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“Stressed Banks”

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Presenter: Diane Pierret, Assistant Professor of Finance, HEC – University of Lausanne

Discussant: Vasso Ioannidou, Professor of Finance, Lancaster University

Stressed Banks*

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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 stress tests effectively encourage prudent investment from stressed banks through regulatory monitoring, but also provide 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, Regulatory Monitoring, Stress Tests.
JEL Classification Numbers: G01, G21, G28.

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1 Introduction

The Great Recession has sparked renewed attention on undertaking regulatory 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. We investigate this link through an empirical analysis of the joint effect of capital requirements and regulatory monitoring induced by the Dodd-Frank Act on banks' investment decisions. This work relates to the recent literature on the impact of post-crisis capital regulation on bank lending and bank risk-taking (Gropp, Mosk, Ongena, and Wix (2018), and Jimenez, Ongena, Peydro, and Saurina (2018)).

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. While equity capital creates a buffer to absorb potential losses, the capital structure of a bank likely affects its investment decisions on the asset side. From a theoretical perspective, several studies 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.[1] 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 can increase 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 regulatory monitoring on bank risk taking is that changes in capital requirements are rarely observed (Gropp, Mosk, Ongena, and Wix (2018)). 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 requirements on the actual capital ratios of stressed banks. The regulator determines such bank-specific requirements on the basis of its assessment of the riskiness of banks' assets under the supervisory stress scenario. Using the bank data disclosed in the regulatory stress tests, we back out such bank-specific capital requirements.

To capture the riskiness of banks' investments in a given quarter, we collect data on new loans banks grant to firms from LPC DealScan, after they learn their capital requirement from the stress

[1] See Koehn and Santomero (1980), Kim and Santomero (1988), Rochet (1992) and more recently Gale (2010) and Harris, Opp, and Opp (2017).

test.[2] 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 in the syndicated loan market, leading to a total of 227,074 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 (ex-ante) promised yield on the portfolio of new loans of banks in a given quarter, and (ii) the loan portfolio allocation of different banks to the same firm with a given level of risk in a given quarter. For the first, the promised yield on a bank's portfolio of new loans is interpreted as a measure of riskiness in a given quarter. However, higher promised yields could be associated not only with more risky loan portfolios, but also with higher bank-specific markups due to imperfect competition in the syndicated loan market. The second analysis mitigates this concern by directly linking new loans to measures of firm risk. To implement the second analysis, 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 for 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 conducted by the Federal Reserve. 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.

[2]Carey and Hrycray (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 (2008) suggest that such fraction has been increasing in the recent years.

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 186 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 the loan portfolio composition of banks confirm the presence of the two contrasting channels. 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. Our results do not imply that stressed banks increase more their supply of loans after Dodd-Frank Act compared to non-stressed banks, but instead 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 reallocate their loan portfolio towards 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.[3]

Finally, we do not find evidence of a differential trend in the portfolio yield and loan portfolio composition of stressed banks compared to non-stressed banks before the Dodd-Frank Act. Furthermore, we show that our findings are robust. For example, our results are robust to restricting the sample to new borrowers such that granting loans to firms in a certain risk class is not only the consequence of relationship lending. Our results are not explained by crisis observations, hold for international loans, and different measures of firm risk, and are not confirmed in placebo tests.

[3]See, for example, Cooper and Ross (2002) and Admati, DeMarzo, Hellwig, and Pfleiderer (2013).

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 reduce the risk of large financial institutions in the U.S.[4]

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 empirical analysis 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, a link between capital regulation and banks' risk taking has already been established in the literature. Several studies show that tighter capital requirements possibly lead to an increase in risk taking, including Koehn and Santomero (1980), Kim and Santomero (1988), Rochet (1992), and more

[4]See Schnabl (2017) for a discussion of the off-ramp rule in the Financial CHOICE Act.

recently in the general equilibrium models of Gale (2010) and Harris, Opp, and Opp (2017). Other works (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.[5] Other studies, such as Cooper and Ross (2002) and Admati, DeMarzo, Hellwig, and Pfleiderer (2013)), instead argue that tighter capital requirements provide shareholders with a larger equity stake in a bank ("skin in the game"), and reduce their incentives to engage in risky lending.

While capital requirements can create desirable capital buffers to absorb losses, banks' possible response in terms of riskier investments can have the unintended consequence to undo the prudential benefits of capital regulation. A first regulatory tool to mitigate the risk-taking problem arising from capital regulation are risk weights, which determine how much capital banks have to hold against various risk-sensitive assets. Kim and Santomero (1988) derive "theoretically-correct" risk weights under risk-based capital regulation in order to restrict banks' asset composition. Rochet (1992) proposes "correct" risk-weights proportional to the systematic risks (the betas) of the assets.

Several studies provide evidence that regulatory risk weights result in only imperfect monitoring of banks' investments. Tirole (2010) states that "the calculation of equity requirements will always be evolving, regulators playing a catch-up game with regulated institutions. Because leverage is key to return on equity, the latter have an incentive to minimize their use of capital an thereby to enjoy greater freedom." There is ample evidence of banks optimizing risk weights (Beltratti and Paladino (2013), Acharya, Engle, and Pierret (2014), Plosser and Santos (2016)) 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

[5]These studies are not necessarily in contradiction with Admati (2013), 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 (see Kisin and Manela (2016) for an estimation of the shadow cost of capital requirements).

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 (Gambacorta and Mistrulli (2004), Aiyar, Calomiris, Hooley, Korniyenko, and Wieladekc (2014), Fraisse, Le, and Thesmar (2015), De Jonghe, Dewachter, and Ongena (2016)). Jimenez, Ongena, Peydro, and Saurina (2018) study the introduction of a form of countercyclical capital requirements in Spain through dynamic provisioning and hint to the risk taking channel when capital requirements are tightened in good times, but also show the positive real effects of higher bank capitalization in bad times. Gropp, Mosk, Ongena, and Wix (2018) 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. As in this work, the paper of Gropp, Mosk, Ongena, and Wix (2018) also exploit the difference between treated banks subject to tightened capital requirements and a group of control banks, but focus on aggregate lending and sectoral allocation rather than on bank risk taking.

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), Hirtle, Kovner, and Bhanot (2016)), and how U.S. banks adjust credit supply as a consequence of being stress tested (Bassett and Berrospide (2017), and Calem, Correa, and Lee (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 work 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 Jimenez and Ongena (2012), Ellul and Yerramilli (2013), Jimenez, Ongena, Peydro, and Saurina (2014), Acharya, Eisert, Eufinger, and Hirsch (2016), De Jonghe, Dewachter, Mulier, Ongena, and Schepens (2016), Lambertini and Mukherjee (2016), Neuhann and Saidi (2017), Heider, Saidi, and Schepens (2017), Acharya, Eisert, Eufinger, and Hirsch (2017), Célérier, Kick, and Ongena (2018), and Juelsrud (2018).

3 Institutional Background: Stress Tests and Capital Requirements

3.1 Dodd-Frank Act and CCAR

The Dodd-Frank Wall Street Reform and Consumer 29 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)).[6] 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),

[6]https://www.federalreserve.gov/newsevents/press/bcreg/20111220a.htm, visited on 11/02/2017.

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, dividend 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.[7]

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 (Table A1), 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 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 Trouble Asset Relief Program (TARP). All domestic bank holding companies with year-end 2008 assets exceeding $100 billion were required to participate in the SCAP.[8] In 2014, the bank size threshold to be subject to the CCAR reduced to $50 billion in consolidated assets.[9] The number of participating banks increased to 30 bank holding companies in the 2014 CCAR (including U.S. subsidiaries of

[7]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.

[8]The SCAP was launched in February 2009 as a response to the 2008 financial crisis. This stress test of 19 bank holding companies led to a substantial recapitalization of the U.S. financial system by forcing banks to raise a $75 billion capital buffer.

[9]Those 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).

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 (Table A1), 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.[10] 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).[11] 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.[12]

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

$$\begin{array}{rcl} CET1R: & \frac{CET1_b}{RWA_b} & \geq & k_1, \\ T1R: & \frac{T1_b}{RWA_b} & \geq & k_2, \\ TotalR: & \frac{Total_b}{RWA_b} & \geq & k_3, \\ LVGR: & \frac{T1_b}{Assets_b} & \geq & k_4, \end{array} \qquad (1)$$

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

[11]Under 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), visited on 11/02/2017.

[12]MetLife, 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).[13] 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. Intuitively, for stressed banks, bank's capital is supposed to absorb the projected losses also under the stress scenario. 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.[14] Specifically, under adverse economic conditions, the decline in value of bank's assets translates into a 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.[15]

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:

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

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

[13]Descriptive 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 (Table A2).

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

[15]Bank's capital ratios can also decrease when the bank has planned net capital distributions over the planning horizon.

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

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

where $CET1R_{b,stress}$, $T1R_{b,stress}$, $TotalR_{b,stress}$, $LVGR_{b,stress}$ are the minimum projected capital ratios of bank b under the supervisory stress scenario. Because $CET1R_{b,stress} \geq CET1R_b$, $T1R_{b,stress} \geq T1R_b$, $TotalR_{b,stress} \geq TotalR_b$, $LVGR_{b,stress} \geq LVGR_b$, 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 above the average post-stress thresholds.[16] While, after 2014, most banks did not fail the CCAR based on quantitative capital inadequacy,[17] the distance between the actual capital ratios of the bank and its post-stress regulatory capital requirements reflects the tightness of the regulatory capital constraint, as well as the probability of

[16]After the crisis, the average capital ratios have increased for all groups of banks, and especially for stressed banks (see descriptive statistics in Table A2in 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 also led to a substantial recapitalization of the U.S. financial system (an additional $75 billion capital buffer).

[17]Some 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.

the bank of failing the stress test, and having to raise additional equity in the future.

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 constraint can be written as

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

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

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

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 $max(0, Cap\,req_b * Assets_b - T1_b)$.

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

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

where $k'_{1b} = \left[k^s_{1b} - \frac{CET1_b - T1_b}{RWA_b}\right] \frac{RWA_b}{Assets_b}$, $k'_{2b} = k^s_{2b} \frac{RWA_b}{Assets_b}$, $k'_{3b} = \left[k^s_{3b} - \frac{Total_b - T1_b}{RWA_b}\right] \frac{RWA_b}{Assets_b}$, and $k'_{4b} = k^s_{4b}$. In the last column of Panel B of Table 1, we report the cross-sectional average single Tier 1 leverage ratio requirement ($Cap\,req_b$) of stressed banks.[18]

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

[18] Note 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).

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 regulatory monitoring under DFA.

[INSERT FIGURE 1 HERE]

3.4 The Stress Test Timeline: 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. Importantly, 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. However, 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 bank funding costs ($(Net\,income + Interest\,expenses)/Total\,Assets$). We then relate changes in asset income to bank-specific capital requirements through the following regression:

$$\triangle asset\,income_{bt} = \beta Cap\,req_{bt} + \gamma' controls_{bt} + \delta_t + \epsilon_{bt}, \quad (5)$$

where $\triangle asset\,income_{bt}$ 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 lagged 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 liquid assets (ratio of cash, securities available for sale, and Fed funds and reverse repurchase agreements, to total assets), bank profitability (ratio of net income to total assets), and bank trading activity (ratio of trading assets 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").[19]

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 ($Cap\,req_{bt}$) just

[19] 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. "The only kind of adjustment permitted under this new procedure was a reduction of the planned capital 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." (https://www.federalreserve.gov/bankinforeg/stress-tests/CCAR/March-2013-Summary-of-Results.htm#secondNav, visited on 04/15/2018).

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 in the quarters following the CCAR disclosure.

[INSERT FIGURE 2 HERE]

Table 2 reports the estimate of β for different components of $asset\,income_{bt}$.[20] Panel A reports the ratio of net income plus interest expenses 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 $\triangle asset\,income_{bt}$ 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 $Cap\,req_{bt}$ with the individual bank-specific thresholds for each regulatory capital ratio (k^s_{1bt}, k^s_{2bt}, k^s_{3bt}, k^s_{4bt}), when we control for bank size, liquidity, profitability, and trading activity, and when we replace the dependent variable by the change in the ratio of net income plus interest expenses to risk-weighted assets (not reported in the table). 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 with the regulatory timing. The immediate reaction to the stress scenario is more pronounced for trading and securities-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 securities markets, it is certainly not conclusive. In particular, several concerns

[20] We report descriptive statistics on different measures of asset income in the Appendix (Table A3).

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

In this section, we consider two measures that likely reflect the ex-ante risk of new loans granted after innovations in capital requirements, namely the average (ex-ante) promised yield on the portfolio of new syndicated loans of a bank, and the proportion a bank lends to risky borrowers in its portfolio of new syndicated loans.

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 (visited on 11/02/2017). This yields a total of 48,113 unique lending companies in our sample period, from December 2000 to September 2016. 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 227,074 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 (2008). 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 119,383 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 178 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 -13,491 and -3,762) 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 (55,187 lender-borrower relationships and 42,479 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.[21] 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. If the regulatory assessment of bank's asset riskiness better reflect the true ranking of asset riskiness within the bank compared to bank's own assessment, then the stress test provides incentives for banks to reduce risk. In addition, stressed banks are subject to a qualitative assessment challenging the bank's risk management team on the assumptions used to derive stressed

[21] Additional 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 45,995 lender-borrower relationships. On the database linked to Compustat, the same additional filters restrict the sample to 34,875 lender-borrower relationships.

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.

Importantly, the channel of risk taking from *higher capital requirements* and the channel of prudential incentives from *more invasive regulatory monitoring* are intertwined in stress tests. The two channels operate at the same for the same bank subject to the regulatory stress test. In this section, we describe the empirical strategy we use to disentangle the two channels on the risk taking behavior of stressed banks.

4.2.1 Effect on Portfolio Yield

We identify the effect of DFA on stressed banks compared to non-stressed banks using a differences-in-differences analysis on the (ex-ante) promised 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

$$portfolio\, yield_{bt} = \sum_{f,\tau \in t} \frac{bankallocation_{bf\tau} * facilityamount_{f\tau} * exchangerate_{f\tau} * allindrawn_{f\tau}}{\sum_{f,\tau \in t} bankallocation_{bf\tau} * facilityamount_{f\tau} * exchangerate_{f\tau}},$$

where, for all dates $\tau \in t$ (DealScan item "FacilityStartDate"), $bankallocation_{bf\tau}$ is the fraction of the loan amount allocated by bank b in the syndicated loan to firm f, $facilityamount_{f\tau}$ is the total amount the syndicate lends to firm f at date τ, $exchangerate_{f\tau}$ 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 $allindrawn_{f\tau}$ is the all-in-drawn spread charged to firm f at date τ.

Importantly, as we discuss in Section 3, the assignment to banks to the treatment and control groups is based on the pre-determined threshold of banks' total assets. Thus, the regulator does not actively "cherry pick" the banks to be included in stress tests and, conditional on size, the treatment status is not determined by the outcome variable. Controlling for bank size is however desirable to account for possible differential trends affecting small and large banks after DFA for other reasons than stress tests.[22]

In order to disentangle the effect of regulatory 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:

$$\begin{aligned} portfolio\,yield_{bt} \;=\;& \alpha_b + \delta_t + \beta_1 stressed_b * DFA_t + \beta_2 stressed_b * DFA_t * Cap\,req_{bt} \\ & + \beta_3 Cap\,req_{bt} + \beta_4 stressed_b * Cap\,req_{bt} \\ & + \beta_5 DFA_t * Cap\,req_{bt} + \gamma' controls_{bt} + \epsilon_{bt}, \end{aligned} \tag{6}$$

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, $Cap\,req_{bt}$ 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.

Specification (6) 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 regulatory 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 (β_1) of stressed banks to DFA compared to non-stressed banks plausibly originates from more invasive monitoring of stressed banks by the regulator.

[22]An alternative identification strategy could rely on a Regression Discontinuity Design (RDD) around the bank size threshold. However, a challenge to implement RDD is the limited number of bank holding companies in our sample. Moreover, we provide a placebo test where we split the groups of treated and control banks according to the average bank size in the Appendix (Table A11).

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^s_{1bt}, k^s_{2bt}, k^s_{3bt}, k^s_{4bt}) 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 $Cap\,req_{bt}$ 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), bank liquid assets (ratio of cash, securities available for sale, and Fed funds and reverse repurchase agreements, to total assets), bank profitability (ratio of net income to total assets), and bank trading activity (ratio of trading assets 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 fixed-effects and bank-level variables capturing differences in bank business models should mitigate additional concerns regarding the interpretation of the regulatory monitoring effect.

4.2.2 Effect on Loan Portfolio Composition

Along with the portfolio yield analysis, we consider the change in the composition of credit for both stressed and non-stressed banks lending to risky firms after DFA. The analysis of the portfolio allocation of banks based on measures of firm risk mitigate the concern that the portfolio yield of the bank reflects not only the average risk of the loan portfolio, but also bank-specific markups due to the absence of perfect competition in the syndicated loan market. 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 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.

In specification (7), 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. In addition, we consider bank-level control variables interacted with firm risk in order to highlight the effect of the bank capital requirement in the bank-firm matching process. Importantly, 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 disentangle the effect of regulatory monitoring from tighter capital requirements on the loan portfolio composition of stressed banks after DFA, we adopt a triple differences-in-differences regression similar to the one we use for the portfolio yield analysis:

$$\begin{aligned} \log(amount_{fbt}) \;=\; & \alpha_{bt} + \alpha_{ft} + \beta_1 stressed_b * DFA_t * Firm\,risk_{ft} \\ & + \beta_2 stressed_b * DFA_t * Cap\,req_{bt} * Firm\,risk_{ft} + \beta_3 Cap\,req_{bt} * Firm\,risk_{ft} \\ & + \beta_4 stressed_b * Cap\,req_{bt} * Firm\,risk_{ft} + \beta_5 DFA_t * Cap\,req_{bt} * Firm\,risk_{ft} \\ & + \beta_6 stressed_b * Firm\,risk_{ft} + \gamma' controls_{fbt} + \epsilon_{fbt}, \end{aligned} \tag{7}$$

where α_{bt} are bank*quarter fixed effects, α_{ft} are firm*quarter fixed effects, $Firm\,risk_{ft}$ is a measure describing the risk of borrower f at date t (as described in detail in Section 5.2), $stressed_b$ 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, $Capreq_{bt}$ is the capital requirement of bank b at date t as defined by Equation (3) and Equation (4) for stressed banks after DFA, and $controls_{fbt}$ are contemporaneous loan-level control variables (including loan maturity, a dummy variable indicating whether the loan is secured, and loan fixed effects), and lagged bank-level control variables interacted with the firm risk. The bank-level control variables are the same as in the yield regressions (i.e. bank size, liquidity, profitability, and trading activity). The panel dataset is composed of firm*bank*quarter data of stressed and non-stressed banks. The capital requirement $Capreq_{bt}$ is derived as for the portfolio yield regressions.

The identification of the regulatory 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 allocation of their loan portfolio towards 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*quarter and firm*quarter fixed effects, the regulatory 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.

4.2.3 Identification Assumption: Absence of Differential Trends in Risk Taking Between Stressed and Non-Stressed Banks before DFA

To apply the differences-in-differences identification strategy described in the previous sections, we inspect the parallel trend assumption in risk taking of stressed and non-stressed banks on their portfolio yields and loan portfolio composition before DFA. The parallel trend assumption in the context of our triple differences-in-differences analysis imply no differential trend in risk taking between stressed and non-stressed banks in the absence of DFA, holding the level of capital requirement of the banks constant.

Portfolio Yield. In Figure 3, we present the average portfolio yield of stressed and non-stressed banks. While a differential trend in the portfolio yield of stressed and non-stressed banks is not clear from the figure before DFA, a differential trend in the portfolio yield does not appear either after DFA. We conjecture that the absence of a differential trend in the portfolio yield after DFA is due to the presence of the two contradicting channels of risk taking (i.e. “higher capital requirements” and “regulatory monitoring”). Our identification strategy highlighting the effect of regulatory monitoring indeed comes from a triple differences-in-differences analysis holding the capital requirement level of the bank constant.

[INSERT FIGURE 3 HERE]

In Figure 4, 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 regulatory monitoring effect since the spread is uncorrelated to capital requirements.

[INSERT FIGURE 4 HERE]

In the Appendix (Table A4), we report statistical tests to inspect the presence of a differential trend in the portfolio yield of stressed and non-stressed banks on a sample restricted to the pre-DFA period. The two rightmost columns of Panel A of Table A4 report the parallel trend assumption test, controlling for the level of the bank capital requirement. The reported t-statistic in the rightmost column of the panel shows no significant differential trend in the portfolio yield of stressed banks before DFA, after controlling for bank fixed effects and bank-level variables.

Loan Portfolio Composition. In Panel B of Table A5 in the Appendix, we report a test for the presence of a differential trend in the loan portfolio composition of stressed and non-stressed banks before DFA. The two rightmost columns of the table report the t-statistics holding the capital requirement of banks constant. The tests show that there is no differential trend in the loan portfolio allocation towards risky firms between stressed and non-stressed banks before DFA.

4.2.4 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 5 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:

$$Cap\,req_{bt} = Cap\,req^*_{bt} + Stress_{bt}, \tag{8}$$

where $Cap\,req_{bt} = \max(k_{1b}, k_{2b}, k_{3b}, k_4, k'_{1b}, k'_{2b}, k'_{3b}, k'_{4b})$, and $Cap\,req^*_{bt} = \max(k_{1b}, k_{2b}, k_{3b}, k_4)$. The variable $Stress_{bt} = Cap\,req_{bt} - Cap\,req^*_{bt}$ 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 5 HERE]

Bank Capitalization and Distance from Capital Requirement. We separate the *actual capitalization level* of the bank and its *distance to the capital requirement* as

$$Capreq_{bt} = LVGR_{bt} - Distance_{bt}, \tag{9}$$

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 portfolio composition 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 "regulatory monitoring" — on bank portfolio yields (Section 5.1), bank loan portfolio composition (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.[23] The results on the portfolio yield analysis are based on 37,892 lender-borrower relationships aggregated at the bank-quarter level (1,084 observations). The results on the loan portfolio composition analysis are based on 28,735 lender-borrower relationships.[24] In Section 5.4, we describe additional analyses and robustness tests.

[23]We consider including the group of new entrants in the treatment group in Section 5.4.

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

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. Within each specification, comparing results in the two columns allows assessing the effect of including control variables in the regression.

[INSERT TABLE 4 HERE]

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 8 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 3, which shows an increase in the average portfolio yield for both stressed and non-stressed banks after DFA.

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 regulatory 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 193 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 51 bps for stressed and non-stressed banks, respectively, after DFA.

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 41 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 regulatory 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 186 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.[25]

5.2 Effect on Loan Portfolio Composition

Table 5 reports the differences-in-differences estimates of regression (7), where $Firm\,risk_{ft}$ is the numerical rating ($rating_{ft}$) of the firm available from Compustat (where AAA=1; D=23). In this table we consider a saturated regression, which includes bank*quarter and firm*quarter fixed

[25]In Section 5.4, we consider an additional test addressing the concern of persistence in bank risk taking, originating for example from relationship lending. On a subsample of loans to new borrowers only, results are qualitatively the same.

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 and fourth columns are based on a regression that includes contemporanous loan-level controls, and lagged bank-level controls interacted with the firm rating such that we can highlight the effect of the bank capital requirement on risk taking.

As for the portfolio yield analysis, the two leftmost columns of Table 5 report estimates of a simple differences-in-differences analysis where $\beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$, ignoring the channel of risk-taking incentives originating from capital requirements. The estimates of β_1 reported in the restricted regressions suggest that stressed banks tilt their portfolio less towards risky firms after DFA compared to non-stressed banks, but the estimates are not significant at the 5% level.

[INSERT TABLE 5 HERE]

The two rightmost columns of Table 5 report the estimates of β_1 and β_2 of the unrestricted regression (7). For a given capital requirement, stressed banks tilt their portfolios towards risky firms less than non-stressed banks after DFA. The reported estimates are significant at the 1% level and 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. 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 0.67 to 0.97 USD million on average after DFA. Instead, stressed banks would increase the loan amount granted to an investment grade firm by 0.98 to 6.36 USD million on average.

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 ($Cap\,req_{bt}$), 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 tilt their loan portfolios towards 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 6 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 ($Cap\,req_{bt}$) 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. While $Stress_{bt}$ is not significant in the portfolio yield analysis, the other estimates are similar to the results reported for our benchmark specification in Section 5.1.

[INSERT TABLE 6 HERE]

7For the loan portfolio composition analysis, we first consider a simple regression in Panel B of Table 6 showing the effect of $Stress_{bt}$ and $Cap\,req_{bt}$ on the portfolio allocation of banks towards risky firms. In the two leftmost columns, we show the effect of the level of the capital requirement ($Cap\,req_{bt}$) only. We find that, holding the volume of credit demand and credit supply fixed, a bank increases its portfolio share by an additional 0.7% to 1.3% to a firm with a S&P rating in the next worse class when the bank capital requirement increases by 1 percentage point.

In the two rightmost columns in Panel B of Table 6, we consider the joint effect of $Stress_{bt}$ and $Cap\,req_{bt}$. 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 ($Cap\,req_{bt}$) constant, a bank decreases by 1.8% to 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% to 2.2% 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.

Panel C of Table 6 reports the results of a differences-in-differences analysis showing the effect of $Stress_{bt}$ on the amount banks lend to risky firms (regression (7)). This regression reports two different regulatory monitoring effects. First, after controlling for the level of the capital requirement ($Cap\,req_{bt}$), the parameter of $Stress_{bt}$ 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.

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. Our results suggest that both the current cost of funding and the probability of an increase in the future cost of funding explain variations in banks' 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 7 reports the estimates from regressions (6), and (7), in which we replace $Cap\,req_{bt}$ with the variables $LVGR_{bt}$, and $Distance_{bt}$.

[INSERT TABLE 7 HERE]

Panel A of Table 7 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 40.16 to 40.66 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 20.57 to 33.16 bps less for stressed banks.[26] The regulatory 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 221.91 to 245.98 bps less for stressed banks.

Panel B of Table 7 reports the joint effect of $LVGR_{bt}$ and $Distance_{bt}$ on the portfolio allocation of banks towards risky firms. 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 1.2% to 1.5% to a firm in the next worse rating class when the bank capital ratio increases by one percentage point. Holding $LVGR_{bt}$

[26]The 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.

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.

Panel C of Table 7 reports the results of a differences-in-differences analysis on banks' loan portfolio composition (regression (7)), 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 loan portfolio allocation towards risky firms. We find the regulatory 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.

5.4 Additional Analyses and Robustness

In the Appendix, we replicate regressions (6) and (7) on the sample of new borrowers only, a sample including loans syndicated outside the U.S., a sample excluding crisis observations, and on a sample including the "new entrants" in the group of stressed banks. We show the robustness of regression (7) to alternative measures of firm risk. We propose placebo tests in the differences-in-differences analyses. Finally, we show how our results are affected by relaxing the bank*quarter fixed effects (but keeping the firm*quarter fixed effects) in order to analyze the amounts different banks lends to a risky firm, instead of focusing on the compositional changes in bank portfolios.

5.4.1 Loans to New Borrowers

New borrowers are firms to which a bank did not grant any loan in the previous quarter. Focusing on new borrowers provides an additional test to mitigate concerns related to relationship lending and persistence of risk taking. We find in Table A6 that our results are robust to focusing on new borrowers only. For example, 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 stressed and non-stressed banks of 23 bps and 67 bps, respectively, after DFA.

5.4.2 Loans Syndicated Outside the U.S.

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. Table A7 shows that our results are overall robust to the inclusion of international loans.

5.4.3 Excluding Crisis Observations

The differences in risk taking between the pre- and post-DFA periods could be driven by crisis observations in the pre-DFA period. To address this concern, we replicate the differences-in-differences regressions excluding the period between the third quarter of 2007 and the third quarter 2010 (the quarter just before DFA). Results are in Table A8. 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 stressed and non-stressed banks of 65 bps and 90 bps, respectively, after DFA.

5.4.4 Including New Entrants

Including new entrants increases our sample of stressed banks even though we do not have many observations for these new entrants when they become "stressed". We include the new entrants in the group of stressed banks, and keep DFA as the treatment date.[27] We show in Table A9 that our results are robust to including new entrants in the group of stressed banks.

5.4.5 Alternative Firm Risk Measures

Table A10 reports the estimates from regression (7) for different measures of $Firm\,risk_{ft}$. As alternative measures to the numerical credit rating of the firm $rating_{ft}$, we consider a dummy

[27]Most new entrants were subject to a milder form of the regulatory stress test (the Capital Plan Review) after DFA and before being part of the CCAR in 2014. The error of measurement for the capital requirement of new entrants comes from the fact that we do not know their capital requirements under the Capital Plan Review.

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, and Altman's z-score ($zScore_{ft}$). While $rating_{ft}$ and $speculative_{ft}$ are measures increasing with firm risk, $rated_{ft}$ and $zScore_{ft}$ are decreasing with firm risk (e.g. $rated_{ft} = 0$ reflects firm opacity). The table shows that our results are robust to using other measures of risk than the rating of the firm, and most importantly, the signs of the estimates are consistent with the two channels of risk taking.

5.4.6 Placebo Tests

In Table A11, we consider three placebo tests for the differences-in-differences regressions using the introduction of Basel III and the advanced approach to derive risk-weighted assets in stress tests instead of the DFA date, using a different size threshold to define the group of treated (or "stressed") banks, and using firm size instead of a measure of firm risk in the analysis of the loan portfolio composition. All placebo tests lead to non-significant results confirming our results of the two channels of risk taking following DFA.

5.4.7 Relaxing Bank*Quarter Fixed Effects

Finally, we relax the bank*quarter fixed effects and replace them by bank and quarter fixed effects, and include bank-specific control variables in addition to these variables being interacted with the firm rating. Thus, the regressions describe a change in the credit supply to risky firms while the credit demand of firms is held constant in a given quarter. In this case, we can interpret the regulatory monitoring effect as a differential response to DFA in the amount stressed banks lend to the same risky firm compared to non-stressed banks.

In Table A12, the estimates suggest that stressed banks (respectively non-stressed banks) do not decrease (respectively increase) more their supply of loans to risky due to regulatory monitoring after DFA, holding their capital requirement constant. Therefore, our benchmark results on the loan portfolio composition are only valid in terms of an interpretation of banks' portfolio reallocation.

Stressed banks reallocate their loan portfolio more towards firms with better ratings after DFA, holding their capital requirement constant.

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. While stringent capital requirements give both stressed and non-stressed banks motives to invest in risky assets, we document 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 on 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 (2013)), 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. 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 (2013).

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 reduce the risk of large financial institutions in the U.S.

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^s_{1b}, k^s_{2b}, k^s_{3b}, k^s_{4b} 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^s_{1b})	CET1R (k^s_{1b})	T1R (k^s_{2b})	TotalR (k^s_{3b})	LVGR (k^s_{4b})	$Cap\,req_b$
2016	-	7.6	9.5	11.5	6.4	7.5
2015	7.8	-	9.9	12.1	6.2	7.8
2014	8.1	-	9.4	11.5	5.9	7.6
2013	9.1	-	6.8	12.2	5.3	6.9
2012	8.5	-	6.8	11.9	5.1	6.8

Panel C: Average Actual Capital Ratios (%)					
	T1CR	CET1R	T1R	TotalR	LVGR
2016	-	12.5	13.6	15.8	9.8
2015	12.7	-	14.1	16.6	9.9
2014	11.7	-	13.1	15.7	9.7
2013	11.3	-	13.1	15.6	8.8
2012	10.4	-	12.7	15.6	8.7

Table 2
Bank Asset Income and Capital Requirements

The table reports estimates from the regression

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

where, for bank b in year t, $\triangle asset\,income_{bt}$ 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. Control variables include the logarithm of bank's total assets (bank size), the ratio of liquid assets to total assets (bank liquidity), the ratio of bank net income to total assets (bank profitability), the ratio of trading assets to total assets (bank trading activity). $Cap\,req_{bt}$ is the bank-specific single capital requirement as defined in Equation (4). k^s_{1bt}, k^s_{2bt}, k^s_{3bt}, k^s_{4bt} 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.

Panel A: Change in Asset Income/Assets										
$Cap\,req_{bt}$	2.22	2.51								
	(3.13)	(3.29)								
CET1R Req. (k^s_{1bt})			1.75	1.94						
			(2.85)	(3.85)						
T1R Req. (k^s_{2bt})					2.25	2.34				
					(2.97)	(2.95)				
TotalR Req. (k^s_{3bt})							1.95	2.00		
							(3.11)	(2.99)		
LVGR Req. (k^s_{4bt})									3.72	3.95
									(4.95)	(6.30)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y	N	Y	N	Y
R^2 (%)	21.45	27.20	23.83	24.33	19.47	25.31	21.11	26.13	16.88	31.28
Adj. R^2 (%)	16.77	19.01	19.30	15.82	14.67	16.91	16.41	17.81	11.93	23.55

Panel B: Change in Loan Interest Income/Loans										
$Cap\,req_{bt}$	3.03	3.52								
	(1.58)	(1.63)								
CET1R Req. (k^s_{1bt})			3.32	3.56						
			(1.84)	(2.02)						
T1R Req. (k^s_{2bt})					2.46	2.73				
					(1.21)	(1.19)				
TotalR Req. (k^s_{3bt})							2.01	2.29		
							(1.27)	(1.26)		
LVGR Req. (k^s_{4bt})									6.32	6.39
									(1.99)	(2.10)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y	N	Y	N	Y
R^2 (%)	22.60	25.54	36.59	32.48	14.85	18.46	14.72	18.73	29.34	37.91
Adj. R^2 (%)	17.99	17.17	32.82	24.88	9.78	9.29	9.64	9.59	25.14	30.93

Panel C: Change in Trading and Securities Revenues/Assets										
$Cap\,req_{bt}$	0.31	0.99								
	(1.21)	(2.84)								
CET1R Req. (k^s_{1bt})			1.18	0.72						
			(2.05)	(2.66)						
T1R Req. (k^s_{2bt})					1.56	0.97				
					(3.14)	(3.16)				
TotalR Req. (k^s_{3bt})							1.24	0.76		
							(2.96)	(3.25)		
LVGR Req. (k^s_{4bt})									1.53	1.39
									(2.33)	(2.86)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y	N	Y	N	Y
R^2 (%)	7.40	40.33	17.57	38.91	20.87	40.13	20.03	39.60	13.24	40.37
Adj. R^2 (%)	1.89	33.61	12.66	32.04	16.16	33.40	15.27	32.80	8.08	33.67

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 into 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 for 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		
	All Stress Tests			New Entrants					
	Before	After	Change	Before	After	Change	Before	After	Change
All-in-Drawn Spread (bps)	233.05	283.97	50.92	193.35	256.55	63.21	250.88	316.67	65.79
Maturity (Months)	45.14	53.79	8.65	44.16	55.28	11.13	47.25	55.39	8.14
Facility Amount (USD mn)	293.42	422.84	129.41	397.41	574.97	177.56	288.18	226.78	-61.40
Number of Facilities	37780	24289	-13491	13664	9902	-3762	2916	3635	719
Bank Amount (USD mn)	52.88	73.45	20.57	33.78	45.67	11.89	14.42	17.10	2.68
Bank Allocation (%)	13.86	11.70	-2.16	9.96	7.15	-2.81	13.37	9.75	-3.63

Table 4

MONITORING VERSUS CAPITAL REQUIREMENTS: EFFECT ON PORTFOLIO YIELD

The table reports estimates from the regression:

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

where $portfolio\,yield_{bt}$ 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, $Cap\,req_{bt}$ 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 liquid assets to total assets, the ratio of bank net income to total assets, the ratio of trading assets to total assets, the weighted average portfolio maturity, and the percentage of secured loans of the bank in quarter t. $\triangle$E($portfolio\,yield_{bt}|stressed_b = 0, \overline{Capreq_{bt}}$) and $\triangle$E($portfolio\,yield_{bt}|stressed_b = 1, \overline{Capreq_{bt}}$) 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.

	Portfolio Yield				
$stressed_b * DFA_t$	9.70	8.31	-196.75	-192.77	-185.60
	(1.15)	(1.16)	(-4.16)	(-3.69)	(-3.67)
$\triangle$E($portfolio\,yield_{bt}\|stressed_b = 0, \overline{Capreq_{bt}}$)	39.43	39.43	51.37	50.08	45.95
$\triangle$E($portfolio\,yield_{bt}\|stressed_b = 1, \overline{Capreq_{bt}}$)	21.37	21.37	21.54	21.53	21.50
$stressed_b * DFA_t * Cap\,req_{bt}$			42.96	42.22	41.05
			(4.18)	(3.60)	(3.58)
Controls	N	Y	N	Y	Y
Bank and Time FE	Y	Y	Y	Y	Y
$stressed_b * DFA_t * portfolio\,yield_{bt-1}$	N	N	N	N	Y
R^2 (%)	69.49	72.23	71.17	73.63	73.78
Adj. R^2 (%)	66.89	69.68	68.59	71.09	71.14
Observations	1084	1084	1084	1084	1084
Banks	29	29	29	29	29

Table 5

MONITORING VERSUS CAPITAL REQUIREMENTS: EFFECT ON LOAN PORTFOLIO COMPOSITION

The table reports estimates from the regression:

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

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, $Cap\,req_{bt}$ 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 loan-level control variables include loan maturity, a dummy variable indicating whether the loan is secured, and fixed effects for loan types and purposes. The bank-level control variables include the logarithm of bank's total assets, the ratio of liquid assets to total assets, the ratio of bank net income to total assets, and the ratio of trading assets to total assets. Regressions are saturated with bank*quarter and firm*quarter fixed effects. $\triangle\text{E}(amount_{fbt}|stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$ and $\triangle\text{E}(amount_{fbt}|stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$ 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 are in parentheses.

log(amount)				
$stressed_b * DFA_t * Firm\,risk_{ft}$	-0.09	-0.05	-1.47	-0.69
	(-1.31)	(-0.95)	(-4.72)	(-3.16)
$\triangle\text{E}(amount_{fbt}\|stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$	0.06	0.05	-0.67	-0.97
$\triangle\text{E}(amount_{fbt}\|stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$	0.96	0.32	0.98	6.36
$stressed_b * DFA_t * Cap\,req_{bt} * Firm\,risk_{ft}$			0.30	0.14
			(4.56)	(3.01)
Loan-Level Controls	N	Y	N	Y
Bank-Level Controls*Firm risk	N	Y	N	Y
Firm*Time FE	Y	Y	Y	Y
Bank*Time FE	Y	Y	Y	Y
Loan Characteristics FE	N	Y	N	Y
R^2 (%)	73.04	74.50	73.25	73.32
Adjusted R^2 (%)	66.92	68.64	67.17	67.26
Observations	21174	21174	21174	21174
Bank*Time	894	894	894	894
Firm*Time	3018	3018	3018	3018

Table 6

Risk Taking and Capital Requirements: the Effect of Stress Tests

The table reports estimates from regressions of portfolio yield (Panel A) and loan amounts (Panels B and C) on variables described in Table 4 and 5, 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:

$$Cap\,req_{bt} = Cap\,req^*_{bt} + Stress_{bt},$$

where $Cap\,req_{bt} = \max(k_{1b}, k_{2b}, k_{3b}, k_4, k'_{1b}, k'_{2b}, k'_{3b}, k'_{4b})$, $Cap\,req^*_{bt} = \max(k_{1b}, k_{2b}, k_{3b}, k_4)$. The variable $Stress_{bt} = Cap\,req_{bt} - Cap\,req^*_{bt}$ 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, and 5. $\triangle\text{E}(portfolio\,yield_{bt}|stressed_b = 0, \overline{Capreq_{bt}}, Stress_{bt} = 0)$ and $\triangle\text{E}(portfolio\,yield_{bt}|stressed_b = 1, \overline{Capreq_{bt}}, Stress_{bt} = 0)$ 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. $\triangle\text{E}(amount_{fbt}|stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}}, Stress_{bt} = 0)$ and $\triangle\text{E}(amount_{fbt}|stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}}, Stress_{bt} = 0)$ 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), and at the bank*quarter and firm*quarter level (Panel B and C) are in parentheses.

Panel A: Portfolio Yield			
$stressed_b * DFA_t$	-203.23	-204.35	-196.14
	(-4.06)	(-3.62)	(-3.72)
$\triangle\text{E}(portfolio\,yield_{bt}\|stressed_b = 0, \overline{Capreq_{bt}}, Stress_{bt} = 0)$	51.39	50.35	46.30
$\triangle\text{E}(portfolio\,yield_{bt}\|stressed_b = 1, \overline{Capreq_{bt}}, Stress_{bt} = 0)$	27.40	29.66	31.34
$Stress_{bt}$	-3.53	-4.90	-5.93
	(-0.47)	(-0.71)	(-0.85)
$stressed_b * DFA_t * Cap\,req_{bt}$	44.66	45.10	44.31
	(4.08)	(3.53)	(3.58)
Controls	N	Y	Y
Bank and Time FE	Y	Y	Y
$stressed_b * DFA_t * portfolio\,yield_{bt-1}$	N	N	Y
R^2 (%)	71.18	73.65	73.81
Adjusted R^2 (%)	68.57	71.09	71.14
Observations	1084	1084	1084
Banks	29	29	29

Panel B: log(amount)				
$Cap\,req_{bt} * Firm\,risk_{ft}$	0.013	0.007	0.022	0.020
	(4.38)	(2.23)	(5.87)	(2.93)
$Stress_{bt} * Firm\,risk_{ft}$			-0.022	-0.018
			(-4.45)	(-2.39)
Loan-Level Controls	N	Y	N	Y
Bank-Level Controls*Firm risk	N	Y	N	Y
Firm*Time FE	Y	Y	Y	Y
Bank*Time FE	Y	Y	Y	Y
Loan Characteristics FE	N	Y	N	Y
R^2 (%)	73.12	74.50	73.18	74.52
Adjusted R^2 (%)	67.03	68.65	67.10	68.67
Observations	21174	21174	21174	21174
Bank*Time	894	894	894	894
Firm*Time	3018	3018	3018	3018

Panel C: log(amount) (diff-in-diff)		
$stressed_b * DFA_t * Firm\,risk_{ft}$	-1.525	-0.719
	(-5.02)	(-3.30)
$\triangle$E$(amount_{fbt} \| stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}}, Stress_{bt} = 0)$	-0.66	-1.26
$\triangle$E$(amount_{fbt} \| stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}}, Stress_{bt} = 0)$	2.30	14.28
$Stress_{bt} * Firm\,risk_{ft}$	-0.022	-0.017
	(-4.07)	(-2.48)
$stressed_b * DFA_t * Cap\,req_{bt} * Firm\,risk_{ft}$	0.317	0.145
	(4.91)	(3.21)
Loan-Level Controls	N	Y
Bank-Level Controls*Firm risk	N	Y
Firm*Time FE	Y	Y
Bank*Time FE	Y	Y
Loan Characteristics FE	N	Y
R^2 (%)	73.28	74.55
Adjusted R^2 (%)	67.22	68.69
Observations	21174	21174
Bank*Time	894	894
Firm*Time	3018	3018

Table 7
Bank Capitalization and Distance from Capital Requirement

The table reports estimates from regressions of portfolio yield (Panel A) and loan amounts (Panels B and C) on variables described in Table 4 and 5, 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, and 5. $\triangle\text{E}(portfolio\,yield_{bt}|stressed_b = 0, \overline{LVGR_{bt}}, \overline{Distance_{bt}})$ and $\triangle\text{E}(portfolio\,yield_{bt}|stressed_b = 1, \overline{LVGR_{bt}}, \overline{Distance_{bt}})$ 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. $\triangle\text{E}(amount_{fbt}|stressed_b = 0, speculative_{ft} = 0, \overline{LVGR_{bt}}, \overline{Distance_{bt}})$ and $\triangle\text{E}(amount_{fbt}|stressed_b = 1, speculative_{ft} = 0, \overline{LVGR_{bt}}, \overline{Distance_{bt}})$ 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), and at the bank*quarter and firm*quarter level (Panel B and C) are in parentheses.

Panel A: Portfolio Yield

$stressed_b * DFA_t$	-221.91	-245.98	-244.51
	(-2.65)	(-2.76)	(-3.24)
$\triangle\text{E}(portfolio\,yield_{bt}\|stressed_b = 0, \overline{LVGR_{bt}}, \overline{Distance_{bt}})$	65.55	72.76	72.88
$\triangle\text{E}(portfolio\,yield_{bt}\|stressed_b = 1, \overline{LVGR_{bt}}, \overline{Distance_{bt}})$	21.99	21.81	22.34
$stressed_b * DFA_t * LVGR_{bt}$	40.66	40.65	40.16
	(3.01)	(2.94)	(3.16)
$stressed_b * DFA_t * Distance_{bt}$	-33.16	-27.30	-20.57
	(-2.86)	(-2.50)	(-1.92)
Controls	N	Y	Y
Bank and Time FE	Y	Y	Y
$stressed_b * DFA_t * portfolio\,yield_{bt-1}$	N	N	Y
R^2 (%)	71.30	73.90	74.20
Adjusted R^2 (%)	68.60	71.27	71.49
Observations	1084	1084	1084
Banks	29	29	29

Panel B: log(amount)		
$LVGR_{bt} * Firm\,risk_{ft}$	0.015	0.012
	(5.45)	(3.45)
$Distance_{bt} * Firm\,risk_{ft}$	-0.003	-0.003
	(-0.99)	(-0.98)
Loan-Level Controls	N	Y
Bank-Level Controls*Firm risk	N	Y
Firm*Time FE	Y	Y
Bank*Time FE	Y	Y
Loan Characteristics FE	N	Y
R^2 (%)	73.18	74.53
Adjusted R^2 (%)	67.10	68.67
Observations	21174	21174
Bank*Time	894	894
Firm*Time	3018	3018

Panel C: log(amount) (diff-in-diff)		
$stressed_b * DFA_t * Firm\,risk_{ft}$	-1.686	-0.857
	(-6.72)	(-4.08)
$\triangle \text{E}(amount_{fbt} \| stressed_b = 0, speculative_{ft} = 0, \overline{LVGR_{bt}}, \overline{Distance_{bt}})$	0.49	11.71
$\triangle \text{E}(amount_{fbt} \| stressed_b = 1, speculative_{ft} = 0, \overline{LVGR_{bt}}, \overline{Distance_{bt}})$	1.44	11.27
$stressed_b * DFA_t * LVGR_{bt} * Firm\,risk_{ft}$	0.209	0.065
	(3.65)	(1.35)
$stressed_b * DFA_t * Distance_{bt} * Firm\,risk_{ft}$	-0.043	0.069
	(-0.48)	(0.86)
Loan-Level Controls	N	Y
Bank-Level Controls*Firm risk	N	Y
Firm*Time FE	Y	Y
Bank*Time FE	Y	Y
Loan Characteristics FE	N	Y
R^2 (%)	73.31	74.57
Adjusted R^2 (%)	67.24	68.71
Observations	21174	21174
Bank*Time	894	894
Firm*Time	3018	3018

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 face if they were not 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.

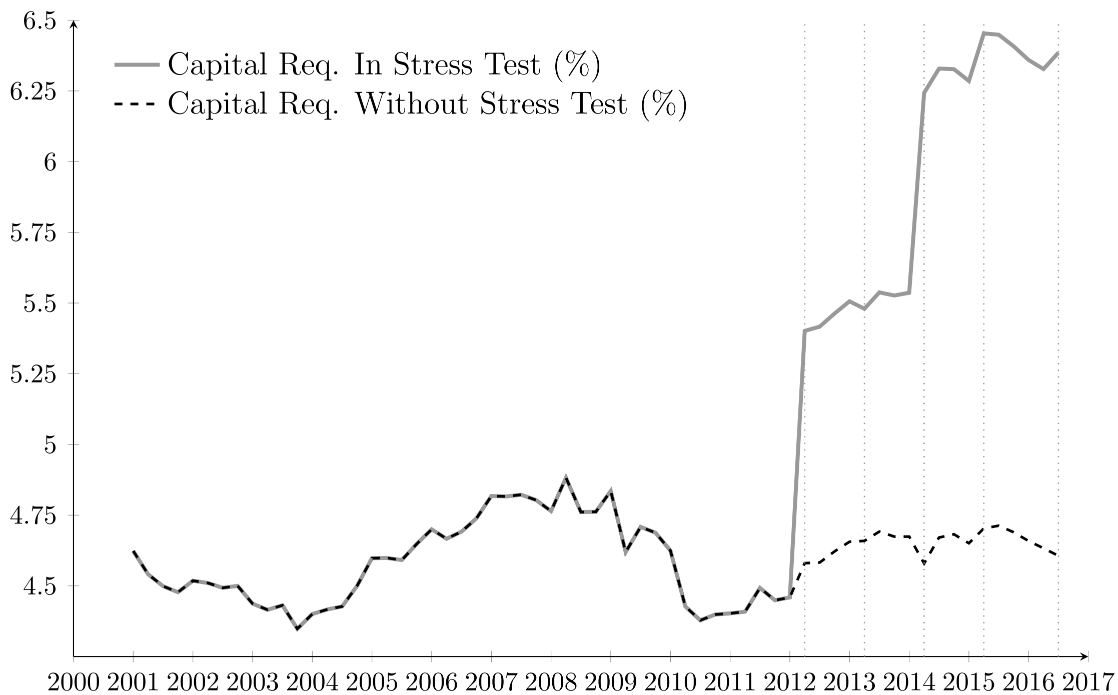


Figure 2
STRESS TEST TIMELINE

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.

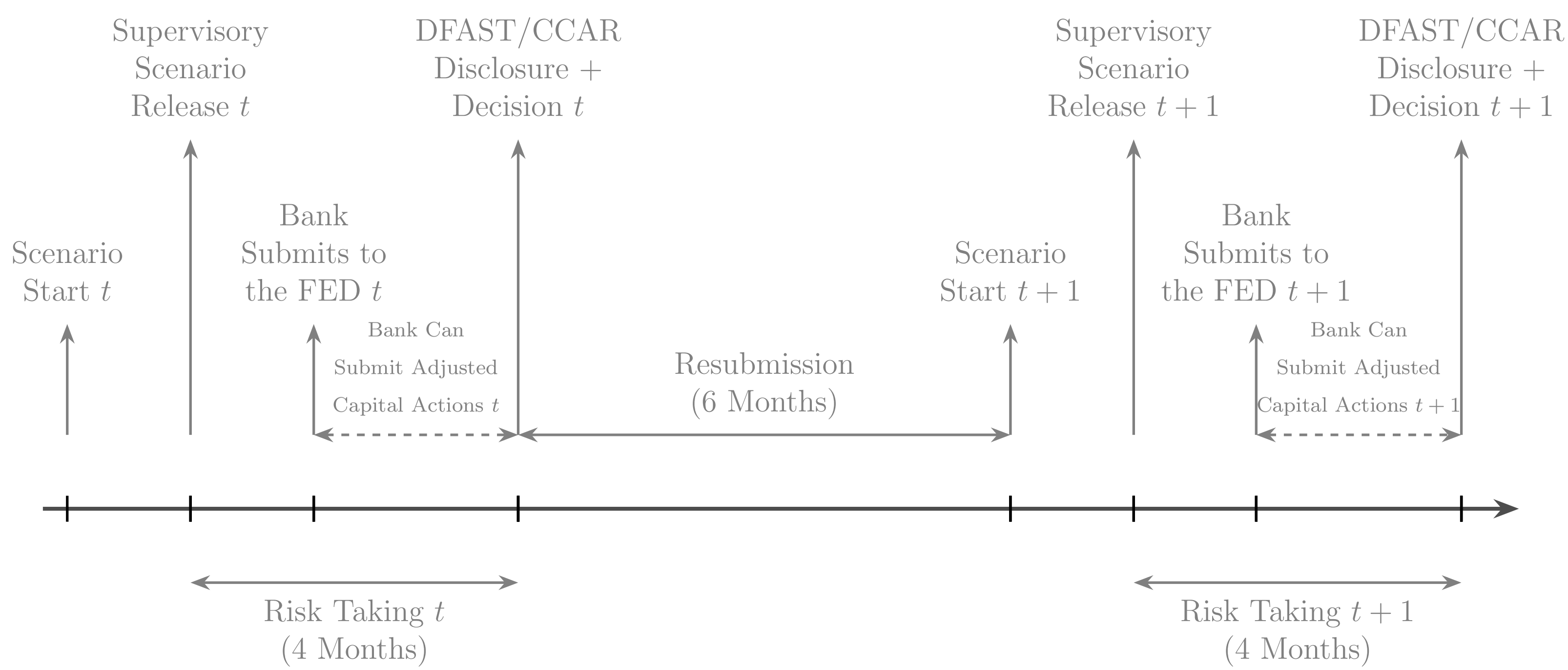


Figure 3

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.

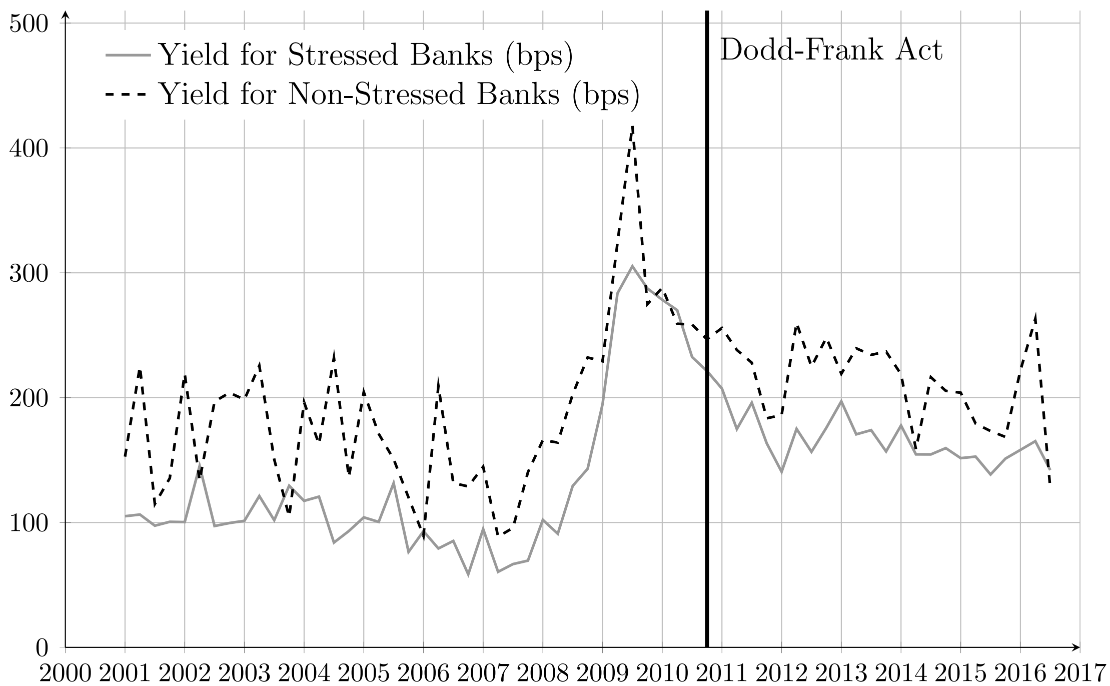


Figure 4
Portfolio Yield: Monitoring Effect

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 substracting 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.

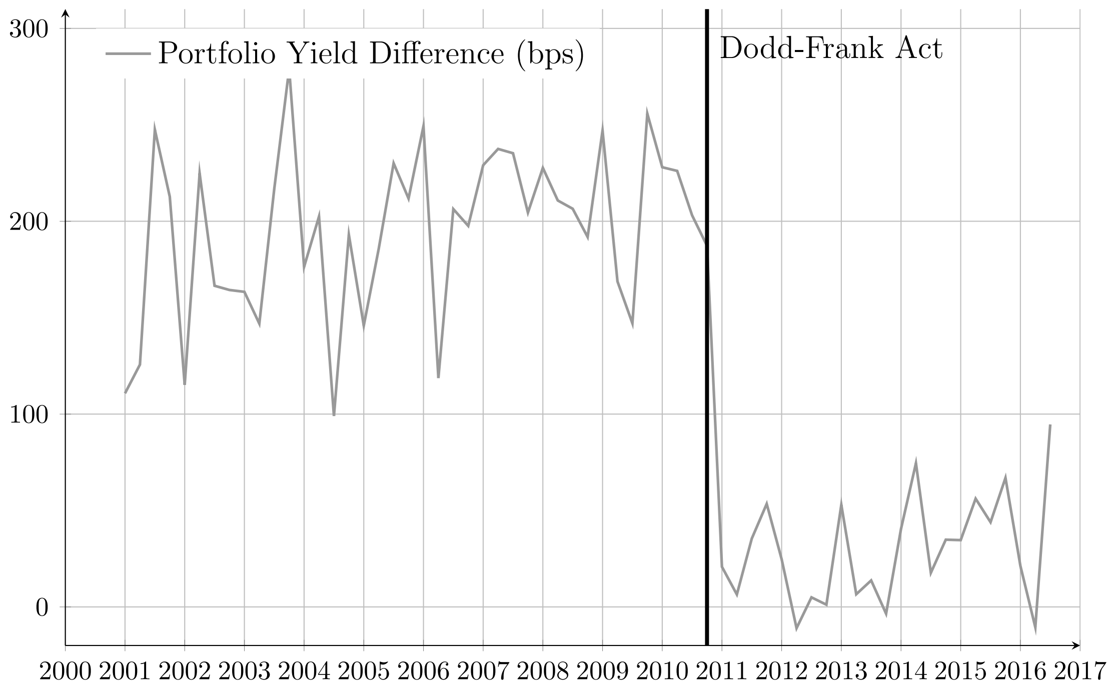
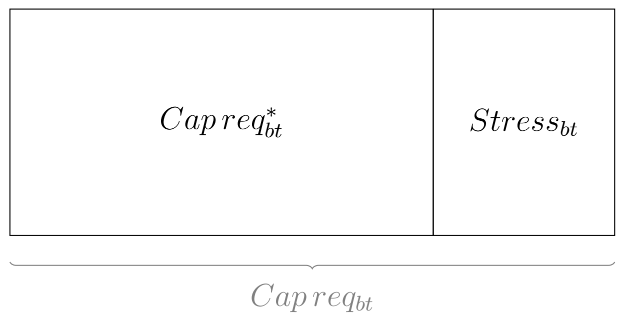


Figure 5

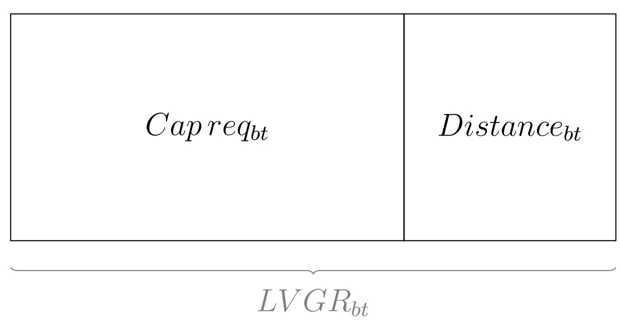
Two Decompositions of Capital Requirements

The figure provides a graphical illustration of the two decompositions of capital requirements discussed in Section 4.2.4.

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



Panel B: Bank Capitalization and Distance from Capital Requirements



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); inspections of the parallel trend assumption for the yield (Table A4) and the loan portfolio composition (Table A5) analyses; additional robustness checks related to the restricted sample of new borrowers only (Table A6), to the extended sample including loans syndicated outside the U.S. (Table A7), to the exclusion of crisis observations (Table A8), to the sample including new entrants (Table A9), to alternative measures of firm risk (Table A10), to placebo tests (Table A11), and to the relaxation of bank*quarter fixed effects in the loan composition analysis (Table A12); the definitions of the variables used in the analyses (Table A13); 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

Capitalization and Market Measures of Risk: 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: PARALLEL TREND ASSUMPTION (PORTFOLIO YIELD)

The table reports estimates from the regression:

$$\begin{aligned} portfolio\,yield_{bt|DFA_t=0} &= \alpha_b + \beta_1 stressed_b * trend_t + \beta_2 trend_t \\ &\quad + \beta_3 Cap\,req_{bt} + \beta_4 stressed_b * Cap\,req_{bt} \\ &\quad + \gamma' controls_{bt} + \epsilon_{bt}, \end{aligned}$$

where $portfolio\,yield_{bt}$ 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, $trend_t$ is a linear trend, $stressed_b$ 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, $Cap\,req_{bt}$ 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 liquid assets to total assets, the ratio of bank net income to total assets, the ratio of trading assets to total assets, the weighted average portfolio maturity, and the percentage of secured loans of the bank in quarter t. 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.

	Portfolio Yield (Before DFA)			
$stressed_b * trend_t$	2.40	2.13	2.36	1.85
	(1.64)	(1.50)	(2.14)	(1.60)
$trend_t$	2.30	2.93	2.34	3.09
	(1.64)	(2.33)	(2.21)	(2.94)
$Cap\,req_{bt}$			2.93	21.91
			(0.11)	(0.82)
$stressed_b * Cap\,req_{bt}$			-19.30	-24.89
			(-0.59)	(-1.03)
Controls	N	Y	N	Y
Bank and Time FE	Y	Y	Y	Y
R^2 (%)	46.27	61.37	46.90	61.58
Adjusted R^2 (%)	43.53	58.96	43.98	59.02
Observations	578	578	578	578
Banks	27	27	27	27

Table A5

MONITORING VERSUS CAPITAL REQUIREMENTS: PARALLEL TREND ASSUMPTION (LOAN PORTFOLIO COMPOSITION)

The table reports estimates from the regression:

$$\begin{aligned}\log(amount_{fbt|DFA=0}) &= \alpha_{bt} + \alpha_{ft} + \beta_1 stressed_b * trend_t * Firm\,risk_{ft} \\ &+ \beta_2 stressed_b * Firm\,risk_{ft} + \beta_3 Cap\,req_{bt} * Firm\,risk_{ft} \\ &+ \beta_4 stressed_b * Cap\,req_{bt} * Firm\,risk_{ft} + \gamma' controls_{fbt} + \epsilon_{fbt},\end{aligned}$$

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, $Cap\,req_{bt}$ is the capital requirement of bank b at date t as defined by Equation (3) , and $Firm\,risk_{ft}$ is the firm's numerical rating (1 is AAA; 23 is D). Loan- and bank-level control variables are defined as in Table 5. Regressions are saturated with bank*quarter and firm*quarter 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*quarter and firm*quarter level.

	log(amount) (Before DFA)			
$stressed_b * trend_t * Firm\,risk_{ft}$	0.002	0.003	0.005	0.006
	(0.32)	(0.75)	(1.06)	(1.27)
$stressed_b * Firm\,risk_{ft}$	0.022	0.021	0.504	0.291
	(0.15)	(0.17)	(2.58)	(1.13)
$Cap\,req_{bt} * Firm\,risk_{ft}$			0.144	0.088
			(4.41)	(2.23)
$stressed_b * Cap\,req_{bt} * Firm\,risk_{ft}$			-0.122	-0.072
			(-3.69)	(-1.71)
Loan-Level Controls	N	Y	N	Y
Bank-Level Controls*Firm Risk	N	Y	N	Y
Firm*Time FE	Y	Y	Y	Y
Bank*Time FE	Y	Y	Y	Y
Loan Characteristics FE	N	Y	N	Y
R^2 (%)	74.01	75.46	74.27	75.51
Adjusted R^2 (%)	67.49	69.17	67.80	69.23
Observations	12253	12253	12253	12253
Bank*Time	480	480	480	480
Firm*Time	1977	1977	1977	1977

Table A6

MONITORING VERSUS CAPITAL REQUIREMENTS: LOANS TO NEW BORROWERS (ROBUSTNESS)

The table is a replica of Table 4 (Panel A) and Table 5 (Panel B) on a subsample including only loans to new borrowers.

Panel A: Portfolio Yield (Loans to New Borrowers)			
$stressed_b * DFA_t$	-200.58	-206.22	-190.21
	(-4.27)	(-4.34)	(-3.95)
$\triangle$E$(portfolio\, yield_{bt}\|stressed_b = 0, \triangle\overline{Capreq_{bt}})$	67.49	64.39	63.54
$\triangle$E$(portfolio\, yield_{bt}\|stressed_b = 1, \triangle\overline{Capreq_{bt}})$	23.39	23.41	23.39
$stressed_b * DFA_t * Cap\, req_{bt}$	42.29	43.62	41.07
	(4.37)	(4.14)	(4.26)
Controls	N	Y	Y
Bank and Time FE	Y	Y	Y
$stressed_b * DFA_t * portfolio\, yield_{bt-1}$	N	N	Y
R^2 (%)	71.92	74.62	74.70
Adjusted R^2 (%)	69.33	72.09	72.06
Observations	1052	1052	1052
Banks	29	29	29

Panel B: log(amount) (Loans to New Borrowers)		
$stressed_b * DFA_t * Firm\,risk_{ft}$	-1.54	-0.65
	(-3.43)	(-1.78)
$\triangle$E($amount_{fbt}$|$stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}}$)	-0.38	-0.21
$\triangle$E($amount_{fbt}$|$stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}}$)	0.84	3.27
$stressed_b * DFA_t * Cap\,req_{bt} * Firm\,risk_{ft}$	0.33	0.14
	(3.42)	(1.82)
Loan-Level Controls	N	Y
Bank-Level Controls*Firm risk	N	Y
Firm*Time FE	Y	Y
Bank*Time FE	Y	Y
Loan Characteristics FE	N	Y
R^2 (%)	75.07	76.33
Adjusted R^2 (%)	67.55	69.07
Observations	13992	13992
Bank*Time	823	823
Firm*Time	2416	2416

Table A7

MONITORING VERSUS CAPITAL REQUIREMENTS: INCLUDING LOANS SYNDICATED OUTSIDE THE U.S. (ROBUSTNESS)

The table is a replica of Table 4 (Panel A) and Table 5 (Panel B) on an extended sample that includes loans originated outside the U.S.

Panel A: Portfolio Yield (Including Loans Outside U.S.)			
$stressed_b * DFA_t$	-158.41	-136.52	-88.47
	(-3.47)	(-2.42)	(-1.28)
$\triangle$E$(portfolio\,yield_{bt} \mid stressed_b = 0, \triangle\overline{Capreq_{bt}})$	58.24	55.97	50.25
$\triangle$E$(portfolio\,yield_{bt} \mid stressed_b = 1, \triangle\overline{Capreq_{bt}})$	21.66	21.95	21.87
$stressed_b * DFA_t * Cap\,req_{bt}$	34.00	29.93	24.22
	(3.30)	(2.32)	(1.73)
Controls	N	Y	Y
Bank and Time FE	Y	Y	Y
$stressed_b * DFA_t * portfolio\,yield_{bt-1}$	N	N	Y
R^2 (%)	66.34	69.60	70.21
Adjusted R^2 (%)	63.37	66.71	67.26
Observations	1097	1097	1097
Banks	29	29	29

Panel B: log(amount) (Including Loans Outside U.S.)		
$stressed_b * DFA_t * Firm\,risk_{ft}$	-1.47	-0.69
	(-4.74)	(-3.23)
$\triangle\text{E}(amount_{fbt}\|stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$	-0.66	-0.77
$\triangle\text{E}(amount_{fbt}\|stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$	0.95	6.32
$stressed_b * DFA_t * Cap\,req_{bt} * Firm\,risk_{ft}$	0.30	0.14
	(4.57)	(3.08)
Loan-Level Controls	N	Y
Bank-Level Controls*Firm risk	N	Y
Firm*Time FE	Y	Y
Bank*Time FE	Y	Y
Loan Characteristics FE	N	Y
R^2 (%)	73.73	74.96
Adjusted R^2 (%)	67.67	69.10
Observations	22155	22153
Bank*Time	894	894
Firm*Time	3255	3255

Table A8

MONITORING VERSUS CAPITAL REQUIREMENTS: EXCLUDING CRISIS OBSERVATIONS (ROBUSTNESS)

The table is a replica of Table 4 (Panel A) and Table 5 (Panel B) on a subsample that excludes the period surrounding the financial crisis (from 2007Q3 until 2010Q3).

Panel A: Portfolio Yield (Excluding Crisis Observations)			
$stressed_b * DFA_t$	-307.98	-235.14	-255.91
	(-3.50)	(-3.37)	(-3.25)
$\triangle$E$(portfolio\,yield_{bt} \mid stressed_b = 0, \triangle\overline{Capreq_{bt}})$	89.74	89.84	87.94
$\triangle$E$(portfolio\,yield_{bt} \mid stressed_b = 1, \triangle\overline{Capreq_{bt}})$	64.50	64.55	64.53
$stressed_b * DFA_t * Cap\,req_{bt}$	67.26	51.73	54.65
	(3.59)	(3.44)	(2.92)
Controls	N	Y	Y
Bank and Time FE	Y	Y	Y
$stressed_b * DFA_t * portfolio\,yield_{bt-1}$	N	N	Y
R^2 (%)	67.72	70.73	70.87
Adjusted R^2 (%)	64.51	67.56	67.53
Observations	828	828	828
Banks	29	29	29

Panel B: log(amount) (Excluding Crisis Observations)		
$stressed_b * DFA_t * Firm\,risk_{ft}$	-1.62	-0.98
	(-5.71)	(-4.37)
$\triangle$E$(amount_{fbt} \vert stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$	-0.35	-0.82
$\triangle$E$(amount_{fbt} \vert stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$	0.75	6.44
$stressed_b * DFA_t * Cap\,req_{bt} * Firm\,risk_{ft}$	0.34	0.21
	(5.67)	(4.39)
Loan-Level Controls	N	Y
Bank-Level Controls*Firm risk	N	Y
Firm*Time FE	Y	Y
Bank*Time FE	Y	Y
Loan Characteristics FE	N	Y
R^2 (%)	73.18	74.42
Adjusted R^2 (%)	67.25	68.67
Observations	18067	18067
Bank*Time	696	696
Firm*Time	2569	2569

Table A9

MONITORING VERSUS CAPITAL REQUIREMENTS: INCLUDING NEW ENTRANTS (ROBUSTNESS)

The table is a replica of Table 4 (Panel A) and Table 5 (Panel B) on an extended sample that includes the "new entrants" in the group of stressed banks.

Panel A: Portfolio Yield (Including New Entrants)			
$stressed_b * DFA_t$	-198.29	-191.88	-174.83
	(-4.20)	(-3.83)	(-3.45)
$\triangle$E$(portfolio\,yield_{bt}\|stressed_b = 0, \triangle\overline{Capreq_{bt}})$	40.44	40.62	38.79
$\triangle$E$(portfolio\,yield_{bt}\|stressed_b = 1, \triangle\overline{Capreq_{bt}})$	23.55	23.55	23.51
$stressed_b * DFA_t * Cap\,req_{bt}$	42.95	41.48	39.58
	(4.13)	(3.68)	(3.37)
Controls	N	Y	Y
Bank and Time FE	Y	Y	Y
$stressed_b * DFA_t * portfolio\,yield_{bt-1}$	N	N	Y
R^2 (%)	69.58	72.98	73.11
Adjusted R^2 (%)	67.49	71.01	71.07
Observations	1591	1591	1591
Banks	42	42	42

Panel B: log(amount) (Including New Entrants)		
$stressed_b * DFA_t * Firm\,risk_{ft}$	-1.46	-0.71
	(-5.00)	(-3.28)
$\triangle\text{E}(amount_{fbt}\|stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$	-0.87	-2.97
$\triangle\text{E}(amount_{fbt}\|stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$	1.05	11.76
$stressed_b * DFA_t * Cap\,req_{bt} * Firm\,risk_{ft}$	0.30	0.14
	(4.84)	(3.15)
Loan-Level Controls	N	Y
Bank-Level Controls*Firm risk	N	Y
Firm*Time FE	Y	Y
Bank*Time FE	Y	Y
Loan Characteristics FE	N	Y
R^2 (%)	73.43	74.64
Adjusted R^2 (%)	67.96	69.35
Observations	25656	25656
Bank*Time	1304	1304
Firm*Time	3074	3074

Table A10

Monitoring Versus Capital Requirements: Alternative Firm Risk Measures (Robustness)

The table is a replica of Table 5 using alternative firm risk measures. Rated is a dummy variable equal to one if the firm has a rating assigned in Compustat, Speculative is a dummy variable equal to one if the firm's rating is worse than BBB, Z-Score is Altman's z-score.

	log(amount) (Alternative Firm Risk Measures)					
	Rated		Speculative		Z-Score	
$stressed_b * DFA_t * Firm\,risk_{ft}$	1.08	0.48	-0.82	-2.05	1.32	1.37
	(2.15)	(1.11)	(-0.85)	(-2.02)	(2.23)	(2.35)
$\triangle$E$(amount_{fbt} \| stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$	-0.02	-0.11	0.15	0.18	0.04	0.05
$\triangle$E$(amount_{fbt} \| stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$	0.34	0.76	1.14	1.40	0.41	0.41
$stressed_b * DFA_t * Capreq_{bt} * Firm\,risk_{ft}$	-0.21	-0.09	0.15	0.42	-0.26	-0.27
	(-1.92)	(-0.92)	(0.67)	(1.78)	(-2.27)	(-2.41)
Loan-Level Controls	N	Y	N	Y	N	Y
Bank-Level Controls*Firm risk	N	Y	N	Y	N	Y
Firm*Time FE	Y	Y	Y	Y	Y	Y
Bank*Time FE	Y	Y	Y	Y	Y	Y
Loan Characteristics FE	N	Y	N	Y	N	Y
R^2 (%)	73.25	73.94	73.10	74.45	74.08	75.37
Adjusted R^2 (%)	67.17	67.64	66.99	68.57	67.28	68.82
Observations	27505	27505	21174	21174	18744	18744
Bank*Time	976	976	894	894	903	903
Firm*Time	3018	3018	3018	3018	2987	2987

Table A11

MONITORING VERSUS CAPITAL REQUIREMENTS: PLACEBO TESTS (ROBUSTNESS)

The table is a replica of Table 4 (Panel A) and Table 5 (Panel B) using the date of introduction of Basel III instead of the date of DFA, using the average bank size as the bank size threshold defining stressed banks, and using the firm size instead of a measure of firm risk.

Panel A: Portfolio Yield (Placebo Tests)						
		Basel III			Average Size Threshold	
$stressed_b * DFA_t$	4.42	6.11	22.02	-5.65	-1.61	-1.34
	(0.21)	(0.33)	(0.98)	(-0.47)	(-0.15)	(-0.05)
$\triangle \text{E}(portfolio\,yield_{bt} \| stressed_b = 0, \triangle\overline{Capreq_{bt}})$	69.06	66.93	61.31	34.16	33.93	33.78
$\triangle \text{E}(portfolio\,yield_{bt} \| stressed_b = 1, \triangle\overline{Capreq_{bt}})$	22.79	22.42	22.23	14.70	15.27	15.43
$stressed_b * DFA_t * Capreq_{bt}$	-0.14	-0.70	-1.04	42.95	-0.24	-0.73
	(-0.04)	(-0.22)	(-0.31)	(4.13)	(-0.12)	(-0.39)
Controls	N	Y	Y	N	Y	Y
Bank and Time FE	Y	Y	Y	Y	Y	Y
$stressed_b * DFA_t * portfolio\,yield_{bt-1}$	N	N	Y	N	N	Y
R^2 (%)	70.42	72.96	73.16	69.70	72.38	72.43
Adjusted R^2 (%)	67.78	70.36	70.46	66.98	69.73	69.66
Observations	1084	1084	1084	1084	1084	1084
Banks	29	29	29	29	29	29

Panel B: log(amount) (Placebo Tests)						
	Basel III		Average Bank Size		Firm Size	
$stressed_b * DFA_t * Firm\,risk_{ft}$	-0.01	-0.06	0.02	0.02	-0.28	-0.15
	(-0.71)	(-1.02)	(0.35)	(0.54)	(-0.88)	(-0.48)
$\triangle \mathrm{E}(amount_{fbt} \mid stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$	-0.01	2.85	0.93	0.40	-0.12	-33.61
$\triangle \mathrm{E}(amount_{fbt} \mid stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$	0.67	5.31	1.54	0.69	1.29	-281.33
$stressed_b * DFA_t * Capreq_{bt} * Firm\,risk_{ft}$	-0.07	0.00	-0.00	-0.00	0.06	0.03
	(-0.87)	(0.10)	(-0.43)	(-0.49)	(0.91)	(0.47)
Loan-Level Controls	N	Y	N	Y	N	Y
Bank-Level Controls*Firm risk	N	Y	N	Y	N	Y
Firm*Time FE	Y	Y	Y	Y	Y	Y
Bank*Time FE	Y	Y	Y	Y	Y	Y
Loan Characteristics FE	N	Y	N	Y	N	Y
R^2 (%)	73.17	74.53	73.17	74.51	73.00	74.58
Adjusted R^2 (%)	67.08	68.67	67.08	68.65	66.55	68.44
Observations	21174	21174	21174	21174	27462	27462
Bank*Time	894	894	894	894	976	976
Firm*Time	3018	3018	3018	3018	4315	4315

Table A12

Monitoring Versus Capital Requirements: Relaxing Bank*Quarter Fixed Effects

The table reports estimates from the regression:

$$\begin{aligned}\log(amount_{fbt}) = {} & \alpha_{ft} + \alpha_b + \alpha_t + \beta_1 stressed_b * DFA_t * Firm\,risk_{ft} \\ & + \beta_2 stressed_b * DFA_t * Cap\,req_{bt} * Firm\,risk_{ft} + \beta_3 Cap\,req_{bt} * Firm\,risk_{ft} \\ & + \beta_4 stressed_b * Cap\,req_{bt} * Firm\,risk_{ft} + \beta_5 DFA_t * Cap\,req_{bt} * Firm\,risk_{ft} \\ & + \beta_6 stressed_b * Firm\,risk_{ft} + \beta_7 stressed_b * DFA_t + \gamma' controls_{fbt} + \delta' controls_{bt} + \epsilon_{fbt},\end{aligned}$$

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_b are bank fixed effects, α_t are quarter fixed effects, α_{ft} are firm*quarter fixed effects, $Cap\,req_{bt}$ 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). Loan- and bank-level control variables are defined as in Table 5. Regressions include bank, quarter and firm*quarter fixed effects. $\triangle E(amount_{fbt}|stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$ and $\triangle E(amount_{fbt}|stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$ 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 are in parentheses.

log(amount)				
$stressed_b * DFA_t * Firm\,risk_{ft}$	0.01	0.03	-0.13	-0.03
	(0.17)	(0.84)	(-1.62)	(-0.54)
$\triangle E(amount_{fbt}\|stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$	0.10	3.13	0.01	0.95
$\triangle E(amount_{fbt}\|stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$	0.66	13.48	0.57	11.90
$stressed_b * DFA_t * Cap\,req_{bt} * Firm\,risk_{ft}$			0.02	0.01
			(1.92)	(1.29)
$stressed_b * DFA_t$	0.08	-0.20	0.38	-0.06
	(0.20)	(-0.62)	(0.99)	(-0.19)
Loan-Level Controls	N	Y	N	Y
Bank-Level Controls*Firm Risk	N	Y	N	Y
Bank-Level Controls	N	Y	N	Y
Firm*Time FE	Y	Y	Y	Y
Bank*Time FE	N	N	N	N
Bank and Time FE	Y	Y	Y	Y
Loan Characteristics FE	N	Y	N	Y
R^2 (%)	71.17	72.77	71.30	72.79
Adjusted R^2 (%)	66.24	68.04	66.39	68.06
Observations	21331	21331	21331	21331
Bank*Time	29	29	29	29
Firm*Time	3023	3023	3023	3023

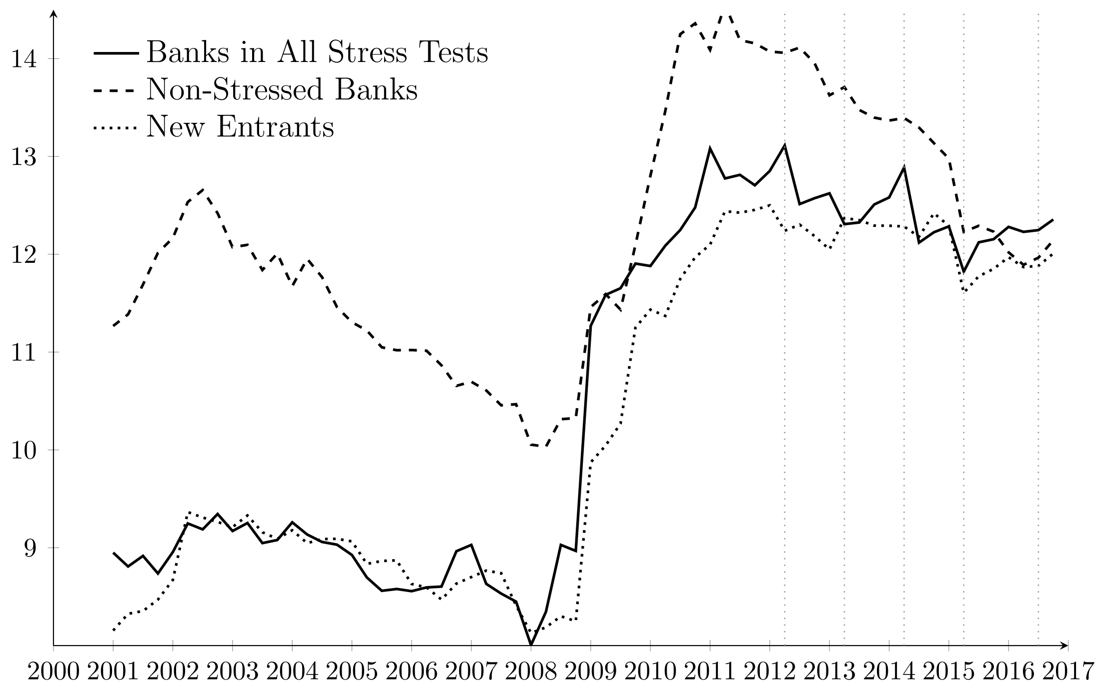
Table A13
VARIABLE DEFINITIONS

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 commited 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
Z-Score	Altman's Z-Score	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. The sample 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 Table A13. 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 A: Tier 1 Capital Ratio (%)



Panel B: Tier 1 Leverage Ratio (%)