Stressed Banks*

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October 3, 2018

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 prevent excessive risk taking by bringing additional scrutiny on the investment portfolios of stressed banks. Higher capital requirements are not a substitute for regulatory scrutiny to promote prudent lending. However, the correction in regulatory capital charges originating from stress tests effectively reduces risky lending. Overall, our results highlight the importance of regulatory scrutiny of bank portfolios in parallel to setting more stringent capital requirements.

Keywords: Capital Regulation, Dodd-Frank Act, Regulatory Scrutiny, Stress Tests.
JEL Classification Numbers: G01, G21, G28.

*We thank Viral Acharya, Sonny Biswas (discussant), Francesca Cornelli, Hans Degryse, Tim Eisert (discussant), Robert Engle, Angela Gallo (discussant), Florian Heider, Alan Jagolinzer (discussant), Ragnar Juelsrud, Artashes Karapetyan, Christian Laux, Stefan Nagel, Frederic Malherbe, Juan Francisco Martinez (discussant), Amiyatosh Purnanandam, Anthony Saunders, Glenn Schepens, Sascha Steffen, Michael Schwert, seminar participants at the Luxembourg School of Finance, McGill University, Danmarks Nationalbank, BI Norwegian Business School, European Central Bank, Vienna Graduate School of Finance, Norges Bank and conference participants at the CRM Montreal Systemic Risk workshop, ELTE Budapest workshop on Stress Testing and Capital Requirements, 2017 Santiago Finance workshop, 11th Swiss Winter Conference on Financial Intermediation, 2018 Lausanne-Cambridge workshop, 5th Empirical Financial Intermediation Research Network, FEBS 2018, 35th Annual Conference of the French Finance Association, 4th IWH-FIN-FIRE Workshop on "Challenges for Financial Stability", 1st Endless Summer Conference on Financial Intermediation and Corporate Finance for valuable comments and suggestions. The authors are grateful to Ina Bialova for excellent research assistance. All errors are our own.

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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 the U.S. Congress approved the Dodd-Frank Wall Street Reform and Consumer Protection Act, which contains a variety of provisions to overcome extant regulatory oversight. The Dodd-Frank Act includes a series of provisions to reduce the risk of large bank holding companies with over $50 billions in assets, whose collective costs of financial distress could harm the real economy. Arguably, annual stress tests administered by the Federal Reserve are the cornerstone of the enhanced scrutiny on such large and systemically important institutions. Regulatory stress tests, as part of the Comprehensive Capital Analysis and Review, encourage more prudent bank investment and lending policies. Stress tests challenge bank risk management and capital planning processes, ascertain data to assess the riskiness of bank investment portfolios, and significantly increase the bank buffer of regulatory capital to absorb potential losses under adverse economic scenarios. Importantly, stress tests are an intrusive form of regulation, which can substantially constrain the investment decisions of profit-maximizing banks. The banks enduring this intrusive form of regulation — the "stressed banks" — are subject to corrective actions whenever they are deemed deficient, and more information about their soundness is disclosed to the public.

Despite the major regulatory changes directed at reducing the risk of large financial institutions and the significant increase in bank regulatory capital, Sarin and Summers (2016) observe that they did not translate into a decline in their financial market measures of risk.[1] Recently, the Financial CHOICE Act proposed by the U.S. House on Financial Services Committee casts for an off-ramp from regulatory stress tests for banks with capital greater than 10% of their assets, *de facto* regarding capital requirements as substitutes for regulatory scrutiny. In addition, regulatory scrutiny requires considerable costs and efforts.[2] In this context, Sarin and Summers's report and the prospected regulatory innovation come as a clarion call to study the effectiveness of regulatory

[1]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.

[2]The 2016 Annual Report of the Federal Reserve Board reports that the 2017 budget for supervision and regulation is $1,533 million out of $5,057 million, with a large share of it devoted to "continue to implement expanded responsibilities mandated by the Dodd-Frank Act".

scrutiny initiatives, and in particular of stress tests, to encourage prudent bank policies. Nevertheless, studies dealing with this matter are yet scarce. In this paper, we take a step in this direction and we examine how regulatory stress tests influence the riskiness of bank investments. This work relates to the recent literature on the impact of post-crisis capital regulation on bank lending and bank risk taking (Jimenez, Ongena, Peydro, and Saurina (2017) and Gropp, Mosk, Ongena, and Wix (2018)).

A challenge in empirically identifying the effects of regulatory scrutiny on bank risk taking in the context of the Dodd-Frank Act is that more regulatory scrutiny goes hand in hand with changes in capital requirements for banks subject to stress tests. On average, stressed banks face more stringent capital requirements than "non-stressed banks", namely 7.5% versus 4.7% of assets in 2016.[3] From a theoretical perspective, there is a large consensus on the existence of a strict link between capital regulation and bank risk taking, although different theories predict different relationships.[4] Appropriately controlling for the variation in capital requirements after Dodd-Frank Act is pivotal to our empirical work. Disregarding or improperly considering the effect of capital requirements on the riskiness of bank investment amounts to omitting an important determinant of bank risk taking in empirical specifications. This omitted variable bias could confound the effect of regulatory scrutiny on the riskiness of bank investments, and produce a misleading assessment of its effectiveness.

Within the current regulatory framework, stress tests 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 each bank's assets under the supervisory stress scenario. We therefore collect bank-level data disclosed in the regulatory stress tests to back out such post-stress capital requirements for each bank subject to stress tests. The post-stress capital requirements then serve as a control to isolate the effect of regulatory scrutiny on bank risk taking.[5]

[3]Our sample of non-stressed banks includes public U.S. bank holding companies with consolidated assets over $10 billion that are subject to internal stress tests under Dodd-Frank Act, but never participated in a regulatory stress test conducted by the Federal Reserve.

[4]As we detail in Section 2, some studies show that tighter capital requirements possibly lead to an increase in bank cost of funding and, as a result, in bank risk taking. Other works argue that tighter capital requirements provide insiders with more "skin in the game"and reduce their motives to engage in risky lending. Finally, some recent papers predict more complex and non-monotone relationships.

[5]Notice that the regulation imposes requirements on four different measures of regulatory capital. Capital requirements are specific to each bank because of their sensitivity to the stress scenarios (stressed banks), and because

Observe that, in our empirical setting, regulatory scrutiny captures all additional regulatory efforts to limit bank risk taking that are not related to the level of the capital requirement. For example, since 2014, banks failed the regulatory stress test based on qualitative grounds. The qualitative part of the stress test features a regulatory review of risk management practices. The improved internal risk controls could limit bank risk taking, in line with Ellul and Yerramilli (2013) . Is the additional scrutiny on large banks' investment decisions effective in preventing excessive risk taking? Is the effect of regulatory scrutiny subsumed by the one of higher capital requirements, as suggested by the Financial CHOICE Act? Do capital requirements considerably influence the riskiness of bank lending and lead to a severe omitted variable problem if not properly accounted for? This work attempts at providing an empirical answer to these questions.

Our identification strategy relies on differences-in-differences estimates to gauge the differential effect of Dodd-Frank Act on the risk taking of stressed banks compared to a control group of "non-stressed banks". The assignment of banks to the treatment and control groups is based on the pre-determined $50 bn threshold of bank total assets defined under Dodd-Frank Act. 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. Given this assignment rule, controlling for bank size is necessary to account for possible differential trends affecting small and large banks.

However, to plausibly identify the effect of regulatory scrutiny on the risk of bank investments, two main concerns must be taken into account. First, banks in the treatment and control groups are likely not comparable in terms of the riskiness of investment undertaken for other reasons than stress tests and size, leading to a selection bias. Thus, their risk taking behavior could respond differently to changes in credit demand and credit supply. In particular, banks in the treatment and in the control group might have different business models and, accordingly, different risk and return profiles of investments. Second, the risk taking behavior of banks can change after Dodd-Frank Act for other reasons than increased regulatory scrutiny. Consider, as an illustration, the case of Regions Financial Corporation ("Regions") and Commerce Bancshares, Inc. ("Commerce") in our sample. In the third quarter of 2011, Regions had total assets of $129.8 bn, and Commerce

of the regulatory risk weights applied to the portfolio holdings of each bank. We provide details on the measurement of bank-specific capital requirements in Section 3.

had total assets of $20.7 bn. Regions was therefore subject to regulatory stress tests. The business models of Regions and Commerce are also different. Regions has branches all over the South East of the U.S., while Commerce operates mostly in Kansas and Missouri. In addition, Regions decreased its trading account from $2,341 mn to $361 mn in 2016, while Commerce's trading account increased from $11 mn to $29 mn. Thus, although Regions decreased the riskiness of its loans after Dodd-Frank Act, this might simply reflect a differential impact of Dodd-Frank Act on banks operating in different states, or be related to an ongoing restructuring of Regions' assets not related to being subject stress tests.

To mitigate these endogeneity concerns, we rely on banks participating in the syndicated loan market, which serves as a laboratory to plausibly isolate the effect of regulatory scrutiny. Crucially, we retain all members of the syndicate in our dataset in order to observe the amounts that multiple banks in a syndicate lend to the exact same borrowing firm in a given period of time. This identification strategy (Kwaja and Mian (2008), Jimenez, Ongena, Peydro, and Saurina (2012), Jimenez, Ongena, Peydro, and Saurina (2014)) allows the inclusion of a strict set of controls for the variation in the credit demand of firms with different risk levels. In particular, this empirical setup allows for the inclusion of bank*time and firm*time fixed effects. This set of indicator variables absorbs all individual bank and firm time-varying heterogeneity in loan amounts, and controls for the level of supply and demand for credit of each firm and each bank that could affect bank risk taking incentives in each period. The remaining variation therefore pertains to the bank-firm matching process resulting in a different composition of credit, and captures the risk allocation of banks' portfolios. In addition to controlling for the level of firm demand and bank supply of loans, we include bank control variables that could plausibly confound the effect of bank capital requirements on their risk allocation.[6] Finally, we inspect the existence of a differential trend in the loan portfolio composition of stressed banks compared to non-stressed banks before the Dodd-Frank Act. Reassuringly enough, we do not find evidence of non-parallel trends.

To measure the riskiness of bank investments in a given quarter, we collect data on *new* loans banks grant to firms from LPC DealScan[7], *after* they learn their capital requirement from the stress

[6]Specifically, we include the logarithm of bank 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.

[7]Carey and Hrycray (1999), estimate that the share of corporate covered by Dealscan in the U.S. is between 50%

test. Starting from Dealscan data, 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. Observe that, unlike previous studies, we do not restrict our sample to lead arrangers only. This choice requires, for each bank in the syndicate and for each quarter, to reconstruct the exhaustive list of directly or indirectly controlled subsidiaries using organization hierarchy data from the National Information Center (NIC). We manually match these subsidiaries to Dealscan by name, time, and location. Although data matching requires a considerable effort, the reason for it is twofold. First, 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. Second, our identification strategy relies on the inclusion of bank*quarter and firm*quarter fixed effects, and therefore requires observations on a given firm borrowing from multiple banks in a given quarter.

Our results highlight the effectiveness of regulatory scrutiny in encouraging prudent lending. 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. The risk taking response resulting from regulatory scrutiny goes in a different direction than the change in the risk taking response resulting from capital requirements,[8] suggesting that capital requirements are not a substitute for scrutiny to promote prudent lending. However, the results show that the effect of regulatory scrutiny is indeed confounded when banks' heterogeneity in capital requirements is not appropriately taken into account. Thus, disregarding the differential response to bank-specific capital requirements of stressed and non-stressed banks after Dodd-Frank Act leads to a severe omitted variable problem and, ultimately, to a misleading assessment of the effectiveness of regulatory scrutiny initiatives.

We complement our analysis of the regulatory scrutiny channel by considering another bank-level measure of risk taking, namely the (ex-ante) promised yield on the portfolio of new loans

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.

[8]The sensitivity of bank lending risk to capital requirements decreases for all banks after Dodd-Frank Act, but by a larger extent for non-stressed banks.

of a bank in a given quarter. Although higher promised yields could be associated not only with riskier loan portfolios, but also with higher bank-specific markups due to imperfect competition in the syndicated loan market, the results are in line with those about loan portfolio composition. 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. Importantly, both measures of lending risk, namely firm rating and promised yield, capture the risk taking behavior of the bank since they are ex-ante measures of risk available to the banker at the time of her investment decision, and not realized (ex-post) measures.[9]

Motivated by the recent literature on regulatory arbitrage, we present additional analyses in which we dissect post-stress capital requirements by isolating the adjustment originating from the stress testing process. Acharya, Schnabl, and Suarez (2013), Acharya and Steffen (2015), and Kirschenmann, Korte, and Steffen (2016) show that bank investment decisions reflect the inadequacy of regulatory risk weights to set capital charges that capture the actual riskiness of bank exposures. However, if regulatory stress tests provide a more accurate assessment of a bank asset riskiness, the "correction" to capital requirements determined by the stress test plausibly has a mitigating effect on bank risk taking behavior. We find that the extent to which capital requirements are determined by the stress test, rather than their level, induces banks to reallocate their loan portfolios towards safe borrowers. Thus, our results suggest that higher capital requirements are not a substitute to stress tests, which effectively correct for underestimated capital charges of some exposures and reduce regulatory arbitrage opportunities.

Remarkably, our evidence should not be interpreted as against a better capitalization of the banking sector. Our findings suggest that higher capital requirements are not a substitute to regulatory scrutiny in containing risk taking on the asset side of banks' balance sheets, but instead might be more effective when accompanied with additional scrutiny of bank asset risk. To this end, tools like the Comprehensive Capital Analysis and Review, an extensive scrutiny exercise by the

[9]In the example of Regions and Commerce discussed above, the minimum capital requirement before and after Dodd-Frank Act increases from 6.2% to 9.3% for Regions, and decreases from 5.8% to 5% for Commerce, as a result of decreasing average regulatory risk weights for Commerce. The average yield on new loans of Regions increased by 30.5 bps (from 139 bps to 169.5 bps), and by 62.9 bps for Commerce (from 116.8 bps to 179.7 bps). Removing the effect predicted by capital requirements on the average yield, the yield would have increased by 47 bps for Regions and by 322 bps for Commerce. The gap of -275 bps in the response of Regions to DFA compared to the response of Commerce, unrelated to their different responses to capital requirements, is interpreted as the effect of regulatory scrutiny on risk taking.

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. In light of our results, 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 might not be an adequate rule to reduce the risk of large financial institutions in the U.S.[10]

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 on the regulatory scrutiny channel. We dissect the effect of the capital requirement from stress tests on bank risk taking in Section 6. In Section 7, we report a battery of robustness and placebo tests. Section 8 concludes.

2 Related Literature

A central tenet of the mandate of central banks and regulatory authorities is to promote responsible risk taking and ensure that large bank holding companies have robust levels of capital relative to the risks they take. A fundamental tool the regulator exploits to influence banks' portfolio decisions is risk-sensitive capital requirements. The latter are implemented through regulatory risk weights which, under the Basel Accords, determine how much capital banks have to hold against various risk-sensitive assets.[11]

Several papers argue for the existence of a regulatory arbitrage opportunity in that the regulatory risk weights only imperfectly reflect bank asset risk. 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." Acharya, Schnabl, and Suarez (2013) document that banks allocate their portfolios towards assets with underestimated risk weights, and

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

[11] 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.

exploited this regulatory arbitrage opportunity for securitized assets during the financial crisis. Acharya and Steffen (2015) and Kirschenmann, Korte, and Steffen (2016) show that a similar pattern affected bank portfolio holdings of sovereign bonds during the European sovereign debt crisis. Other studies provide evidence of banks manipulating regulatory risk weights (Beltratti and Paladino (2013), Behn, Haselmann, and Vig (2016), Begley, Purnanandam, and Zheng (2017), and Plosser and Santos (2018)) when using their internal models in Basel II. Our findings relate to these studies by showing that stress tests can alleviate the regulatory arbitrage problem in two ways. First, through the regulatory scrutiny in stress tests, which encompasses all regulatory initiatives that do not affect the level of the capital requirement. One important initiative is the qualitative assessment of banks' risk management practices by the regulator in the Comprehensive Capital Analysis and Review (CCAR).[12] Second, we provide evidence that stress tests have an effect on the capital requirement of banks and can correct for the underrepresentation of some asset risks. However, the regulatory scrutiny channel appears to be prominent in our results, consistent with Acharya, Engle, and Pierret (2014), who show that capital ratios in stress tests can remain largely reliant on regulatory risk weights.

Two strands of the literature have provided empirical evidence on, respectively, the market response to information produced by stress tests, and the banks' response in terms of lending to regulatory stress tests. The first strand documents that regulatory scrutiny initiatives increase the amount and quality of information on banks' assets collected and analyzed by the regulator, and released to the market. A number of papers have shown that stress tests indeed produce information (Bayazitova and Shivdasani (2012), Petrella and Resti (2013), Morgan, Peristiani, and Savino (2014), and Flannery, Hirtle, and Kovner (2016)). In particular, Flannery, Hirtle, and Kovner (2016) find significant cumulative abnormal returns and abnormal trading volumes for stressed banks around different CCAR disclosure dates. Given the significant effect of stress test disclosure on investors' evaluations of banks' assets, a growing body of literature studies the optimal features of stress tests results disclosure (Goldstein and Sapra (2012), Goldstein and Leitner (2018), and Quigley and Walther (2018), among others). Our work relates to this literature by documenting the economic relevance of one beneficial effect of regulatory scrutiny, namely its effectiveness in

[12]Since 2014, the Federal Reserve has objected ten times to stressed banks' capital plans as a result of the CCAR. All objections were due to qualitative reasons, while, in all cases, objected banks had capital ratios above their capital requirements in the stress test.

encouraging prudent lending. Because the assets of banks are typically more opaque than the assets of non-financial firms (Morgan (2002)), our findings suggests that the costly collection of additional invasive information on banks' investments by the regulator in stress tests is especially relevant in a context in which banks have incentives to stay opaque or to misreport to the regulator.

The second strand analyzes the effect of stress tests on bank lending activities. This is the first paper to document the effectiveness of regulatory scrutiny in reducing banks incentives to take risks when they are subject to annual regulatory stress tests. Calem, Correa, and Lee (2016), Bassett and Berrospide (2017), Acharya, Berger, and Roman (2018), and Cortes, Demyanyk, Li, Loutskina, and Strahan (2018) investigate how U.S. banks adjust their aggregate credit supply as a consequence of being stress tested. In their studies, Acharya, Berger, and Roman (2018), and Cortes, Demyanyk, Li, Loutskina, and Strahan (2018) also report analyses connected with the risk taking behavior of banks subject to the CCAR since the Dodd-Frank Act. Cortes, Demyanyk, Li, Loutskina, and Strahan (2018) focus on banks' portfolios of loans to small businesses, and find that stressed banks subject to larger increases of their capital requirements in the stress test reduce lending, increase interest rates and rebalance their loan portfolios toward safer loans. Acharya, Berger, and Roman (2018) compare stressed and non-stressed banks, and find that stressed banks reduce their aggregate supply of credit, but stressed banks increase ex-ante loan spreads more than non-stressed banks after the Dodd-Frank Act. 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. Importantly, our results highlight the importance to appropriately account for the differential response to bank-specific capital requirements of stressed and non-stressed banks after Dodd-Frank Act. We show that backing out post-stress capital requirements for each bank from bank-level data disclosed in regulatory stress tests is key to avoid a severe omitted variable problem. We find that disregarding the effect of capital requirements would ultimately lead to a misleading assessment of the effectiveness of regulatory scrutiny initiatives.

While the effect of capital requirements on bank risk taking is not the core analysis of this paper, we relate to this literature by showing that controlling for the capital structure channel is central to highlight the channel of regulatory scrutiny. The literature on capital requirements points out

to different effects on bank investment behavior. From a theoretical perspective, a link between capital regulation and bank risk taking has already been established. Several studies show that tighter capital requirements increase bank cost of funding and possibly lead to an increase in risk taking, including Koehn and Santomero (1980), Kim and Santomero (1988), Rochet (1992), and more recently in the general equilibrium model of Gale (2010).[13] 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. Finally, two recent studies, Harris, Opp, and Opp (2017) and Bahaj and Malherbe (2018), predict a hump-shaped relationship between the amount and the riskiness of lending and capital requirements.

Empirically, a number of papers have investigated 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 (2017) study the introduction of a form of countercyclical capital requirements in Spain through dynamic provisioning and hint to increased risk taking 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, Gropp, Mosk, Ongena, and Wix (2018) 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.

Finally, and more broadly, our paper relates to the large literature that links regulation and policy to banks' riskiness and lending activity. Recent contributions include Jimenez, Ongena, Peydro, and Saurina (2012), Ellul and Yerramilli (2013), Jimenez, Ongena, Peydro, and Saurina (2014), De Jonghe, Dewachter, Mulier, Ongena, and Schepens (2016), Lambertini and Mukherjee (2016), Neuhann and Saidi (2018), Heider, Saidi, and Schepens (2017), Acharya, Eisert, Eufinger,

[13]These studies are not necessarily in contradiction with Admati (2013), who concludes 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).

and Hirsch (2017), Acharya, Eisert, Eufinger, and Hirsch (2018), 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)).[14] The act also features annual stress tests conducted by the regulator in addition to stress tests ran by the banks (DFA Section 165(i)). These annual stress tests, called Dodd-Frank Act Stress Test or "DFAST", are part of a broader supervisory exercise called the Comprehensive Capital Analysis and Review (CCAR), which demands that banks also submit their capital plans for regulatory review. In their capital plans, bank holding companies describe all capital issuances and distributions (e.g., issuance of capital instruments, 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.[15]

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

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

[15] 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.

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.[16] In 2014, the bank size threshold to be subject to the CCAR reduced to $50 billion in consolidated assets.[17] The number of participating banks increased to 30 bank holding companies in the 2014 CCAR (including U.S. subsidiaries of Canadian and European banks). Deutsche Bank Trust Corporation joined the CCAR in 2015, and BancWest Corporation and TD Group US Holdings LLC joined in 2016. In the Appendix (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.[18] 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

[16]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.

[17]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).

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

(including CCAR 2017).[19] 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.[20]

3.3 Capital Requirements Under DFA

In this section, we describe how the bank-level capital requirements that serve as a controls in our analyses are measured. We first describe how regulatory capital requirements for all banks, stressed and non-stressed, are set. Then we turn to how the post-stress capital requirements for each bank subject to stress tests can be backed out using the bank-level data disclosed in regulatory stress tests. Finally, to the extent that banks simultaneously face multiple minimum capital requirements based on different capital ratios, we show how all the requirements can be expressed in terms of a single accounting ratio and made comparable. Ultimately, all capital requirements can be combined in a unique measure that captures the tightest capital constraint each bank is subject to for each quarter.

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

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

[19] 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.)

[20] 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).[21] 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. To assess capital adequacy for all banks subject to the CCAR, the regulator uses as a capital ratio the minimum projected capital ratio under the supervisory stress scenario. This minimum capital ratio is lower than the actual bank capital ratio.[22] Specifically, under adverse economic conditions, the decline in value of bank's assets translates into a hypothetical loss under the stress scenario. As a result, the buffer of post-stress capital reduces by this hypothetical loss for each quarter of the stress test horizon, as if the bank had less equity capital under severe economic conditions. In addition, the riskiness of the bank's assets increases in the hypothetical stress scenario, resulting in higher regulatory risk weights assigned to risky exposures and lower post-stress capital ratios defined as a percentage of risk-weighted assets.[23]

Denote as $CET1R_{b,stress}$, $T1R_{b,stress}$, $TotalR_{b,stress}$, and $LVGR_{b,stress}$ the minimum projected capital ratios of bank b under the supervisory stress scenario, as available in the data disclosed in regulatory stress tests. These projected ratios can be used to back out thresholds that are applicable to the actual capital ratios of each bank, as follows:

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

[21] 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).

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

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

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

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

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

Therefore, a bank subject to the regulatory stress test equivalently faces bank-specific capital requirements, in which thresholds are determined based on the bank's riskiness under the stress scenario. Because $CET1R_{b,stress} \leq CET1R_b$, $T1R_{b,stress} \leq T1R_b$, $TotalR_{b,stress} \leq TotalR_b$, $LVGR_{b,stress} \leq LVGR_b$, 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 *as assessed by the Federal Reserve*. The capital requirement of a stressed bank increases by the extent to which the bank is vulnerable to the supervisory stress scenario. The increase is a "surprise component" of the capital requirement since, by opposition to stress tests ran by the banks, the increase in the capital requirement from regulatory stress test is determined by the Federal Reserve using its own confidential model, and revealed at the disclosure of stress tests results. 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.[24] While,

[24] After the crisis, the average capital ratios have increased for all groups of banks, and especially for stressed banks (see descriptive statistics in Table A2 in the Appendix). The average Tier 1 capital ratio increased by 4% for stressed banks, compared to an increase of 2.1% for non-stressed banks. This difference is explained by the low level of capitalization of stressed banks before the crisis compared to non-stressed banks. In Figure A1 (in the Appendix), we observe an upward shift in banks' regulatory capital ratios during the fourth quarter of 2008, which coincides with the launch on October 14, 2008 of the Capital Purchase Program (CPP) and the Temporary Liquidity Guarantee Program (TLGP) under the TARP. Under the CPP, the Treasury Department injected $205 billion capital into banks by buying warrants, common shares, and preferred shares. The SCAP also led to a substantial recapitalization of the U.S. financial system (an additional $75 billion capital buffer).

after 2014, banks did not fail the CCAR based on quantitative capital inadequacy, 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 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.[25]

[25]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).

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

[INSERT FIGURE 1 HERE]

4 Data and Empirical Strategy

In this section, we describe our sample and empirical strategy. As discussed in the introduction, 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).[26] 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

[26] Available at www.ffiec.gov/nicpubweb/nicweb/nichome.aspx (visited on 11/02/2017).

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.

In our yield analyses, as a measure of borrower risk we use the spread, in basis points, that the borrower agrees to pay over the LIBOR rate (plus any annual, or facility-related, fee paid to the bank group) to the bank for each dollar drawn down at loan origination, as reported by DealScan as "all-in-drawn" spread. Table 2 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 by 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.[27] 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 2 HERE]

4.2 Empirical Strategy

As discussed before, there are different channels that plausibly affect banks' risk taking incentives in stress tests. First, *higher capital requirements* are likely to have a non-negligible effect on banks' investment decisions. Second, the channel of prudential incentives from *additional scrutiny* is intended to influence banks' composition of credit.

Specifically, banks might have incentives to take more risks when they expect their funding costs to raise. However, they might also have incentives to decrease their asset risk before reporting to the Federal Reserve in order to reduce their risk-sensitive capital requirements in the CCAR.

[27] 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.

In addition, the asset portfolios of stressed banks are more scrutinized by the regulator compared to other banks. For example, stressed banks are subject to a qualitative assessment challenging the bank's risk management team on the assumptions used to derive stressed projections, capital plans and regulatory risk weights. The assessment of the regulator and additional data are publicly disclosed every year. Markets react to the publication of results, especially for the weakest banks in the stress test (Flannery, Hirtle, and Kovner (2016)). This additional "scrutiny" effect on stressed banks should induce them to follow more prudential standards when making investment decisions.

Because the different channels operate at the same time for the same bank subject to the regulatory stress test, it is critical to adopt an empirical strategy that allows to disentangle their effect on the risk taking behavior of stressed banks. In this section, we describe such empirical approach.

4.2.1 Effect on Portfolio Yield

We identify the effect of DFA on stressed banks compared to non-tressed 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 promised yield is available to the bank at the time of its decision to invest in a new loan, and therefore reflects the required premium for borrower risk. An advantage of the differences-in-differences approach is that it accounts for omitted factors that influence treated and untreated banks alike by considering the time difference of group differences.

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 of 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.[28]

As outlined in the introduction, the effect of regulatory scrutiny on risk taking of banks subject to stress test can be made apparent only after controlling for the level of their capital requirements. The reason for it being that capital requirements are plausibly a non negligible determinant of risk taking. Stress tests affect the level of capital requirements to a large extent (as documented in section 3.3), and the change in sensitivity of bank risk taking to capital requirements after DFA might be different compared to non-stressed banks for this reason. Not controlling for this change in risk taking sensitivity to capital requirements amounts to omit an important determinant of the change in risk taking following DFA. To consider the effect of capital requirements in our empirical specifications, we adopt a triple differences-in-differences analysis. This specification allows us to test 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

[28] 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, to show that it is not any size threshold that matters in the assignment of banks to control and treatment groups but the threshold specified in DFA, 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 A15).

requirements:

$$\begin{aligned} portfolio\,yield_{bt} &= \alpha_b + \delta_t + \beta_1 stressed_b * DFA_t + \beta_2 stressed_b * DFA_t * Capreq_{bt} \\ &\quad + \beta_3 Capreq_{bt} + \beta_4 stressed_b * Capreq_{bt} \\ &\quad + \beta_5 DFA_t * Capreq_{bt} + \gamma' controls_{bt} + \epsilon_{bt}, \end{aligned} \tag{5}$$

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

Specification (5) allows for different responses of the portfolio yield of stressed versus non-stressed banks to capital requirements before and 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 scrutiny 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 a higher level of scrutiny of the portfolios of stressed banks. Given that we do not explicitly measure regulatory scrutiny at the bank level, the additional scrutiny of stressed banks could take different forms as it is the case in the CCAR (i.e., qualitative assessments of banks' assets, capital planning and risk management processes, market discipline due to investors' reactions to stress test results disclosure). The parameter β_1 will however not reflect the effect of the quantitative assessment that affects the level of the capital requirement.

The panel dataset is composed of quarterly data of stressed and non-stressed banks. We take advantage of the stress test timeline and consider the risk taking response of banks after they learn their new capital requirement from the regulatory stress test. The "surprise" component of the capital requirement determined by the Federal Reserve is revealed at the disclosure date of the stress

test, and banks respond to it in the following quarters until the disclosure of the next regulatory stress test. Therefore, the post-stress bank-specific thresholds (k^s_{1bt}, k^s_{2bt}, k^s_{3bt}, k^s_{4bt}) of Equation (2) used to derive $Capreq_{bt}$ of stressed banks after DFA are held constant between the quarter of the stress test disclosure until the quarter before the next stress test disclosure. In addition, the single bank-specific capital requirement $Capreq_{bt}$ is updated each quarter with information provided by the bank — average total assets, risk-weighted assets, and the different measures of capital — based on end of *previous* quarter $(t-1)$ 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), 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 scrutiny 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 (6), 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 scrutiny 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:

$$\begin{aligned}\log(amount_{fbt}) &= \alpha_{bt} + \alpha_{ft} + \beta_1 stressed_b * DFA_t * Firm\,risk_{ft} \\ &\quad + \beta_2 stressed_b * DFA_t * Cap\,req_{bt} * Firm\,risk_{ft} + \beta_3 Cap\,req_{bt} * Firm\,risk_{ft} \\ &\quad + \beta_4 stressed_b * Cap\,req_{bt} * Firm\,risk_{ft} + \beta_5 DFA_t * Cap\,req_{bt} * Firm\,risk_{ft} \\ &\quad + \beta_6 stressed_b * Firm\,risk_{ft} + \gamma' controls_{fbt} + \epsilon_{fbt},\end{aligned} \tag{6}$$

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 scrutiny 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 scrutiny of stressed banks. Including bank*quarter and firm*quarter fixed effects, the regulatory scrutiny 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 2, 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 confounded channels of risk taking (i.e. "higher capital requirements" and "regulatory scrutiny"). Our identification strategy highlighting the effect of regulatory scrutiny indeed comes from a triple differences-in-differences analysis holding the capital requirement level of the bank constant.

[INSERT FIGURE 2 HERE]

In Figure 3, 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 (5). We interpret the fall in the average yield spread between stressed and non-stressed banks after DFA as a regulatory scrutiny effect since the spread is uncorrelated to capital requirements.

[INSERT FIGURE 3 HERE]

In the Appendix (Table A3), 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 Table A3 report the results, 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. However, our differences-in-differences results for the portfolio yield that do not include bank control variables need to be interpreted carefully, as we cannot reject the presence of a differential trend in the portfolio yield before DFA when bank control variables are not included.

Loan Portfolio Composition. In Table A4 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.

5 Effect of Regulatory Scrutiny

In this section, we present the empirical results concerning the empirical relevance of the regulatory scrutiny channel. We show the effect of this channel on the average yield and composition of the portfolio of new loans of the bank. The differences-in-differences results 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.[29] 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.[30]

5.1 Effect on Portfolio Yield

Table 3 reports the estimation results of regression (5). 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 3 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, we report two columns to assess the effect of including control variables in the regression.

[29] We consider including the group of new entrants in the treatment group in Section 7. The reasons for excluding new entrants from our analysis are twofold. First, the period for which new entrants become stressed is short. Second, we do not know the capital requirements of new entrants for the period they were subject to another type of stress tests (CapPR) after DFA, and prior to being subject to the CCAR (their capital requirements under the CapPR are not observed).

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

[INSERT TABLE 3 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 2, which shows an increase in the average portfolio yield for both stressed and non-stressed banks after DFA.

The three rightmost columns of Table 3 report the estimates of β_1 (regulatory scrutiny) and β_2 (differential response to capital requirements) of the unrestricted regression (5). 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 scrutiny 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 sensitivity of yields to capital requirements decreased for all banks after DFA, but 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. We

report the estimates of risk sensitivities to capital requirements for each group of banks (stressed and non-stressed), before and after DFA in Table A5 in the Appendix.

Finally, the last column of Table 3 checks the robustness of results to some persistence in bank 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 is not captured by controls *and fixed effects*. Although our differences-in-differences analyses are based on the riskiness of new loans, banks in the treatment and control groups might be systematically different in the persistence of their level of risk taking. For example, each bank might overweight each quarter the same group of firms, specific to its business model. Thus, the effect of the capital requirement based on asset risk in the previous quarter could just be an artifact of an autoregressive component in banks' portfolio yield. 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 scrutiny effect (β_1) remains significant at the 1% level. Holding the capital requirement and the riskiness of previous loans constant, the average portfolio yield increased for all banks after DFA, but by 186 bps less for stressed banks.[31]

5.2 Effect on Loan Portfolio Composition

Table 4 reports differences-in-differences estimates of regression (6), 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 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 contemporaneous loan-level controls, and lagged bank-level controls

[31] In Section 7, 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. In addition, observe that if capital requirements would mechanically reflect the riskiness of both banks' existing and new loans, they should always have a positive effect on our risk measure both before and after DFA, which as discussed above is not the case.

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 4 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 portfolios towards less risky firms after DFA compared to non-stressed banks, but the estimates are not significant at the 5% level.

[INSERT TABLE 4 HERE]

The two rightmost columns of Table 4 report the estimates of β_1 (regulatory scrutiny) and β_2 (differential response to capital requirements) from the unrestricted regression (6). 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). The results in the last column show that non-stressed banks would reduce the amount they lend to an investment grade firm by 0.97 USD million on average after DFA. Instead, stressed banks would increase the loan amount granted to an investment grade firm by 6.36 USD million on average.

In Table A6 in the Appendix, we report estimates from a specification similar to the differences-in-differences regression for the average yield on the portfolio of new loans (Equation (5)). In Table A6, however, the dependent variable is the bank-level average numerical rating of the portfolio of new loans of the bank. The results confirm the presence of a regulatory scrutiny channel encouraging investments towards safer borrowers for stressed banks, after controlling for the level of their capital requirements.

6 Dissecting the Effect of Capital Requirements of Stressed Banks

Table 1 shows that, compared to non-stressed banks, stressed banks are subject to more stringent capital requirements. The additional equity capital that stressed banks are required to hold might more closely track the riskiness of bank assets and, all else equal, dampen excessive risk taking of stressed banks and regulatory arbitrage. To test this hypothesis, we implement a test in which, holding the level of the capital requirement fixed, we investigate banks' response to the "correction" to their capital requirement due to the quantitative exercise in the stress test, defined as

$$Correction_{bt} = Capreq_{bt}/Capreq^{*}_{bt}, \tag{7}$$

where $Capreq_{bt} = \max(k_{1bt}, k_{2bt}, k_{3bt}, k_4, k'_{1bt}, k'_{2bt}, k'_{3bt}, k'_{4bt})$, and $Capreq^{*}_{bt} = \max(k_{1bt}, k_{2bt}, k_{3bt}, k_4)$. The variable $Correction_{bt}$ is the ratio between the capital requirement in stress tests and the standard capital requirement that bank b would be subject to if it were not subject to the stress test in quarter t. The larger this "correction" to the capital requirement, the larger the extent to which the capital requirement reflects the sensitivity of the bank's assets to the regulatory stress scenario. This variable is only different from one for stressed banks after DFA, and captures the amplification effect on the stressed bank capital requirement resulting from the stress test.

Panel A of Table 5 reports the results of a differences-in-differences analysis on the yield on the bank's portfolio of new loans (regression (5)) to assess the effect of the variable $Correction_{bt}$, holding the regulatory capital requirement ($Capreq_{bt}$) constant. Observe that, in a differences-in-differences analysis, it is not necessary to interact $Correction_{bt}$ with the treatment group and post-treatment dummies given that this variable is only different from one for stressed banks after DFA. While $Correction_{bt}$ 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 5 HERE]

For the loan portfolio composition analysis, we first consider a simple regression in Panel B of Table 5 showing the effect of $Correction_{bt}$ and $Capreq_{bt}$ 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 ($Capreq_{bt}$) 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 of Panel B of Table 5, we consider the joint effect of $Correction_{bt}$ and $Capreq_{bt}$. 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 ($Capreq_{bt}$) constant, a bank decreases by 3.5% to 6.6% its share of lending to a firm that has a rating in the next worse class when $Correction_{bt}$, the ratio 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 $Correction_{bt}$ constant, a bank increases its lending to a firm in the next worse rating class by 1.3% to 1.9% 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 5 reports the results of a differences-in-differences analysis showing the effect of $Correction_{bt}$ on the amount banks lend to risky firms (regression (6)). This regression reports jointly the effect of regulatory scrutiny and the effect of the correction to the capital requirement from the stress test. While the regulatory scrutiny channel does not affect the capital requirement banks are subject to, the stress test also alters the ranking of capital requirements among stressed banks. First, after controlling for the level of the capital requirement ($Capreq_{bt}$), the parameter of $Correction_{bt}$ 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. Second, after controlling for the capital requirement and the composition of the capital requirement ($Correction_{bt}$), the remaining

variation between stressed and non-stressed banks could be attributed to other regulatory efforts to encourage prudent investments embedded in the CCAR exercise (e.g., qualitative assessment), or any other reason stressed banks have to reduce risk that is unrelated to their level of capital requirements. The two estimates that capture regulatory scrutiny and the correction to the capital requirement in stress tests are significant at the 5% level in the first column of Panel C (without controlling for bank-specific variables explaining the portfolio composition). $Correction_{bt}$ is however not significant when we include bank control variables that could also explain the reduction in risk taking.

Overall, the results of this section indicate that, after controlling for the capital requirement level ($Capreq_{bt}$), the correction to the capital requirement resulting from the stress test ($Correction_{bt}$) does not lead to more risk taking, and even induces banks to tilt their loan portfolios towards safe borrowers. The extent to which capital requirements are determined by the stress test, rather than their level, induces banks to reallocate their loan portfolios towards safe borrowers. Our results suggest that higher capital requirements are not a substitute to stress tests, which correct for the underestimated capital charges of some exposures. The negative correlation of $Correction_{bt}$ with the average yield and rating of new loans is also visible in Figure 4, illustrating the reduction in risk taking incentives of stressed banks induced by the correction to their capital requirements in stress tests.

[INSERT FIGURE 4 HERE]

7 Additional Analyses and Robustness

In the Appendix, we consider the joint effect of the actual bank capitalization level and its distance from the capital requirement on bank risk taking. We analyze realized income measures on the whole balance sheet of the bank, and provide descriptive evidence of the effect of the capital requirement of stressed banks. Finally, we consider a series of robustness tests for regressions (5) and (6).

7.1 Bank Capitalization and Distance from Capital Requirement

In this section, we jointly consider the effect on risk taking of the actual bank capitalization level and its distance from the capital requirement. We separate the *actual capitalization level* of the bank and its *distance to the capital requirement* as $Capreq_{bt} = LVGR_{bt} - Distance_{bt}$, where $Capreq_{bt} = \max(k_{1bt}, k_{2bt}, k_{3bt}, k_4, k'_{1bt}, k'_{2bt}, k'_{3bt}, k'_{4bt})$. 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 ($Distance_{bt}$) occurring whenever the bank capitalization level falls below the capital requirement.

Table A7 reports the estimates from regressions (5), and (6), in which we replace $Capreq_{bt}$ with the variables $LVGR_{bt}$, and $Distance_{bt}$. Panel A of Table A7 shows the results of a differences-in-differences analysis on the bank's yield on its portfolio of new loans (regression (5)). 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.[32] The regulatory scrutiny 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 A7 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

[32]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.

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 $LVGR_{bt}$ 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 A7 reports the results of a differences-in-differences analysis on banks' loan portfolio composition (regression (6)), 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 scrutiny 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.

7.2 Bank Asset Income

In this section, we inspect the external validity to our results based on the portfolio of syndicated loans of the bank by analyzing its income on its whole portfolio (asset income), as available from financial statements. Note that 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.[33] However, high asset income in good times is an indicator of systematic tail risk exposure (Meiselman, Nagel, and Purnanandam (2018)) and the evidence in this section is suggestive that banks are not taking risks "somewhere else" on their balance sheet as a result of additional regulatory scrutiny.

[33]In particular, several concerns arise when interpreting the asset income measures reported in quarterly income statements as proxies for risk taking behavior during that quarter. For example, asset income can decrease due to non-performing loans when existing borrowers do not pay interests in a timely fashion. When the quality of existing borrowers deteriorates, asset income measures might decrease because the bank fails at collecting interest payments.

We measure asset income as the part of bank income that is not directly affected by the bank's own funding costs ($(Net\,income + Interest\,expenses)/Total\,Assets$). In Table A8, we report the results of a differences-in-differences regression as in the analysis of portfolio promised yields in the syndicated loan market (Table 3). This time, the dependent variable is the measure of asset income described above. The results are qualitatively in line with the ones for the portfolio yield on new syndicated loans. Thus, the estimates in Table A8 suggest that banks are not able to substitute the reduction in risk taking in the syndicated loan market by taking more risks elsewhere in their balance sheets.

In addition, we show some descriptive evidence on how banks' asset income is affected by how capital requirements evolve along the timeline of the regulatory stress testing process. We relate changes in asset income to bank-specific capital requirements through the following regression:

$$\triangle asset\,income_{bt} = \beta Cap\,req_{bt} + \gamma' controls_{bt} + \delta_t + \epsilon_{bt}, \tag{8}$$

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, bank liquid assets, bank profitability, and bank trading activity. The dataset used in this regression is obtained by pooling cross-sections of stressed bank data for the five CCAR years.[34]

In Table A9, we find that the estimate of β is positive and statistically significant at the 5% level. 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},

[34]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 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.

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). Overall, the results in Table A9 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.

7.3 Robustness

In this section, we replicate regressions (5) and (6) 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 (6) 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.

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 A10 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.

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 A11 shows that our results are overall robust to the inclusion of international loans.

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 A12. 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.

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.[35] We show in Table A13 that our results are robust to including new entrants in the group of stressed banks.

Alternative Firm Risk Measures Table A14 reports the estimates from regression (6) for different measures of $Firm\,risk_{ft}$. As alternative measures to the numerical credit rating of the firm $rating_{ft}$, we consider a dummy variable $rated_{ft}$ equal to one if the firm has a rating reported in Compustat, a dummy variable $speculative_{ft}$ equal to one if the firm's rating is worse than BBB, 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 documented effects of regulatory scrutiny and capital requirements on bank risk taking.

Placebo Tests In Table A15, we consider three placebo tests for the differences-in-differences regressions. First, we use the introduction of Basel III and the advanced approach to derive risk-

[35] 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.

weighted assets in stress tests instead of the DFA date. Second, we consider a different size threshold to define the group of treated (or "stressed") banks. Third, we use firm size instead of a measure of borrower risk in the analysis of the loan portfolio composition to gauge whether stressed banks after DFA simply lend more to larger firms. All placebo tests lead to non-significant results confirming our results of the two channels of risk taking following DFA.

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 scrutiny 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 A16, 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 scrutiny 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.

8 Discussion and Conclusions

We study the risk taking behavior of "stressed banks" — the banks that are subject to annual regulatory stress tests in the U.S. since 2011. In all, our results highlight the importance of regulatory scrutiny of bank portfolios in parallel to setting more stringent capital requirements.

We find that stress tests are effective in preventing excessive risk taking by bringing additional scrutiny on the lending portfolios of stressed banks. We show that, under the Dodd-Frank Act, the

effect of regulatory scrutiny is confounded when bank heterogeneity in capital requirements, which themselves affect bank risk taking incentives, is not appropriately accounted for. In fact, more regulatory scrutiny goes hand in hand with changes in capital charges for banks subject to stress tests, for which the regulator determines bank-specific requirements on the basis of their riskiness under a supervisory stress scenario. Our results suggest that higher capital requirements do not substitute regulatory scrutiny on bank portfolios in promoting prudent lending. Rather, stress tests help setting regulatory capital charges that dampen excessive risk taking and regulatory arbitrage.

Importantly, our evidence should not be interpreted as against a better capitalization of the banking sector. Rather, our results highlight an empirically relevant channel — regulatory scrutiny — induced by Dodd-Frank Act that reduce the risk taking incentives of large banks and should be taken into account in the design of new regulations to promote financial stability. 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. Our results contribute to the debate on the substitutability between capital requirements and bank supervision (Anginer, Demirguc-Kunt, and Mare (2018)), particularly relevant in light of recent trends to reduce regulatory scrutiny initiatives in the U.S. (e.g., exempting banks from the qualitative portion of the CCAR, and the proposal of an off-ramp rule from stress tests in the Financial CHOICE Act).

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 post-stress bank-specific thresholds (Panel B), and the cross-sectional average actual capital ratios (Panel C). $Capreq_b$ 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 the ratio of common equity Tier 1 capital to risk-weighted assets (Basel III definition), T1R is the 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})	$Capreq_b$
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

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 3
REGULATORY SCRUTINY: EFFECT ON PORTFOLIO YIELD

The table reports estimates from the regression:

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

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. $\triangle \mathrm{E}(portfolio\,yield_{bt}|stressed_b = 0, \overline{Capreq_{bt}})$ and $\triangle \mathrm{E}(portfolio\,yield_{bt}|stressed_b = 1, \overline{Capreq_{bt}})$ 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)
$\triangle \mathrm{E}(portfolio\,yield_{bt}|stressed_b = 0, \overline{Capreq_{bt}})$	39.43	39.43	51.37	50.08	45.95
$\triangle \mathrm{E}(portfolio\,yield_{bt}|stressed_b = 1, \overline{Capreq_{bt}})$	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 4

Regulatory Scrutiny: Effect on Loan Portfolio Composition

The table reports estimates from the regression:

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

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. $\triangle \mathrm{E}(amount_{fbt}|stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$ and $\triangle \mathrm{E}(amount_{fbt}|stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$ 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)
$\triangle \mathrm{E}(amount_{fbt}\|stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}})$	0.06	0.05	-0.67	-0.97
$\triangle \mathrm{E}(amount_{fbt}\|stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}})$	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 5

Dissecting the Effect of the 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 3 and 4, and including the effect of the correction to the capital requirement $Correction_{bt}$ due to the stress test, defined as follows:

$$Correction_{bt} = Capreq_{bt}/Capreq^*_{bt},$$

where $Capreq_{bt} = \max(k_{1bt}, k_{2bt}, k_{3bt}, k_4, k'_{1bt}, k'_{2bt}, k'_{3bt}, k'_{4bt})$, $Capreq^*_{bt} = \max(k_{1bt}, k_{2bt}, k_{3bt}, k_4)$. The variable $Correction_{bt}$ is the ratio 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 3, and 4. $\triangle$E$(portfolio\,yield_{bt}|stressed_b = 0, \overline{Capreq_{bt}}, Correction_{bt} = 1)$ and $\triangle$E$(portfolio\,yield_{bt}|stressed_b = 1, \overline{Capreq_{bt}}, Correction_{bt} = 1)$ 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 $Correction_{bt} = 1$ for all banks in the sample. $\triangle$E$(amount_{fbt}|stressed_b = 0, speculative_{ft} = 0, \overline{Capreq_{bt}}, Correction_{bt} = 1)$ and $\triangle$E$(amount_{fbt}|stressed_b = 1, speculative_{ft} = 0, \overline{Capreq_{bt}}, Correction_{bt} = 1)$ 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			
$stressed_b * DFA_t$	-197.32	-194.81	-186.74
	(-4.16)	(-3.69)	(-3.69)
$\triangle$E$(portfolio\,yield_{bt}\|stressed_b = 0, \overline{Capreq_{bt}}, Correction_{bt} = 1)$	51.36	50.15	46.02
$\triangle$E$(portfolio\,yield_{bt}\|stressed_b = 1, \overline{Capreq_{bt}}, Correction_{bt} = 1)$	22.80	24.21	24.99
$Correction_{bt}$	-3.22	-6.84	-8.90
	(-0.18)	(-0.41)	(-0.56)
$stressed_b * DFA_t * Capreq_{bt}$	43.16	42.80	41.70
	(4.18)	(3.61)	(3.60)
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	73.64	73.79
Adjusted R^2 (%)	68.56	71.07	71.12
Observations	1084	1084	1084
Banks	29	29	29

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

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

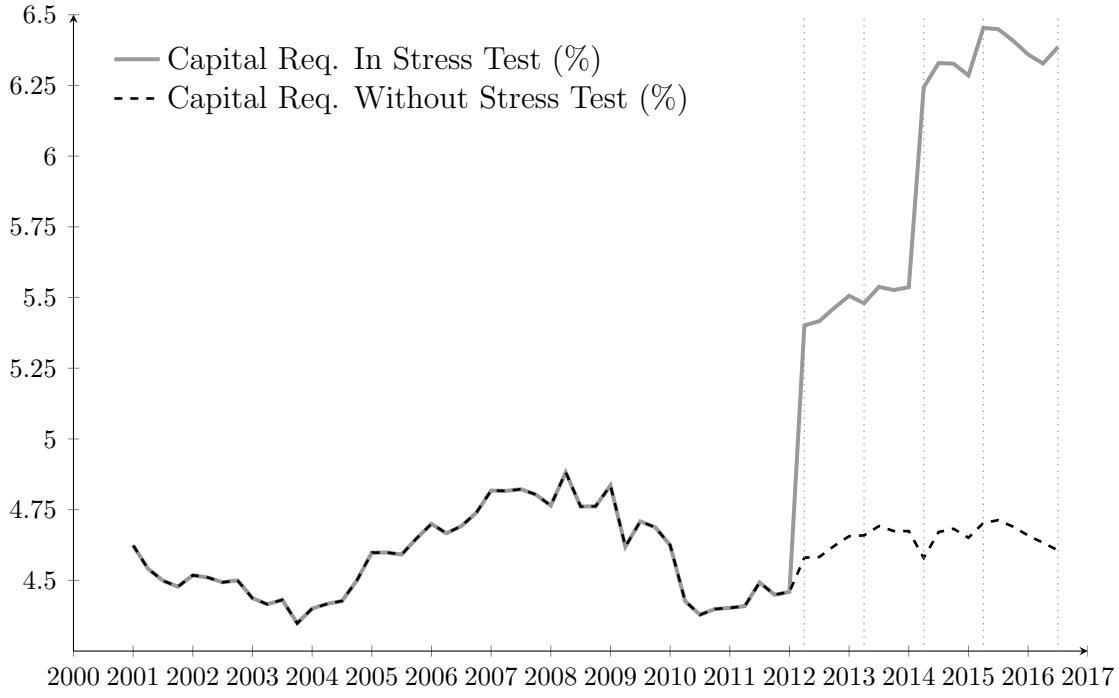


Figure 2

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.

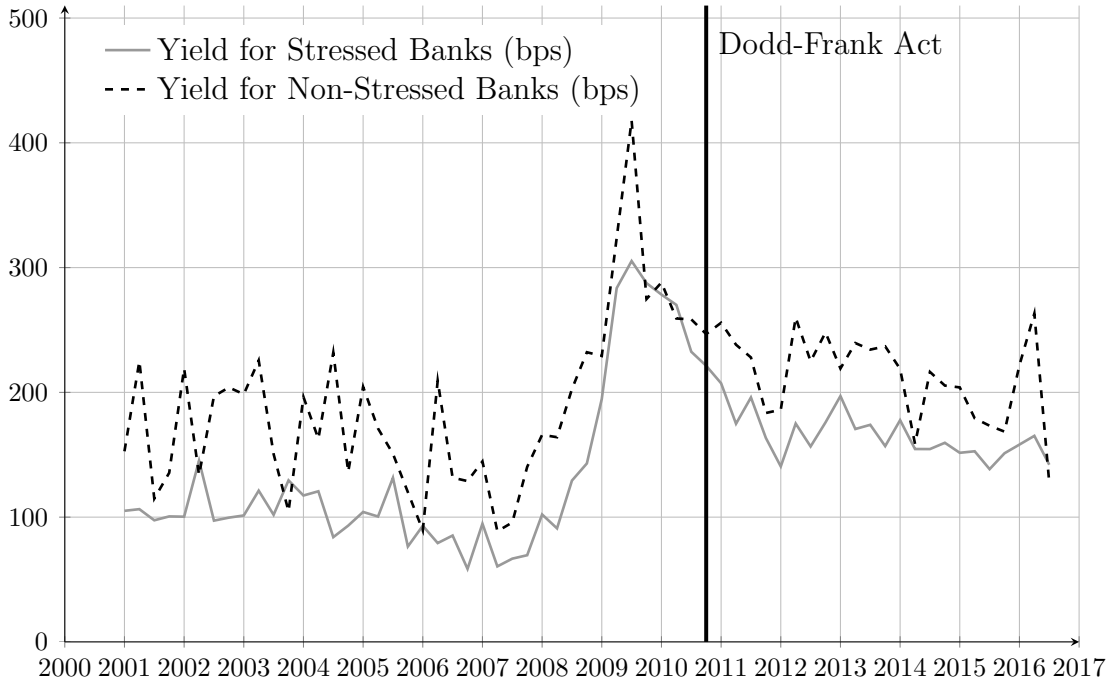


Figure 3
PORTFOLIO YIELD: REGULATORY SCRUTINY EFFECT

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 (5)) 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.

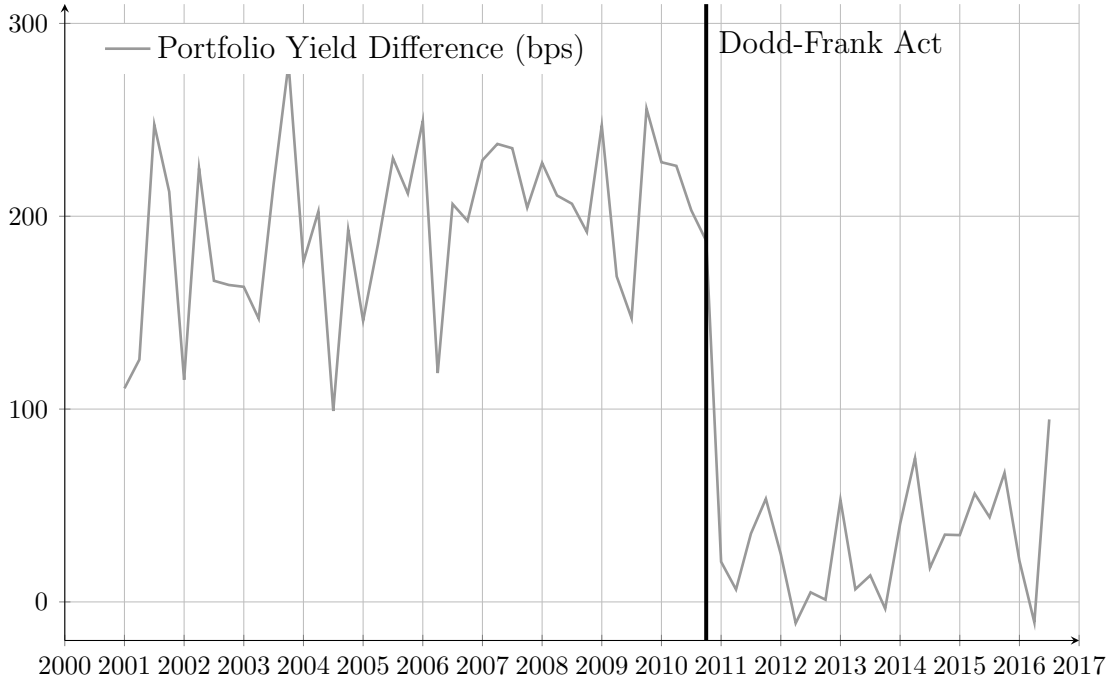
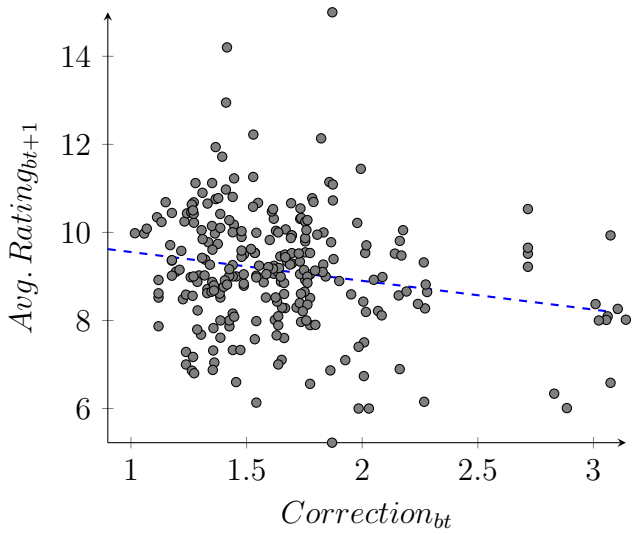


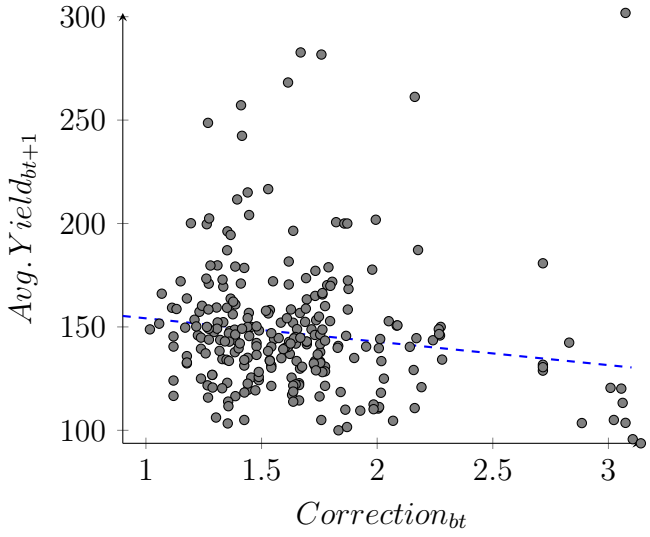
Figure 4
DISSECTING THE EFFECT OF THE CAPITAL REQUIREMENT

The figures show the correlation between the correction to the capital requirement due to the stress test ($Correction_{bt}$ as defined in Table 5) and measures of bank risk taking in the next period, namely the average rating ($Avg.\,Rating_{bt+1}$) in Panel A, and the average yield ($Avg.\,Yield_{bt+1}$) in Panel B, on the portfolio of new loans of the bank. The sample includes all post-DFA observations for stressed banks that participated in all stress tests.

Panel A: Average Rating vs. Correction



Panel B: Average Yield vs. Correction



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); inspections of the parallel trend assumption for the yield (Table A3) and the loan portfolio composition (Table A4) analyses; estimates of the sensitivities of bank risk taking to capital requirements (Table A5); differences-in-differences regressions involving the average rating of the new loans of a bank (Table A6); additional analyses decomposing the capital requirement into the capitalization level and the distance from the capital requirement (Table A7); evidence showing the effect of regulatory scrutiny and capital requirements on the asset income of a bank (Tables A8 and A9); additional robustness checks related to the restricted sample of new borrowers only (Table A10), to the extended sample including loans syndicated outside the U.S. (Table A11), to the exclusion of crisis observations (Table A12), to the sample including new entrants (Table A13), to alternative measures of firm risk (Table A14), to placebo tests (Table A15), and to the relaxation of bank*quarter fixed effects in the loan composition analysis (Table A16); summary statistics and balance sheet ratios for the banks in our sample before and after DFA (Table A17); the definitions of the variables used in the analyses (Table A18); 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
Regulatory Scrutiny: 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 A4

REGULATORY SCRUTINY: PARALLEL TREND ASSUMPTION (LOAN PORTFOLIO COMPOSITION)

The table reports estimates from the regression:

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

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 4. 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 A5

Estimated Risk Sensitivities to Capital Requirements

The table reports the estimates of the sensitivity of the portfolio yield to $Capreq_{bt}$ in the panels referring to Tables 3 and 5A, and the sensitivity of the logarithm of loan amount to $Capreq_{bt} * Firmrisk_{ft}$ in the panels referring to Tables 4 and 5C. The regressions reported in these tables allow for different sensitivities of risk taking to capital requirements, depending on whether banks are stressed or non-stressed, and before or after DFA. T-statistics based on clustered standard errors at the bank level (Tables 3 and 5A), and at the bank*quarter and firm*quarter level (Tables 4 and 5C) are in parentheses.

	Table 3			Table 4		Table 5A			Table 5C	
Stressed	-0.29	-0.25	-0.15	0.01	0.00	0.32	1.05	1.53	0.01	0.01
After DFA	(-0.18)	(-0.17)	(-0.10)	(2.36)	(1.51)	(0.08)	(0.27)	(0.41)	(4.07)	(1.87)
Stressed	2.92	3.48	4.06	0.02	0.01	3.42	4.50	5.35	0.02	0.01
Before DFA	(0.71)	(0.89)	(1.04)	(4.45)	(1.25)	(0.64)	(0.94)	(1.13)	(4.45)	(1.62)
Non-Stressed	15.94	14.56	10.15	-0.18	-0.02	15.93	14.65	10.24	-0.17	-0.02
After DFA	(1.94)	(2.37)	(1.23)	(-3.10)	(-0.62)	(1.95)	(2.37)	(1.24)	(-3.19)	(-0.63)
Non-Stressed	62.12	60.51	55.41	0.14	0.12	62.19	60.91	55.75	0.15	0.12
Before DFA	(4.47)	(3.81)	(3.32)	(4.30)	(3.25)	(4.46)	(3.82)	(3.33)	(4.29)	(3.26)

Table A6
Regulatory Scrutiny: Effect on Portfolio Rating

The table reports estimates from the regression:

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

where $portfolio\,rating_{bt}$ is the weighted average borrower rating for 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. 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.

	Average Borrower Rating				
$stressed_b * DFA_t$	0.72	0.70	-8.11	-7.06	-8.83
	(1.33)	(1.62)	(-2.48)	(-1.76)	(-2.12)
$stressed_b * DFA_t * Cap\,req_{bt}$			1.96	1.74	1.64
			(2.74)	(1.98)	(1.69)
Controls	N	Y	N	Y	Y
Bank and Time FE	Y	Y	Y	Y	Y
$stressed_b * DFA_t * portfolio\,rating_{bt-1}$	N	N	N	N	Y
R^2 (%)	53.84	64.98	55.52	66.38	67.05
Adj. R^2 (%)	49.29	61.25	50.89	62.62	63.18
Observations	925	925	925	925	925
Banks	27	27	27	27	27

Table A7

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 3 and 4, 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 $Capreq_{bt} = \max(k_{1bt}, k_{2bt}, k_{3bt}, k_4, k'_{1bt}, k'_{2bt}, k'_{3bt}, k'_{4bt})$, 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 3, and 4. $\triangle\text{E}(portfolio\,yield_{bt}|stressed_b = 0, \overline{LVGR_{bt}}, \overline{Distance_{bt}})$ 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)
$\triangle$E$(amount_{fbt}\|stressed_b = 0, speculative_{ft} = 0, \overline{LVGR_{bt}}, \overline{Distance_{bt}})$	0.49	11.71
$\triangle$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

Table A8
Regulatory Scrutiny: Effect on Asset Income

The table reports estimates from the regression:

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

where $asset\,income_{bt}$ is the asset income of bank b in a given quarter t with respect to the previous 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. 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.

	Asset Income				
$stressed_b * DFA_t$	-0.01	-0.01	-0.43	-0.40	-0.56
	(-0.22)	(-0.29)	(-2.01)	(-1.94)	(-1.97)
$stressed_b * DFA_t * Cap\,req_{bt}$			0.10	0.09	0.13
			(2.08)	(1.99)	(1.96)
Controls	N	Y	N	Y	Y
Bank and Time FE	Y	Y	Y	Y	Y
$stressed_b * DFA_t * asset\,income_{bt-1}$	N	N	N	N	Y
R^2 (%)	60.62	60.74	61.11	61.24	67.20
Adj. R^2 (%)	57.99	57.92	58.39	58.33	64.59
Observations	1420	1420	1420	1420	1358
Banks	33	33	33	33	33

Table A9
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, $Cap\,req_{bt}$ 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.

	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

Table A10

Regulatory Scrutiny: Loans to New Borrowers (Robustness)

The table is a replica of Table 3 (Panel A) and Table 4 (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)
$stressed_b * DFA_t * Capreq_{bt}$	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)
$stressed_b * DFA_t * Capreq_{bt} * Firm\,risk_{ft}$	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 A11

REGULATORY SCRUTINY: INCLUDING LOANS SYNDICATED OUTSIDE THE U.S. (ROBUSTNESS)

The table is a replica of Table 3 (Panel A) and Table 4 (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)
$stressed_b * DFA_t * Capreq_{bt}$	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)
$stressed_b * DFA_t * Capreq_{bt} * Firm\,risk_{ft}$	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 A12

Regulatory Scrutiny: Excluding Crisis Observations (Robustness)

The table is a replica of Table 3 (Panel A) and Table 4 (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)
$stressed_b * DFA_t * Capreq_{bt}$	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)
$stressed_b * DFA_t * Capreq_{bt} * Firm\,risk_{ft}$	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 A13

REGULATORY SCRUTINY: INCLUDING NEW ENTRANTS (ROBUSTNESS)

The table is a replica of Table 3 (Panel A) and Table 4 (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)
$stressed_b * DFA_t * Capreq_{bt}$	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)
$stressed_b * DFA_t * Capreq_{bt} * Firm\,risk_{ft}$	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 A14

Regulatory Scrutiny: Alternative Firm Risk Measures (Robustness)

The table is a replica of Table 4 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	
$stressed_b * DFA_t * Firmrisk_{ft}$	1.08	0.48	-0.82	-2.05	1.32	1.37
	(2.15)	(1.11)	(-0.85)	(-2.02)	(2.23)	(2.35)
$stressed_b * DFA_t * Capreq_{bt} * Firmrisk_{ft}$	-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 A15

Regulatory Scrutiny: Placebo Tests (Robustness)

The table is a replica of Table 3 (Panel A) and Table 4 (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)
$stressed_b * DFA_t * Capreq_{bt}$	-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	
$stressed_b * DFA_t * Firmrisk_{ft}$	-0.01	-0.06	0.02	0.02	-0.28	-0.15
	(-0.71)	(-1.02)	(0.35)	(0.54)	(-0.88)	(-0.48)
$stressed_b * DFA_t * Capreq_{bt} * Firmrisk_{ft}$	-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 A16
Regulatory Scrutiny: 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 4. Regressions include 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 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)
$stressed_b * DFA_t * Cap\,req_{bt} * Firm\,risk_{ft}$			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 A17

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

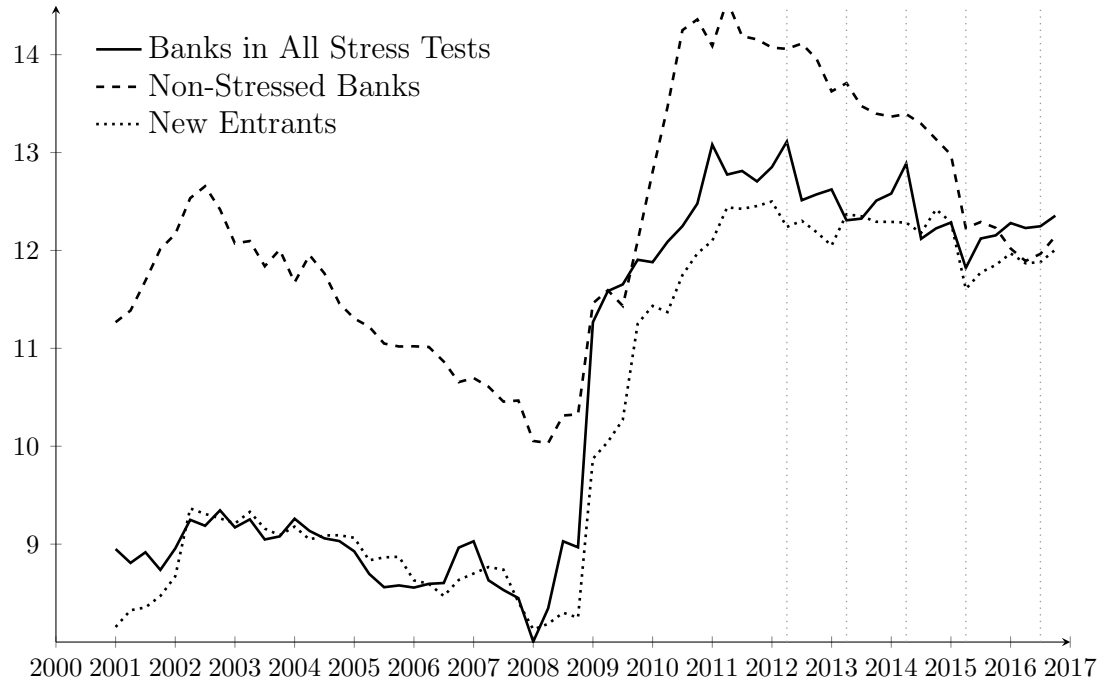
Table A18
Variable Definitions

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 A18. 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 (%)