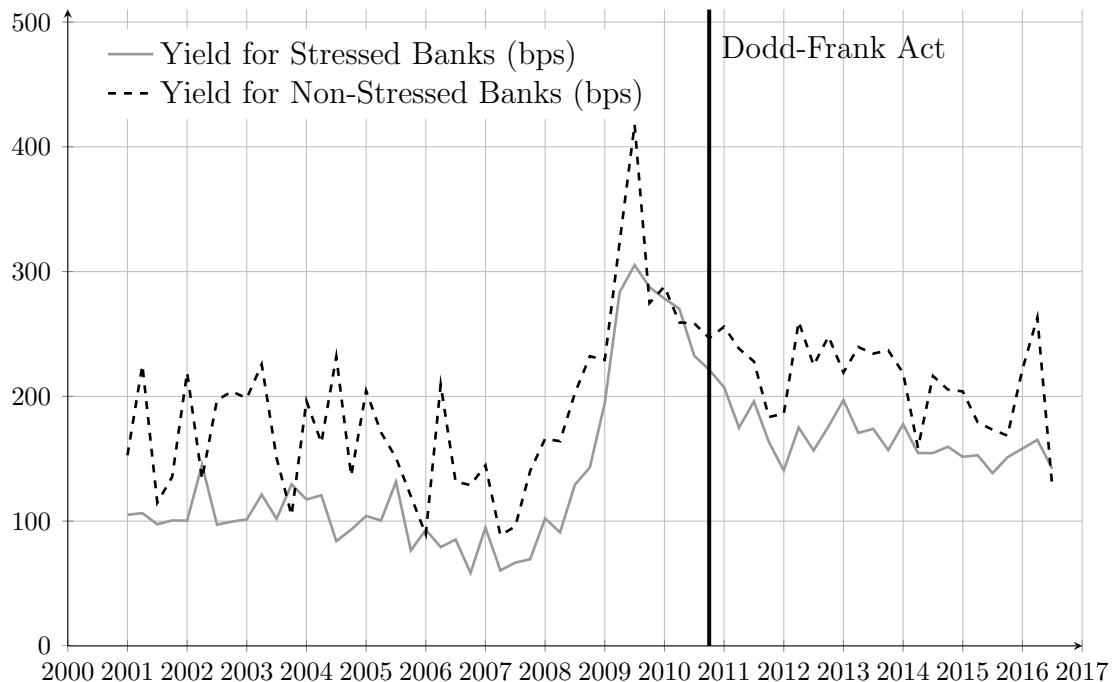
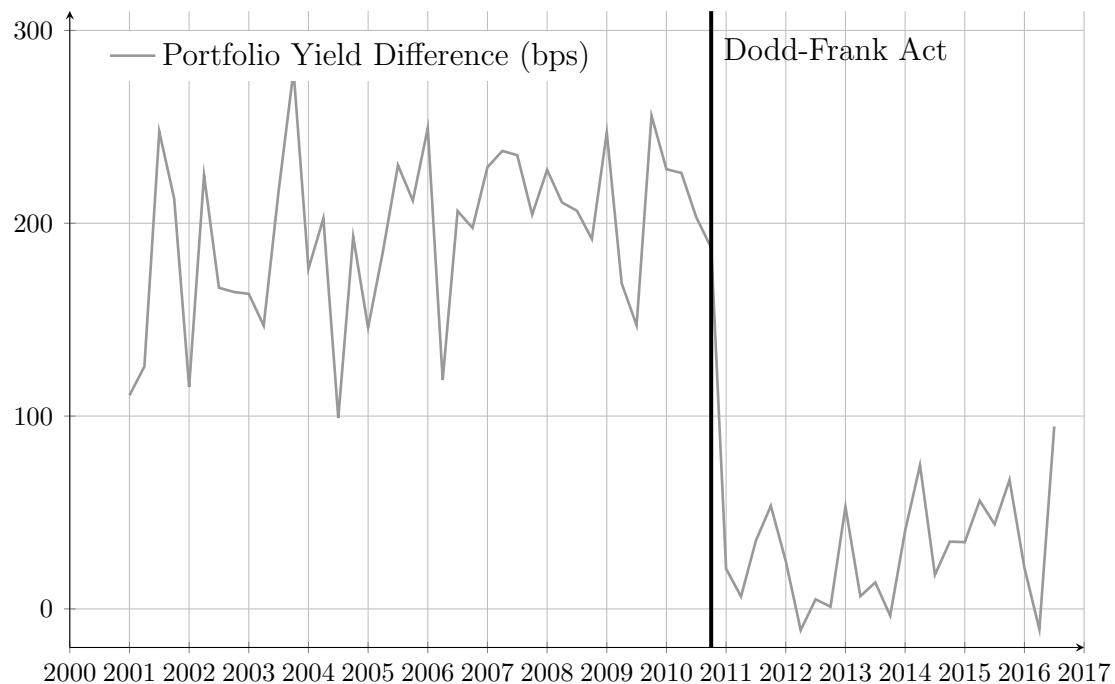


Figure 5
PORTFOLIO YIELD: MONITORING EFFECT

The figure shows the evolution of the difference in the average residual portfolio yield of stressed banks compared to non-stressed banks. The residual portfolio yield is obtained by subtracting the effect of the capital requirement on the portfolio yield (from regression (6)) from the observed portfolio yield of a bank. The vertical thick line is in correspondence of Dodd-Frank Act. Our sample is selected as described in Sections 3.2 and 4.1.



Appendix

The appendix contains: the list of stressed banks in our sample (Table A1), capital ratios and market measures of risk for stressed banks (Table A2), additional summary statistics and balance sheet ratios for the banks in our sample before and after DFA (Table A3), additional robustness checks for the analyses on portfolio yield (Table A4), the definitions of the variables used in the analyses (Table A5), and the illustration of how capital ratios of stressed and non-stressed banks evolved over time in our sample period (Figure A1).

Table A1
STRESSED BANKS

The table lists the banks subject to annual regulatory stress tests in the U.S.. A cross indicates whether a bank participated in a regulatory stress test exercise for a given year (SCAP 2009, CCAR 2011, 2012, 2013, 2014, 2015 and 2016). “Fail” indicates the number of banks that did not satisfy the regulatory criteria in each regulatory stress test exercise (except for CCAR 11, for which bank-specific results are not available).

Bank	2009	2011	2012	2013	2014	2015	2016
Ally Financial Inc.	×	×	×	×	×	×	×
American Express Company	×	×	×	×	×	×	×
Bank of America Corporation	×	×	×	×	×	×	×
BB&T Corporation	×	×	×	×	×	×	×
The Bank of New York Mellon	×	×	×	×	×	×	×
Capital One Financial Corporation	×	×	×	×	×	×	×
Citigroup Inc.	×	×	×	×	×	×	×
Fifth Third Bancorp	×	×	×	×	×	×	×
The Goldman Sachs Group, Inc.	×	×	×	×	×	×	×
JPMorgan Chase & Co.	×	×	×	×	×	×	×
KeyCorp	×	×	×	×	×	×	×
MetLife, Inc.	×	×	×				
Morgan Stanley	×	×	×	×	×	×	×
The PNC Financial Services Group, Inc.	×	×	×	×	×	×	×
Regions Financial Corporation	×	×	×	×	×	×	×
State Street Corporation	×	×	×	×	×	×	×
SunTrust Banks, Inc.	×	×	×	×	×	×	×
U.S. Bancorp	×	×	×	×	×	×	×
Wells Fargo & Company	×	×	×	×	×	×	×
BBVA Compass Bancshares, Inc.					×	×	×
BMO Financial Corp.					×	×	×
Comerica Incorporated					×	×	×
Discover Financial Services					×	×	×
HSBC North America Holdings Inc.					×	×	×
Huntington Bancshares Incorporated					×	×	×
M&T Bank Corporation					×	×	×
Northern Trust Corporation					×	×	×
Citizens Financial Group, Inc.					×	×	×
Santander Holdings USA, Inc.					×	×	×
MUFG Americas Holdings Corporation					×	×	×
Zions Bancorporation					×	×	×
Deutsche Bank Trust Corporation						×	×
BancWest Corporation							×
TD Group US Holdings LLC							×
Sample	19	19	19	18	30	31	33
Fail	10		4	4	5	3	3

Table A2
BEFORE AND AFTER DODD-FRANK ACT

The table presents descriptive statistics of stressed banks compared to non-stressed banks before the crisis (“Before”) and after Dodd-Frank Act (“After”). Stressed banks are the banks subject to annual regulatory stress tests in the U.S.. Stressed banks are split between banks that participated in all stress tests (“All Stress Tests”) and banks that were included in stress tests at a later stage (“New Entrants”). The variables reported in Panel A include: book capital ratio (ratio of equity to assets), CET1R (ratio of common equity Tier 1 capital to risk-weighted assets), T1R (ratio of Tier 1 capital to risk-weighted assets), TotalR (ratio of Total capital to risk-weighted assets), LVGR (ratio of Tier 1 capital to average total assets) and the ratio of risk-weighted assets to total assets (RWA/TA). The variables reported in Panel B include the monthly market beta, monthly realized volatility, market-to-book (ratio of market capitalization to book equity), and market leverage (ratio of quasi market assets to market capitalization). Our sample includes 18 stressed banks participating in all stress test, 15 new entrants, and 21 non-stressed banks and is selected as described in Section 3.2.

Panel A: Capital Ratios (%)									
	Stressed Banks						Non-Stressed Banks		
	All Stress Tests			New Entrants			Before	After	Change
	Before	After	Change	Before	After	Change			
Book Capital	8.02	10.71	2.70	10.04	12.39	2.35	8.99	11.28	2.30
CET1R	7.16	11.17	4.00	7.47	11.33	3.87	9.53	12.08	2.55
T1R	8.48	12.49	4.01	8.77	12.12	3.36	10.74	12.82	2.09
TotalR	11.92	14.93	3.01	11.86	14.44	2.57	12.99	14.50	1.51
LVGR	6.16	8.46	2.29	7.68	10.17	2.49	8.34	9.58	1.23
RWA/Assets	70.40	65.00	-5.40	82.66	80.01	-2.64	74.91	71.83	-3.08

Panel B: Market Measures of Risk									
	Stressed Banks						Non-Stressed Banks		
	All Stress Tests			New Entrants			Before	After	Change
	Before	After	Change	Before	After	Change			
Beta	1.05	1.34	0.29	0.86	1.25	0.40	0.92	1.22	0.30
Realized Volatility	1.59	1.43	-0.15	1.39	1.44	0.05	1.58	1.45	-0.13
Market-to-Book	2.72	1.14	-1.58	2.06	1.05	-1.01	2.70	1.42	-1.28
Market Leverage	5.91	9.65	3.74	6.00	8.83	2.83	5.15	7.63	2.49

Table A3

PROFITABILITY AND BALANCE SHEET RATIOS: BEFORE AND AFTER DODD-FRANK ACT

The table presents descriptive statistics for stressed banks compared to non-stressed banks before the crisis (“Before”) and after Dodd-Frank Act (“After”). Stressed banks are the banks subject to annual regulatory stress tests in the U.S. Stressed banks are separated between banks that participated in all stress tests and new entrants. Panel A summarizes profitability and return on assets, where asset income is net income plus interest expenses. Panel B reports balance sheet ratios that include different balance sheet items scaled by banks’ total assets. Our sample includes 18 stressed banks participating in all stress test, 15 new entrants, and 21 non-stressed banks and is selected as described in Section 3.2.

Panel A: Profitability and Return on Assets (%)									
	Stressed Banks						Non-Stressed Banks		
	All Stress Tests			New Entrants			Before	After	Change
	Before	After	Change	Before	After	Change			
Net Income/Assets	0.34	0.25	-0.10	0.31	0.17	-0.14	0.35	0.23	-0.13
Asset Income/Assets	0.87	0.34	-0.53	0.80	0.25	-0.55	0.83	0.33	-0.50
Loan Int. Income/Loans	1.49	0.96	-0.53	1.52	0.92	-0.59	1.71	1.14	-0.56
Non Int. Income/Assets	0.77	0.56	-0.21	0.50	0.38	-0.13	0.56	0.32	-0.25

Panel B: Balance Sheet Ratios (%)									
	Stressed Banks						Non-Stressed Banks		
	All Stress Tests			New Entrants			Before	After	Change
	Before	After	Change	Before	After	Change			
Loans/Assets	54.36	48.97	-5.40	65.98	63.91	-2.07	61.61	60.15	-1.46
Deposits/Assets	59.27	67.65	8.38	70.84	78.00	7.16	72.19	77.51	5.32
Cash/Assets	5.90	9.99	4.08	6.36	9.20	2.85	4.28	4.85	0.57
Trading/Assets	6.14	4.87	-1.27	0.51	0.92	0.40	0.49	0.65	0.16
Securities/Assets	17.80	21.08	3.28	16.98	17.05	0.07	24.31	25.32	1.01
Rev. Repos/Assets	4.97	3.78	-1.19	1.75	0.48	-1.26	1.84	0.93	-0.91
Repos/Assets	8.89	3.52	-5.38	5.93	1.23	-4.70	7.62	3.20	-4.43

Table A4
MONITORING VERSUS CAPITAL REQUIREMENTS: EFFECT ON PORTFOLIO YIELD
(ROBUSTNESS)

The table is a replica of Table 4 on a subsample including only term and revolver loans (Panel A), on a subsample including only loans to new borrowers (Panel B), and on an extended sample that includes loans originated outside the U.S. (Panel C).

Panel A: Portfolio Yield (Term and Revolver Loans)			
	Term and Revolver Loans		
$stressed_b * DFA_t$	-221.20 (-4.36)	-162.20 (-3.10)	-114.74 (-1.95)
$E(\Delta portfolio\ yield_{bt} stressed_b = 0, \Delta \overline{Capreq_{bt}})$	44.81	48.92	44.62
$E(\Delta portfolio\ yield_{bt} stressed_b = 1, \Delta \overline{Capreq_{bt}})$	8.39	8.25	8.31
$stressed_b * DFA_t * Capreq_{bt}$	48.02 (4.48)	33.98 (3.04)	31.29 (2.72)
Controls	N	Y	Y
Bank and Time FE	Y	Y	Y
$stressed_b * DFA_t * portfolio\ yield_{bt-1}$	N	N	Y
R^2 (%)	71.73	74.38	74.70
Adj. R^2 (%)	69.09	71.87	72.11
Observations	1,053	1,053	1,053
Banks	30	30	30

Panel B: Portfolio Yield (Loans to New Borrowers)			
	Loans to New Borrowers		
$stressed_b * DFA_t$	-199.50 (-4.24)	-183.94 (-4.12)	-166.31 (-3.82)
$E(\Delta portfolio\ yield_{bt} stressed_b = 0, \Delta \overline{Capreq_{bt}})$	67.31	67.44	66.52
$E(\Delta portfolio\ yield_{bt} stressed_b = 1, \Delta \overline{Capreq_{bt}})$	23.56	23.58	23.57
$stressed_b * DFA_t * Capreq_{bt}$	42.09 (4.33)	38.46 (3.91)	36.19 (3.94)
Controls	N	Y	Y
Bank and Time FE	Y	Y	Y
$stressed_b * DFA_t * portfolio\ yield_{bt-1}$	N	N	Y
R^2 (%)	71.91	74.41	74.49
Adj. R^2 (%)	69.31	71.92	71.90
Observations	1,053	1,053	1,053
Banks	29	29	29

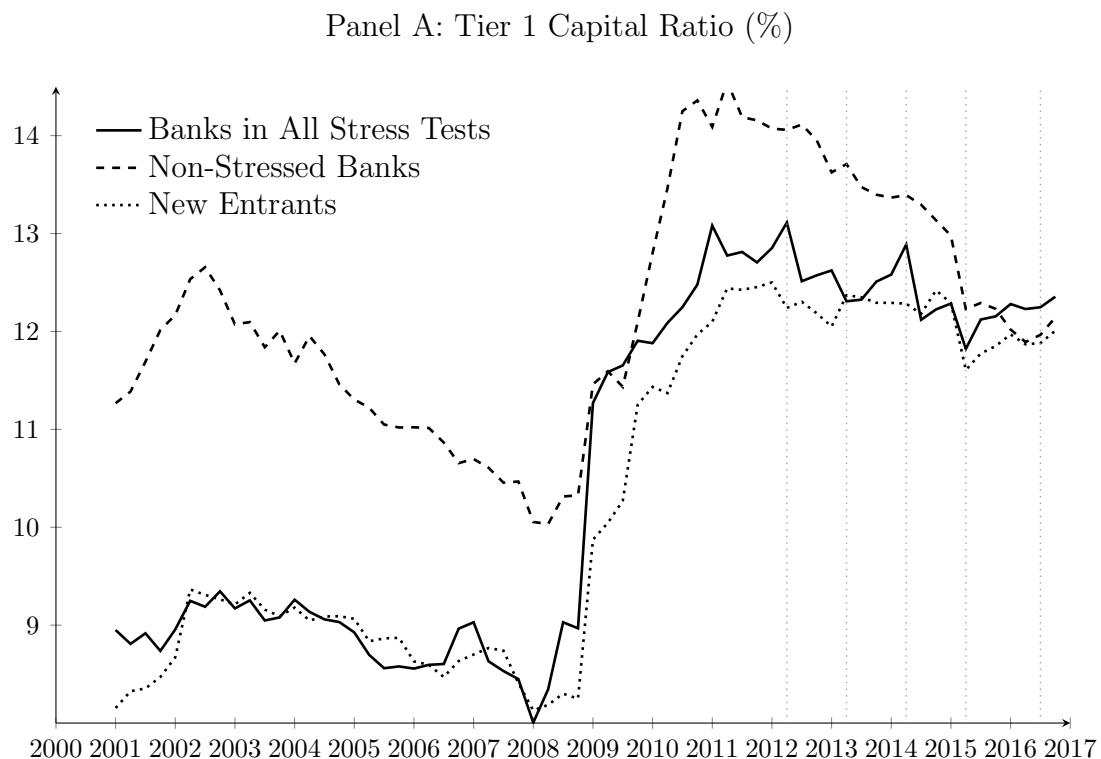
Panel C: Portfolio Yield (Including Loans Outside U.S.)			
	Including Loans Outside U.S.		
$stressed_b * DFA_t$	-158.95 (-3.47)	-122.62 (-2.53)	-77.85 (-1.36)
$E(\Delta portfolio\ yield_{bt} stressed_b = 0, \Delta \overline{Capreq_{bt}})$	57.93	55.61	50.26
$E(\Delta portfolio\ yield_{bt} stressed_b = 1, \Delta \overline{Capreq_{bt}})$	21.73	22.19	22.11
$stressed_b * DFA_t * Capreq_{bt}$	34.17 (3.31)	26.42 (2.35)	21.25 (1.76)
Controls	N	Y	Y
Bank and Time FE	Y	Y	Y
$stressed_b * DFA_t * portfolio\ yield_{bt-1}$	N	N	Y
R^2 (%)	67.31	70.52	71.07
Adj. R^2 (%)	64.39	67.76	68.24
Observations	1,100	1,100	1,100
Banks	30	30	30

Table A5
VARIABLE DEFINITIONS

Variable	Definition	Source
$CET1R$	Ratio of common equity Tier 1 capital to risk-weighted assets	Fed, SNL
$T1R$	Ratio of Tier 1 capital to risk-weighted assets	Fed, SNL
$TotalR$	Ratio of Total capital to risk-weighted assets	Fed, SNL
$LVGR$	Ratio of Tier 1 capital to average total assets	Fed, SNL
$CET1R_{stress}$	Minimum ratio of common equity Tier 1 capital to risk-weighted assets over the stress scenario horizon	Fed
$T1R_{stress}$	Minimum ratio of Tier 1 capital to risk-weighted assets over the stress scenario horizon	Fed
$TotalR_{stress}$	Minimum ratio of Total capital to risk-weighted assets over the stress scenario horizon	Fed
$LVGR_{stress}$	Minimum ratio of Tier 1 capital to average total assets over the stress scenario horizon	Fed
$CET1$	Common equity Tier 1 capital	SNL
$T1$	Tier 1 capital	SNL
$Total$	Total capital	SNL
$Assets$	Average total assets	SNL
RWA	Risk-weighted assets	SNL
Asset income	Net income plus interest expenses divided by total assets	SNL
All-in-drawn spread	Amount the borrower pays in bps over LIBOR for each dollar drawn down	DealScan
Facility amount	Actual amount of the facility committed by the facility's lender pool	DealScan
Bank allocation	Amount a particular lender has committed to the given facility	DealScan
Exchange rate	The current exchange rate compared to USD based on the exchange rate date of the company's native currency	DealScan
Maturity	A calculation of how long (in months) the facility will be active from signing date to expiration date	DealScan
Rating	Firm's numerical rating (1 is AAA; 23 is D)	Compustat
Rated	Binary variable that indicates if the firm has a rating assigned in Compustat	Compustat
Speculative	Binary variable that indicates if the firm's rating is worse than BBB	Compustat
Cash flow volatility	Three-year rolling volatility of firm's cash flows	Compustat
Whited & Wu	Whited-Wu Index (index of firm's financial constraints)	Compustat

Figure A1
EVOLUTION OF ACTUAL CAPITAL RATIOS

The figure shows the evolution of the average actual capital ratios for the 18 stressed banks participating in all stress test, 15 new entrants, and 21 non-stressed banks and is selected as described in Section 3.2. Panel A reports the Tier 1 capital ratio, while Panel B reports the Tier 1 leverage ratio, as defined in the Appendix. The solid lines refer to the sample of stressed banks, the dashed lines to the sample of non-stressed banks, and the dotted lines to the sample of new entrants. The vertical dotted lines indicate the stress-test disclosure dates.



Panel B: Tier 1 Leverage Ratio (%)

