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Liquidity Regulations, Bank Lending, and Fire-Sale Risk

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Abstract

We examine whether U.S. banks subject to the Liquidity Coverage Ratio (LCR) reduce lending (an unintended consequence) and/or become more resilient to liquidity shocks, as intended by regulators. We find that LCR banks tighten lending standards, and reduce liquidity creation that occurs mainly through lower lending relative to non-LCR banks. However, covered banks also contribute less to fire-sale externalities relative to exempt banks. For LCR banks, we estimate that the total after-tax benefits of reduced fire-sale risk (net of the costs associated with foregone lending) exceed $50 billion from second-quarter 2013 to 2017, mostly accruing to the largest LCR banks. Non-LCR regulations enacted during our sample period cannot fully account for these findings. For the banking sector as a whole, lending migrates to smaller, non-LCR banks so that lending shares increase but fire-sale risk does not decrease. Our results highlight the trade-off between liquidity creation and resiliency arising from liquidity regulations that underlie the debate on whether the LCR should be extended following the banking crisis of March 2023.

Key words: liquidity coverage ratio, banks, liquidity creation, lending, fire-sale risk

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1 Introduction

Banks may be specially qualified to create liquidity by providing long-maturity loans to firms against demandable deposits. But, in so doing, banks are exposed to the risk of liquidity and maturity mismatches on their balance sheets. To manage this risk, banks hold liquidity buffers. However, they may hold too few liquid assets due to incentive reasons or market incompleteness, and so liquidity regulation is needed to enhance banks' resilience to liquidity shocks (Allen and Gale (2017)). The Liquidity Coverage Ratio (LCR) addresses this issue by requiring covered banks to hold enough high quality liquid assets (HQLA) to meet 30 days of expected net cash outflows during a stress event.

Perhaps due to their relative novelty, liquidity regulations have received far less attention in the academic literature than capital regulations. Given that the LCR restricts both assets and liabilities of covered banks, they have incentives to adjust the compositions of their balance sheets when responding to it. The costs and benefits of LCR depend on the exact nature of these adjustments. For example, if banks primarily adjust by holding more liquid assets, then lending and liquidity creation are expected to decline. If banks instead focus on increasing their stable funding, they may have less need to cut lending and liquidity creation.

Motivated by these considerations, we study how US banks subject to the LCR (LCR banks) adjust their balance sheet mixes – in particular, their lending – and, using the measure introduced by Berger and Bouwman (2009), the implications for asset- and liability-side liquidity creation. To account for *credit demand*, we examine whether these banks also adjust their *lending standards*. Throughout, we distinguish the LCR effects from those that may arise due to a wide range of non-LCR regulations implemented during our sample period from 2013Q2 to 2017. Second, we analyze changes in the fire-sale risk of LCR banks due to changes in the concentration of illiquid assets in the cross-section of banks. While LCR banks are expected to hold fewer illiquid assets, thereby reducing fire-sale risk (Carletti, Goldstein and Leonello (2020)), fire-sale risk may *increase* if LCR leads to banks having similar, correlated exposures (Cecchetti and Kashyap (2018)). Thus, the effect of LCR on fire-sale risk is an empirical issue. Finally, because we find that covered banks both reduce lending *and* contribute less to fire-sale risk, we quantify the net benefits of LCR.

Under the Basel LCR rules, which were finalized in 2013Q1, internationally active bank holding companies (BHCs or simply "banks") with assets of $50 billion or over are subject to the LCR. We identify LCR effects by estimating difference-in-differences (DiD) regressions of changes in outcomes for LCR banks relative to midsized banks exempt from the LCR (non-LCR banks) since 2013Q2. (Thus, we use the term "*after LCR*" to mean "*after the finalization of Basel's LCR.*") A challenge in implementing the DiD design is that other event dates may also be considered such as September 2014, when the final version of LCR was released by US regulators, or 2012 when banks may have started to adjust in anticipation of the LCR proposals. To check for robustness, we conduct placebo tests using alternative event dates and show that the estimated effects mostly obtain around 2013Q1. We also provide evidence of parallel pre-trends across control and treatment groups. A second challenge is that the bank size cutoff correlates with bank business models and the incidence of regulations. To address this issue, we test arbitrary size groupings and identify LCR effects at the $50 billion cutoff or higher. Finally, as an alternative to DiD regressions, we exploit treatment heterogeneity – that is, variations *across* LCR banks with respect to their pre-LCR balance sheet holdings.

We find that covered banks subject to LCR decrease their illiquid assets as shares of total assets, resulting in decreased asset-side liquidity creation, relative to non-LCR banks. LCR banks also reduce their dependence on liquid borrowings, and so their overall liquidity creation declines relative to non-LCR banks, consistent with Donaldson, Piacentino and Thakor (2018). Since banks can comply with LCR by increasing stable funding or cutting loans, they have incentives to exploit synergies between the two sides of their balance sheets. Consistent with this idea, we find that large LCR banks with lower *pre-LCR* shares of stable funding decrease their loan shares by less *after LCR*, indicating a credit insurance effect of stable deposits (Berlin and Mester (1999), Ivashina and Scharfstein (2010) and Cornett, McNutt, Strahan and Tehranian (2011)).

LCR banks shed illiquid assets mostly by cutting lending relative to non-LCR banks, to the tune of $3.54 trillion in 2013Q2-2017, resulting in foregone net interest income equal to 6% of their net income during this time. Changes in LCR banks' securitization activity (Maddaloni and Peydró (2011)) cannot explain these results. Regulated banks also tighten lending standards or terms more frequently than exempt banks after LCR – a decision that they are more likely to attribute to regulation or supervision in the Federal Reserve Board's Senior Loan Officers' Opinion Survey (SLOOS). This implies that credit demand factors (such as greater bond issuance by large firms) cannot explain the evidence; rather, LCR is associated with lower credit supply.

A slew of other regulations were enacted during our sample period, such as stress tests, changes in leverage ratios and risk-weights from capital rules, and enhanced supervision. By exploiting differences in implementations between LCR and non-LCR regulations, we argue that the estimated lending effects cannot be fully ascribed to these other regulations. In particular, asset holdings of LCR banks respond to LCR haircuts even when there are no changes in the corresponding risk weights imposed by capital rules. Also, lending reductions by LCR banks mostly occur independent of participation in stress tests, borrower size and G-SIB designations. Finally, evidence based on differences in the incidence of LCR and non-LCR regulations on banks of various sizes are consistent with incremental LCR effects.

We next test whether fire-sale spillovers arising from a concentration of illiquid assets are lower for banks subject to LCR, relative to non-LCR banks, as intended by regulators. To do so, we estimate the illiquidity component of fire-sale risk measure introduced by Duarte and Eisenbach (2021) and find that it decreases more for covered banks relative to exempt banks. Since capital regulations are likely to have minimal effects on illiquidity linkages, this result is compelling evidence of an LCR effect.

As LCR banks reduce their lending shares following LCR, they incur a private opportunity cost of foregone lending that partially offsets the benefits associated with lower fire-sale externalities. *Net* of this cost, we estimate that the after-tax benefits from LCR, aggregated over all LCR banks, exceed $50 billion from 2013Q2 to 2017. Thus, the evidence shows that private costs to large banks were lower than the estimated social benefits of LCR. Notably, smaller LCR banks with assets less than $250 billion account for less than 7% of net benefits. This result has current policy relevance since some smaller LCR banks were made exempt from LCR in 2018 and 2019 but, following the failure of Silicon Valley Bank in March, 2023, regulators have discussed whether standardized liquidity requirements should apply to a broader set of banks.[1]

Related literature and contributions. This paper has five contributions. First, consistent with theoretical insights, we show how banks utilize synergies between their assets and liabilities in responding to LCR (Calomiris, Heider and Hoerova (2018), Carletti et al. (2020) and Kashyap, Tsomocos and Vardoulakis (2020)). We further map changes in the composition of bank assets and liabilities to liquidity creation by LCR banks. Second, unlike papers that document only the costs of regulations, we quantify the net benefits from reduced fire-sale externalities and bank lending. In estimating fire-sale risk, we focus on its illiquidity component, thereby analyzing a channel proposed in the theoretical literature that is unique to liquidity regulations. Our results support Carletti et al. (2020) who argue that increasing liquidity reduces the extent of costly fire-sales. Third, to the best of our knowledge, we are the first to show *tighter lending standards* of LCR banks, relative to exempt banks.

Fourth, we contribute to the literature on the unintended consequences of regulations from reduced lending and the sub-optimal choice of liquidity weights. We show (based on novel identifications) negative lending effects that are incremental to those from capital regulations. Our evidence is consistent with theoretical predictions (Perotti and Suarez (2011) and Kashyap et al. (2020)) that liquidity regulations limit credit expansion. By comparison, the empirical evidence is mixed. Studies of national rules that resemble LCR show that

[1]After the passage of Senate Bill 2155 on May 24, 2018, BHCs with assets between $50 billion and $100 billion are no longer subject to LCR (see Senate Bill 2155 and Reubenstein and Sarkar (2021)). Further revisions in 2019 substantially reduced LCR requirments for banks between $100 billion and $250 billion in total assets (see 2019 revision). For regulator comments following bank failures in 2023, see Barr letter.

banks increase their shares of stable deposits instead of reducing lending (BIS (2016) and Banerjee and Mio (2018)), but calibrations of macro-finance models suggest that liquidity regulations may lower lending and output (see BIS (2021) for a summary). Unintended consequences – such as incentivizing regulatory arbitrage – may also occur from regulators' choice of liquidity weights (Glaeser and Shleifer (2001)), in spite of theoretical support for a liquidity-weighted approach to regulations (Dewatripont and Tirole (2018)). Empirically, Schmidt (2019) shows that banks arbitrage differences in relative liquidity weights of assets in LCR and the ECB's collateral framework. As further evidence, we find that as the LCR favors GNMA over GSE MBS, covered banks increase their relative holdings of the former, even though there were no changes in risk weights of GNMA or GSE MBS from capital rules. Gete and Reher (2020) show that this shift from GSE to GNMA MBS has unintended consequences for the mortgage market by increasing the market share of shadow bank lenders and the credit risk borne by U.S taxpayers. Inefficiencies may also arise as the same liquidity ratio applies to all banks, even though it is generally optimal for liquidity requirements to vary with bank characteristics (Farhi, Golosov and Tsyvinski (2009), Diamond and Kashyap (2016) and Carletti et al. (2020)). Nevertheless, as our results suggest, the *effects* of liquidity regulations are heterogeneous due to the endogeneity of bank responses.

Fifth, studies show a shift in lending following regulations from banks to shadow banks or unregulated banks for *specific* loan types, such as mortgages (Gete and Reher (2020)) or small business lending (Chen, Hanson and Stein (2017) and Sundaresan and Xiao (2021)). By comparison, our paper documents reallocations in both *total* lending and liquidity creation from regulated to unregulated banks such that, for the banking sector as a whole, the lending ratio actually increases. New in this paper, we further assess the implications of these shifts for aggregate fire-sale risk in the banking sector and find that the illiquidity component of fire-sale risk is not significantly lower, contrary to the conjecture by Cortes, Demyanyk, Li, Loutskina and Strahan (2020). The net effect of LCR on the banking sector is neutral as net benefits are unchanged.

The paper is organized as follows. Section 2 reviews the literature and develops hypotheses while section 3 provides background on LCR. In section 4, we discuss the data and our methodology. We investigate the effects of LCR on bank lending and liquidity creation in section 5 and on lending standards in section 6. In section 7, we examine changes in the fire-sale externalities of LCR banks and quantify the net benefits from LCR. Section 8 concludes. Additional results are in the internet appendix (denoted simply as "appendix").[2]

2 Literature Review and Hypotheses Development

We review the literature on liquidity regulations and then develop testable hypotheses to take to the data.

Studies of the effect of LCR on lending show mixed results. OFR (2014) suggest that lending decreases after an early version of LCR, but EBA (2013) find no effects on European bank lending for different levels of the LCR. Sundaresan and Xiao (2021) compare *within* US LCR banks and find that LCR banks with a higher liquidity gap (i.e. between the mandated and actual liquidity ratios) in 2012Q4 lend less afterwards. While we mostly use difference-in-differences (DiD) regressions, we also show results based on heterogeneity within the treated group in section 5.5 but using an alternative approach since estimating the regulatory liquidity ratio accurately from Y-9C and Call Reports is challenging (Cetina and Gleason (2015)). A more detailed comparison of the two approaches is provided in footnote 24 of section 5.5. Notably, unlike us, these papers do not consider the benefits from LCR nor quantify its net benefits.

Studies of regulations similar to LCR also find mixed evidence on lending effects – it could increase, decrease or remain unchanged. For example, Banerjee and Mio (2018) find that national liquidity rules in the UK have no effect on lending but negative effects on short-term wholesale funding and interbank borrowings. For the Netherlands, Ananou, Chronopoulos, Tarazi and Wilson (2021) report that Dutch banks increase lending relative to unregulated

[2] `https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr852_appendix`.

banks while Haan and van den End (2013) find that most banks hold more liquid assets than required. Curfman and Kandrac (2022) study cash reserve requirements in the US and find that it causes banks to lend less. Naceur, Marton and Roulet (2018) study liquidity indicators while Chen, Goldstein, Huang and Vashishtha (2021) examine liquidity mismatches of banks and show that lending *increases* with more liquidity.

Theoretical studies mostly derive a negative effect of liquidity regulations on lending. Perotti and Suarez (2011) conclude that liquidity regulations limit credit expansion when banks differ in their incentives to take on risk. Kashyap et al. (2020) argue that planners need to balance the benefits of greater liquidity provision against the costs of lower credit extension when correcting run risk. They recommend a lending subsidy to supplement LCR as banks will otherwise channel less deposits towards loans. Calibrations of macro-finance or general equilibrium models also find a negative effect on lending (De Nicolo, Gamba and Lucchetta (2014), Heuvel (2017)) but not on deposits (Covas and Driscoll (2015)).

Thus, the literature suggests that banks may adjust to liquidity regulations by changing their mix of liabilities (EBA (2013) and Banerjee and Mio (2018)), or by cutting loans. For a given asset size, LCR requires banks to increase their share of HQLA, or decrease their shares of short-term, volatile liabilities, or do both. If banks do not change their liabilities sufficiently, they will need to cut non-HQLA assets (e.g., loans) to meet their LCR targets.

Hypothesis 1: Lending. Covered banks will reduce their total loan shares after LCR, relative to exempt banks.

As private banking choices generate run externalities via asset- and liability-side distortions, regulations need to consider both sides of bank balance sheets, like the LCR does (Cecchetti and Kashyap (2018), Carletti et al. (2020) and Kashyap et al. (2020)). Further, banks face trade-offs between managing asset- and liability-side risk in responding to regulations. For example, when banks hold more liquidity, their current portfolio values increase due to reduced fire-sale risk but at the cost of lower future returns (Diamond and Kashyap (2016) and Carletti et al. (2020)). An implication is that banks' asset-side adjustments to the LCR are likely to vary with their reliance on stable funding.

We test this implication by positing that the extent to which LCR banks cut loans likely depends on their mix of assets and liabilities *prior to* the finalization of LCR. Relatively low initial shares of HQLA imply that banks need to increase HQLA and cut lending more to comply with LCR. Conversely, if banks do not adjust assets, they will need to rely more on longer-maturity, stable funding. Thus, relatively low initial shares of stable funding give banks more scope to comply with LCR by increasing stable funding instead of cutting loans (especially since the cost of obtaining such funding was relatively low during our sample).

Hypothesis 2: Treatment Heterogeneity. Covered banks with lower shares of liquid assets prior to LCR cut their lending shares more after LCR. Covered banks with lower shares of stable funding prior to LCR reduce their lending shares less after LCR.

Risk-based capital rules and stress tests apply to banks covered by the LCR and may also affect lending (e.g., by reducing incentives to monitor borrowers or by increasing the capacity to absorb risk). We exploit differences in the implementations of capital rules and LCR to argue that our main results are not driven exclusively by effects due to capital regulations.

Hypothesis 3: Capital Regulations and LCR. If LCR constrains bank lending, then (a) loans to large and small firms will decrease by similar amounts; (b) banks not included in the stress tests of 2013 will reduce lending during 2013Q2-2014, (c) global systemically important banks (G-SIBs) and non-G-SIB full-banks will have similar lending reductions, and (d) asset holdings will respond to LCR haircuts even if regulatory risk-weights are unchanged.

Loans to smaller borrowers are expected to suffer larger reductions if capital rules are binding. While standardized risk-weights make no distinction between small and large borrowers, Covas (2017) finds that risk-weights implied by stress tests are higher for small business loans than for aggregate C&I loans and, further, stress-tested banks reduced small business loans compared to non-stress-tested banks. Acharya, Berger and Roman (2018) and Cortes et al. (2020) show that stress-tested banks cut loans to small business borrowers. In contrast, the LCR rules make no distinction between loans based on borrower size and thus should impact large and small borrowers similarly.

Since 2009, large banks have been subject to stress tests requiring them to calculate their expected capital surplus under macroeconomic stress scenarios. As risky assets are more sensitive to business cycles, the stress tests imply their own risk-weights, complementing the standardized risk-weights (Covas (2017)). Some LCR banks (denoted *late stress test* (*LST*) banks) did *not* take part in the initial stress tests but did so from 2014 onward. Given evidence that stress test banks lend less in the year after stress tests (Acharya et al. (2018)), lower lending by *LST* banks in 2013Q2-2014 is likely attributable mainly to LCR.

Unlike the LCR, capital rules are more stringent for G-SIBs relative to other full-banks. Since 2014, G-SIBs have been subject to a capital surcharge and loss-absorbency requirements (Bouwman (2018)). The capital surcharge or stress tests are likely to result in less lending, as evidenced by Chen et al. (2017) who find that the four largest banks (all of who are G-SIBs) cut small business lending more than other banks. Thus, we expect larger changes in G-SIB lending relative to other full-banks if only capital rules are binding but similar lending reductions if LCR is also a binding constraint on bank balance sheets.

To study the effect of risk-weights relative to LCR haircuts, we compare GNMA and GSE MBS. LCR categorizes GNMA as a Level 1 asset and GSE as a Level 2A asset, implying zero haircut for GNMA and 15% for GSE (see section 3), even though they are of similar risk. In contrast, risk-weights for GSE and GNMA MBS were unchanged during our sample (see risk weights). Thus, if LCR is the binding constraint, then we expect LCR banks to increase their holdings of GNMA but not of GSE after LCR but, if risk-based capital rules are binding, no changes are expected in either GNMA or GSE holdings.

The LCR also has implications for liquidity creation. Lower lending shares likely result in lower asset-side liquidity creation given the large share of loans in total assets. The effect on LCR banks' liability-side liquidity creation is ambiguous since LCR outflow rates depend on counterparty, collateral and term. For example, banks have an incentive to both reduce short-term wholesale funding and to increase stable retail deposits in response to LCR, creating offsetting effects on liquidity creation. The relation of capital and liquidity creation is explored by Berger and Bouwman (2009) who show a positive relation between the two for large banks, and by Berger, Bouwman, Kick and Schaeck (2016) who find no effect of capital support on liquidity creation.

Hypothesis 4: Bank Liquidity Creation. Relative to non-LCR banks, covered banks' asset-side liquidity creation decreases after LCR.

While theoretical models examine various sources of run risk from illiquidity, we focus on fire-sale externalities. Mostly, theory suggests that fire-sale risk is lower after liquidity regulations as banks can delay fire-sales with their liquidity buffers (for example, Bolton, Cecchetti, Danthine and Vives (2019), Kara and Ozsoy (2020) and Carletti et al. (2020)), although regulators may choose not to eliminate fire sales if the cost of liquidity is too high (Carletti et al. (2020)). An alternative view is that fire-sale risk may increase if the resulting bank exposures are correlated (Cecchetti and Kashyap (2018)) or if the money premium is higher (Hanson, Shleifer, Stein and Vishny (2015)).[3]

Hypothesis 5: Fire-Sale Risk. Relative to non-LCR banks, the fire-sale externality of covered banks – and, in particular, its illiquidity component – is lower after LCR.

As the liquidity component of fire-sale risk is based on the distribution of asset liquidities across banks, changes in this component are uniquely attributable to liquidity regulations. For LCR banks, this component is expected to be lower after LCR if there is a reduced concentration of illiquid assets among them.

3 The Liquidity Coverage Ratio

The LCR was introduced by the Basel Committee on Banking Supervision (BCBS) in December 2010 and revised in January 2013 as part of the Basel III Accord. The US version

[3]In equilibrium, banks must be indifferent between a strategy with high fire-sale discount and one with high money premium. Because the money premium arises from deposit insurance and capital requirement costs, it may increase if the LCR encourages banks to hold more long-term loans to maturity and fund these loans with insured deposits (Diamond and Kashyap (2016)).

of LCR was first proposed in October 2013 and finalized in September 2014.[4] For bank j, LCR is equal to its unencumbered[5] HQLA divided by its total expected net cash outflows ($ENCO30$) over a prospective 30 calendar day period in a stress event:

$$LCR_j = \frac{HQLA_j}{ENCO30_j}. \tag{1}$$

BHCs that hold at least $250 billion in consolidated assets or are internationally active (i.e., with at least $10 billion in on-balance-sheet foreign exposure) are required to have LCR ≥1 on a daily basis. We call them "*full-banks*." If a full-bank's LCR falls below one on any business day, it must notify its supervising agency. After three consecutive shortfall days, it must submit a "plan for remediation" with a timeline for compliance. BHCs with consolidated assets of at least $50 billion but less than $250 billion – denoted "*mod-banks*" – are subject to a modified version of LCR that instead requires HQLA to meet outflows over 21 out of 30 calendar days. BHCs with consolidated assets under $50 billion are not subject to the LCR.[6] These prudential size limits were changed after 2017, when our sample ends.

HQLA are classified into three categories by liquidity: Level 1, Level 2A, and Level 2B. Level 1 assets, the most liquid category, are not subject to a haircut and must constitute at least 60 percent of HQLA. Levels 2A and 2B assets are subject to 15% and 50% haircuts, respectively. The sum of Level 2A and 2B assets cannot exceed 40%, and Level 2B assets cannot independently exceed 15%, of the HQLA portfolio. The LCR rule specifies the eligible assets for each HQLA level (Panel A in Table A.1 of the appendix).

$ENCO30$ is the total expected cash outflows minus inflows maturing in 30 calendar days or less, estimated by applying outflow and inflow rates to outstanding liability balances and

[4]The Basel and US versions of LCR have some differences (Bouwman (2018)).

[5]An asset is "unencumbered" if it is free of legal, regulatory, contractual, or other restrictions on the bank's ability to liquidate, sell, transfer, or assign it.

[6]Depository institutions that are subsidiaries of covered BHCs and have at least $10 billion in consolidated assets are also subject to LCR.

receivables, respectively.[7] However, inflows cannot offset more than 75% of outflows:

$$
\begin{aligned}
ACO30_j &= \sum_{k=1}^{k=n_l} O_{k,j} * L_{k,j} \\
ENCO30_j &= ACO30_j - Min(0.75 * ACO30_j, \sum_{m=1}^{m=n_a} I_{m,j} * A_{m,j})
\end{aligned} \tag{2}
$$

$ACO30_j$ is the aggregate cash outflow in a 30 day period, and $L_{k,j}$ and $A_{m,j}$ are the liability and asset balances outstanding, respectively. $O_{k,j}$ and $I_{m,j}$ are the outflow and inflow rates that reflect historical stress events and depend on many factors. Liabilities that are volatile, uninsured, collaterized with illiquid assets or have institutional counterparties, tend to have high net outflow rates. For example, unsecured retail funding have outflow rates between 3% and 40% versus 5-100% for wholesale funding, depending on the account type (Panel B of Table A.1 in the appendix). Fully insured retail deposits are assigned outflow rates of 3 percent versus 10 percent for all other retail deposits. Outflow rates for repo transactions are 0-15% using Level 1 or 2A assets as collateral, but 25-100% with lower quality collateral.

The LCR rules are more stringent for full-banks than for mod-banks. In addition to facing higher HQLA requirements, full-banks were required to achieve 80% of LCR by 2015, 90% by 2016, and 100% by 2017. They had to calculate LCR on the last business day of each month beginning in January 2015 and on every business day beginning in July 2016. Full-banks were required to publicly disclose their LCR from April 1 2018. Mod-banks, by comparison, were required to achieve 90% of LCR by 2016 and 100% of LCR by 2017, calculate LCR only on a monthly basis and begin public disclosure by October 1, 2018.

4 Data and Methodology

We describe the data in section 4.1. Our empirical methodology is described in section 4.2. The validity of the parallel trends assumption is examined in section 4.3.

[7] For balance sheet items without a contractual maturity, there is a maturity mismatch add-on.

4.1 Data

Bank balance sheet items are from the FR Y-9C report except for small business lending and insured deposits that are from Call Reports, as these data are not reported on the Y-9C. We also distinguish between different types of deposits — insured and uninsured deposits, and core deposits, as further discussed in Section B.1 of the appendix.

We examine bank-level changes in standards and terms of C&I loans as reported in the Senior Loan Officer Opinion Survey (SLOOS), usually conducted four times per year by the Federal Reserve Board.[8] For loans to large or small firms, the SLOOS asks banks whether standards or terms over the past three months have tightened, eased or stayed the same. There are 80 domestic banks in the survey, covering all 12 Fed districts. After merging with the Y-9C data and rebalancing the panel, we have 1,006 observations for small firms and 1,078 for large firms, including all LCR banks. The non-LCR banks in the merged sample are on average larger than those in our full sample, implying a closer size-match between the treatment and control groups in the SLOOS relative to the full sample.

We use this data for two purposes. First, we infer changes in lending standards and terms after LCR since they are more likely to reflect changes in credit *supply* conditions, whereas changes in loan holdings can reflect both demand and supply conditions. To do so, we code SLOOS responses as -1 (looser), 0 (same) or 1 (tighter) for standards and terms separately. We then combine them to define $StanTerm$ – an indicator for tightening, easing or not changing standards or terms (see Section B.2 of the appendix for details) – and use it as an outcome variable in the DiD regressions.

Second, the SLOOS responses allow us to link changes in lending standards or terms to banks' concerns about regulations, taking advantage of questions that ask banks to give the reason for changing standards or terms, with one response being "increased concerns about the effects of legislative changes, supervisory actions, or changes in accounting standards."[9]

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[8] See `https://www.federalreserve.gov/data/sloos/about.htm` for further details. While the aggregated SLOOS survey results are made public, the micro-SLOOS data that we use is not.

[9] This question is relatively new in SLOOS. In the longer past, respondents have often pointed to their

Since no major changes in accounting standards occur for large banks in our sample, the responses likely reflect regulatory or supervisory concerns only.[10] For this analysis, we define the variable *RegTight* to indicate whether banks tighten standards or terms for regulatory or other reasons (Section B.2 of the appendix has more details) and then examine if LCR banks are more likely to cite regulatory reasons for tightening relative to non-LCR banks.

4.2 Methodology

We construct a balanced panel of US banks from 2009Q1 until 2017Q4. The sample start date is chosen to remove effects due to the Global Financial Crisis (GFC), while the end date precedes regulatory changes in May 24, 2018 after which smaller mod-banks became exempt from LCR. Section B.3 of the appendix provides further details of our panel construction.

LCR banks are defined as BHCs with consolidated assets of at least $50 billion. We define non-LCR banks as midsized banks with assets between $3 billion and $50 billion. Smaller banks are excluded as they are typically community banks with unique characteristics. Panel A of Table 1 presents summary statistics for the 109 banks in our sample. The sample includes 25 LCR banks (of which 12 are full-banks and 13 are mod-banks) and 84 non-LCR banks for a total of 3,924 bank-quarters. As data on control variables are missing for eight bank-quarters, the regressions use 3,916 observations. The average assets of full-, mod- and midsized banks in the pre-LCR period (2009 to 2013Q1) are $894 billion, $99 billion and $10 billion, respectively, and they each increase over the sample period.

The remaining columns of Panel A of Table 1 show asset items, as shares of total assets. While, in the pre-LCR period, the HQLA share of midsized banks is similar to those of LCR banks and the loan share is comparable to that of mod-banks, these shares diverge

competitors or other factors outside of their control, and it is possible that banks blame regulations for tightening standards to avoid possible blame for their choices.

[10]Many accounting standard updates are clarifications of existing laws and not amendments or do not apply to large banks (see Accounting standards). As updated standards do not become effective for a few years, we look for amendments that apply to large banks between 2009-2013: No. 2009-06, 2011-03, 2011-08 and 2012-02. All relate to intangibles and transfers and servicing, and likely irrelevant to lending decisions.

after LCR.[11] For example, the HQLA share during the pre-LCR period is about 14%, 8% and 11% for full-, mod- and midsized banks, respectively, and it increases for LCR banks – especially for the most liquid Level 1 assets – but decreases for non-LCR banks over the sample.[12] The loan shares – the dominant share of assets – are 43%, 67% and 63% in the pre-LCR period for full-, mod- and midsized banks, respectively. LCR banks' loan shares decrease only slightly post-LCR but that of midsized non-LCR banks increases (also see Figure 1). The lower *relative* loan share of LCR banks suggests an opportunity cost of foregone lending that we quantify in section 7.2.

Panel B of Table 1 reports descriptive statistics of liabilities. LCR penalty rates are relatively high for short-term funding and relatively low for stable retail and insured deposits (see section 3). In the pre-LCR period, midsized banks have similar shares of overnight (ON) fed funds as full-banks and of insured deposits as mod-banks, while its share of ON repo is in-between that full- and mod-banks. After LCR, covered banks decrease their shares of ON repo and fed funds (columns 1 and 2) while insured deposit shares increase for full-banks (column 3).[13]

The last 4 columns of Panel B of Table 1 report descriptive statistics of the control variables used in the regressions: the net interest margin (NIM), to indicate the profitability of lending; common equity tier 1 to risk-weighted assets ratio (CET1), to measure the effects of regulatory capital; non-performing loans (NPL) as shares of total loans, which proxies for bank risk; and core deposits as shares of total assets, since access to core deposits may

[11]Our HQLA calculations incorporate LCR haircuts and caps (to the extent they are binding). Since we do not have data on excess reserves, we approximate it by the sum of cash and reserve balances minus estimated reserve requirements.

[12]Relative to non-LCR banks, changes in HQLA and Level 1 assets are significant for LCR banks (Panel A of Table C.1 in the appendix). Conversely, the share of structured products – a non-HQLA item – falls from 9% pre-LCR to 6% post-LCR for full-banks – a significant change (Panel A of Table C.1 in the appendix).

[13]However, Panel B of Table C.1 in the appendix reports that, relative to midsized banks, changes in insured deposit shares of LCR banks are insignificant but the changes are significant for ON repo holdings of full-banks in 2013Q2-2014 and for ON fed funds holdings for all LCR banks in 2015-2017. Roberts, Sarkar and Shachar (2018) show a shift to repo and fed funds funding of maturity exceeding one-year by covered banks after LCR. Macchiavelli and Pettit (2021) show that dealers reduce their reliance on repos to finance inventories of HQLA. This is because, while LCR outflow rates for repos are low when the collateral is a level 1 or level 2A asset, these assets then become "encumbered" and ineligible as HQLA.

encourage riskier loans (Black, Hancock and Passmore (2010)). In the pre-LCR period, the midsized banks have somewhat higher CET1 and NIM, while its core deposit and NPL shares are similar to those of mod-banks. For all banks, the shares of NPL and the NIM decrease in the post-LCR periods, suggesting that both the profitability and the loan risk falls. CET1 increases for LCR banks and decreases for midsized banks during this period. All banks increase their shares of core deposits.

The summary statistics indicate that, while the control banks are much smaller in size than the treatment banks, the bank groups are more similar with respect to other covariates during the pre-LCR period, but with diverging trends after LCR. A natural research design involves estimating DiD panel regressions of changes in the outcome variables around 2013Q2 for the LCR banks relative to the non-LCR banks, with two exceptions.[14] We estimate changes in lending *within* the treatment group in section 5.5 and multinomial lgotistic regressions to model banks' SLOOS choices in section 6. The basic DiD panel regressions for bank i and quarter t are specified as follows:

$$\frac{\Delta Y_{it}}{A_{i,t-1}} = \alpha_0 + \alpha_i + \alpha_t + \delta_1 \textit{Post-LCR}_t \times \textit{LCR-Bank}_i + \sum_{j=1}^{4} \beta_{ij} \frac{X_{ijt-1}}{A_{i,t-1}} + \epsilon_{it} \tag{3}$$

where Y is the outcome variable (i.e., loans, liquidity creation or illiquidity risk) and A is total assets.[15] The vector X includes the bank controls. Y and X are normalized by the previous period's assets to account for bank size effects. *Post-LCR* is 1 from 2013Q2 to 2017Q4 and 0 otherwise. The sensitivity of our results to alternative event dates is discussed in section 5.4. *LCR-Bank* = 1 for banks with assets of \$50 billion or more. Non-LCR banks are the omitted group. Standard errors are clustered by bank and robust to heteroskedasticity and serial correlation. The coefficient of interest is δ_1, indicating the change in outcome for LCR banks relative to non-LCR banks from the pre- to the post-LCR period.

[14] A regression discontinuity (RD) design around the size cut-offs would make the bank group sizes more similar; however, a paucity of banks close to the cutoffs made the RD design infeasible.

[15] We use the change, rather than the level of Y, due to the high serial correlation in levels of Y. Alternatively, one might estimate a DiD regression in levels and include lags of Y but, as discussed in Angrist and Pischke (2009), consistent estimates of the treatment effects are difficult to obtain in these models.

We use bank fixed effects α_i to account for bank characteristics that may be correlated with LCR shocks. We test for parallel pre-trends (section 4.3), and run "placebo" tests with alternative bank size groupings (section 5.3) and event dates (section 5.4). The period fixed effects α_t control for bank-independent credit demand effects (e.g., from macroeconomic changes). Examining lending standards in section 6 allow us to further distinguish credit demand and credit supply effects.

Next, we separate LCR banks into full- and mod-banks. Since the former needed to be compliant with LCR earlier, we split the post-LCR period into *2013Q2-2014* and *2015-2017*. The coefficients of interest in (4) are δ_1 and δ_3 for full-banks and δ_2 and δ_4 for mod-banks.

$$\begin{aligned}\frac{\Delta Y_{it}}{A_{i,t-1}} &= \alpha_0 + \alpha_i + \alpha_t + \delta_1 \mathit{2013Q2\text{-}2014}_t \times \mathit{Full\text{-}Bank}_i + \delta_2 \mathit{2013Q2\text{-}2014}_t \times \mathit{Mod\text{-}Bank}_i \\ &+ \delta_3 \mathit{2015\text{-}2017}_t \times \mathit{Full\text{-}Bank}_i + \delta_4 \mathit{2015\text{-}2017}_t \times \mathit{Mod\text{-}Bank}_i + \sum_{j=1}^{4} \beta_{it} \frac{X_{it}}{A_{i,t-1}} + \epsilon_{it}\end{aligned} \tag{4}$$

A departure from these specifications occurs in Table 5, where we conduct a placebo test by using bank size buckets of \$40 billion width instead of the full- and mod-bank groups.[16]

4.3 Parallel trends assumption

We test for parallel pre-trends by estimating DiD coefficients in every period except 2013Q1:

$$\frac{\Delta Y_{it}}{A_{i,t-1}} = \alpha_0 + \alpha_i + \alpha_t + \sum_{t \neq k} \delta_t \mathit{Full\text{-}Bank}_i I(t) + \sum_{t \neq k} \gamma_t \mathit{Mod\text{-}Bank}_i I(t) + \sum_{j=1}^{4} \beta_{ij} \frac{X_{it}}{A_{i,t-1}} + \epsilon_{it} \tag{5}$$

I is an indicator variable equal to 1 for all quarters except k=2013Q1, the last quarter of the pre-LCR period. We require that δ_t and γ_t are not significantly different from zero for $q < t$ (i.e. the pre-LCR period). In Section B.4 of the appendix, we plot δ_t and γ_t for periods $t < k$ and $t > k$ and the associated confidence intervals for our main outcome variables (i.e.,

[16] Since some banks move between these smaller buckets, the size bucket dummy variables are no longer absorbed by the bank fixed effects. So we include them in the regressions (although their estimates are not shown for brevity). Removing these transitioning banks was infeasible due to sample size considerations. In other tables of this paper, we use bank groups that are fixed over time, and so this issue does not arise.

lending, liquidity creation and the illiquidity component of fire-sale risk). Consistent with parallel pre-trends, we find that, for $t < k$, the confidence bands straddle zero in virtually all quarters for all outcome variables. Further, the outcome variables shift down in the post-event period, with δ_t and γ_t mostly below the zero line since 2013Q2. However, the quarter by quarter estimates are often insignificant, suggesting the tests have low power.

Accordingly, we provide additional tests suggested in the literature (reported in section B.4 of the appendix) to support parallel pre-trends and rule out alternative hypotheses. First, we include differential pre-trends in the regressions and show that differences in the slopes for LCR and midsized banks are insignificantly different from zero. Further, we show that the post-event trend is significantly more negative for LCR banks. These results are consistent with parallel pre-trends and rule out the alternative hypothesis that post-LCR outcomes are continuations of a pre-event trend.

5 Bank Adjustments to LCR

In this section, we evaluate the effects of LCR on bank balance sheets. To test Hypothesis 1, we examine changes in lending by LCR banks relative to non-LCR banks since 2013Q2 (section 5.1). In section 5.2, we provide several tests to distinguish between the effects of liquidity and other regulations implemented during our sample, including those outlined in Hypothesis 3. We check the robustness of identifying LCR effects with asset size cutoffs by considering "placebo" bank size groupings (section 5.3). We also check robustness with respect to alternative event dates and omitting the event quarter (section 5.4). We examine treatment heterogeneity (Hypothesis 2) in section 5.5) – whether LCR banks' pre-LCR liquid asset and runnable liability shares affect their post-LCR lending shares. Finally, section 5.6 considers the effect of LCR on bank liquidity creation.

5.1 Effect of LCR on Bank Lending

The descriptive statistics reported in Table 1, and discussed in section 4.2, indicate that covered banks increase their shares of HQLA and decrease their shares of less liquid assets following LCR. While their loan share falls only slightly, LCR banks lose market share to midsized banks. On the liability-side, the effects of LCR are less clear, consistent with the discussion in section 2. While LCR banks shift to term funding, their shares of stable funding do not appear to increase relative to midsized banks. LCR banks have more capital post-LCR while all banks experience declining profitability along with reduced risk of nonperformance. While lower profitability discourages lending, lower risk and higher capital likely do the opposite, and so the overall effect on lending is ambivalent.

Table 2 reports regression results for changes in loans as shares of lagged assets for LCR relative to non-LCR banks. We find that the change in lending of LCR banks as a share of assets is 1.30 percentage points (pp) less between 2013Q2 and 2014 and 1.48 pp less in 2015-2017, relative to midsized banks (column 1). In dollar terms, LCR banks reduce lending by $3.54 trillion relative to midsized banks in 2013Q2-2017.[17] Of the control variables, higher capital ratios and lower shares of nonperforming loans increase lending significantly. Net interest margins and core deposit shares have insignificant effects on total loans. Reduced securitizations may also lower lending capacity (Maddaloni and Peydró (2011)), but we show in Table C.3 of the appendix that changes in securitization are not driving these results.[18] The significant negative effect of LCR on lending is consistent with US banks having adjusted to the regulations mainly by shedding illiquid assets, per Hypothesis 1.

To evaluate economic significance, we estimate the income foregone from lower lending by LCR banks in the post-LCR period, relative to midsized banks. The loan income is

[17]The lending reduction in dollars per LCR bank for period p is: lending coefficient*mean assets in period p* number of quarters. For 2013q2-2014, we have 0.013*$509.36 billion*7 quarters = $46.35 billion per LCR bank and, for 2015-2017, we have 0.0148*$537.37 billion*12 quarters = $95.44 billion per LCR bank. Multiplying by the number of LCR banks (25), we get a total lending reduction of $3.54 trillion.

[18]In particular, the coefficient on a lagged securitization dummy is generally positive, as hypothesized, but insignificant. The dummy is 1 if the securitization income is positive and 0 otherwise. We use a dummy variable as many banks have zero securitization income in several quarters.

defined to be the net interest income (NII) minus provisions for loan and lease losses (LLP). We assume that, absent LCR, the average pre-LCR ratio of loan income to loans of covered banks would remain the same following the LCR. Then, the foregone income of LCR banks equals this pre-LCR ratio multiplied by the estimated reduction in lending by covered banks after LCR, relative to exempt banks. The post-LCR change in lending is obtained from the coefficient estimates in column 1 of Table 2. Table C.4 in the appendix reports the formula and the steps in the calculation, showing that LCR banks forego about \$1.3 billion in NII per bank (amounting to \$31.9 billion over all LCR banks) in 2013Q2-2017, or 6% of their net income during this period.[19]

Column 2 of the table shows that both mod- and full-banks reduce lending significantly in 2013Q2-2014 and 2015-2017. Thus, even though mod-banks did not implement LCR till 2016, it appears that they adjusted their asset mix ahead of the regulations. Indeed, Ihrig, Kim, Kumbhat, Vojtech and Weinbach (2017) report that some banks publicly discussed LCR in their quarterly earnings calls as early as 2014. Nevertheless, we find that, while full-banks reduced lending significantly in 2013, mod-banks did not do so till 2014 (see Table C.5 in the appendix). Moreover, the reductions in total lending are larger for full-banks than for mod-banks, based on a Wald test. Hence, the results are consistent with mod-banks facing less stringent restrictions than full-banks.

Could the declining loan *share* be due to a mechanical effect from an increase in asset growth after LCR? To address this concern, we show in Table C.6 of the appendix that the results are robust to using the *growth of total loans* as the dependent variable.

5.2 Effects of Other Regulations on Bank Lending

In addition to LCR, many other regulations were implemented during our sample and thus, the estimated effect on lending is likely a composite of several regulations.[20] We now examine

[19]The net income per LCR bank in 2013Q2-2017, obtained by summing over quarterly net income, was \$21.32 billion.

[20]Large banks also incurred substantial legal settlements following the global financial crisis (GFC). However, these were exclusively paid by the largest banks (see violations tracker). As discussed below, we

whether these non-LCR regulations could *entirely* account for the estimated lending effects.

5.2.1 Stress tests

Following Hypothesis 3(a), stress-testing constraints predict a larger reduction in lending to small firms whereas LCR constraints predict similar reductions to large and small borrowers. Panel B of Table C.2 in the appendix and Figure 1 show that the share of small business C&I loans declines for all bank groups since 2009, even as their overall C&I loan shares increase. Columns 3 and 4 of Table 2 show no evidence of *significantly more* negative effects for C&I loans to small firms than to all firms, inconsistent with the effects of capital constraints. In all cases, relative to midsized banks, LCR banks reduce their total C&I loan shares more than their small business C&I loan shares, although in two cases (for mod-banks in 2013Q2-2014 and full-banks in 2015-2017) the reductions in small business loans are significant while those in total C&I loans are insignificant.

To further distinguish the effects of stress tests and LCR, we isolate those LCR banks not included in the stress tests prior to 2014, denoted *LST* banks (see Hypothesis 3(b)). The remaining LCR banks are denoted *early stress test* or *EST* banks. These banks are listed in Table C.7 in the appendix. Since the hypothesis relates only to 2013Q2-2014, the sample for these regressions ends in 2014. Figure B.1 in the appendix shows that the lending trends for both EST and LST banks shift down since 2013Q1 (although the quarterly changes are not statistically significant). Column 1 of Table 3 shows that *LST* and *EST* banks have significantly larger reductions in total loan shares by 0.95% and 1.55%, respectively, in 2013Q2-2014, relative to non-LCR banks. A Wald test shows that we cannot reject the equality of these coefficients. Similar results obtain for all and small business C&I loans (columns 2-3), as *LST* banks reduce lending by statistically similar amounts as *EST* banks in 2013Q2-2014. The results are consistent with banks shedding loans due to LCR, over and above any stress test effects.

do not find the largest lending effects for the biggest banks.

Could the results for *LST* banks be due to anticipation of stress test results? The Fed announced the rules governing the 2014 stress tests on October 12, 2012 (see DFAST2012). The bottom panels of Figure B.1 in the appendix show that *LST* banks do not cut lending significantly relative to midsized banks in 2012Q4 – prior to LCR but after the announcement of the 2014 stress tests – inconsistent with an announcement effect.

Banks that fail the stress tests are subject to restrictions on their dividends and share buybacks. Since there may be significant lending effects of stress test failures, we exclude from our sample banks that failed the tests in various years and obtain similar results (see Table C.8 in the appendix).

5.2.2 Risk-based capital rules

Per Hypothesis 3(c), G-SIBs face additional capital requirements compared to non-G-SIB full-banks (such as a capital surcharge) while LCR treats both groups similarly. We separate G-SIBs from other full-banks in columns 5-7 of Table 2. For G-SIBs relative to non-G-SIB full-banks, changes in total (C&I) loans are lower (higher) while changes in small business loans are similar in 2013Q2-2014 and higher in 2015-2017. However, in all cases, changes in loans are not statistically different for G-SIBs compared to those of other full-banks, according to the Wald tests. For other loan types (i.e., real estate, credit card and consumer loans), changes in shares for G-SIBs are either smaller than or similar to those for other full-banks, inconsistent with the effects of enhanced capital rules (see Table C.9 in the appendix). One exception is consumer loans, where we observe a greater reduction for G-SIBs than for non-GSIB full banks, but these differences are not statistically different, based on Wald tests.

Following Hypothesis 3(d), we compare the effect of risk-weights and LCR haircuts on bank behavior by estimating changes in the GNMA MBS and GSE MBS holdings of LCR banks. Table 4 reports the results. We find that GNMA MBS holding, as shares of lagged assets, increase significantly relative to midsized banks for LCR banks (column 1), with this increase mostly attributable to mod-banks (column 2).[21] By comparison, the GSE MBS holdings betray no LCR effects (columns 3-4). These results indicate that banks increase their holdings of the asset with the lower LCR haircut, relative to another asset with similar risk but higher LCR haircut, potentially increasing HQLA (see Table 1) at the expense of loans. Since regulatory risk-weights on the asset pair were constant during our sample, these results suggest an LCR-induced channel for lower lending.

5.2.3 Leverage ratio

In 2012, US regulators proposed the supplementary leverage ratio (SLR) that requires full-banks to maintain a minimum ratio of 3% of tier 1 capital to total on- and off-balance sheet exposures. Since the SLR treats all exposures equally (independent of risk), it creates incentives for banks to *increase* their shares of risky assets (Choi, Holcomb and Morgan (2020)), contrary to our evidence. But the SLR could become risk-sensitive in the post-stress scenario since banks with larger balance sheets are more sensitive to business cycles (Covas (2017)). If SLR reduces lending, we should find greater effects on G-SIBs than on non-GSIB full-banks since the former have been subject to a higher leverage ratio (the eSLR) since 2014. However, we do *not* find that G-SIBs typically reduce lending more than non-G-SIB full-banks.

5.2.4 CLAR and enhanced supervision

The Fed uses the Comprehensive Liquidity Analysis and Review (CLAR), introduced in 2012, for institutions subject to the Large Institution Supervision Coordinating Committee (LISCC) program to assess more accurately bank-specific liquidity risk during a crisis. It includes a bank-run liquidity stress test, an independent Federal Reserve review of the bank's analysis, and an evaluation of the banks' liquidity planning and governance (see LISCC). Enhanced supervision requires higher standards for internal risk controls and is dispropor-

[21] The different results for mod- and full-bank results are likely due to bank specialization in mortgage-related activities.

tionately focused on the largest 5 banks (Hirtle, Kovner and Plosser (2020)). Thus, both CLAR and enhanced supervision affect the largest and most systemically important banks. However, we do not find that the LCR effects are greatest for the largest banks, as further examined in section 5.3 below. Moreover, we omit from our sample the LISCC banks that CLAR was applied to and find our results little changed (see Table C.10 in the appendix).

5.2.5 Discussion

Given the sheer volume of non-LCR regulations implemented during our sample period, some of our estimated lending effects may well be due to these other regulations. Nevertheless, the evidence presented in this section suggests that non-LCR regulations are unlikely to entirely account for our estimated lending effects. In particular, we have shown that lending reductions by LCR banks mostly occur independent of participation in stress tests, borrower size and G-SIB designations. Moreover, asset holdings of LCR banks respond to LCR haircuts even when there are no changes in the risk weights. Finally, evidence based on differences in the incidence of LCR and non-LCR regulations on banks of various sizes are consistent with incremental LCR effects – an issue that is further discussed in the next section.

5.3 Bank Size or LCR Effects? Additional Investigations

As large banks have different business models than smaller banks and are more heavily regulated, our results may be driven by bank size rather than LCR (EBA (2013)). Our prior results show that the decline in the non-G-SIB full banks' lending is similar to that of the G-SIBs (that have unique business models). Also, the presence of parallel pre-trends and the inclusion of bank fixed effects mitigate the concern about bank size to some extent. Nevertheless, we perform a placebo test to separate the effects of bank size and the LCR threshold of \$50 billion. Specifically, we use dummy variables for each \$40 billion size bucket starting from \$10 billion up to \$250 billion. In addition, banks with size $\geq$ \$250 billion are separated into G-SIBs and non-GSIBs.[22]

The results for total loans are reported in column 1 of Table 5; the remaining columns are discussed in sections 5.6 and 7. Changes in total lending of banks in the \$10 – \$50 billion group – who are subject to certain capital rules but not LCR[23] – are not statistically significant. In contrast, the change in the lending share of the \$50 – \$90 billion group declines by 1.10% and the change is significant at the 1% level. Since both groups face capital regulations but LCR only applies to the larger group and, moreover, these groups are similar in size, this additional decline in lending is likely an effect of the LCR. Further, banks with assets $\geq$ \$250 billion do not cut loan shares the most, even though they face the strictest capital regulations. Finally, G-SIBs do not reduce lending more than non-G-SIBs. Thus, bank groupings using LCR cutoffs are not just proxies for size- or business model-based differences, but rather identify LCR effects in addition to those from capital rules.

5.4 Alternative Event Dates and Event Quarter Effects

Could US banks have started adjusting to the LCR earlier than 2013Q1 (our event date)? While some banks started to calculate internal metrics of LCR as early as December 31 2012, actual compliance could not occur till 2013 due to uncertainty about the final version of the LCR (see, for example, JPMC (2013)). Consistently, the dynamic DiD coefficients for total loans (see Figure B.1 in the appendix) are mostly on or above the zero line prior to 2013Q2. To further examine this issue, for the pre-treatment sample of 2009-2012, we estimate a DiD regression with an alternative event date of 2011Q1 and find no significant changes in lending since 2011Q2, relative to midsized banks (see Table B.2 in the appendix).

Could the event date be later, given that the US rules were not finalized until 2013Q4 (and eligibility of municipal bonds for HQLA was not decided until 2018)? Since full-banks shed loans significantly in 2013Q2-2013Q4 (see Table C.5 in the appendix), it appears that

[22] In similar vein, Bindal, Bouwman, Hu and Johnson (2018) identify the effects of the Dodd-Frank Act (DFA) by examining banks within size bands 30% above and below the size thresholds of \$10 and \$50 billions.

[23] Basel III rules increased the amount and quality of capital that *both* LCR and non-LCR banks must hold against risk-weighted assets (Walter (2019)).

they adjusted after the finalization of the Basel version of LCR. Similarly, from Figure B.1 in the appendix, mod-banks do not appear to adjust lending around 2016, when they were required to start complying with LCR. Thus, while complying with LCR is costly for banks, there may also be benefits to adjusting their portfolios early, given the complexities of implementing the regulations (Cetina and Gleason (2015)).

To account for potential contaminating effects from announcements and the GFC, we repeat our analysis after excluding the event quarter of 2013Q1 and 2009, respectively, and obtain virtually unchanged results (as reported in Tables C.11 and C.12, respectively, in the appendix).

5.5 Pre-LCR Heterogeneity and Bank Lending

In this section, we examine Hypothesis 2 which states that covered banks with *lower* shares of stable funding and *higher* shares of HQLA and Level 1 assets prior to LCR, cut lending less after LCR. We choose 2011Q1 as the pre-regulation baseline.[24]

For the sample of 25 LCR banks, we regress changes in total loans on *Post-LCR* interacted with 2011Q1 shares of stable funding and liquid assets.

$$\frac{\Delta Y_{it}}{A_{i,t-1}} = \alpha_0 + \alpha_i + \alpha_t + \delta_1 Post\text{-}LCR_t \times \frac{Z_{i,2011Q1}}{A_{i,2011Q1}} + \sum_{j=1}^{4} \beta_{ij} \frac{X_{ijt-1}}{A_{i,t-1}} + \epsilon_{it} \tag{6}$$

where $Y = Total\,Loans$ and $Z_{2011Q1} = Conditioning\,Variable$ in 2011Q1. Panel A of Table 6 shows results when conditioning on stable funding shares (columns 1-4) and liquid asset shares (columns 5-6) in 2011Q1. We find that pre-LCR shares of liquid assets and stable

[24]Sundaresan and Xiao (2021) also estimate treatment heterogeneity using the gap between required and actual liquidity ratios in 2012Q4 as their pre-LCR variable. There are four differences with our approach. First, we use balance sheet values rather than the liquidity ratio. While the ratio is meant to proxy LCR, the latter cannot be accurately estimated from Call Reports and Y-9C. Cetina and Gleason (2015) document the complexity of LCR calculations (e.g., it requires over 300 inputs, HQLA diversification and various cash flow adjustments to the denominator). Second, we perform separate analyses for asset and liability items since they have opposite implications for loan growth whereas the liquidity ratio combines assets and liabilities. Third, we use 2011Q1 as the pre-LCR benchmark because anticipatory effects of the LCR may already be reflected in banks' portfolios in 2012Q4 (EBA (2013)). Fourth, we separate the effects for full- and mod-banks that have different pre-LCR balance sheet constraints.

funding (other than core deposits) are insignificantly related to loan growth.

Pre-LCR balance sheet constraints may be different for mod- and full-banks. On the one hand, as full-banks were required to meet higher LCR ratios along with earlier compliance (section 3), they may be more sensitive to pre-LCR constraints. On the other hand, the pre-LCR shares of HQLA and Level 1 assets were already high for full-banks relative to that of mod-banks (Table 1), implying reduced sensitivity to initial shares. Further, balance sheet constraints at a point in time may become less binding in later periods. Accordingly, we modify (6) to identify incremental effects for full-banks and in 2015-2017, as follows:

$$\begin{aligned}\frac{\Delta Y_{it}}{A_{i,t-1}} &= \alpha_0 + \alpha_i + \alpha_t + \delta_1 \textit{2013Q2-2014}_t \times \frac{Z_{i,2011Q1}}{A_{i,2011Q1}} + \delta_2 \textit{2015-2017}_t \times \frac{Z_{i,2011Q1}}{A_{i,2011Q1}} \\ &+ \gamma_1 \textit{Full-Bank}_i \times \textit{2013Q2-2014}_t \times \frac{Z_{i,2011Q1}}{A_{i,2011Q1}} + \gamma_2 \textit{Full-Bank}_i \times \textit{2015-2017}_t \times \frac{Z_{i,2011Q1}}{A_{i,2011Q1}} \\ &+ \gamma_3 \textit{Full-Bank}_i \times \textit{2013Q2-2014}_t + \gamma_4 \textit{Full-Bank}_i \times \textit{2015-2017}_t + \sum_{j=1}^{4} \beta_{ij} \frac{X_{ijt-1}}{A_{i,t-1}} + \epsilon_{it}\end{aligned} \tag{7}$$

The results are reported in Panel B of Table 6. Column 2 (Z=ON repo) of the table shows that $\gamma_1 > 0$ and statistically significant. Since $(\delta_1 + \gamma_1) > 0$, this implies that full-banks with higher pre-LCR shares of ON repo (i.e., lower stable funding shares) have significantly higher loan growth in 2013Q2-2014, as hypothesized. Moreover, column 3 (Z=Insured deposits) reports that γ_1 and γ_2 are both negative and statistically significant, indicating that lower pre-LCR shares of insured deposits for full-banks predict higher loan growth in 2013Q2-2014 and also in 2015-2017 (since $(\delta_2 + \gamma_2) < 0$). Finally, column 6 ($Z$=Level 1 assets) reports that $\gamma_2 > 0$ and significant, indicating that higher pre-LCR shares of Level 1 assets of full-banks predict higher loan growth in 2015-2017, also as hypothesized. Thus, lower pre-LCR stable funding shares and higher pre-LCR liquid asset shares appear to mitigate post-LCR lending reductions by full-banks, suggesting that these banks take into account potential synergies between their assets and liabilities when responding to LCR.[25]

[25]However, in contrast to full-banks, lower pre-LCR stable funding shares of mod-banks reinforce rather than mitigate post-LCR lending reductions, perhaps suggesting different pre-LCR balance sheet constraints

5.6 Liquidity Creation by LCR and non-LCR Banks

Diamond and Kashyap (2016) note that, absent costs to limiting liquidity creation, the value of liquidity regulations cannot be assessed. Banks create liquidity by funding illiquid, long-maturity assets with liquid, short-term liabilities, thereby providing liquidity and maturity transformation services. Banks' primary asset-side adjustment to LCR, cutting loans in favor of HQLA, likely decreases their asset-side liquidity creation. However, since the LCR penalizes liquid liabilities differentially based on counterparty, collateral, and other factors, its effect on liability-side liquidity creation is unclear, per Hypothesis 4.

Our liquidity creation measure BB is taken from Berger and Bouwman (2009) and is equal to liquidity-weighted liabilities plus liquidity-weighted assets (see section D.1 of the appendix for implementation details). In Table D.3 in the appendix, we examine the effects of LCR on asset- and liability-side liquidity creation, and on each of the Berger and Bouwman (2009) liquidity categories. Mod-banks increase their share of liquid assets, which include HQLA (column 1), while full-banks decrease their shares of illiquid assets since 2013Q2, relative to non-LCR banks (column 3). Consistent with Hypothesis 4a, asset-side liquidity creation $BBNA$ by LCR banks decreases significantly (column 4). On the liability side, all LCR banks (except for mod-banks in 2013Q2-2014) decrease their shares of liquid liabilities relative to non-LCR banks since 2013Q2 (column 5), while changes in less-liquid liabilities are mostly not significant. Liability-side liquidity creation $BBNL$ is lower and significantly so in all cases except for mod-banks in 2013Q2-2014 (column 8). Driven by declines in asset-side liquidity creation $BBNA$, overall balance sheet liquidity creation BBN by LCR banks decreases significantly in the post-LCR period, relative to non-LCR banks (column 9).

Considering alternative bank-size groupings, columns 2-4 of Table 5 show that decreases in *asset-side* liquidity creation kick in at the \$50 billion cutoff but not below, once more indicating that the LCR dummy variables are not mere proxies for bank size. There is

for full- and mod-banks. Specifically, for mod-banks, $\delta_1 < 0$ and significant when $Z = ON\ repo$ and $\delta_2 > 0$ and significant when $Z = Insured\ deposits$.

weaker evidence of an LCR effect on liability-side liquidity creation since the latter declines even in the $\$10 - \$50$ billion size group (column 4), albeit at the 10% level of significance.[26] We conclude that liquidity creation declines significantly after LCR, particularly on the asset-side, consistent with Hypothesis 4.

6 Bank Lending Standards and Terms

While changes in loan amounts reflect both credit demand and supply conditions, changes in lending standards and terms should mostly reflect supply side conditions. In this section, we examine bank-level changes in standards and terms of C&I loans as reported on SLOOS. We also examine to what extent banks' changes in standards or terms are related to regulations.

The blue-shaded bars in Figure 2 plot the asset-weighted shares of banks that change standards or terms for small firms (top panel) and large firms (bottom panel). Increased tightening (easing) is indicated by bars above (below) the zero line. While there are more instances of easing than tightening, more LCR banks appear to tighten standards or terms for small and large borrowers compared to midsized non-LCR banks.

In Table 7, we report results from panel regressions using $StanTerm$ as the dependent variable. $StanTerm$ equals 1 (-1) if both standards and terms are tighter (looser) or if one is tighter (looser) and the other is "no change," while it is 0 if both standards and terms are unchanged. In case of conflicting answers (e.g., standards tighter but terms easier), $StanTerm$ is coded as missing (see section B.3 of the appendix).[27] A positive coefficient indicates that LCR banks tighten standards or terms more often after LCR than before LCR, relative to non-LCR banks. We find that LCR banks significantly tighten standards or terms for large firms in 2013Q2-2014 and 2015-2017 (column 1). Column 2 shows that mod-banks tighten standards or terms for large firms but results for full-banks are not significant. To purge

[26] Also consistent with a weaker effect of LCR on liability-side liquidity creation, when we include off-balance-sheet liabilities, our results remain unaffected (see Section D.2 in the appendix).

[27] Since we have fewer observations after merging the standards data with Y-9C, we have verified that the results in Table 2 continue to hold in the shorter sample (see Table E.1 in the appendix).

effects unrelated to credit supply, Bassett, Chosak, Driscoll and Zakrajsek (2014) regress standards on macro and financial conditions, risk tolerance and other SLOOS responses regarding loan demand, and show that the regression residual is a good proxy of the supply of bank loans. We perform a similar regression for $StanTerm$[28] and use the regression residual as the outcome variable, and find that all LCR banks tighten standards or terms except for full-banks in 2015-17 (column 3). Results for small firms are not significant (columns 4-6).

Banks tighten standards for many reasons. Conditional on tightening standards or terms, are LCR banks more likely than non-LCR banks to cite regulatory or supervisory concerns as reasons for doing so? The green-shaded bars in Figure 2 suggest that this may be the case. In particular, for large borrowers, higher asset-weighted shares of LCR banks appear to cite regulation as a reason for tightening standards or terms, as compared to shares of non-LCR banks. We set $RegTight$ equal to 2 whenever $Stanterm$ equals 1 *and* a bank cites regulatory or supervisory concerns; in all other cases, $RegTight$ equals $StanTerm$. We model banks' choices using a multinomial logistic regression, estimated with maximum likelihood. $RegTight = 1$ is the reference category, and *Post-LCR*, *LCR-Bank*, *Post-LCR* $*$ *LCR-Bank* and bank controls are the regressors.

Panel A of Table 8 shows results when banks choose $RegTight = 2$ versus $RegTight = 1$ (i.e., whether banks implicate regulations when they tighten standards or terms).[29] The likelihood ratio test rejects the null that all coefficients are zero. The results for large (small) firms show that when *Post-LCR* $*$ *LCR-Bank* increases from 0 to 1, the log-odds for citing regulations when tightening increase significantly by 1.72 (2.12) units. Since the coefficients are difficult to interpret, Panel B of the table shows the estimated odds ratios which, due to the interaction term, are evaluated at different values of *Post-LCR* and *LCR-Bank*. The first two rows show results for the pre- and post-LCR periods. For large firms, the odds ratio of regulation-related tightening by LCR banks versus non-LCR banks is 1.69 after

[28]Results from the regression are in Table E.2 of the appendix.

[29]Estimates for $RegTight = 0$ versus $RegTight = 1$ and $RegTight = -1$ versus $RegTight = 1$ are not shown to save space.

LCR (*Post-LCR* = 1) as compared to 0.30 before LCR (*Post-LCR* = 0), and the lower bound of the 95% confidence level is 0.61 after LCR as compared to 0.06 before LCR. For small firms, we have similar results, as the lower bound of the 95% confidence interval for the corresponding odds ratio is 0.57 after LCR as compared to 0.04 before LCR. Thus, the results are consistent with a greater likelihood of regulation-related tightening by covered banks relative to exempt banks after LCR, as compared to before LCR. The last two rows of Panel B show results for LCR and non-LCR banks. Regulation-related tightening is also more likely in the post- versus the pre-LCR period for LCR banks as compared to non-LCR banks, although the odds ratios are smaller in magnitude.

The survey question does not refer to LCR specifically, so could the results be due to capital regulations? To address this issue, we repeat the regression after replacing *Post-LCR* with a dummy variable *CapReg*=1 in 2011-2012 (since Basel III rules were released in December 2010) and 0 otherwise. The first two rows in Panel B of Table E.3 in the appendix show relatively *lower* likelihood of regulation-related tightening by LCR banks in the capital regulation period. For example, for large (small) firms, the odds ratio of regulation-related tightening by LCR banks versus non-LCR banks is 0.32 (0.07) when *CapReg*=1 as compared to 1.05 (1.27) when *CapReg*=0, and the lower bound of the 95% confidence level is 0.04 (0.01) when *CapReg*=1 compared to 0.41 (0.43) when *CapReg*=0. As such, our results are consistent with banks tightening standards or terms due to concerns specifically about LCR in addition to concerns about capital regulations.

7 Fire-Sale Risk: LCR and Non-LCR Banks

The analysis has so far focused on the costs of LCR in terms of foregone lending and liquidity creation by covered banks. We now turn to the potential benefits from LCR banks' reduced contributions to fire-sale losses due to a lower concentration of illiquid assets (section 7.1). As we find that banks subject to LCR reduce their fire-sale externalities, we then quantify the benefits of LCR net of the costs associated with foregone lending (section 7.2). In 7.3, we discuss the effect on the banking sector as a whole if lending and fire-sale risk shift from LCR banks to unregulated banks.

7.1 Fire-Sale Risk of LCR and non-LCR Banks

The fire-sale risk measure is from Duarte and Eisenbach (2021) and captures spillovers following an asset price drop that increases bank leverage. After an initial shock to a bank's assets, other banks holding assets correlated with the "hit" bank also sell assets to return to their target leverage, and thereby suffer "second-round losses." A bank's contribution to fire-sale losses is the sum of all second-round spillover losses. As a share of assets, it depends on the concentration of large and illiquid assets (denoted illiquidity linkage) and its leverage relative to the system leverage at the time of the shock.[30] Lower loan shares of LCR banks, relative to non-LCR banks, may result in lower illiquidity linkages for LCR banks, as long as their portfolio similarity does not increase (Hypothesis 5). Leverage risk of LCR banks may increase due to lower loan shares (Duarte and Eisenbach (2021)), or decrease if banks delever to meet LCR requirements. As leverage risk may also respond to broad financial conditions (Duarte and Eisenbach (2021)), it is difficult to decompose LCR effects from these broader effects. As such, we focus on the effect of LCR on the illiquidity component of fire-sale risk which is expected to primarily measure the contribution of *liquidity* regulations.

We estimate the the fire-sale measure for the largest 500 banks in the Y-9C data.[31] To measure asset illiquidity, we follow Duarte and Eisenbach (2021) and use the Net Stable Funding Ratio (NSFR) liquidity weights. Section F.1 and Table F.1 in the appendix discuss how shares of securities and loans that make up the fire-sale measure change around the LCR for control and treated banks. We find that, relative to midsized banks, LCR banks

[30] As we normalize by assets, the effect of size disappears (equation (9) in Duarte and Eisenbach (2021)).

[31] We do not use the full sample of Y-9C banks as the asset size cut-off for reporting purposes changes over time, resulting in large drops in the number of reporters in the later sample. Duarte and Eisenbach (2021) estimate their measure for the 130 largest banks. We thank the authors for the fire-sale data and code.

generally shift towards assets that have lower price impact during fire-sales. Figure 3 charts the fire-sale measure as a share of bank assets and its illiquidity linkage component. Table 9 shows the effects of LCR on changes in the fire-sale risk as a ratio of bank assets, and its illiquidity and leverage (expressed as a ratio of system leverage) components. LCR banks' contributions to overall fire-sale losses decrease significantly by 7 bp in 2013Q2-2014 and 8 bp in 2015-2017 (column 1) while those of full-banks decrease significantly by 11 bp and 13 bp, respectively (column 2). More important, relative to non-LCR banks, the illiquidity component is lower for LCR banks (column 3), and for *both* full- and mod-banks in 2013Q2-2014 and 2015-2017 (column 4). Changes in the leverage component are also negative and significant but only for full-banks (column 6). Hence, the results indicate greater resilience of LCR banks stemming from lower concentrations of large and illiquid assets.

Since capital regulations are unlikely to substantially affect the illiquidity linkage, the results in this section are compelling evidence of an LCR effect. Moreover, column 5 of Table 5 shows that significant changes in the illiquidity component do not occur in size buckets below $50 billion, providing further evidence of an LCR effect.

7.2 Net Benefits from LCR

We have thus far documented a private cost (regulated banks pass over potentially profitable lending opportunities) and a social benefit (regulated banks contribute less to systemic risk) of LCR. Do the reductions in systemic risk contributions justify the costs imposed on regulated banks?[32]

We calculate the benefits in the post-LCR period – i.e., reduced illiquidity linkages of LCR banks, relative to non-LCR banks – from the estimates in columns 3-4 of Table 9. As the illiquidity component is unitless, we convert it into dollars by scaling by the post-LCR

[32]EBA (2013) finds the opportunity cost of LCR for European banks to be 1.8 bp of assets from lower returns on HQLA. Kara and Ozsoy (2020) show large increases in the price of risky assets from liquidity regulations. Hoerova, Mendicino, Nikolov, Schepens and Heuvel (2018) estimate the real effects of liquidity regulations using the spread between deposits and HQLA rates. Gam (2021) and Sundaresan and Xiao (2021) also consider the real effects of LCR.

sample mean of (fire-sale losses/illiquidity component) for the relevant bank group. As in section 5.1, we approximate the costs of LCR by the net interest income foregone from lower lending by LCR banks, except that we adjust for corporate income taxes and the estimated post-LCR change in lending is obtained for the shorter sample of banks with both fire-sake risk measures and lending data. Section F.2 of the appendix provides full details of the estimation of net benefits.

Panel A of Table 10 shows the pre-tax net benefits per bank-quarter from LCR. For LCR banks in the post-LCR period, the benefit from lower illiquidity concentration is 2.6 bp (column 2) and the net interest income foregone is 1.2 bp (column 3) for a net benefit of 1.4 bp (column 4) as a share of assets, which is statistically significant.[33] In dollar terms, LCR banks contribute \$64 billion less to fire-sale risk (column 5) but give up \$29 billion in interest income (column 6) for a net benefit of \$34 billion (column 7). Most of the net benefits accrue to full-banks. In 2013Q2-2014, the net benefit to full-banks from lower illiquidity concentration is 2.6 bp (column 4) as a share of assets, amounting to about \$23 billion (column 7) when summed over 12 full-banks and 7 quarters. By comparison, the aggregate net benefit to mod-banks in 2013Q2-2014 is about \$1.7 billion. Considering full- and mod-banks separately, and summing benefits for each group over the full post-LCR sample of 2013Q2-2017, the benefits from reduced fire-sale risk are substantial, exceeding \$90 billion, but costs from lost interest income eat about half of the benefits, so that the net benefits are about \$44 billion on a pre-tax basis.

The aggregate after-tax net benefits are higher (Panel B) since taxes decrease the income foregone from loans but are assumed to have no effect on benefits. Total after-tax net benefits in dollars from 2013Q2 to 2017 are about \$53 billion for full-banks and \$4 billion for mod-banks. Thus, only about 7% of net benefits accrue from regulating mod-banks. This is due to two reasons. First, the reduction in the illiquidity linkage is larger for full-banks (column 4 of Table 9). More important, full-banks contribute more to overall fire-sale risk in the

[33]We calculate the standard error of net benefits as the square root of the sum of squares of the standard errors of benefits and costs.

banking sector so that the scaling factor $\frac{firesale\ risk}{illiquidity\ linkage}$ is substantially larger for full-banks (Panel B of Table F.2 in the appendix). In other words, as full-banks are more systemic, a reduction in their fire-sale risk results in larger net benefits. Relatedly, column 6 of Table 5 shows that reductions in *overall* fire-sale risk are consistently insignificant below the $250 billion size bucket. This evidence supports recent actions by US regulators to exempt some of these smaller banks from LCR, although this decision has been questioned following the distress of large regional banks in March 2023.

7.3 Do Non-LCR Banks Offset Lending Effects on LCR Banks?

We have so far examined the private costs to LCR banks from reduced lending shares. To what extent does lending shift from covered banks to non-LCR banks after LCR? In section G of the appendix, we find that lending expansion and liquidity creation by unregulated banks more than offset reductions in lending and liquidity creation by LCR banks, so that aggregate banking sector loan shares increased after LCR. However, we find no evidence of a significantly *lower* illiquidity component of fire-sale risk for the average bank. Thus, the reallocation of lending to smaller banks does not improve financial stability. As the net benefit to the banking sector does not change significantly following LCR, we conclude that the effect of LCR on the banking sector as a whole was neutral.

8 Conclusion

In this paper, we examine the costs and benefits of the LCR as implemented in the US. We show that banks subject to the LCR increase their liquid assets and decrease their lending, as shares of total assets, in the post-LCR period, resulting in decreased asset-side liquidity creation relative to non-LCR banks. Banks with lower liquid asset shares prior to LCR decrease their loan shares by *more* following LCR. On the liability side, LCR banks reduce their shares of liquid borrowings relative to non-LCR banks. Consequently, liability-side liquidity creation also decreases, resulting in lower overall liquidity creation by LCR banks. Large LCR banks with lower pre-LCR shares of stable funding decrease their loan shares *less*, thus complying with LCR by increasing stable funding in lieu of cutting loans. Using microdata from SLOOS, we also show that LCR banks tighten lending standards or terms in the post-LCR period and frequently cite regulation or supervision as a reason for doing so, consistent with an LCR-induced credit supply shock.

While our estimated lending effects likely include components due to non-LCR regulations — such as stress tests, changes in the risk-weights from capital rules and the leverage ratio, CLAR or enhanced supervision — we argue that they are unlikely to account for all of the estimated effects. We show this by exploiting differences in the implementation and incidences of LCR and non-LCR regulations (for example, with respect to penalties on specific assets and the exemption status of certain banks).

Diminished credit supply by LCR banks is a substantive, albeit unintended consequence of liquidity regulations, as these banks reduce lending relative to non-LCR banks by $3.54 trillion, thereby suffering losses in net interest income equal to 6% of their net income in 2013Q2-2017. However, these costs are offset by the benefits from reduced fire-sale externalities due to a lower concentration of illiquid assets among LCR banks. We estimate that these net benefits exceed $50 billion from 2013Q2 to 2017, accruing almost entirely due to lower contributions to fire-sale risk from the largest LCR banks. For the banking sector as a whole, we find that lending shares are unchanged as lending shifted from large to smaller banks after LCR. With more lending concentrated in the portfolios of smaller banks, fire-sale risk in the banking sector does not decrease after LCR. Thus, LCR has a neutral effect on the aggregate banking sector.

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Table 1: Asset- and Liability-Side Changes Around LCR: Descriptive Statistics

The table shows select asset and liability items, as shares of total assets, for LCR and non-LCR banks before and after the finalization of LCR. High Quality Liquid Assets (HQLA) is an LCR-defined category and calculated based on LCR haircuts and caps. *Mod-Bank* are LCR banks with assets between $50 billion and $250 billion. *Full-Bank*, also subject to LCR, are internationally active or have assets exceeding $250 billion. Midsized banks are not subject to LCR and have assets between $3 billion and $50 billion.

Panel A: Assets

Size Group	Period	Number of Banks	Total Assets (Billions)	Share of Total Assets (%): HQLA	HQLA Level 1	Structured Products	Loans	Fixed and Intangible Assets	Other Assets
All Banks	2009-2013Q1	109	117.69	11.14	7.55	1.87	60.89	8.73	17.37
	2013Q2-2014	109	125.28	9.70	6.69	1.63	62.71	7.98	17.98
	2015-2017	109	133.78	9.10	6.30	1.44	64.60	7.63	17.23
Full-Banks	2009-2013Q1	12	894.39	14.03	10.33	8.88	42.88	11.02	23.19
	2013Q2-2014	12	944.42	17.16	13.04	7.39	42.56	9.45	23.43
	2015-2017	12	984.05	19.72	14.78	5.87	42.38	8.65	23.39
Mod-Banks	2009-2013Q1	13	99.49	8.02	5.48	1.70	66.83	11.88	11.57
	2013Q2-2014	13	107.77	8.86	6.05	1.42	67.63	9.95	12.14
	2015-2017	13	125.04	10.98	7.02	1.04	66.40	9.33	12.25
Midsized Banks	2009-2013Q1	84	9.55	11.20	7.47	0.90	62.54	7.91	17.44
	2013Q2-2014	84	10.97	8.77	5.88	0.83	64.83	7.46	18.10
	2015-2017	84	13.66	7.30	4.98	0.87	67.49	7.22	17.12

Panel B: Liabilities and Regression Controls

Size Group	Period	Share of Total Liabilities (%): ON FedFunds	ON Repo	Insured Deposits	Controls (%): Core Deposits	CET1	Nonperforming Loan Share	Net Interest Margin
All Banks	2009-2013Q1	0.45	4.58	42.83	60.95	13.58	3.48	0.87
	2013Q2-2014	0.32	3.37	42.06	66.63	13.68	1.70	0.83
	2015-2017	0.26	2.62	39.76	66.15	12.81	1.16	0.81
Full-Banks	2009-2013Q1	0.37	8.00	19.37	33.10	12.51	3.98	0.73
	2013Q2-2014	0.10	7.66	20.66	37.93	13.67	2.54	0.63
	2015-2017	0.04	6.00	21.15	38.87	14.02	1.88	0.62
Mod-Banks	2009-2013Q1	0.62	1.51	38.65	64.30	11.77	3.36	0.82
	2013Q2-2014	0.30	1.20	38.02	71.09	11.85	1.45	0.77
	2015-2017	0.27	1.35	36.26	69.89	11.87	1.17	0.73
Midsized Banks	2009-2013Q1	0.44	4.56	46.83	64.41	14.01	3.42	0.90
	2013Q2-2014	0.35	3.09	45.74	70.04	13.96	1.62	0.87
	2015-2017	0.30	2.33	42.96	69.46	12.78	1.06	0.85

Table 2: Changes in Bank Lending and LCR

The table shows results from estimating panel regressions (3) and (4) where the outcome variable is the change in loans, divided by the prior quarter's total assets. *LCR-Bank* is 1 for banks that were required to implement the LCR. *Mod-Bank* is 1 for LCR banks with assets between \$50 billion and \$250 billion. *G-SIB* is 1 for global systemically important banks. *Full-Bank* is 1 for LCR banks that are internationally active or have assets exceeding \$250 billion (excluding G-SIBs when the G-SIB dummy is included). We report $p-values$ from a $Wald$ test of the null hypothesis that the change in lending is equal for G-SIBs and non-GSIB full-banks. The omitted group is midsized banks, which have assets between \$3 billion and \$50 billion. The sample period is 2009 Q1 to 2017 Q4. Standard errors are clustered at the bank-level. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively. C&I=Commercial & Industrial.

	(1) All Loans	(2) All Loans	(3) All C&I Loans	(4) Small Business C&I Loans	(5) All Loans	(6) All C&I Loans	(7) Small Business C&I Loans
	Without G-SIB Dummy Variable				With G-SIB Dummy Variable		
LCR Bank x 2013Q2-2014	-1.30***						
	(-3.72)						
Mod-Bank x 2013Q2-2014		-0.90**	-0.17	-0.04*	-0.90**	-0.17	-0.04*
		(-2.21)	(-1.46)	(-1.82)	(-2.21)	(-1.46)	(-1.81)
Full-Bank x 2013Q2-2014		-1.74***	-0.26**	-0.06***			
		(-4.69)	(-2.31)	(-2.81)			
Full (Non-G-SIB) x 2013Q2-2014 (α)					-1.88***	-0.21	-0.06**
					(-3.43)	(-1.45)	(-2.44)
G-SIB x 2013Q2-2014 (β)					-1.61***	-0.32***	-0.06***
					(-5.21)	(-3.07)	(-2.76)
LCR Bank x 2015-2017	-1.48***						
	(-4.12)						
Mod-Bank x 2015-2017		-0.97**	-0.29**	-0.03	-0.97**	-0.29**	-0.03
		(-2.05)	(-2.10)	(-1.18)	(-2.05)	(-2.11)	(-1.18)
Full-Bank x 2015-2017		-2.07***	-0.18	-0.07**			
		(-5.89)	(-1.39)	(-2.24)			
Full (Non-G-SIB) x 2015-2017 (γ)					-2.34***	-0.06	-0.06
					(-5.73)	(-0.29)	(-1.26)
G-SIB x 2015-2017 (δ)					-1.79***	-0.30***	-0.08***
					(-4.34)	(-3.26)	(-3.11)
Lag Tier 1 Capital Ratio	0.23***	0.24***	0.07***	0.01**	0.24***	0.07***	0.01**
	(3.60)	(3.67)	(3.90)	(1.99)	(3.66)	(3.90)	(1.99)
Lag Share Nonperforming Loans	-0.25***	-0.25***	-0.05**	-0.00	-0.25***	-0.05*	-0.00
	(-3.45)	(-3.42)	(-2.00)	(-0.70)	(-3.44)	(-1.98)	(-0.70)
Lag Net Interest Margin	-0.89	-0.90	-0.02	-0.15**	-0.91	-0.02	-0.15**
	(-1.35)	(-1.37)	(-0.11)	(-2.33)	(-1.39)	(-0.08)	(-2.31)
Lag Share Core Deposits	-0.01	-0.01	-0.00	-0.00*	-0.01	-0.00	-0.00*
	(-0.79)	(-0.83)	(-0.49)	(-1.85)	(-0.85)	(-0.46)	(-1.83)
Wald Test P-value: $\alpha = \beta$					0.59	0.30	0.94
Wald Test P-value: $\gamma = \delta$					0.22	0.32	0.58
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.06	0.06	0.05	0.02	0.06	0.05	0.02
Observations	3920	3920	3920	3379	3920	3920	3379

Table 3: Stress Testing, LCR and Changes in Bank Lending

The table shows results from panel regressions of changes in loans, as shares of total assets. LCR banks are split up into *late stress test* or *LST* banks that did not participate in stress tests till 2014 and the remaining LCR banks (denoted *early stress test* or *EST* banks) that participated in earlier stress tests (listed in Table C.7 in the appendix). We report $p-values$ from a $Wald$ test of the null hypothesis that the change in lending is equal for *LST* and *EST* banks in 2013Q2-2014. LCR banks are those with assets of at least $50 billion. The omitted group is midsized banks, which have assets between $3 billion and $50 billion. The sample period is 2009 Q1 to 2014 Q4. Standard errors are clustered at the bank-level. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively. C&I=Commercial & Industrial.

	All Loans	C&I Loans	
	(1)	(2) All	(3) Small Business
LST Bank x 2013Q2-2014 (α)	-0.95**	-0.19	-0.07**
	(-2.23)	(-1.66)	(-2.56)
EST Bank x 2013Q2-2014 (β)	-1.55***	-0.22*	-0.04**
	(-4.14)	(-1.90)	(-2.14)
Lag Tier 1 Capital Ratio	0.24***	0.06***	0.02**
	(2.88)	(2.85)	(2.00)
Lag Share Nonperforming Loans	-0.30***	-0.07**	-0.00
	(-2.99)	(-2.36)	(-0.31)
Lag Net Interest Margin	-1.27	-0.02	-0.12
	(-1.56)	(-0.06)	(-1.34)
Lag Share Core Deposits	-0.02	-0.01	-0.00
	(-0.97)	(-0.95)	(-1.30)
Wald Test P-Value: $\alpha = \beta$	0.14	0.76	0.25
Bank F.E.	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes
Adj R^2	0.06	0.05	0.02
Observations	2612	2612	2071

Table 4: Changes in GNMA and GSE MBS Holdings and LCR

The table shows results from estimating panel regressions (3) and (4) where the outcome variable is the change in GNMA or GSE MBS, divided by the prior quarter's total assets. *LCR-Bank* is 1 for banks that were required to implement the LCR. *Mod-Bank* is 1 for LCR banks with assets between $50 billion and $250 billion. *Full-Bank* is 1 for LCR banks that are internationally active or have assets exceeding $250 billion. The omitted group is midsized banks, which have assets between $3 billion and $50 billion. The sample period is 2009 Q1 to 2017 Q4. Standard errors are clustered at the bank-level. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) GNMA MBS	(2) GNMA MBS	(3) GSE MBS	(4) GSE MBS
LCR Bank x 2013Q2-2014	0.10*		-0.12	
	(1.69)		(-1.20)	
Mod-Bank x 2013Q2-2014		0.19**		-0.20
		(2.36)		(-1.29)
Full-Bank x 2013Q2-2014		-0.01		-0.04
		(-0.19)		(-0.46)
LCR Bank x 2015-2017	0.08**		-0.03	
	(2.05)		(-0.33)	
Mod-Bank x 2015-2017		0.10**		-0.09
		(2.13)		(-0.72)
Full-Bank x 2015-2017		0.05		0.03
		(0.99)		(0.34)
Bank F.E.	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes
Adj R^2	0.01	0.01	0.02	0.02
Observations	3920	3920	3920	3920

Table 5: Changes in Lending, Liquidity Creation and Fire-Sale Risk, Using Alternative Bank Size Groups

The table shows results from panel regressions of changes in various LCR-related outcomes, as shares of total assets: total loans (column 1), liquidity creation (columns 2-4) and fire-sale risk (columns 5-6). The on-balance sheet liquidity creation measure BBN ((Berger and Bouwman 2009)) is decomposed into its asset-side ($BBNA$) and liability-side ($BBNL$) components. The overall fire-sale risk and its illiquidity component is from (Duarte and Eisenbach 2021). *Post-LCR* is set equal to 1 from 2013 Q2 to 2017 Q4. Banks are grouped into $40B size buckets starting from $10B. Banks with assets ≥$250B are split into G-SIBs (i.e., global systemically important banks) and non-G-SIBs.The omitted group includes banks with assets between $3 billion and $10 billion. The sample period is 2009 Q1 to 2017 Q4. Standard errors are clustered at the bank-level. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) Loans	(2) BBN	(3) BBNA	(4) BBNL	(5) Illiquidity Component	(6) Fire-Sale Risk
10-50B x Post-LCR	-0.21	-0.41	-0.11	-0.30*	-0.01	-0.02
	(-0.54)	(-1.42)	(-0.53)	(-1.86)	(-0.28)	(-0.95)
50-90B x Post-LCR	-1.10***	-1.10***	-0.72***	-0.38***	-0.14**	-0.02
	(-3.26)	(-4.77)	(-3.88)	(-2.84)	(-2.54)	(-0.91)
90-130B x Post-LCR	-1.12	-1.23*	-0.44	-0.79*	-0.11*	-0.09
	(-1.18)	(-1.80)	(-1.27)	(-1.83)	(-1.72)	(-1.43)
130-170B x Post-LCR	-1.28	-1.16***	-1.14***	-0.03	-0.18**	-0.03
	(-0.96)	(-2.92)	(-2.70)	(-0.16)	(-2.13)	(-0.34)
170-210B x Post-LCR	-1.23**	-0.88***	-0.65***	-0.24*	-0.18***	-0.11
	(-2.13)	(-4.50)	(-2.87)	(-1.81)	(-3.57)	(-1.40)
210-250B x Post-LCR	-2.57***	-0.80**	-0.67**	-0.13	-0.07	-0.12
	(-2.96)	(-2.50)	(-2.11)	(-0.60)	(-1.20)	(-1.51)
≥250B x Post-LCR	-2.22***	-1.68***	-1.14***	-0.53**	-0.29***	-0.13***
	(-4.24)	(-6.30)	(-3.09)	(-2.04)	(-4.84)	(-4.51)
GSIB x Post-LCR	-1.57***	-1.17***	-0.76***	-0.41***	-0.23***	-0.11***
	(-4.23)	(-3.91)	(-3.43)	(-2.90)	(-5.73)	(-4.31)
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.07	0.06	0.07	0.06	0.24	0.10
Observations	3920	3920	3920	3920	3920	3920

Table 6: Heterogeneity in LCR Bank Lending: Effect of Pre-LCR Liquid Asset and Liability Shares

For the sample of LCR banks, Panel A of the table shows results from panel regressions of changes in total loans on $Post\text{-}LCR \times (Z/Assets)_{2011Q1}$. *Post-LCR* is 1 from 2013 Q2 to 2017Q4. Z is an asset or liability item as of 2011Q1. In Panel B, we further interact the regressor with *Full-Bank* which is 1 for LCR banks that are internationally active or have assets exceeding $250 billion. The liability items are overnight (ON) fed funds, ON repo and insured deposits. The asset items are HQLA (high quality liquid assets, as defined by LCR) and Level 1 HQLA – the most liquid segment of HQLA. The sample period is 2009 Q1 to 2017 Q4. Standard errors are clustered at the bank-level. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	Z = ON Fed Funds	Z = ON Repo	Z = Insured Deposits	Z = Core Deposits	Z = HQLA	Z = Level 1 Assets
	(1)	(2)	(3)	(4)	(5)	(6)
Post-LCR x Z_{2011Q1}	0.10	0.00	0.02	0.01*	-0.01	-0.01
	(0.57)	(0.14)	(1.65)	(1.83)	(-0.55)	(-0.65)
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.06	0.06	0.06	0.06	0.06	0.06
Observations	897	897	897	897	897	897

	Z = ON Fed Funds	Z = ON Repo	Z = Insured Deposits	Z= Core Deposits	Z = HQLA	Z = Level 1 Assets
	(1)	(2)	(3)	(4)	(5)	(6)
2013Q2-2014 x Z_{2011Q1} (δ_1)	0.24	-0.18**	0.04	0.04	-0.01	-0.03
	(1.64)	(-2.59)	(1.38)	(1.17)	(-0.18)	(-0.55)
2015-2017 x Z_{2011Q1} (δ_2)	-0.10	0.07	0.08**	0.04	-0.04	-0.05
	(-0.21)	(0.36)	(2.34)	(1.20)	(-1.25)	(-1.47)
Full-Bank x 2013Q2-2014	-0.15	0.24***	-0.06*	-0.04	0.03	0.05
x Z_{2011Q1} (γ_1)	(-0.86)	(3.18)	(-1.76)	(-1.39)	(0.55)	(1.06)
Full-Bank x 2015-2017	0.21	-0.03	-0.09**	-0.04	0.06	0.07*
x Z_{2011Q1} (γ_2)	(0.45)	(-0.17)	(-2.43)	(-1.30)	(1.61)	(1.83)
Full-Bank x 2013Q2-2014 (γ_3)	-0.73	-1.67***	1.10	1.69	-1.20	-1.30*
	(-1.59)	(-2.99)	(1.03)	(1.00)	(-1.49)	(-1.83)
Full-Bank x 2015-2017 (γ_4)	-1.07*	-1.15*	2.35*	1.71	-1.56**	-1.50**
	(-2.04)	(-2.00)	(1.87)	(0.80)	(-2.15)	(-2.21)
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	897	897	897	897	897	897

Table 7: Changes in C&I Lending Standards or Terms: LCR and Non-LCR Banks

The dependent variable is *StanTerm*, the change in C&I lending standards or terms by banks. *StanTerm* equals 1 (-1) if both standards and terms are tighter (looser) or if one is tighter (looser) and the other is "no change," while it is 0 if both standards and terms are unchanged. In columns 1-3, the loans are to large firms. In columns 4-6, the loans are to small firms. Standards are coded as -1 (looser), 0 (no change) and 1 (tighter). *Residual* refers to residuals from a regression of *StanTerm* on loan demand, risk tolerance, macro and financial conditions. *2013Q2-2014* is set equal to 1 from 2013 Q2 to 2014 Q4 and *2015-2017* is set equal to 1 from 2015 Q1 to 2017 Q4. *LCR-Bank* is set equal to 1 for banks that were required to implement the LCR. *Mod-Bank* is set equal to 1 for LCR banks with assets between $50 billion and $250 billion. *Full-Bank* is set equal to 1 for LCR banks that are internationally active or have assets exceeding $250 billion. The omitted group is midsized banks, which have assets between $3 billion and $50 billion. The sample period is 2009 Q1 to 2017 Q4. Standard errors are clustered at the bank-level. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	Large Businesses			Small Businesses		
	(1) Large	(2) Large	(3) Residual	(4) Small	(5) Small	(6) Residual
LCR Bank x 2013Q2-2014	0.20**			0.09		
	(2.09)			(0.78)		
Mod-Bank x 2013Q2-2014		0.23*	0.17**		0.12	0.09
		(1.96)	(2.12)		(0.97)	(1.04)
Full-Bank x 2013Q2-2014		0.18	0.17**		0.02	0.03
		(1.59)	(2.16)		(0.12)	(0.32)
LCR Bank x 2015-2017	0.35**			0.21		
	(2.43)			(1.43)		
Mod-Bank x 2015-2017		0.48***	0.32***		0.22	0.16
		(3.32)	(3.12)		(1.58)	(1.55)
Full-Bank x 2015-2017		0.20	0.11		-0.03	-0.04
		(1.24)	(0.97)		(-0.14)	(-0.27)
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.29	0.30	0.03	0.30	0.30	-0.00
Observations	1079	1079	1079	1006	1006	1006

Table 8: Changes in Lending Standards or Terms Related to Regulation

The table shows, for large and small firms, results from a multinomial logistic regression of $RegTight$ on *Post-LCR*, *LCR-Bank* and *Post-LCR* $*$ *LCR-Bank* with $RegTight = 1$ as the reference category, along with bank controls. $RegTight$ is coded as -1 when standards or terms are looser, 0 when there is no change, 1 when tighter for non-regulatory reasons and 2 when tighter due to regulatory or supervisory concerns. *Post-LCR* is set equal to 1 from 2013 Q2 to 2017 Q4. *LCR-Bank* is set equal to 1 for banks that were required to implement the LCR. The omitted group is midsized banks, which have assets between \$3 billion and \$50 billion. Panel A shows coefficient estimates when banks choose $RegTight = 2$ versus $RegTight = 1$. Estimates for "0" versus "1" and "-1" versus "1" are not shown. The likelihood ratio is a test of whether all regression coefficients are simultaneously zero. Panel B shows estimated odds ratios of citing regulations as a reason for tightening standards or terms for LCR versus non-LCR banks and pre- versus post-LCR periods. The sample period is 2010 Q3 to 2017 Q4. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Multinomial Logistic Estimates: $RegTight = 2$ versus $RegTight = 1$

	Large Firms			Small Firms		
	Estimate	Chi-Square	Prob>Chi-Square	Estimate	Chi-Square	Prob>Chi-Square
	(1)	(2)	(3)	(4)	(5)	(6)
LCR bank*Post-LCR	1.72*	3.58	0.06	2.12**	4.41	0.04
Post-LCR	-2.20***	8.61	0.00	-1.47**	3.79	0.05
LCR bank	-1.20	2.08	0.15	-1.45	2.44	0.12
Likelihood Ratio		175.76***	0.00		141.90***	0.00
Bank Controls?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1.442			1.395		

Panel B: Odds-Ratio Estimates and Wald Confidence Intervals

	Large Firms			Small Firms		
Odds Ratio of Citing regulation	Estimate	95% Confidence Intervals		Estimate	95% Confidence Intervals	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-LCR = 0: LCR vs non-LCR bank	0.30	0.06	1.54	0.24	0.04	1.45
Post-LCR = 1: LCR vs non-LCR bank	1.69	0.61	4.73	1.97	0.57	6.75
LCR-Bank = 0: Post-LCR vs Pre-LCR	0.11	0.03	0.48	0.23	0.05	1.01
LCR-Bank = 1: Post-LCR vs Pre-LCR	0.62	0.21	1.87	1.92	0.41	8.88

Table 9: Fire-Sale Risk of LCR and Non-LCR Banks

The table shows results from panel regressions of changes in the overall fire-sale risk (i.e., the contribution of a bank to fire-sale losses in the banking sector, as a share of the bank's assets) and its two components: illiquidity and leverage. *2013Q2-2014* is set equal to 1 from 2013 Q2 to 2014 Q4 and *2015-2017* is set equal to 1 from 2015 Q1 to 2017 Q4. *Mod-Bank* is set equal to 1 for LCR banks with assets between $50 billion and $250 billion. *Full-Bank* is set equal to 1 for LCR banks that are internationally active or have assets exceeding $250 billion. The omitted group is midsized banks, which have assets between $3 billion and $50 billion. The sample period is 2009 Q1 to 2017 Q4. Standard errors are clustered at the bank-level. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) Overall	(2) Overall	(3) Illiquidity Component	(4) Illiquidity Component	(5) Leverage Component	(6) Leverage Component
LCR Bank x 2013Q2-2014	-0.07***		-0.23***		-0.01	
	(-2.88)		(-6.45)		(-0.90)	
Mod-Bank x 2013Q2-2014		-0.03		-0.20***		0.00
		(-0.93)		(-4.09)		(0.69)
Full-Bank x 2013Q2-2014		-0.11***		-0.28***		-0.02***
		(-5.19)		(-7.17)		(-2.66)
LCR Bank x 2015-2017	-0.08***		-0.18***		-0.01	
	(-3.52)		(-5.68)		(-1.55)	
Mod-Bank x 2015-2017		-0.05		-0.13***		-0.00
		(-1.50)		(-3.52)		(-0.57)
Full-Bank x 2015-2017		-0.13***		-0.24***		-0.01**
		(-5.73)		(-7.07)		(-2.26)
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2	0.09	0.10	0.24	0.24	0.07	0.07
Observations	3920	3920	3920	3920	3920	3920

Table 10: Net Benefits from LCR

The table shows the net benefits from LCR, equal to the benefits of reduced illiquidity concentrations (resulting in lower fire-sale externalities) minus costs due to the income foregone from less lending, by LCR banks relative to non-LCR banks. The estimated benefits are from columns 3 and 4 of Table 9, scaled by the average ratio of fire-sale losses to illiquidity (to convert to dollars). The loan income is the net interest income (NII) minus provisions for loan and lease losses (LLP), adjusted for taxes. To obtain the foregone income, the average pre-LCR ratio of loan income to loans of LCR banks is multiplied by the estimated reduction in lending by LCR banks, relative to non-LCR banks, during the post-LCR period. The net benefits are shown as a share of assets (columns 2-4) and in dollars (columns 5-7). Panel A shows the the pre-tax net benefits from LCR. Panel B shows the after-tax net benefits from LCR. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Pre-Tax Net Benefits

			Share of Assets (Basis Points) Per Bank-Quarter			Total ($Billions)		
		(1)	(2)	(3)	(4)	(5) = (1)*(2)* Quarters*Banks	(6) = (1)*(3)* Quarters*Banks	(7)
Group	Period	Mean Assets ($Billions)	Benefit	Cost	Benefit - Cost	Benefit	Cost	Benefit - Cost
LCR Banks	Post-LCR	513.82	2.61	1.21	1.40***	63.68	29.44	34.25***
LCR Banks	2013Q2-2014	493.83	3.26	1.09	2.17***	28.16	9.39	18.77***
Full-Banks	2013Q2-2014	1051.48	4.21	1.60	2.61***	37.16	14.14	23.02***
Mod-Banks	2013Q2-2014	107.77	2.37	0.61	1.76***	2.32	0.60	1.72***
LCR Banks	2015-2017	525.47	2.24	1.28	0.96*	35.38	20.17	15.21*
Full-Banks	2015-2017	1103.87	3.11	2.02	1.10**	49.49	32.06	17.42**
Mod-Banks	2015-2017	125.04	1.66	0.66	1.00*	3.24	1.29	1.94*

Panel B: After-Tax Net Benefits

			Share of Assets (Basis Points) Per Bank-Quarter			Total ($Billions)		
		(1)	(2)	(3)	(4)	(5) = (1)*(2)* Quarters*Banks	(6) = (1)*(3)* Quarters*Banks	(7)
Group	Period	Mean Assets ($Billions)	Benefit	Cost	Benefit - Cost	Benefit	Cost	Benefit - Cost
LCR Banks	Post-LCR	513.82	2.61	0.87	1.74***	63.68	21.19	42.49***
LCR Banks	2013Q2-2014	493.83	3.26	0.78	2.48***	28.16	6.76	21.40***
Full-Banks	2013Q2-2014	1051.48	4.21	1.15	3.06***	37.16	10.17	26.99***
Mod-Banks	2013Q2-2014	107.77	2.37	0.44	1.93***	2.32	0.44	1.89***
LCR Banks	2015-2017	525.47	2.24	0.92	1.32***	35.38	14.52	20.86***
Full-Banks	2015-2017	1103.87	3.11	1.45	1.66***	49.49	23.06	26.43***
Mod-Banks	2015-2017	125.04	1.66	0.48	1.18**	3.24	0.94	2.30**

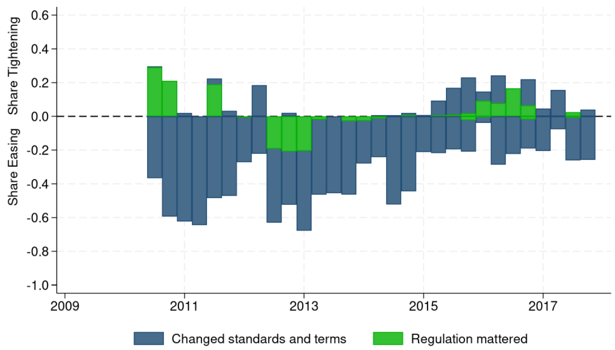
Figure 1: Share of Loans in Total Assets: LCR and Non-LCR Banks

The top panel plots total loans and residential real estate loans as shares of assets, averaged over all banks (dashed line) or over banks in different size groups (solid lines). Shares are normalized to 100 in 2009Q1 for all bank groups. The middle panel plots the shares of commercial real estate and C&I loans, and the bottom panel plots shares of small business C&I loans. Banks with assets ≥ \$50 billion are required to implement the LCR rule. Full-banks are internationally active or have assets exceeding \$250 billion. Mod-banks have assets between \$50 billion and \$250 billion. Midsized banks have assets between \$3 billion and \$50 billion and are not subject to the LCR rule. The sample period is 2009 Q1 to 2017 Q4.

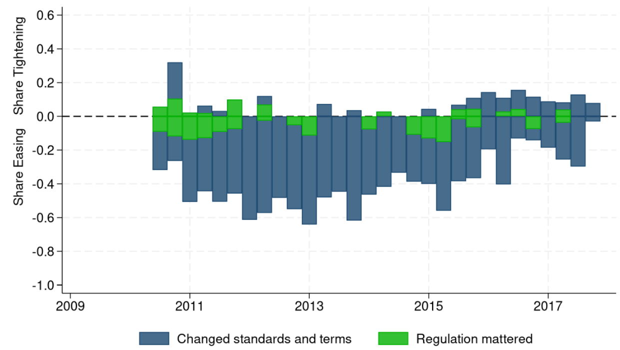
Figure 2: Lending Standards, Terms and Regulation: C&I Loans to Small and Large Firms

The blue shaded bars in the figure show the asset-weighted share of banks that indicated that they either tightened or eased lending standards or terms to small firms (top panel) or large firms (bottom panel) for C&I loans in the Senior Loan Officer Opinion Survey. The green-shaded areas show the asset-weighted share of banks indicating regulatory, supervisory or accounting changes as the reason for tightening or easing. "LCR Banks" have assets exceeding $50 billion and are required to implement the LCR rule. Non-LCR midsized banks have assets between $3 billion and $50 billion are not subject to the LCR rule. The sample period is 2010 Q3 to 2017 Q4.

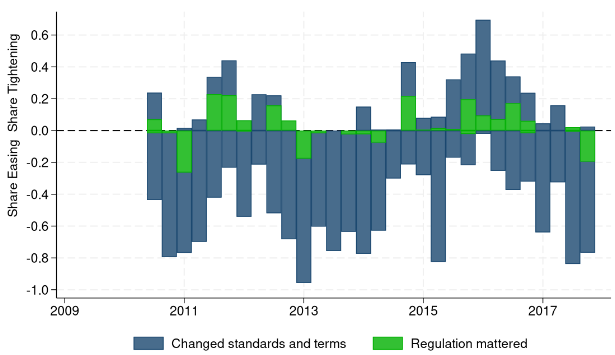
Small firms: LCR Banks



Small firms: Non-LCR Banks



Large firms: LCR Banks



Large firms: Non-LCR Banks

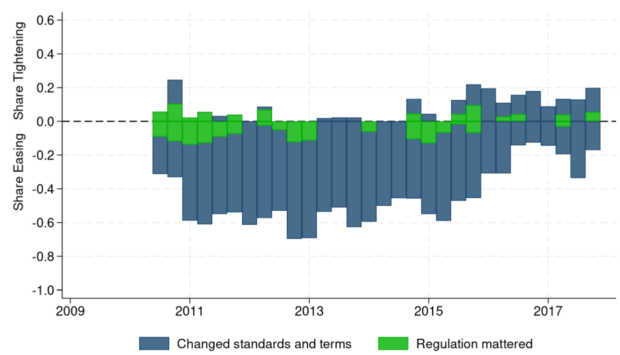


Figure 3: Fire-Sale Risk and Its Illiquidity and Aggregate Components: LCR and Non-LCR Banks

The top left panel of the figure shows the contribution of a bank to fire-sale losses in the banking sector (scaled by $1e^{-15}$), as a share of the bank's assets, averaged over banks in different size groups. The top right panel shows the illiquidity component of fire-sale risk scaled by $1e^{15}$. The bottom panel shows the aggregate (not bank-specific) component of fire-sale risk. Banks that have assets exceeding \$50 billion are required to implement the LCR rule. Full-banks are internationally active or have assets exceeding \$250 billion. Mod-banks have assets between \$50 billion and \$250 billion. Midsized banks have assets between \$3 billion and \$50 billion are not subject to the LCR rule. The sample period is 2009 Q1 to 2017 Q4.