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Bank Liquidity Creation, Systemic Risk, and Basel Liquidity Regulations

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Abstract

We find that banks subject to the Liquidity Coverage Ratio (LCR banks) create less liquidity per dollar of assets in the post-LCR period than non-LCR banks by, in part, lending less. However, we also find that LCR banks are more resilient as they contribute less to fire-sale risk, relative to non-LCR banks. We estimate the net after-tax benefits from reduced lending and fire-sale risk to be about 1.4 percent of assets in 2013:Q2-2014 for large banks. Our findings, which we show are unlikely to result from capital regulations, highlight the trade-off between lower liquidity creation and greater resilience from liquidity regulations.

Key words: LCR, banks, liquidity creation

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1 Introduction

Banks create liquidity by funding illiquid, long-maturity assets with liquid, short-term liabilities, thereby providing liquidity and maturity transformation services. In the process, they take on risk from liquidity and maturity mismatches. While liquidity buffers can provide insurance against this risk, banks are likely to under-provide liquidity ex-ante due to moral hazard or negative externalities. These issues became prominent in the financial crisis of 2007-2008, prompting regulators to implement liquidity requirements for banks, such as the Liquidity Coverage Ratio (LCR). The LCR requires internationally active bank holding companies (BHCs or simply "banks") with assets of $50 billion or over to hold enough high quality liquid assets (HQLA) that can be liquidated to cover 30 days of expected net cash outflows during a stress event.

The LCR encourages covered banks to lower their liquidity mismatch by reducing the shares of illiquid assets and liquid liabilities on their balance sheets. Consequently, the banking sector as a whole may produce less liquidity since the large US banks that implement LCR have historically created the most liquidity (Berger and Bouwman (2009)). On the other hand, reduced holdings of illiquid assets (such as loans) held in common by LCR banks may also reduce the price impact of fire-sales (Allen and Gale (2004)). Further, LCR banks may become less complex since illiquid securities also tend to be complex. Consequently, banks are likely to become more resilient in the short-term, as intended by the LCR.

In this paper, we empirically examine the short-run trade-off between LCR banks' liquidity creation and their resilience. While liquidity creation decreases as banks hold more HQLA, all else equal, banks may offset this effect by increasing the share of illiquid assets in their non-HQLA portfolios. Similarly, systemic risk may increase if LCR results in banks having similar, correlated exposures (Cecchetti and Kashyap (2018)). Thus, the nature of the trade-off (if any) is an empirical question.

Our liquidity creation measure is the Liquidity Mismatch Index (LMI) (Bai, Krishnamurthy and Weymuller (2018)), which is defined as the liquidity weighted liabilities minus liquidity weighted assets. To compare banks of different sizes, we divide LMI by total assets, and denote the normalized measure as $LMIN$. For example, if a bank's only assets are loans worth \$100 (weight=0.2, say), fully funded with demandable debt (weight=1, say), then $LMI = \$80$ and $LMIN = 0.8$.

To identify LCR effects, we examine changes in liquidity creation by banks that are required to implement LCR (LCR banks) relative to smaller banks that are not subject to LCR (non-LCR banks) since 2013Q2, the quarter after the Basel LCR rules were finalized. We show that, since 2013Q2, there is lower liquidity creation LMI in the banking sector, and LCR banks are responsible for most of this reduction. Further, LCR banks have lower liquidity creation per dollar of assets $LMIN$ since 2013Q2, compared to non-LCR banks. Lower liquidity creation by LCR banks occurs on both sides of their balance sheets, via lower shares of illiquid assets and liquid liabilities. We verify that the parallel trends assumption is satisfied (Section 4.4) and that the results are robust to using an alternative liquidity creation measure by Berger and Bouwman (2009) and including off-balance-sheet liabilities.

To further identify LCR effects, we examine changes in asset and liability items within liquidity categories and find that these changes mainly respond to LCR rules. For example, considering liquid assets, while LCR banks increase their share of HQLA, they *decrease* their share of structured products (that are ineligible as HQLA), relative to non-LCR banks. Similarly, regarding liquid liabilities, they increase their share of insured deposits that are treated favorably under LCR rules but reduce their shares of uninsured deposits and short-term funding that are less favorably treated under the rules. In other words, LCR banks do not prefer liquid assets and illiquid liabilities broadly, implying that our results are unlikely to be due to a shift in bank preferences since 2013Q2 instead of LCR.

Next, for liquid assets and liabilities, we distinguish the effects of LCR from those of post-crisis capital regulations that also impinged on LCR banks. We compare GNMA and GSE MBS – similarly risky assets but with a lower LCR haircut for GNMA. We find that LCR banks increase the share of GNMA but not of GSE MBS since 2013Q2, relative to non-

LCR banks, consistent with the effect of LCR but not those of risk-based capital rules. We further consider securities classified as Available-for-sale (AFS) or Held-to-maturity (HTM) for accounting purposes. While LCR treats these holdings equally, the Basel III capital rules incentivize large banks to reclassify securities holdings as HTM (Fuster and Vickery (2018)). We find that large LCR banks do not favor HTM over AFS holdings, inconsistent with an effect of the capital rules. Finally, while LCR rules are the same for global systemically important banks (G-SIBs) and other large LCR banks, G-SIBs face a higher leverage ratio. However, our results for G-SIBs are mostly inconsistent with effects of the leverage ratio.

Lower liquidity creation might hurt the real economy if banks lend less in order to shed illiquid assets, potentially lowering output and employment. We show that LCR banks provide less loans, relative to non-LCR banks since 2013Q2. We further show, by exploiting differences in implementation of LCR and capital rules that, with a few exceptions, these results cannot be attributed to stress tests or risk-based capital rules. To separate credit demand and supply effects, we use unique bank survey data on lending standards, and find that LCR banks also tighten lending standards and attribute this partly to regulation or supervision. These results are consistent with lower credit supply due to LCR.

While banks reduce lending following LCR, they may also become more resilient. Using estimates by Duarte and Eisenbach (2015) that build on the vulnerable banks framework of Greenwood, Landier and Thesmar (2015), we find that LCR banks' contributions to banking sector fire-sale losses decline since 2013Q2, relative to non-LCR banks, driven mostly by the illiquidity component of fire-sale risk. Moreover, using two different complexity measures, we also find that LCR banks have less complexity risk since 2013Q2, relative to non-LCR banks.[1] These results imply increased bank resilience to liquidity risk following LCR.

Do the benefits of increased resilience offset the costs from lower lending due to LCR? This is a challenging task as we cannot estimate the real economy effects of lending. Further, non-bank lending may offset bank lending while also creating financial instability (Gete and

[1]Complexity is measured by the share of net derivative liabilities and by the number of subsidiaries of BHCs (Cetorelli, Jacobides and Stern (2017)) of LCR banks, relative to non-LCR banks.

Reher (2018)). Nevertheless, we provide a rough estimate of the net after-tax benefits from lower lending and fire-sale risk to be about 1.4% of assets or $13.5 billion per bank-quarter in 2013Q2-2014 for banks with more than $250 billion in assets. However, we find insignificant benefits for smaller LCR banks. These results support recent actions by US regulators to exempt smaller banks from LCR.[2]

This paper has four contributions. First, following Carletti, Goldstein and Leonello (2018), we examine LCR effects on both sides of the balance sheet. Our results indicate that LCR banks reduce lending and short-term repo funding, along with securitizations.[3] In other words, LCR banks do less "securitized banking" (Gorton and Metrick (2012))). Second, we introduce new identifications to distinguish the effects of capital and liquidity rules on lending and provide new results on how LCR affects lending standards. Third, we identify (and confirm) channels whereby LCR increases bank resilience. Finally, we examine the net benefits from reduced bank lending and greater bank resilience.

The remainder of the paper is organized as follows. In section 2, we review the literature on liquidity regulations. Section 3 provides background on LCR and post-crisis capital regulations. In section 4, we discuss the data, likely bank responses to LCR and our methodology. In section 5, we show the effect of LCR on liquidity creation by LCR and non-LCR banks. In section 6, we examine if bank responses to LCR are driven by shifts in LCR banks' liquidity preferences. Section 7 assesses whether capital or liquidity regulations drive changes in liquid assets and liabilities. The effects of LCR on banks' loans and standards, and on fire-sale and complexity risk, are investigated in sections 8 and 9, respectively. Section 10 concludes. Additional results are in the internet appendix.[4]

[2] Senate Bill 2155, passed on May 24, 2018, raised the size threshold for prudential regulations. See `https://www.congress.gov/bill/115th-congress/senate-bill/2155`.

[3] As we account for changes in securitizations in our regressions, reduced lending by LCR banks cannot be explained by less securitizations.

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

2 Literature Review: Liquidity Regulations

Banks may be specially qualified to provide liquidity to the economy.[5] Traditionally, banks created liquidity by funding loans, that they held to maturity, with demandable deposits (Diamond and Dybvig (1983)). Modern banks sell off or securitize loans and the funding occurs via short-term repos or asset-backed-securities that are subject to runs. Both types of liquidity creation result in liquidity mismatches on bank balance sheets. To manage this liquidity risk, banks need liquidity buffers. However, financial markets may under-provide liquidity due to incentive reasons or market incompleteness, and so liquidity regulation is needed to enhance banks' resilience to liquidity shocks (Allen and Gale (2017)).[6]

Does the optimal liquidity regulation involve quantity restrictions? Rochet (2008) proposes a two-part liquidity ratio, a uniform part to deal with individual bank failures and a second part that varies with a measure of macro shock. Allen and Gale (2004) find that a liquidity floor improves over the competitive market allocation. Farhi, Golosov and Tsyvinski (2009) show that the optimal regulation is a liquidity floor that requires intermediaries to hold a minimal portfolio share in the short-term asset. However, Glaeser and Shleifer (2001) note the difficulty of choosing the eligible liquid assets and their weights. Our results highlight that these choices may have unintended effects on banks' portfolio decisions, since the liquidity preferences of banks and regulators differ. Also, unlike the LCR, it is generally optimal for the liquidity requirements to vary with bank characteristics (Farhi et al. (2009)).

Liquidity regulations potentially mitigate banks' vulnerability to liquidity shocks. Calomiris, Heider and Hoerova (2015) show that cash requirements limit default risk and encourage prudent risk management. Our results show that, as illiquid and opaque asset shares are lower, liquidity regulations limit the fire-sale and complexity risks of banks. However, Diamond and Kashyap (2016) point out that quantity regulations are ex-post inefficient as the bank

[5]Banks may be special as they have significant synergies between deposit-taking and lending (Kashyap, Rajan and Stein (2002)), or expertise in managing risk (Harry and Stulz (2015), among other reasons.

[6]Ex-ante liquidity regulations may also be needed to offset ex-ante moral hazard caused by ex-post lender of last resort interventions (Cao and Illing (2010)).

must continue to hold liquid assets after a run. This inefficiency is removed if the bank can borrow from the central bank against liquid assets. Indeed, Santos and Suarez (2019) argue that the liquidity buffer allows banks to buy time in crisis by paying off some debt, allowing the central bank to make a more informed liquidity support decision.[7]

Our paper is about the effect of LCR on liquidity creation across the entire balance sheet, a focus is consistent with Carletti et al. (2018) who show that regulations should consider both sides of bank balance sheets. While Berger and Bouwman (2009) show that higher capital increases liquidity creation by large banks, the effect of liquidity requirements on liquidity creation has not been studied. Instead, research has mostly focused on the effects of LCR on lending. Early versions of LCR suggest a decrease in lending (OFR (2014)), but no such effects are found for European banks (EBA (2013)). Others study pre-LCR liquidity regulations in Netherlands (Haan and van den End (2013)) and UK (Banerjee and Mio (2018)). The former report that most banks hold more liquid assets than required while the latter find no effect on lending but lower short-term wholesale funding and inter-bank borrowings. Of theoretical studies, Perotti and Suarez (2011) conclude that LCR is effective in limiting credit expansion when banks differ in their incentives to take on risk. However, the LCR may impose large deadweight costs when banks differ in their lending capacities.

If credit risk and run risk endogenously interact, Kashyap, Tsomocos and Vardoulakis (2017) show theoretically that capital regulations result in lower lending and liquid asset holdings while the opposite is true for liquidity regulations. We find that LCR has a negative effect on lending and at least some of this effect is unlikely to be due to capital regulations, consistent with calibrations of macro-finance models (Covas and Driscoll (2014), De Nicolo, Gamba and Lucchetta (2014), Heuvel (2017)).

[7]The final LCR rule does not discourage or deter banks from using HQLA to meet liquidity shocks (see https://www.occ.gov/news-issuances/federal-register/79fr61440.pdf). However, it also does not provide for a reduction or waiver of LCR during a crisis, absent which, banks might be reluctant to allow LCR to fall below the regulatory level to avoid signaling financial distress to the market.

3 LCR and Capital Regulations

We describe the LCR in section 3.1, focusing on how the rules impinge on assets and liabilities in different liquidity categories. In section 3.2, we discuss new capital regulations and highlight differences in their implementations from LCR that potentially allow for separate identification of the effects of capital and liquidity rules.

3.1 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 U.S. version of LCR was first proposed in October 2013, and finalized on September 2014.[8] For bank j, LCR is equal to its unencumbered[9] HQLA divided by its total expected net cash outflows ($ENCO30$) over a prospective 30 calendar day period:

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

BHCs who have 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 $\geq$1 on a daily basis. We denote these banks as "*full-banks.*"[10] If a full-bank's LCR falls below one on any business day, the bank 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, are subject to a modified version of LCR that requires HQLA to meet outflows over 21 instead of 30 calendar days in a stress scenario.[11] These banks are denoted as "*mod-banks.*"

[8]The Basel and US versions of LCR have some differences, such as which assets qualify as HQLA.

[9]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.

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

[11]Since May 2018, BHCs between \$50 billion and \$100 billion in assets are no longer subject to LCR (`https://www.federalreserve.gov/newsevents/pressreleases/files/bcreg20180706b1.pdf`.

BHCs with consolidated assets under \$50 billion are not subject to the LCR.

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 on its own cannot exceed 15%, of the HQLA portfolio. The LCR rule specifies the eligible assets for each HQLA level (Panel A in Table 1).[12]

$ENCO30$ is the total expected cash outflows minus inflows maturing in $\leq$ 30 calendar days, estimated by applying outflow and inflow rates to outstanding liabilities balances and receivables, respectively.[13] 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 1). 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 higher HQLA requirements, full-banks were required to achieve 80% of LCR by 2015, 90%

[12]To be HQLA-eligible, assets must be issued by non-financial firms with low risk, trade in large markets with no history of sharp price declines, be readily valued and monetized in times of liquidity stress.

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

of LCR by 2016, and 100% of LCR from 2017. They had to calculate LCR on the last business day of each month from January 2015 and on each business day from July 2016. Full-banks began public disclosure of their LCR from April 1 2018. Mod-banks, by comparison, were required to achieve 90% of LCR by 2016 and 100% of LCR from 2017, calculate LCR only on a monthly basis and begin public disclosure from October 1 2018.

3.2 US Capital Regulations Since 2010

While capital rules and LCR apply to similar sets of banks, in this section we highlight differences in their implementations that potentially allow for their separate identifications.

New capital regulations implemented in the US are either *risk-based* or not, and their stringency increases with *bank size*. Basel III rules, released in December 2010, increased the amount and quality of capital that *both* LCR and non-LCR banks must hold against risk-weighted assets (Walter (2019)). For full-banks, there was also an effective increase in their risk-weights relative to Basel II rules.[14] While both LCR and risk-based capital rules are expected to discourage investments in risky assets, such as loans, risk-weights vary with loan types but the LCR haircut is 100% for all loans.

Since 2011 most LCR banks are subject to stress tests that require 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)). LCR banks with assets between $50 billion and $100 billion did not take part in the initial stress tests but did so from 2014. Thus, between 2013 and 2014, these banks were subject to LCR but not to stress tests. Section 8.1 discusses the relative effects of LCR, stress tests and risk-based capital rules on bank lending.

Basel III rules also introduced risk-insensitive capital requirements. In 2012, US regulators proposed the supplementary leverage ratio (SLR) that require full-banks to maintain a

[14] Under Basel II, full-banks could estimate risk-weights using their own internal models, and these were typically smaller than the standardized risk weights. Now, full-banks must apply the greater of the standardized and internally estimated risk-weights.

minimum ratio of 3% of tier 1 capital to total on- and off-balance sheet exposures. As full-banks have relatively high shares of off-balance-sheet assets, they are likely to be constrained by SLR (Bolton, Cecchetti, Danthine and Vives (2019)). Covered banks started publicly reporting their SLR in 2015. As the SLR treats all exposures equally, it creates incentives for banks to *increase* their shares of risky assets (Choi, Holcomb and Morgan (2018)), opposite of what the LCR implies. Section 7 compares the relative effects of LCR and SLR.

Unlike the LCR, capital rules are more stringent for G-SIBs relative to other full-banks. G-SIBs are subject to a capital surcharge and loss-absorbency requirements (Bouwman (2018)). They are also subject to a higher leverage ratio (the eSLR) since 2014. Finally, G-SIBs face enhanced supervision that require higher standards for internal risk controls. Sections 7 and 8 investigate a G-SIB effect on bank balance sheets.

Finally, an accounting change in Basel III rules requires that full-banks mark-to-market their AFS holdings, making their capital ratios more volatile (Ihrig, Kim, Kumbhat, Vojtech and Weinbach (2017)), and incentivizing them to reclassify securities holdings as HTM (Fuster and Vickery (2018)).[15] In contrast, the LCR treats AFS and HTM holdings similarly. Section 7 examines the relative changes in AFS and HTM holdings of LCR banks.

4 Data, Liquidity Measures, and Methodology

We describe the LMI liquidity measure (Bai et al. (2018)) in section 4.1. We discuss possible bank responses to LCR and the resultant effects on liquidity creation in section 4.2. Our empirical methodology is described in section 4.3. The validity of the parallel trends assumption is examined in section 4.4.

[15]This rule removes the other comprehensive income (AOCI) filter for investment securities classified as AFS (`https://www.govinfo.gov/content/pkg/FR-2013-10-11/pdf/2013-21653.pdf`).

4.1 Data and Liquidity Creation Measure

The LMI measure is defined as the difference between liquidity weighted assets $LMIA$ and liquidity weighted liabilities $LMIL$. For bank i and quarter t, we define:

$$\begin{aligned} LMI_{i,t} &= -\sum_{j=1}^{m} \lambda_{a,jt}^{LMI} A_{ijt} + \sum_{k=1}^{n} \lambda_{l,kt}^{LMI} L_{ikt} \\ &= -LMIA_{i,t} + LMIL_{i,t} \end{aligned} \tag{3}$$

We deviate from Bai et al. (2018) by reverting the signs in (3) so that higher values of `LMI` indicate more liquidity creation. The liquidity weights λ_a^{LMI} and λ_l^{LMI} are derived from repo haircuts and the OIS-Tbill spread, respectively, as described in Appendix A of Bai et al. (2018). The balance sheet items A_i and L_i are from the FR Y-9C report, and listed in Tables 2 and 3, respectively. We exclude off-balance-sheet items when estimating LMI as they are held disproportionately by full-banks, but show results when including them in section 5.4. Other data sources are listed in section A.1 of the internet appendix.

In calculating insured deposits, we follow Acharya and Mora (2015) in using Call Reports data. As we lose observations when aggregating bank-level Call Reports data up to the holding company level, we initially show results with a single liquidity weight for all deposits with maturity equal to the weighted average of the maturities of insured and uninsured deposits). Details are in Section A.2 of the internet appendix, where core deposits and transactions deposits are also defined. In section 6.1, we separate insured and uninsured deposits, and discuss their effects on liquidity creation.

To compare liquidity creation across banks of different sizes, we divide LMI by the bank's total assets to obtain $LMIN$. More generally, for Y=$\{LMI, LMIA, LMIN\}$:

$$YN_{i,t} = \frac{Y_{i,t}}{A_{i.t}} \tag{4}$$

For a bank group k, we first calculate $YN_{k,i}$ for bank i and then obtain the group mean:

$$YN_{k,t} = \frac{\sum_{i=1}^{n} YN_{k,i,t}}{n} \tag{5}$$

Our sample is from 2009Q1, to remove crisis period effects. We construct a balanced panel of US banks from 2009 Q1 to 2017Q4. Thus, new entrants during our sample are excluded as are BHCs acquired by a non-sample bank.[16] We also drop Bank of NY Mellon, State Street and Deutsche Bank since these banks have unique business models, specializing in asset management and settlement activities that are cash intensive. Foreign banks are excluded as they did not report data to FR Y-9C till 2016.[17] We also exclude banks with assets less than \$3 billion as they are too different from LCR banks. Thus, we define non-LCR banks as those with assets between \$3 billion and \$50 billion.

We have 113 banks in our sample, consisting of 12 full-banks, between 13 and 14 mod-banks and between 87 and 88 midsized non-LCR banks, for a total of 4,068 bank-quarters. When using Call Reports data, we have 3,405 observations. The average assets of full, mod and midsized banks in the pre-LCR period were \$894 billion, \$98 billion and \$11 billion, respectively. More descriptive statistics are discussed in section A.3 of the internet appendix.

4.2 Bank responses to LCR and Liquidity Creation

If a bank's LCR<1, then it may increase its share of HQLA assets, or decrease its share of short-term, volatile liabilities, or both. How do these adjustments change liquidity creation?

Suppose that LMI weights accurately reflect a bank's own liquidity preferences. Initially, assume that the balance sheet size is fixed. Then, on the asset side, banks favor assets with LCR liquidity weights that are similar or higher then LMI weights (see section A.4 of the

[16]We drop 24 (53) new entrants that would qualify as LCR (non-LCR) banks since 2009Q1 because they exited our sample for at least one quarter.

[17]Since 2016, foreign banking organizations with \$50 billion or more in US assets have been required to place virtually all of their US subsidiaries under a US Intermediate Holding Company (IHC). The IHCs report data to FR Y-9C but we cannot include them due to their late entry in the sample.

internet appendix). From the last 2 columns of Table 1 Panel A, the (LMI-LCR) weights are on average 0.03, 0.11 and 0.29 for level 1, 2A and 2B assets, respectively. Thus, banks prefer more liquid assets and this, by itself, reduces asset-side liquidity creation. However, bank responses may also *increase* liquidity creation. For example, within HQLA levels, banks may optimize by shifting to higher-yielding assets.[18] Moreover, since all non-HQLA have LCR weights of zero, banks may shift to more illiquid assets within the non-HQLA portfolio. Thus, the net effect on asset-side liquidity creation is ambiguous.

On the liability side, the bank has incentives to increase liabilities with lower LCR outflow rates than LMI weights, as discussed in section A.4 of the internet appendix. From Table 1 Panel B and Table 3, the LCR penalizes liquid liabilities that are short-term, uninsured, collaterized with illiquid assets or with institutional counterparties. Thus, the effect on liquidity creation depends on the specific details of banks' funding choices.

Banks may also fund illiquid assets by expanding the balance sheet. In this case, liquidity creation may increase (decrease) if banks fund the expansion with relatively liquid liabilities with low (high) LCR outflow rates. For example, the bank might use stable, term funding with maturity greater than 30 days to provide more loans, thus creating liquidity.

Overall, although LCR aims to reduce the liquidity mismatch, since it constrains *broad* asset and liability categories *and* in only a portion of the balance sheet, the effect on liquidity creation is ambiguous and needs to be determined empirically. In addition to LCR, the largest banks must also conduct internal liquidity stress tests (known as Comprehensive Liquidity Assessment and Review or CLAR) since 2012. For some banks, the liquidity stress tests may be more binding than LCR (Elliott (2014)). Thus, our results could be viewed as due to liquidity regulations generally, rather than due to LCR alone. Alternative hypotheses, such as changes in banks' liquidity preferences and capital regulations, are explored in section 6 and section 7, respectively.

[18] Ihrig et al. (2017) argue that, given the low recent volatility of level 1 assets, banks should hold few low-yielding excess reserves.

4.3 Methodology

We estimate panel regressions using a difference-in-differences (DID) specification:

$$\begin{aligned}\Delta Y_{it} = {} & \alpha_0 + \gamma_1 \textit{Post-LCR}_t + \gamma_2 \textit{LCR-Bank}_{it} + \delta_1 \textit{Post-LCR}_t \times \textit{LCR-Bank}_{it} \\ & + \sum_{j=1}^{4} \beta_{ij} \Delta X_{ijt-1} + \epsilon_{it}\end{aligned} \tag{6}$$

where Y is the outcome variable, *Post-LCR* is 1 from 2013Q2 to 2017Q4 and 0 otherwise. Alternative event dates are considered in section 5.3). *LCR-Bank* $= 1$ for banks with assets of \$50 billion or over. The omitted group is midsized banks with assets between \$3 billion and \$50 billion. The standard errors are clustered by bank size group and robust to heteroskedasticity and serial correlation. $\delta_1 < 0$ implies that LCR banks create less liquidity than midsized banks since 2013Q2.

The vector X in (6) includes bank controls: the net interest margin, the common equity tier 1 to risk-weighted assets ratio (CET1), and non performing loans and core deposits, as shares of loans and assets, respectively. Higher net interest margins imply more profitable lending and thus more liquidity creation. Higher non-performing loan ratios suggest greater bank risk. CET1 indicates the effect of regulatory capital on liquidity creation. Access to sticky core deposits may encourage riskier loans (Black, Hancock and Passmore (2010)).

Next, we separate full-banks from mod-banks. The effects of LCR on full-banks may be stronger and earlier than on mod-banks as they face more stringent LCR rules and had to be compliant earlier than mod-banks (section 3.1). So, we split *Post-LCR* into dummy variables *2013-2014* and *2015+*, equal to 1 in 2013Q2-2014Q4 and 2015Q1-2017Q4, respectively.

$$\begin{aligned}\Delta Y_{it} = {} & \alpha_0 + \gamma_1 \textit{2013-2014}_t + \gamma_2 \textit{2015+}_t + \gamma_3 \textit{Full-Bank}_{it} + \gamma_4 \textit{Mod-Bank}_{it} \\ & + \delta_1 \textit{2013-2014}_t \times \textit{Full-Bank}_{it} + \delta_2 2015{+}_t \times \textit{Full-Bank}_{it} \\ & + \delta_3 \textit{2013-2014}_t \times \textit{Mod-Bank}_{it} + \delta_4 2015{+}_t \times \textit{Mod-Bank}_{it} + \sum_{j=1}^{4} \beta_{it} \Delta X_{it} + \epsilon_{it}\end{aligned} \tag{7}$$

$\delta_1 < 0 (\delta_3 < 0)$ indicates that full (mod) banks' liquidity creation is lower in 2013Q2-2014Q4, relative to non-LCR banks. $\delta_2 < 0 (\delta_4 < 0)$ indicates that full (mod) banks' liquidity creation is lower since 2015Q1, relative to non-LCR banks.

To account for deterministic time-series and cross-section variations, we also estimate (7) with bank and period fixed effects:

$$\begin{aligned}\Delta Y_{it} = \alpha_0 + \alpha_i + \alpha_t + \delta_1 \mathit{2013\text{-}2014}_t \times \mathit{Full\text{-}Bank}_{it} + \delta_2 2015+_t \times \mathit{Full\text{-}Bank}_{it} \\ + \delta_3 \mathit{2013\text{-}2014}_t \times \mathit{Mod\text{-}Bank}_{it} + \delta_4 2015+_t \times \mathit{Mod\text{-}Bank}_{it} + \sum_{j=1}^{4} \beta_{ij} \Delta X_{ijt} + \epsilon_{it} \quad (8)\end{aligned}$$

4.4 Parallel trends assumption

Validity of the DID specification requires that the parallel trends assumption is satisfied. We evaluate this assumption by estimating DID coefficients in every period, as follows:

$$\Delta Y_{it} = \alpha_0 + \alpha_i + \alpha_t + \sum_{t \neq k} \delta_t \mathit{Full\text{-}Bank}_{it} I(t) + \sum_{t \neq k} \gamma_t \mathit{Mod\text{-}Bank}_{it} I(t) + \sum_{j=1}^{4} \beta_{ij} X_{ijt} + \epsilon_{it} \quad (9)$$

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 A.5 of the internet appendix, we plot δ_t and γ_t for periods $t < k$ and $t > k$ and the associated confidence intervals, for each outcome variable Y. Consistent with parallel trends, we find that, for $t < k$, the confidence bands straddle the zero-line in most quarters. One exception is illiquid assets of full-banks (Figure A.2 in the internet appendix) where 7 of 15 pre-LCR quarters have coefficients significantly different from zero. However, most illiquid assets are loans, which satisfy the parallel trends assumption (Figure A.7 in the internet appendix).

5 Liquidity Creation by LCR and non-LCR Banks

Since LCR impinges on the largest banks, and these banks historically created the most liquidity (Berger and Bouwman (2009)), we first consider aggregate liquidity creation in the banking sector following LCR finalization in 2013Q1 (section 5.1). We then examine changes in liquidity creation by LCR banks relative to non-LCR banks since 2013Q1 (section 5.2). As lower liquidity creation may occur via lower shares of illiquid assets or liquid liabilities, we further consider changes in liquid and illiquid assets and liabilities. We check the robustness of our results to alternative event dates (section 5.3), adding off-balance-sheet liabilities (section 5.4) and using the liquidity measure of Berger and Bouwman (2009) (section 5.5).

5.1 Liquidity Creation in the Banking Sector

Aggregate liquidity creation is shown by the dashed line, labeled "All Banks," in the top panel of Figure 1. LMI, the average liquidity creation per bank in billion dollars is negative, implying that liquidity-weighted assets exceed liquidity-weighted liabilities.[19] LMI declines throughout the sample, implying that banks hold more liquid assets or less liquid liabilities, or both. By comparison, the average $LMIN$ declines until 2013 but then increases. That LMI decreases but $LMIN$ (an equally-weighted average) does not, suggests lower liquidity creation by large banks that are subject to LCR compared to smaller banks that are not.

Regression results (in Table B.1 in the internet appendix) are consistent with Figure 1. We regress LMI on *Post-LCR* and find its coefficient to be negative and significant, implying a decline in LMI of about \$11 billion per bank-quarter since 2013Q2. Separating the 2013Q2-2014 and 2015-2017 periods, we find lower LMI in both periods. The result is similar after accounting for financial conditions using the Chicago Fed's National Financial Conditions Index (NFCI) and for serial correlation in LMI.[20] In contrast, we find no significant decline in $LMIN$ since 2013Q2, after accounting for NFCI and serial correlation in $LMIN$.

[19] Bai et al. (2018) argue that this indicates there is no bank-run equilibrium.

[20] NFCI includes indicators related to risk, credit and leverage. See `https://www.chicagofed.org/research/data/nfci/background` for the list of measures.

5.2 Liquidity Creation by LCR and non-LCR Banks

The top panel of figure 1 shows that full- and mod-banks reduce liquidity creation since 2009, whether in nominal terms (LMI, left chart) or size-adjusted ($LMIN$, right chart). In contrast, midsized non-LCR banks' $LMIN$ also falls until 2013Q1 in parallel with the LCR banks, but subsequently increases.[21] Strikingly, midsized banks have the lowest $LMIN$ of all bank groups in 2009Q1 but the highest in 2017Q4 – a reversal of how US banks have historically provided liquidity (Berger and Bouwman (2009)).

To understand differences in liquidity creation by LCR and non-LCR banks, we estimate equation (6) with $\Delta LMIN$ as the dependent variable and report results in Table 4. In column 1, we find that LCR banks significantly reduce liquidity creation, relative to non-LCR banks, by 32 basis points (bp) per quarter since 2013Q2, as indicated by the coefficient on *LCR-Bank* $*$ *Post-LCR*. This result is robust to including bank and period fixed effects (column 2). In the extended specification (7), the decline in liquidity creation mainly occurs in 2013Q2-2014 (columns 3-4) and is significant for both mod-banks and full-banks. While $LMIN$ also declines after 2015, the change is not significant. These results are robust to including the change in $NFCI$, the coefficient on which is positive and significant (column 5). As a higher NFCI indicates tighter conditions, the result implies that when financial conditions are tighter, liquidity creation is higher – possibly because banks shift to higher-yielding illiquid assets in tight market conditions. Of the controls, higher non-performing loan shares (indicating greater bank risk) result in lower liquidity creation, consistent with Berger and Bouwman (2009). Lagged CET1 is negatively related to $LMIN$, indicating higher capital ratios are followed by lower liquidity creation. The lagged net interest margin and core deposits are not significant. To address possible co-determination of the controls and liquidity creation, we repeat the regressions after excluding the controls (see Table B.2 in the internet appendix) and find qualitatively similar results. Thus, the decline in liquidity

[21] LMI decreases for midsized banks post-2012 even though $LMIN$ increases because their total assets increased more than the slight decrease in liquidity creation. Since LMI is negative, this has the effect of making $LMIN$ less negative.

creation following LCR obtains whether we account for regulatory capital ratios or not.

Does reduced liquidity creation by LCR banks occur on the asset or liability side of the balance sheet? The bottom panel of Figure 1 plots liquidity-weighted asset shares $LMINA = \frac{\lambda_a A_a}{A}$ and $LMINL = \frac{\lambda_l L_l}{L}$ (see equation 3). $LMINA$ rises for all groups until 2012 after which LCR banks' shares continue to rise while midsized banks' share falls. $LMINL$ declines for full-banks relative to midsized banks since 2013Q2. Regression results are shown in Table 5. We find that $LMINA$ is significantly higher for mod-banks (column 1) and $LMINL$ is significantly lower for full-banks (column 5) since 2013Q2, compared to non-LCR banks. There is no statistically significant change in $LMINA$ for full-banks and in $LMINL$ for mod-banks. Thus, liquidity creation is lower on both sides of the balance sheet.

Next, we separate liquid and illiquid assets and liabilities using the `BB` categories (Tables 2 and 3)).[22] The results are shown in Table 5. We find that, since 2013Q2, mod-banks increase their share of liquid assets (column 2). Both full- and mod-banks hold less semi-liquid assets in 2013Q2-2014 (column 3) and less illiquid assets since 2013Q2 (column 4). On the liability side, full-banks decrease their share of liquid liabilities relative to non-LCR banks since 2013Q2 (column 6). By comparison, mod-banks report a relative increase in semi-liquid liabilities since 2013Q2 (columns 7). Hence, reduced liquidity creation occurs from lower shares of illiquid assets and liquid liabilities, and higher shares of liquid assets.

5.3 Alternative Event Dates

Our event date is 2013Q1 when the Basel LCR rule was finalized. Although the US rules were not finalized until 2013Q4 (and eligibility of municipal bonds for HQLA was undecided till 2018), could US banks have started adjusting to LCR earlier than 2013Q1? The dynamic DID coefficient charts for $LMIN$ (see Figure A.1 in the internet appendix) show that the $LMIN$ estimates for full-banks and mod-banks were not statistically different from zero in

[22] The liquidity categories are determined by the ease, cost and time to liquidate assets or obtain funds (Berger and Bouwman (2009)). For example, shorter maturity liabilities and easier-to-securitized assets are considered liquid. Illiquid liabilities are not reported as they have LMI weight of zero.

2011-2012, relative to 2013Q1. To further examine this issue, we re-estimate the regressions using 2010Q4, instead of 2013Q1, as the event date. The results are in Table B.3 of the internet appendix. We find no significant change in liquidity creation by mod-banks or full-banks in 2011Q1-2013Q1, relative to non-LCR banks. We continue to find a significant reduction in liquidity creation by mod-banks in 2013Q2-2014, although the reduction for full-banks is no longer significant in this period. Overall, the evidence does not support the notion that US banks reduced liquidity creation prior to 2013Q2.

5.4 Off-Balance-Sheet Liabilities

So far, we've excluded off-balance-sheet (OBS) items when calculating LMI. We now include OBS liabilities with positive LMI weights (unused commitments, letters of credit, securities lent and net derivative liabilities), and recalculate LMI. When we repeat our analysis using the updated measure, we continue to find lower $LMIN$ by LCR banks, relative to non-LCR banks, in 2013Q2-2014 (see Table B.4 of the internet appendix). Thus, our results are robust to including OBS items. Accordingly, going forward, we use the on-balance-sheet LMI measure since OBS holdings are skewed towards full-banks.

5.5 The Berger-Bouwman Liquidity Creation Measure

We use an alternate liquidity creation measure BB due to Berger and Bouwman (2009). The BB and LMI measures are both given by equation 3 but they differ according to how balance sheet items are categorized and liquidity weights are assigned. For example, BB categorizes some loans as illiquid assets and others as semi-liquid assets, whereas LMI has one loans category. Further, the BB weights are fixed within a liquidity bucket and pre-assigned whereas LMI weights are time-varying and estimated from market prices. To compare results with LMI, we calculate the on-balance sheet version of BB (denoted `catnonfat` in Berger and Bouwman (2009)) using the liquidity categories in Tables 2 and 3 and the liquidity weights from Table 1 of Berger and Bouwman (2009). To compare BB across banks in different size groups, we divide BB by the bank's assets to obtain BBN.

Figure B.2 in the internet appendix shows that BBN is decreasing for LCR banks and increasing for midsized banks since 2013Q2. We re-estimate regressions (6), (7) and (8) using BBN as the dependent variable. The results, reported in Table B.5 of the internet appendix, show lower liquidity creation by LCR banks since 2013Q2 relative to non-LCR banks. One difference with the $LMIN$ results is that mod-banks also have significantly lower BBN since 2015 whereas we find no significant changes in mod-banks' $LMIN$ since 2015. Therefore, the evidence for reduced liquidity creation is stronger when using the BBN measure.

In summary, we find lower liquidity creation by the large banks that implement LCR, relative to midsized non-LCR banks, driven by lower illiquid asset shares, higher liquid asset shares and lower liquid liability shares. The results are robust to using alternative event dates and liquidity measures, and including off-balance-sheet items.

6 Bank Responses to Liquidity Regulation

Reduced liquidity creation since 2013Q2 may be an outcome of changes in bank liquidity preferences (e.g. a greater desire for liquid assets and safe liabilities) at this time, rather than LCR. In this case, LCR bank portfolio weights are likely to change similarly within liquidity categories. On the other hand, if LCR banks respond to the LCR's rankings of assets by haircuts and liabilities by outflow rates, then their portfolio weights are expected to vary with the rankings, even *within* liquidity categories.[23] We use the BB liquidity categories (Tables 2 and 3) to test these hypotheses. In section 6.1, we compare liquid liabilities with different LCR penalty rates applied to their outflows. In section 6.2, we explore changes in bank holdings of liquid assets, distinguishing HQLA (with LCR haircuts $\leq 50\%$) from non-HQLA (with implicit LCR haircuts of 100%).

[23] An alternative hypothesis is that regulators anticipated changes in bank liquidity preferences as their preferences were closely aligned with those of banks. We consider this unlikely since, for regulators to impose liquidity regulations, their liquidity preferences must be different from those of banks in the first place.

6.1 Runnable Liabilities of LCR and non-LCR Banks

LCR outflow rates are relatively high for short-term funding and uninsured deposits, and relatively low for stable retail deposits, insured deposits and longer maturity funding (section 3.1). The top panel of Figure 2 plots the book value shares of insured and uninsured deposits. Full-banks' insured deposits shares increase from 2015 while those of midsized and mod-banks decrease since 2015. Uninsured deposit shares of full-banks and midsized banks are similar till 2015, after which they trend down for full-banks and up for midsized banks.

The first 3 columns of Table 6 show results for liquid liability items: short-term funding and transactions deposits. There are no significant LCR effects on overnight fed funds (column 1) but full-banks reduce their shares of overnight repo sold (column 2), relative to non-LCR banks. By comparison, shares of transactions deposits increase since 2013Q2 for all LCR banks, except for mod-banks after 2014 (column 3). Thus, since 2013Q2, LCR banks rely more on transactions deposits that are considered sticky (Berlin and Mester (1999)) and have low LCR outflow rates, and less on overnight repos with high outflow rates.[24] Insured deposits are also sticky, and have lower LCR lower outflow rates than uninsured deposits (Panel B of Table 1). Consistent with these incentives, full-banks increase their share of insured deposits since 2013Q2 (column 4) and decrease their share of uninsured deposits since 2015 (column 5), relative to midsized banks.[25]

Banks have an incentive to use funding of maturity exceeding 30 days that do not count as LCR outflows. As we do not have maturity splits around 30-days in our data, we use instead Other Borrowed Money of maturity less than or equal to a year (OBM≤1Y) and more than a year (OBM>1Y). OBM includes term repo and fed funds (excluding overnight maturities) and Federal Home Loan Bank (FHLB) advances. The bottom panel of Figure 2

[24]While LCR outflow rates are also low for repos when the collateral is a level 1 or level 2A asset, these assets then become "encumbered" and ineligible as HQLA. Thus, dealers are unlikely to use repos to finance their HQLA (Macchiavelli and Pettit (2018)).

[25]Previously, we assigned a uniform liquidity weight to all deposits. As LCR banks hold relatively more insured deposits with longer effective maturities, splitting deposits into its insured and uninsured components results in even lower liquidity creation by LCR banks (see Figure C.1 and Table C.1 in the internet appendix).

shows that full-banks have declining shares of OBM≤1Y and rising shares of OBM>1Y, the opposite of midsized banks. Table 6 shows that full-banks rely less on OBM≤1Y (column 7) and more on OBM>1Y (column 8) since 2013Q2, relative to non-LCR banks. Since OBM includes term repos, and recalling that LCR banks reduce their shares of ovenight repos, the result is consistent with a lengthening of funding maturity by LCR banks.[26]

6.2 Liquid Assets of LCR and non-LCR Banks

We now examine changes in bank holdings of liquid assets. To identify an LCR effect, we distinguish between non-HQLA liquid assets (i.e. structured products) and HQLA. Consistent with LCR rules, assets held in banks' trading books are excluded. Investment grade corporate bonds issued by non-financial companies are eligible as level 2B assets but we exclude them since we do not have corporate bond holdings by ratings or industry.

In Table 7, we show regression results for changes in the book values of liquid assets, as shares of total assets. We find that, for structured products, full-banks have lower weights since 2013Q2, relative to non-LCR banks (column 1). In contrast, all LCR banks (except full-banks since 2015) *increase* their shares of HQLA since 2013Q2 (column 2). *Within* the HQLA portfolio, banks prefer more liquid assets, as hypothesized in section 4.2. For example, in 2013Q2-2014, increases in HQLA mostly occur due to level 1 assets (column 3). More generally, LCR banks' HQLA shares are greater for more liquid levels (columns 3-5). Further, of level 1 assets, increases are mostly in the safest asset (i.e. excess reserves) rather than higher yielding Treasuries and GNMA MBS (see Table C.2 of the internet appendix).

In summary, portfolio weights of LCR banks respond to the LCR rules. On the liabilities side, they shift towards more stable and longer-maturity fundings with low LCR outflow rates, and avoid short-term funding and uninsured deposits with high outflow rates. On the asset side, LCR banks increase the shares of HQLA but not HQLA-ineligible liquid assets.

[26] Macchiavelli and Pettit (2018) find that dealers favored term repos of more than 30 days maturity following LCR. Also, OBM includes FHLB advances that typically have maturity exceeding one year and low LCR outflow rates. Thus, the result supports the view that banks relied on FHLB advances to satisfy LCR (Anadu and Baklanova (2017)).

7 Capital or Liquidity Regulations?

This section distinguishes between the effects of capital and liquidity regulations on liquid assets and liabilities. We examine this issue in three ways. First, we identify a unique LCR effect by examining the GNMA MBS and GSE MBS asset pair that have similar risk but different LCR haircuts (i.e. zero for GNMA versus 15% for GSE). Next, we distinguish securities holdings that are classified for accounting purposes as AFS or HTM. Unlike LCR, the Basel III capital rules incentivize full-banks to reclassify securities holdings as HTM (section 3.2). Finally, we compare the effects on full-banks of LCR and the leverage ratio SLR. If SLR is binding, we expect full-banks' share of liquid assets to be lower, opposite of the LCR effect (section 3.2). SLR may also adversely affect low-margin activities such as repo funding (Allahrakha, Cetina and Munyan (2018)). These effects may be larger for G-SIBs who implement a higher leverage ratio eSLR.

In Table 8, we show results for changes in GNMA and GSE MBS portfolio weights (in book values, since their `LMI` weights are identical). Mod-banks' GNMA MBS weights increase significantly by 18 bp in 2013Q2-2014 and 9 bp since 2015 relative to midsized banks (column 1). By comparison, the GSE MBS weights show no LCR effects (column 2). These results identify an effect that's consistent with LCR but, since the asset pair is of similar risk, they are unlikely to be an effect of risk-based capital rules. Also, the results cannot be due to the effects of SLR since shares of full-banks are unaffected.

Next, we estimate holdings classified as AFS or HTM and find that mod-banks increase their AFS holdings of GNMA MBS since 2013Q2, relative to midsized banks (column 3) but changes in their HTM holdings are insignificant (column 5). Notably, full-banks do not preferentially reclassify their holdings as HTM, inconsistent with capital rules. There are no significant changes in either AFS or HTM shares of GSE MBS (columns 4 and 6).

Finally, we separate G-SIBs from other full-banks by defining a dummy variable G-SIB equal to 1 if a bank is a G-SIB and redefining the full-bank group to exclude the G-SIBs.[27]

[27] US G-SIBs in our sample are Bank of America, Citigroup, Goldman, JPM Chase, Morgan Stanley and

We continue to separate the AFS and HTM holdings. The G-SIB dummy is not significant in any case (columns 7-10), inconsistent with the effects of eSLR. Mod-banks increase their GNMA AFS shares (column 7) but not their HTM shares (column 9). There are no significant changes in GSE MBS shares for AFS or HTM holdings (columns 8 and 10). Thus, mod-banks favor GNMA MBS holdings, as before, consistent with an LCR effect.

To account for MBS market-specific effects, we include in the regression the change in the GNMA issuance share and the change in the GNMA - GSE current coupon spread for the 30Y maturity.[28] These results are shown in Table D.1 of the internet appendix. Of the MBS market controls, the GSE portfolio weights decline when the share of GNMA issuances is higher but the other controls are not significant. Most important, we continue to find that LCR banks favor GNMA over GSE MBS holdings, relative to midsized banks.

We now examine liquid liabilities (see Table D.2 in the internet appendix). For short-term funding (ON fed funds and ON repo), only the G-SIB dummy is significant. The estimate is negative, indicating reduced short-term funding by G-SIBs relative to non-LCR banks, consistent with an effect of eSLR. For deposits, in contrast, we find *increased* shares of transactions and insured deposits, and decreased shares of uninsured deposits, for full-banks and G-SIBS, consistent with responses to the LCR. The differentiated responses of uninsured and insured deposits are inconsistent with the effects of SLR.

The evidence in this section indicates that LCR banks generally respond to LCR rather than capital rules when changing their shares of liquid assets and liabilities. Of a pair of assets with similar risk, LCR banks favor the one with a lower LCR haircut. LCR banks also show no preference for classifying their holdings as HTM instead of AFS, contrary to the implications of new capital rules. Except for short-term funding, there are no significant effects on G-SIBs consistent with facing a higher leverage ratio than non-G-SIB full-banks.

Wells Fargo.

[28]Current coupons are the industry standard for measuring MBS yields.

8 LCR, Bank Lending and Standards

LCR banks respond to LCR by, in part, shedding their illiquid assets. As loans are a major part of illiquid assets, banks may reduce lending and potentially affect the real economy.[29] However, LCR banks also rely more on stable deposits and such banks may reduce lending *less* in response to funding shocks (Ivashina and Scharfstein (2010), Cornett, McNutt, Strahan and Tehranian (2011)), thus mitigating the adverse lending effects from the LCR. In section 8.1, we empirically evaluate LCR effects on loan amounts. We distinguish LCR and stress test effects by exploiting differences in their implementations with respect to bank size and timing. To compare LCR with risk-based capital rules, we consider loan types with different regulatory risk-weights. Next, to identify credit supply effects on lending, we use unique survey data to examine changes in bank lending standards and whether banks cite regulations as the reason for changing standards (section 8.2). We further purge standards of credit demand effects following Bassett, Chosak, Driscoll and Zakrajsek (2014).

8.1 Bank Lending and LCR

In this section, we focus on the share of loan amounts in banks' assets. In this analysis, we cannot separate credit demand and supply effects, but explore this issue in the next section.

Table 9 reports results for changes in book value weights of loans by LCR and non-LCR banks. We find that LCR banks lend less since 2013Q2, relative to midsized banks (column 1). Since reduced securitizations may lead to lower lending, we include the lagged change in the securitization dummy in the regressions.[30] The estimate on the securitization dummy is positive, as hypothesized, but not significant.

Stress tests may also be a binding constraint on lending. For example, Acharya, Berger

[29] Fixed and intangible assets are another major category of illiquid assets but we have verified that shares of these assets show no significant LCR effects.

[30] 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 many quarters. Relative to non-LCR banks, LCR banks have similar or *higher* securitizations, depending on the time period (see Table E.2 in the internet appendix). Thus, securitization changes cannot explain why LCR banks lend less than non-LCR banks.

and Roman (2018) find banks with assets of at least \$100B lend less in the *year following* the stress tests of 2009-2013, relative to 2004-2009. In 2014, stress tests were expanded to include banks with assets between \$50 billion and \$100 billion (section 3.2). These banks (denoted $Mod < 100B$) reduce lending in 2013Q2-2014, relative to non-LCR banks, and the estimate is highly significant (column 2 of Table 9) – even though they were not part of pre-2014 stress tests. In contrast, mod-banks that took part in pre-2014 stress tests (denoted $Mod \geq 100B$) have a smaller reduction in lending during 2013Q2-2014, and the estimate is only significant at the 10% level. These results are consistent with effects of LCR rather than stress tests. Further, all mod-banks were subject to stress tests in 2015-2017 but their lending did not change significantly during this time. While full-banks reduce lending in 2015-2017 relative to non-LCR banks, this result could be the effect of stress tests or, alternatively, it could be due to LCR rules that are stricter for full-banks than for mod-banks (section 3.1).

To further distinguish capital and liquidity regulations, we examine loan pairs with different risk-weights. Whereas banks must set aside more capital against loans with higher risk-weights, the LCR haircut is 100% for all loans independent of their risk-weights. Thus, if our results are driven by capital rules, we expect a bigger reduction for loans with higher risk-weights but similar reductions independent of risk-weights, if LCR rules are binding.

We first consider residential and commercial real estate loans (RRE and CRE, respectively). RRE loans have standardized risk-weights of 50%, and these have not increased during our sample.[31] CRE loans, by comparison, have since 2014 been subject to enhanced supervisory guidance (CRS (2016)) and higher risk-weights on a subset of loans.[32] Thus, risk-weights imply bigger reductions in CRE relative to RRE loans while the LCR implies similar reductions for both loan types. We find that, in 2013Q2-2014, all mod-banks reduce their shares of RRE loans but not of CRE loans while full-banks have similar reductions in

[31] Stress tests might reduce origination of jumbo mortgages that cannot be sold to government sponsored enterprises, but Calem, Correa and Lee (2017) find that this effect was confined to the 2011 stress test when large banks had low capital buffers.

[32] Risk-weights on high volatility CRE loans were increased from 100% to 150% in 2014 (`https://www.federalregister.gov/documents/2013/10/11/2013-21653/regulatory-capital-rules-regulatory-capital-implementation-of-basel-iii-capital-adequacy-transition`.

their shares of both loan types, inconsistent with effects of risk-based capital rules (columns 3 and 4 of Table 9). But, since 2015, full-banks reduce their shares of CRE loans but not RRE loans, consistent with relative risk-weights on these loans.

Next, we compare commercial and industrial (C&I) loans to large and small firms. 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 (SBL) than for aggregate C&I loans and, further, stress test banks have reduced SBL holdings since 2011 compared to non-stress test banks. Consistently, Acharya et al. (2018) show that banks subject to the stress tests reduce loans to more risky small business borrowers.[33] By comparison, the LCR rules make no distinction between loans based on borrower size.

The top panel of Figure E.1 in the internet appendix shows that the SBL shares decline for all bank groups since 2009, during a period when their overall C&I loan shares increase. Results for overall C&I loans, in column 5 of Table 9, show reduced share for mod-banks since 2015. Shares of SBL, in contrast, are unchanged for all banks groups (column 6). Perhaps, only SBL by the largest banks were affected by capital regulations (Chen, Hanson and Stein (2017) and Cortes, Demyanyk, Li, Loutskina and Strahan (2018)).[34] Consistent with this notion, SBL shares of G-SIBs decline since 2013Q2 but those of non-G-SIB full banks do not (column 7). The securitization dummy is positive and significant, indicating that higher past securitizations lead to more lending. Since LCR rules are identical for non-GSIB full banks and G-SIBs, this result is consistent with the effect of capital regulations.

Covas (2017) finds that the leverage ratio SLR becomes risk-sensitive in the post-stress scenario since banks with larger balance sheets are more sensitive to business cycles. As G-SIBs face a higher leverage ratio than other full-banks and mod-banks are exempt from SLR, there may be greater reductions in lending by G-SIBs for all loan types. We find that, for CRE loans, both the G-SIB and non-G-SIB full-bank estimates are negative and significant,

[33] In contrast, Bord, Ivashina and Taliaferro (2018) find no evidence of a regulatory impact on SBL.

[34] Chen et al. (2017) find that counties where the top four banks had the largest market share also had the sharpest reduction in SBL from 2008 to 2014.

and the difference between them is statistically zero (see Table E.3 of the internet appendix). Thus, the G-SIB effect exists for small business loans only. Finally, Acharya et al. (2018) find a negative effect of stress tests on credit card loans and Covas (2017) finds an increase in implied risk-weights of consumer loans in the post-stress scenario. We do not find significant reductions in consumer loan or credit card loan shares of LCR banks, relative to non-LCR banks, inconsistent with stress test effects (see Table E.4 of the internet appendix).

This section provides evidence of reduced lending attributable to liquidity rather than capital regulations. First, reductions in total loan shares in 2013Q2-2014 are not driven by stress tests. Second, reductions in real estate lending in 2013Q2-2014 are not greater for loans with greater risk-weights. However, lower small business lending by G-SIBs is consistent with stress test effects (Chen et al. (2017) and Cortes et al. (2018)).

8.2 Bank Lending Standards

Changes in loan amounts may occur due to credit demand or supply effects. We examine bank-level changes in standards of C&I loans as reported on the Federal Reserve Board's Senior Loan Officers' Opinion Survey (SLOOS).[35] Tighter standards are likely to arise from supply side conditions, in that borrowers who are willing to take loans at current rates are being denied credit. However, since standards may also respond to credit demand and macro conditions (Weinberg (1995)), we follow Bassett et al. (2014) and regress standards on macro and financial conditions, risk tolerance and loan demand changes from SLOOS.[36] The regression residual is a good proxy of the supply of bank loans (Bassett et al. (2014)).

For loans to large or small businesses, the survey asks banks whether standards over the past three months had tightened or eased, or stayed the same. We code these responses as -1 (looser), 0 (same) or 1 (tighter).[37] There are 80 domestic banks in the survey with

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

[36] The survey asks whether loan demand has increased, decreased or stayed the same in the past 3 months. Results from this regression are in Table E.5 of the internet appendix.

[37] Consistent with the literature, we combine tightening or easing "somewhat" versus "considerably."

meaningful C&I loan activity, covering all 12 Fed districts. After merging with the Y-9C data, we have 924 observations for small firms and 1,031 for large firms.[38]

We examine whether LCR banks that reduced C&I loans also tightened standards, relative to non-LCR banks. Regarding standards for large businesses, we follow the specification for all C&I loans in column 5 of Table 9, as most C&I loans go to large firms. We find that LCR banks tighten standards to large firms relative to non-LCR banks since 2015 (column 1 of Table 10). Full-banks tighten standards in 2013Q2-2014 and mod-banks do so since 2015 (column 2). To purge standards of credit demand effects, we use the residual from the Bassett et al. (2014) regression as the dependent variable and find that the result remains robust (column 3). Regarding standards for small businesses, we find that LCR banks tighten standards to small firms since 2015 relative to non-LCR banks (column 4). However, of LCR banks, only G-SIBs tighten standards significantly since 2013Q2 relative to non-LCR banks (column 5), and this result remains after purging standards of demand effects (column 6).

We conclude that the results for lending amounts and standards are generally consistent, suggesting that both are driven by credit supply effects. For C&I loans to small businesses, G-SIBs reduce lending amounts *and* tighten standards since 2013Q2, while smaller LCR banks do not. Further, mod-banks reduce overall C&I loans *and* also tighten standards to large firms since 2015.[39] Finally, the results are robust after purging standards of credit demand, macro and financial conditions.

Tighter standards and regulations. Are tighter standards triggered by regulation? The SLOOS survey asks banks to give the reason for changing standards, with one response being "increased concerns about the effects of legislative changes, supervisory actions, or changes in accounting standards," The blue-shaded bars in Figure 3 plot the share of banks that change standards to small firms (top panel) and large firms (bottom panel). Increased tightening (easing) is indicated by bars above (below) the zero line. The green-shaded bars show that a

[38]Results in Table 9 are unchanged when using the shorter sample (see Table E.6 in the internet appendix).

[39]Bordo and Duca (2018) show that banks tightened lending standards more for small relative to large firms following the Dodd-Frank Act of 2010.

large fraction of LCR banks that tighten standards in 2015-2016 cite regulatory or accounting factors for their decisions. Regression analysis (see Section E.1 of the internet appendix) shows that banks tighten standards even more when they cite these three factors, of which regulation and/or supervision are likely the main ones as no major changes in accounting standards occurred for large banks during this period.[40]. While the survey answers do not cite LCR specifically, the results reinforce the evidence of a credit supply effect on lending.

9 Effect of LCR on Systemic Risk of Banks

Lower liquidity mismatch from LCR is expected to result in lower systemic risk (Brunnermeier, Krishnamurthy and Gorton (2014), Adrian and Boyarchenko (2017)). We find reduced systemic risk contributions due to LCR in section 9.1. As LCR banks also reduce lending, we then estimate the net benefits from reduced lending and systemic risk in section 9.2.

9.1 Systemic Risk of LCR and non-LCR Banks

The reduction in runnable liabilities potentially decreases fire-sale risk for LCR banks. However, fire-sale risk may *increase* if the money premium is also higher since, in equilibrium, banks must be indifferent between a strategy with high fire-sale discount and one with high money premium (Hanson, Shleifer, Stein and Vishny (2015)).[41] Thus, whether fire-sale risk of LCR banks decreased is an empirical issue.

The fire-sale risk measure is from Duarte and Eisenbach (2015) and captures spillovers following an asset price drop that causes bank leverage to rise. In returning to their original leverage, banks sell assets and suffer “second-round losses” that spill over to all banks holding

[40] A list of accounting standard updates is in `https://www.fasb.org/jsp/FASB/Page/SectionPage&cid=1176156316498#2009`. Many updates are clarifications of existing laws and not amendments and, further, do not apply to large banks. Since 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. These relate to intangibles and transfers and servicing, likely irrrelevant to lending decisions.

[41] In Hanson et al. (2015), the money-premium arises from deposit insurance and capital requirement costs. Thus, if LCR encourages banks to hold more long-term, held-to-maturity loans that are funded with insured deposits, then the money premium may increase (Diamond and Kashyap (2016)).

correlated assets. The fire-sale measure, estimated using Y-9C data for the 130 largest banks, is the sum of all second-round spillover losses. When expressed as a share of a bank's assets, a bank's contribution to fire-sale losses depends on the concentration of illiquid assets with large banks (denoted illiquidity linkage) and leverage, relative to system leverage, at the time of the shock.[42] Lower illiquid asset shares of LCR banks imply lower illiquidity linkages, and thus a decline in their contributions to fire-sale risk following LCR. Leverage risk of LCR banks may increase (as liquid assets have lower haircuts) or decrease (if banks delever to meet LCR requirements). However, in Duarte and Eisenbach (2015), leverage may change due to financial conditions more broadly, and so cannot be attributed to the LCR alone.

Complexity risk may also be lower because the LCR penalizes opaque assets and liabilities holdings, such as derivatives (Allahrakha, Glasserman and Young (2015)). Table F.2 in the internet appendix shows that LCR banks have lower shares of net derivative liabilities since 2013Q2, relative to non-LCR banks. However, regulators only consider OTC derivatives as complex, and we do not have this measure. As an alternative, we consider the number of subsidiaries of BHCs (Cetorelli et al. (2017)). The difficulty of resolving, without government support, global banks operating in multiple legal jurisdictions increases with the number of subsidiaries (Bright, Glasserman, Gregg and Hamandi (2016)). Given that LCR banks hold less structured products (that are often funded via subsidiaries), we expect LCR to result in lower complexity risk.

Our third measure is the expected capital shortage of a firm in case of a systemic event (Acharya, Pedersen, Philippon and Richardson (2010) and Acharya, Engle and Richardson (2012)). The firm's systemic risk contribution $SRISK$ is proportional to the firm's expected capital shortfall (losses beyond some threshold) in the event of a crisis. As $SRISK$ mainly intends to capture solvency rather than liquidity risk, we expect it to respond more to capital rules than to LCR. We obtained firm-level estimates of $SRISK$ (in billions of dollars) for

[42]This follows from multiplying both sides of equation (3) in Duarte and Eisenbach (2015) by $\frac{e}{a_i}$, where e is the total equity of banks and a_i is the asset of bank i.

firms exceeding $5 billion in market capitalization as of the end of June 2007.[43]

Figure 4 charts the three systemic risk measures. Since complexity and SRISK scale with size, we divide them by bank assets (in million $) to compare across size groups. Relative to midsized banks, contributions to fire-sale risk are similar for mod-banks but lower for full-banks since 2013Q2. Trends in complexity risk and SRISK appear similar for all groups.

Table 11 shows the effects of LCR on systemic risk. LCR banks' contributions to fire-sale losses decrease in 2013Q2-2014 by 1 bp per thousand dollars of assets, relative to non-LCR banks, but there are no further reductions since 2015 (column 1). Full-banks' contributions to fire-sale losses decreased in 2013Q2-2014 by 2 bp but those of mod-banks are not significant (column 2). Considering the illiquidity component of fire-sale risk, we find that it is lower for LCR banks (column 3), and for both full- and mod-banks (column 4) in all periods except for mod-banks since 2015. By comparison, the leverage component of fire-sale risk is higher for LCR and full-banks since 2015 but the results are weakly significant (columns 5 and 6). Hence, consistent with an effect of the LCR, lower fire-sale contributions of LCR banks are due to the lower concentration of illiquid assets held in common by them.

Turning to complexity risk, it is lower for LCR banks in 2013Q2-2014, relative to non-LCR banks, but the result is weakly significant (column 7). However, mod-banks' complexity risk is lower by 1 bp since 2013Q2 and the changes are strongly significant (column 8). There is no significant change in $SRISK$ for LCR banks, relative to non-LCR banks (columns 9 and 10), suggesting that reductions in systemic risk of LCR banks since 2013Q2 are not due to capital regulations. Overall, the results indicate greater resilience of LCR banks and the banking system from the reductions in their illiquid and complex asset shares.

9.2 Net Benefits from LCR

The net social benefits from LCR are the lower systemic risk contributions of LCR banks minus the social losses (e.g. lower GDP) from lower bank lending, net of any increase in

[43] We thank the cited authors for the fire-sale and complexity data, and the NYU Volatility Lab (`http://vlab.stern.nyu.edu/`) for the SRISK data.

lending by non-banks. This is a challenging task as we lack data on non-bank lending, nor can we estimate the effects of lending on GDP.[44] Moreover, although our analyses distinguish the effects of capital and liquidity regulations, we cannot precisely decompose our estimates to those from different regulations during our sample. Keeping these caveats in mind, we nevertheless provide a rough estimate of the net benefits as a guide to policy makers.

The benefits from LCR are reduced fire-sale contributions by LCR banks, relative to non-LCR banks. These are estimated from columns 1 and 2 of Table 11. We approximate costs of LCR by the income foregone from lower lending by LCR banks, relative to non-LCR banks. The loan income is assumed to be the net interest income (NII) minus provisions for loan and lease losses (LLP), adjusted for taxes. We assume that, absent LCR, the average pre-LCR ratio of loan income to loans of LCR banks would remain the same in the post-LCR period. Then, the foregone income of LCR banks is equal to this pre-LCR ratio multiplied by the estimated reduction in lending by LCR banks in the post-LCR period, relative to non-LCR banks. The post-LCR change in lending is estimated from regressions similar to those reported in Table 9, except that they are estimated over the shorter fire-sale sample and the mod-banks are not split up. Details are in section F.1 of the internet appendix. Our measure over-estimates social losses by ignoring non-bank lending but under-estimates them if non-banks decrease financial stability (Gete and Reher (2018)) or the real economy is more sensitive to bank lending.

Panel A of Table 12 shows the pre-tax net benefits of LCR. For full-banks in 2013Q2-2014, the net interest income foregone is 53 bp and the reduced contribution to fire-sale losses is 181 bp for a net benefit of 128 bp, as a share of assets, which is statistically significant.[45] If we scale by average assets of $944 billion in 2013Q2-2014 (column 1), then the total net benefit is about $12 billion per bank-quarter. In contrast to full-banks, mod-banks' net benefits

[44] Hoerova, Mendicino, Nikolov, Schepens and Heuvel (2018), following Heuvel (2017), estimate the real effects of liquidity regulations using the spread between deposit and HQLA rates. As we require this spread at the bank level, we cannot produce a similar analysis.

[45] The standard error of net benefits is obtained by taking the square root of the sum of squares of the standard errors of benefits and costs.

are small and insignificant. Also, there are no benefits since 2015. These conclusions are strengthened when taxes on net interest income are considered (Panel B). The net benefits of all LCR banks in 2013Q2-2014 are now positive and significant, albeit at the 10% level of significance, while the significance of full-banks' net benefits increases. The net benefits are somewhat larger since taxes decrease the income foregone from loans but are assumed to have no effect on benefits. We conclude that implementation of LCR was beneficial, but only for the largest banks in the early-LCR period. These results support recent initiatives of US regulators to exempt some mod-banks from implementing LCR.

10 Conclusion

In this paper, we examine liquidity creation by LCR and non-LCR banks using the Liquidity Mismatch Index (Bai et al. (2018)), divided by total assets (denoted `LMIN`) to compare liquidity creation across banks of different sizes. We find lower $LMIN$ by LCR banks after 2013Q1 (when LCR was finalized), relative to non-LCR banks, resulting in lower liquidity creation in the banking sector. This occurs via higher liquid asset and lower illiquid asset shares, along with lower liquid liability shares, of LCR banks compared to non-LCR banks. We show that these changes cannot be attributed to a greater preference since 2013Q2 for liquid assets and illiquid liabilities generally as the changes vary with specific LCR rules. Our results are robust to using the liquidity creation measure of Berger and Bouwman (2009).

Decreased holdings of illiquid assets by LCR banks are mainly due to less lending by LCR banks relative to non-LCR banks since 2013Q2. We attribute these changes to credit supply effcts since we also find relatively tighter lending standards by LCR banks in the same period that they attribute in part to regulation or supervision in the SLOOS survey. Lower lending accompanied by reduced reliance on overnight repo and securitizations indicate reduced "securitized banking" (Gorton and Metrick (2012)) following LCR.

LCR increases the resilience of the banking sector since 2013Q2 as LCR banks lower their contributions to fire-sale risk, likely as lower concentrations of illiquid assets with LCR banks reduce the price impact of fire-sales. Also, LCR banks' complexity risk is lower. We estimate that the benefits from lower fire-sale risk offset the costs of lower lending so that net benefits are almost $12 billion per bank-quarter in 2013Q2-2014 for full-banks.

We show that our results are mostly due to LCR and not capital regulations. Of a pair of assets with similar risk, LCR banks favor the one with a lower LCR haircut. LCR banks also do not classify their securities holdings for accounting purposes in a manner implied by new capital rules. Except for short-term funding, the results are inconsistent with the effects of the leverage ratio. Finally, lending reductions by LCR banks in 2013Q2-2014 are not driven by participation in stress tests and do not vary with risk-weights.

While the negative effect of LCR on liquidity creation is not offset by smaller non-LCR banks, lower systemic risk may enable greater bank lending in the long-run (Hanson et al. (2015)). Non-bank financial intermediaries could also provide liquidity (Gorton and Pennacchi (1990) and Pennacchi (2016)). Saar, Sun, Yang and Zhu (2019) argue theoretically that this may be a more efficient form of financial intermediation. However, Gete and Reher (2018) show that non-banks lower lending standards and thereby harm financial stability.

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Table 1: The Liquidity Coverage Ratio (LCR): Asset and Liability Side Requirements

Panel A of the table shows assets eligible as High Quality Liquid Assets (HQLA) by the LCR rules in three liquidity categories: Level 1, Level 2A and Level 2B. The non-HQLA assets are all assets that are HQLA-ineligible. The *LCR Haircut* column shows the haircut imposed by LCR on assets in the liquidity level. The *Constraint* column shows the minimum or maximum share of total HQLA allowed for assets in the level. The LCR weight equals 1 minus the haircut. The *LMI* weights are the average of *LMI* weights of assets in the level as of January 2013, estimated following Bai et al. (2018). Panel B shows the LCR outflow and inflow rates for LCR outflow categories. Abbreviations used in Panel A: RW =Risk Weights; MBS=Mortgage-Backed Securities; GSE=Government-Sponsored Enterprise; L1 = Level 1, L2a = Level 2a and L2b = Level 2b. .

Panel A: Eligible Assets and Haircuts for HQLA Portfolio					
Level	Asset	LCR Haircut	Constraint	LCR Weight	Average LMI Weight
Level 1 HQLA	Excess Reserves Treasuries Government Agency Debt & MBS Foreign Debt (RW=0%)	0%	≥60% of HQLA	1	.97
Level 2A HQLA	GSE Debt GSE MBS Foreign Debt (RW=(0,20]%)	15%	L2A + L2B <40% of HQLA	.85	.96
Level 2B HQLA	Investment Grade Non-financial corporates Russell 1000 equities Investment Grade Municipals[1]	50%	<15% of HQLA	.5	.79
Non-HQLA	All Other Assets	100%	N/A	0	.48

1. Investment grade municipal bonds were initially not HQLA-eligible but were made so by Senate Bill S.2515 in 2018.

Table 1: (Continued) The Liquidity Coverage Ratio (LCR): Asset and Liability Side Requirements

Abbreviations for secured funding collateral are for levels of High Quality Liquid Assets: Abbreviations for funding counterparties are SB = small business; NFin = non-financial; Fin = financial.

Panel B: LCR Outflow Categories, Inflow and Outflow Rates			
LCR Outflow Category	Y-9C item	LCR Outflow Rate	LCR Inflow Rate
Secured Funding	ON Repo Sold	L1 & L2A collateral: 0-15%	L1 & L2A collateral: 0-15%
	Securities Lent	L2B & non-HQLA collateral: $25-100\%$[1]	L2B & non-HQLA collateral: $50-100\%$
Unsecured Funding	ON fed funds purchased	Retail & SB: $3-40\%$[2]	
	Deposits	Insured retail deposits: 3%	
	Trading Liabilities	Uninsured retail deposits: 10%	
	Commercial Paper	Wholesale: 5-100%	
	Other Borrowed Money		
	Subordinated Debt		
	Other Liabilities		
	Equity		
Commitments	Unused Commitments	Retail & SB non-mortgage: 5%	
	Standby Letters of Credit	NFin Wholesale: 10-30% Fin Wholesale: 40-100%	
Derivatives	Net Derivatives	100%	

1. Borrowings from exempted central banks has rate=0%.

2. Brokered deposits maturing less than or equal to 30 days has a 100% runoff rate.

Table 2: Asset-Side Liquidity Categories and Liquidity Weights

For each liquidity category in Berger and Bouwman (2009) (*BB* category) and in Bai et al. (2018) (Liquidity Mismatch Index *LMI* category), the table shows the included assets from the Y9-C data. For assets in each *LMI* category, we also report the average *LMI* weight as of January 2013 and the LCR weight.

<table>
<tr><th>BB Category</th><th>Y9-C Asset Item</th><th>LMI Category</th><th>Average LMI Weight: Jan. 2013</th><th>LCR Weight</th></tr>
<tr><td rowspan="3">Illiquid Assets</td><td>Other Real Estate owned,
Customers liab. on acceptances,
Inv. in subsidiaries, Premises</td><td>Fixed Assets</td><td rowspan="2">0</td><td rowspan="4">0</td></tr>
<tr><td>Intangible & Other</td><td>Intangible & Other</td></tr>
<tr><td>Loans:
Commercial & Industrial,
Commercial Real Estate,
Agricultural, Other, Lease Financing</td><td rowspan="2">Loans</td><td rowspan="2">.24</td></tr>
<tr><td>Semi-liquid Assets</td><td>Loans:
Residential Real Estate, Consumer,
To Depository Institutions,
To State & Local, To Foreign Govts.</td></tr>
<tr><td rowspan="8">Liquid Assets</td><td>Cash/Balances due from Dep. Institutions
Fed Funds Sold</td><td>Cash</td><td>1</td><td rowspan="3">1</td></tr>
<tr><td>Treasury Securities</td><td rowspan="7">Securities
(Available for Sale,
Held to Maturity,
Trading)</td><td>.96</td></tr>
<tr><td>Government Agency Debt and MBS</td><td rowspan="2">.96</td></tr>
<tr><td>GSE Debt and MBS</td><td>.85</td></tr>
<tr><td>Municipal Securities</td><td>.77</td><td rowspan="2">.5</td></tr>
<tr><td>Equity Securities</td><td>.83</td></tr>
<tr><td>Other Domestic Debt</td><td>.77</td><td rowspan="2">0</td></tr>
<tr><td>Structured Products
(incl. non-agency MBS)</td><td>.71</td></tr>
</table>

Table 3: Liability-Side Liquidity Categories and Liquidity Weights

For each liquidity category in Berger and Bouwman (2009) (BB category) and in Bai et al. (2018) (Liquidity Mismatch Index LMI category), the table shows the included liabilities from the Y9-C data. For liabilities in each LMI category, we also report the average LMI weight as of January 2013. Also shown are off-balance-sheet liability items. Abbreviation used: ON=overnight.

Panel A: Liquidity Categories and Weights

BB category	Y-9C Liquidity Item	LMI Category	Average LMI Weight: Jan. 2013
Liquid Liabilities	ON Fed. Funds. Purchased ON Repo sold	Overnight Debt	1
	Trading Liabilities	Trading liabilities	.94
	Transaction Deposits Savings Deposits	Insured Deposits	$\sim$0
Semi-Liquid Liabilities	Time Deposits	Uninsured Deposits	.23
	Other Borrowed Money	Commercial Paper	.88
		Maturity <= 1 Year	.23
		Maturity >= 1 Year	$\sim$0
Illiquid Liabilities	Subordinated Debt Other Liabilities	Other Liabilities	$\sim$0
	Equity	Equity	$\sim$0
Off Balance Sheet Liabilities	Unused Commitments Standby Letters of Credit Securities Lent Net Derivatives	Off Balance Sheet Liabilities	$\sim$0

Table 4: Liquidity Creation by LCR and Non-LCR Banks

The table shows results from panel regressions for the change in *LMIN*, equal to the Liquidity Mismatch Index *LMI* divided by assets. Dummy variables are defined as: *Post-LCR*=1 from 2013 Q2 to 2017 Q4; *2013-2014*=1 from 2013 Q2 to 2014 Q4; *2015+*=1 from 2015 Q1 to 2017 Q4; *LCR-Bank*=1 for banks that had to implement the LCR rule; *Mod-Bank*=1 for LCR banks with assets $\geq$ \$50 billion and less than \$250 billion; and *Full-Bank*=1 for LCR banks that are internationally active or have assets \$250 billion or over. The omitted group is midsized non-LCR banks with assets between \$3 billion and \$50 billion. The Chicago Fed's National Financial Conditions Index (NFCI) is an indicator for risk, credit and leverage conditions; higher values mean tighter financial conditions. CET1 is the common equity tier 1 capital ratio. Non-performing loans and core deposits are shares of loans and assets, respectively. The sample is 2009 Q1 to 2017 Q4 with a total of 4,068 bank-quarters.

	(1)	(2)	(3)	(4)	(5)
Post-LCR	0.75***				
	(9.86)				
2013-2014			0.90***		0.64***
			(9.72)		(6.55)
2015+			0.65***		0.33***
			(7.97)		(3.96)
LCR Bank	0.01				
	(0.13)				
Mod-Bank			-0.02		
			(-0.14)		
Full-Bank			0.05		
			(0.28)		
LCR Bank x Post-LCR	-0.32**	-0.31**			
	(-2.56)	(-2.59)			
Mod-Bank x 2013-2014			-0.48**	-0.55**	-0.55***
			(-2.25)	(-2.61)	(-2.68)
Full-Bank x 2013-2014			-0.64***	-0.53**	-0.64***
			(-3.12)	(-2.52)	(-3.12)
Mod-Bank x 2015+			-0.08	-0.14	-0.13
			(-0.68)	(-0.98)	(-0.97)
Full-Bank x 2015+			-0.30	-0.25	-0.27
			(-1.52)	(-1.40)	(-1.40)
Lag Δ Tier 1 Capital Ratio	-4.02***	-1.74	-4.56***	-2.19	-5.40***
	(-3.17)	(-0.66)	(-3.47)	(-0.79)	(-4.11)
Lag Δ Share Nonperforming Loans	-0.29***	-0.09	-0.29***	-0.09	-0.10
	(-4.03)	(-1.13)	(-3.91)	(-1.13)	(-1.42)
Lag Δ Net Interest Margin	0.13	-0.19	0.14	-0.20	0.10
	(0.42)	(-0.56)	(0.44)	(-0.56)	(0.30)
Lag Δ Core Deposits	0.01	0.02	0.01	0.02	0.02
	(0.60)	(0.92)	(0.50)	(0.92)	(1.23)
$\Delta NFCI$					2.08***
					(8.97)
Constant	-0.69***	-4.21***	-0.68***	-4.22***	-0.34***
	(-12.26)	(-13.10)	(-12.19)	(-13.10)	(-7.39)
Bank F.E.	No	Yes	No	Yes	Yes
Time F.E.	No	Yes	No	Yes	No

Table 5: Asset and Liability Side Liquidity Creation

The table shows results from estimating the panel regression (8) for changes in the assets and liabilities-side components of *LMIN*. $LMINA$ is the liquity-weighted assets divided by assets. Liquid, semi-liquid, and illiquid asset categories are defined in Table 2. $LMINL$ is the liquidity-weighted liabilities divided by assets. Liquid and semi-liquid liability categories are defined in Table 3; illiquid liabilities are not shown since they have LMI liquidity weight=0. *2013-2014* is 1 from 2013 Q2 to 2014 Q4 and *2015+* is 1 from 2015 Q1 to 2017 Q4. *Mod-Bank* is a dummy variable equal to 1 for LCR banks with assets $\geq$ \$50 billion and less than \$250 billion. *Full-Bank* is a dummy variable equal to 1 for LCR banks that are internationally active or have assets \$250 billion or over. The omitted group is midsized non-LCR banks have assets between \$3 billion and \$50 billion. The sample is 2009 Q1 to 2017 Q4 with a total of 4,068 bank-quarters. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	$\Delta LMINA$	Δ Liquidity-Weighted Assets			$\Delta LMINL$	Δ Liquidity-Weighted Liabilities	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Liquid	Semi-Liquid	Illiquid		Liquid	Semi-Liquid
Mod-Bank x 2013-2014	0.71***	0.88***	-0.09**	-0.07*	0.16	0.06	0.10*
	(3.44)	(3.43)	(-2.42)	(-1.69)	(1.39)	(0.51)	(1.91)
Full-Bank x 2013-2014	0.15	0.34	-0.08***	-0.11***	-0.38**	-0.35*	-0.02
	(0.73)	(1.43)	(-2.68)	(-2.94)	(-2.00)	(-1.90)	(-0.31)
Mod-Bank x 2015+	0.33***	0.40***	0.00	-0.07**	0.18	0.04	0.14***
	(2.76)	(3.03)	(0.04)	(-2.02)	(1.25)	(0.28)	(3.44)
Full-Bank x 2015+	0.03	0.12	0.00	-0.09**	-0.23***	-0.20**	-0.02
	(0.19)	(0.60)	(0.13)	(-2.26)	(-2.70)	(-2.33)	(-0.38)
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6: Liquid Liabilities Shares: LCR and Non-LCR Banks

The table shows results from a panel regression (8) of changes in liquid liabilities as shares of total assets. *2013-2014* is a dummy variable equal to 1 from 2013 Q2 to 2014 Q4 and *2015+* is 1 from 2015 Q1 to 2017 Q4. *Mod-Bank* is a dummy variable equal to 1 for LCR banks with assets $\geq$ \$50 billion and less than \$250 billion. *Full-Bank* is a dummy variable equal to 1 for LCR banks that are internationally active or have assets \$250 billion or over. The omitted group is midsized non-LCR banks with assets between \$3 billion and \$50 billion. The sample is 2009 Q1 to 2017 Q4 with a total of 4,068 bank-quarters. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	Liquid					Semi-Liquid		
	(1) Δ ON FedFunds	(2) Δ ON Repo	(3) Δ Transactions Deposits	(4) Δ Insured Deposits	(5) Δ Uninsured Deposits	(6) Δ Com. Paper	(7) Δ OBM $\leq$ 1Y	(8) Δ OBM $>$ 1Y
Mod-Bank x	0.09	-0.07	0.12*	-0.04	-0.12	0.01	0.13	0.19
2013-2014	(0.84)	(-1.32)	(1.70)	(-0.25)	(-0.42)	(1.13)	(0.92)	(1.46)
Full-Bank	0.02	-0.35**	0.15**	0.43**	-0.09	0.01	-0.29*	0.27**
x 2013-2014	(0.46)	(-2.18)	(2.09)	(2.18)	(-0.50)	(0.15)	(-1.91)	(2.47)
Mod-Bank x	0.01	0.04	-0.05	0.25	-0.42	-0.01	0.34***	0.09
2015+	(0.23)	(0.35)	(-0.68)	(1.09)	(-1.50)	(-0.80)	(3.21)	(0.73)
Full-Bank	-0.03	-0.14**	0.15**	0.72***	-0.48***	-0.06	-0.02	0.20**
x 2015+	(-1.48)	(-2.35)	(2.40)	(5.21)	(-4.17)	(-1.48)	(-0.17)	(2.40)
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: Liquid Asset Shares: LCR and Non-LCR Banks

The table shows results from estimating the panel regression (8) for changes in the shares of liquidity-weighted high quality liquid assets (HQLA) and non-HQLA liquid assets. Level 1, 2A and 2B are HQLA liquidity categories, with Level 1 assets the most liquid and Level 2B assets the least. *2013-2014* is 1 from 2013 Q2 to 2014 Q4 and *2015+* is 1 from 2015 Q1 to 2017 Q4. *Mod-Bank* is a dummy variable equal to 1 for LCR banks with assets $\geq$ \$50 billion and less than \$250 billion. *Full-Bank* is a dummy variable equal to 1 for LCR banks that are internationally active or have assets \$250 billion or over. The omitted group is midsized non-LCR banks with assets between \$3 billion and \$50 billion. The sample is 2009 Q1 to 2017 Q4 with a total of 4,068 bank-quarters. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	Non-HQLA	HQLA			
	(1) Δ Structured Products	(2) Δ HQLA All	(3) Δ HQLA Level 1	(4) Δ HQLA Level 2A	(5) Δ HQLA Level 2B
Mod-Bank x	-0.06	0.87***	0.58***	0.23	0.07**
2013-2014	(-1.33)	(3.70)	(3.74)	(1.25)	(2.61)
Full-Bank	-0.33***	0.87***	0.48*	0.32**	0.07*
x 2013-2014	(-3.56)	(4.22)	(1.87)	(2.21)	(1.92)
Mod-Bank x	0.01	0.33***	0.12	0.15	0.06**
2015+	(0.17)	(2.96)	(0.92)	(1.31)	(2.51)
Full-Bank	-0.19**	0.27	0.06	0.12	0.09**
x 2015+	(-2.51)	(1.50)	(0.34)	(1.08)	(2.30)
Bank F.E.	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes

Table 8: GNMA and GSE MBS Shares: LCR and Non-LCR Banks

The table shows results from panel regressions of the change in the book values of GNMA MBS and GSE MBS, as shares of total assets. *AFS* and *HTM* are securities classified as available-for-sale and held-to-maturity, respectively, for accounting purposes. *2013-2014* is a dummy variable equal to 1 from 2013 Q2 to 2014 Q4 and *2015+* is 1 from 2015 Q1 to 2017 Q4. *Mod-Bank* is a dummy variable equal to 1 for banks with assets $\geq$ \$50 billion and less than \$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 \$250 billion or over, excluding G-SIBs when the *G-SIB* dummy is included. The omitted group is midsized non-LCR banks with assets between \$3 billion and \$50 billion. The sample is 2009 Q1 to 2017 Q4 with a total of 4,068 bank-quarters. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	All holdings		AFS		HTM		AFS, with GSIBs		HTM, with GSIBs	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Δ GNMA	Δ GSE	Δ GNMA	Δ GSE	Δ GNMA	Δ GSE	Δ GNMA	Δ GSE	Δ GNMA	Δ GSE
Mod-Bank x 2013-2014	0.18**	-0.14	0.13**	-0.16	0.05	0.02	0.13**	-0.16	0.05	0.02
	(2.45)	(-0.98)	(2.11)	(-1.13)	(1.63)	(0.58)	(2.11)	(-1.13)	(1.63)	(0.58)
Full-Bank x 2013-2014	-0.03	0.01	-0.05	-0.04	0.03	0.05	-0.01	-0.06	0.01	0.03
	(-0.54)	(0.12)	(-0.89)	(-0.42)	(1.10)	(0.87)	(-0.11)	(-0.38)	(0.39)	(0.29)
G-SIB x 2013-2014							-0.09	-0.02	0.04	0.06
							(-1.00)	(-0.29)	(1.16)	(1.42)
Mod-Bank x 2015+	0.09*	-0.01	0.09**	-0.05	-0.00	0.03	0.09**	-0.05	-0.00	0.03
	(1.89)	(-0.13)	(2.09)	(-0.47)	(-0.24)	(0.80)	(2.09)	(-0.47)	(-0.24)	(0.80)
Full-Bank x 2015+	0.03	0.07	0.01	0.03	0.02	0.03	-0.01	0.11	0.02	-0.01
	(0.55)	(0.96)	(0.13)	(0.55)	(1.11)	(0.97)	(-0.18)	(1.07)	(1.02)	(-0.15)
G-SIB x 2015+							0.02	-0.02	0.02	0.06
							(0.25)	(-0.37)	(0.82)	(1.32)
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: Book Value Changes of Loan Amounts

The table shows results from panel regressions of changes in the book values of loans, as shares of total assets. The loan securitization dummy is 1 if the bank had positive securitization income and 0 if it was not. Other dummy variables are as follows. *Post-LCR* is 1 from 2013 Q2 to 2017 Q4 and zero otherwise. *2013-2014* is 1 from 2013 Q2 to 2014 Q4 and *2015+* is 1 from 2015 Q1 to 2017 Q4. *LCR-Bank*=1 for banks that had to implement the LCR rule. $Mod < 100B$ is 1 for LCR banks with assets $\geq$ \$50 billion and less than \$100 billion. $Mod >= 100B$ is 1 for LCR banks with assets $\geq$ \$100 billion and less than \$250 billion. $G\text{-}SIB$ is 1 for global systemically important banks. *Full-Bank* is 1 for LCR banks that are internationally active or have assets \$250 billion or over, except G-SIBs when the $G\text{-}SIB$ dummy is included. The omitted group is midsized non-LCR banks with assets between \$3 billion and \$50 billion. The sample is 2009 Q1 to 2017 Q4 with a total of 4,068 bank-quarters. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively. Abbreviations used: C&I=Commercial & Industrial; CRE=Commercial real estate; RRE=Residential real estate.

	Δ All Loans		Δ Real Estate Loans		Δ C&I Loans		
	(1)	(2)	(3) RRE	(4) CRE	(5) All	(6) Small Business	(7)
LCR Bank x 2013-2014	-0.70*** (-3.67)						
Mod<100B x 2013-2014		-0.91** (-2.49)	-0.37** (-2.12)	-0.14 (-0.95)	-0.16 (-1.29)	-0.04 (-1.39)	-0.04 (-1.39)
Mod>=100B x 2013-2014		-0.50* (-1.66)	-0.32*** (-2.63)	-0.07 (-0.58)	-0.16 (-1.57)	-0.03 (-1.46)	-0.03 (-1.46)
Full-Bank x 2013-2014		-0.70*** (-3.76)	-0.28** (-2.61)	-0.28*** (-3.44)	-0.01 (-0.07)	-0.02 (-1.02)	-0.01 (-0.26)
G-SIB x 2013-2014							-0.03* (-1.79)
LCR Bank x 2015+	-0.28* (-1.74)						
Mod-Bank x 2015+		-0.26 (-1.14)	-0.02 (-0.14)	-0.06 (-0.62)	-0.19* (-1.95)	-0.00 (-0.13)	-0.00 (-0.13)
Full-Bank x 2015+		-0.30* (-1.85)	-0.04 (-0.39)	-0.37*** (-5.28)	0.17 (1.50)	-0.00 (-0.13)	0.03 (0.42)
G-SIB x 2015+							-0.03** (-2.01)
Lagged Δ Securitization Dummy	0.17 (1.11)	0.17 (1.11)	0.03 (0.49)	0.03 (0.45)	-0.01 (-0.16)	0.03* (1.79)	0.04* (1.81)
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 10: C&I Lending Standards: LCR and non-LCR Banks

The dependent variable is the change in C&I lending standards by banks. 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 standards on loan demand, risk tolerance, macro and financial conditions. *2013-2014* is a dummy equal to 1 from 2013 Q2 to 2014 Q4 and *2015+* is 1 from 2015 Q1 to 2017 Q4. *LCR-Bank* is a dummy variable equal to 1 for banks subject to LCR. *Mod-Bank* is a dummy variable equal to 1 for LCR banks with assets $\geq$ \$50 billion and less than \$250 billion. $Mod < 100B$ is 1 for LCR banks with assets $\geq$ \$50 billion and less than \$100 billion. $Mod >= 100B$ is 1 for LCR banks with assets $\geq$ \$100 billion and less than \$250 billion. G-SIB is a dummy for global systemically important banks. *Full-Bank* is a dummy equal to 1 for LCR banks that are internationally active or have assets \$250 billion or over, excluding G-SIBs when the G-SIB dummy is included. The omitted group is non-LCR banks with assets between \$3 billion and \$50 billion. The sample is 2009 Q1 to 2017 Q4. The number of observations are 924 (1,031) for loans to small (large) firms.

	Large Businesses			Small Businesses		
	(1)	(2)	(3)	(4)	(5)	(6)
	Standards	Standards	Residual	Standards	Standards	Residual
LCR Bank x 2013-2014	0.10			0.04		
	(1.54)			(0.76)		
Mod<100B x 2013-2014		0.08	0.04		0.03	0.01
		(0.49)	(0.33)		(0.27)	(0.10)
Mod>=100B x 2013-2014		0.07	0.04		0.05	0.03
		(0.74)	(0.58)		(0.97)	(0.62)
Full-Bank x 2013-2014		0.15**	0.12*		-0.04	-0.06
		(2.01)	(1.87)		(-0.40)	(-0.67)
G-SIB x 2013-2014					0.20***	0.15***
					(5.45)	(4.45)
LCR Bank x 2015+	0.12*			0.12*		
	(1.84)			(1.86)		
Mod-Bank x 2015+		0.15**	0.11*		0.13	0.10
		(1.99)	(1.84)		(1.63)	(1.47)
Full-Bank x 2015+		0.08	0.05		0.05	0.03
		(1.03)	(0.81)		(0.90)	(0.56)
G-SIB x 2015+					0.19***	0.15***
					(3.55)	(3.24)
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

Table 11: Systemic Risk of LCR and non-LCR Banks

The table shows results from a panel regression (8) of changes in systemic risk, in basis points. In the first 6 columns, the dependent variables are the overall fire-sale risk (i.e. the contribution of a bank to fire-sale losses in the banking sector, as a share of its assets) and its two components: illiquidity and leverage. In columns 7-8, the dependent variable is complexity, as measured by the number of subsidiaries of BHCs, as a share of assets. In columns 9-10, the dependent variable is SRISK, the capital loss conditional on a systemic event, as a share of assets. Coefficients of complexity and SRISK are scaled up by 1,000 for visibility. *Post-LCR* is a dummy variable equal to 1 from 2013 Q2 to 2017 Q4. *2013-2014* is a dummy variable equal to 1 from 2013 Q2 to 2014 Q4 and *2015+* is 1 from 2015 Q1 to 2017 Q4. *Mod-Bank* is a dummy variable equal to 1 for LCR banks with assets $\geq$ \$50 billion and less than \$250 billion. *Full-Bank* is a dummy variable equal to 1 for LCR banks that are internationally active or have assets \$250 billion or over. The omitted group is midsized non-LCR banks with assets between \$3 billion and \$50 billion. The sample is 2009 Q1 to 2017 Q4 with a total of 4,068 bank-quarters. t statistics are shown in parenthesis. *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	Δ Fire-Sale Risk						Δ Complexity		Δ SRISK	
	(1) Overall	(2) Overall	(3) Illiquidity Component	(4) Illiquidity Component	(5) Leverage Component	(6) Leverage Component	(7)	(8)	(9)	(10)
LCR Bank x 2013-2014	-0.01***		-0.97***		-0.40		-0.00*		0.08	
	(-2.65)		(-4.32)		(-0.78)		(-1.76)		(1.35)	
Mod-Bank x 2013-2014		-0.01		-0.59**		-0.07		-0.01***		0.10
		(-1.35)		(-2.51)		(-0.11)		(-2.84)		(1.44)
Full-Bank x 2013-2014		-0.02***		-1.28***		-0.66		0.00		0.07
		(-3.07)		(-5.05)		(-1.10)		(0.13)		(0.92)
LCR Bank x 2015+	-0.00		-0.42***		0.62*		-0.00		0.07	
	(-0.15)		(-2.66)		(1.66)		(-1.63)		(0.77)	
Mod-Bank x 2015+		0.00		-0.03		0.37		-0.01**		-0.02
		(0.24)		(-0.15)		(0.76)		(-2.30)		(-0.40)
Full-Bank x 2015+		-0.00		-0.76***		0.85*		0.00		0.16
		(-0.34)		(-4.41)		(1.68)		(0.31)		(1.10)
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 12: Net Benefits from LCR

The table shows the net benefits from LCR, equal to the benefits of reduced fire-sale contributions minus costs due to the income foregone from less lending, by LCR banks relative to non-LCR banks. The estimated benefits are from columns 1 and 2 of Table 11. 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. 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

		Post-LCR Assets	Share of Assets (Basis Points)			Total (Billions of Dollars)		
		(1)	(2)	(3)	(4)	(1)*(2)	(1)*(3)	(1)*(4)
Group	Period	Mean ($Billions)	Benefit	Cost	Benefit - Cost	Benefit	Cost	Benefit - Cost
LCR-Banks	Post-LCR	578.55	0.54	0.31	0.23	3.11	1.77	1.34
LCR-Banks	2013Q2-2014	586.21	1.40	0.58	0.82	8.23	3.41	4.82
Full-Banks	2013Q2-2014	944.42	1.81	0.53	1.28**	17.11	5.01	12.09**
Mod-Banks	2013Q2-2014	108.60	0.88	0.45	0.43	0.96	0.49	0.47
LCR-Banks	2015+	574.44	0.06	0.15	-0.10	0.33	0.88	-0.55
Full-Banks	2015+	984.05	0.19	0.28	-0.09	1.86	2.73	-0.87
Mod-Banks	2015+	120.72	-0.10	0.02	-0.12	-0.13	0.02	-0.15

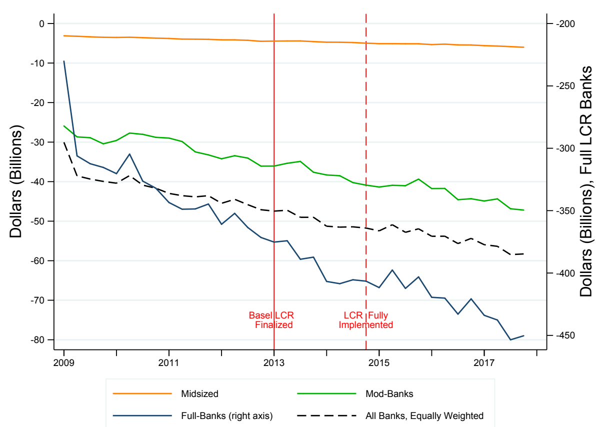
Panel B: After-Tax Net Benefits

		Post-LCR Assets	Share of Assets (Basis Points)			Billions of Dollars		
		(1)	(2)	(3)	(4)	(1)*(2)	(1)*(3)	(1)*(4)
Group	Period	Mean ($Billions)	Benefit	Cost	Benefit - Cost	Benefit	Cost	Benefit - Cost
LCR-Banks	Post-LCR	578.55	0.54	0.22	0.32	3.11	1.27	1.84
LCR-Banks	2013Q2-2014	586.21	1.40	0.42	0.99*	8.23	2.45	5.78*
Full-Banks	2013Q2-2014	944.42	1.81	0.38	1.43***	17.11	3.60	13.51***
Mod-Banks	2013Q2-2014	108.60	0.88	0.33	0.55	0.96	0.36	0.60
LCR-Banks	2015+	574.44	0.06	0.11	-0.05	0.33	0.63	-0.30
Full-Banks	2015+	984.05	0.19	0.20	-0.01	1.86	1.96	-0.10
Mod-Banks	2015+	120.72	-0.10	0.01	-0.12	-0.13	0.02	-0.14

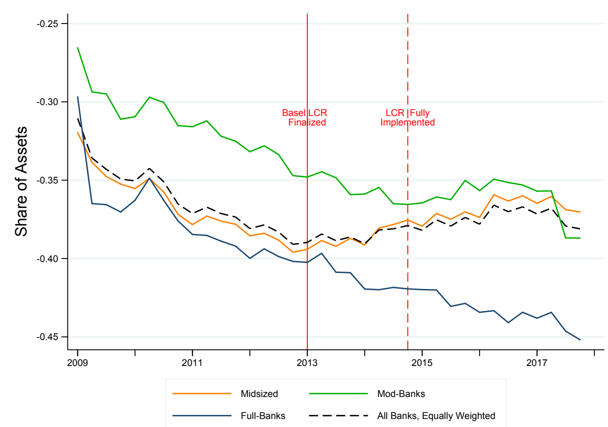
Figure 1: Liquidity Creation by LCR and non-LCR Banks

The top panel plots LMI, the liquidity creation in billions of dollars, and $LMIN = \frac{LMI}{Assets}$, averaged over all banks (dashed line) or over banks in different size groups (solid lines). The bottom panel plots the average LMINA and LMINL, equal to the liquidity-weighted assets and liabilities, respectively, divided by assets. LMINA and LMINL are calculated for each bank, and then averaged across banks in the size group. Banks with assets $\geq$ \$50 billion are required to implement the LCR rule. Full-banks (plotted on right vertical axis in the LMI chart) are internationally active or have assets $\geq$ \$250 billion. Mod-banks have assets $\geq$ \$50 billion and less than \$250 billion. Midsized banks with assets between \$3 billion and \$50 billion are not subject to the LCR rule. LMI is calculated using on-balance-sheet items only. The sample is 2009 Q1 to 2017 Q4.

Liquidity Creation in Billions of Dollars: LMI



Liquidity Creation Per Asset: LMIN



Asset-Side Liquidity Creation Per Asset: LMINA

Liability-Side Liquidity Creation Per Asset: LMINL

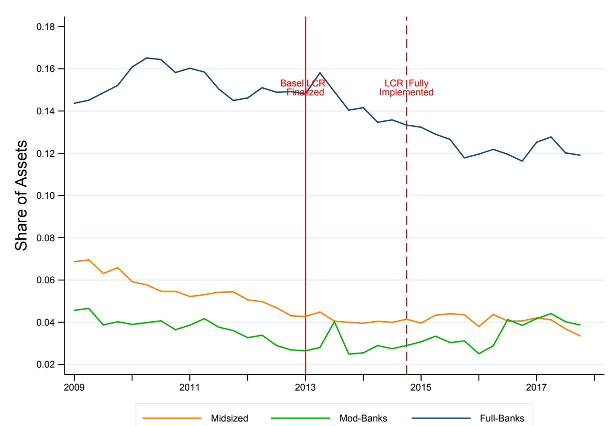


Figure 2: Book Values of Insured and Uninsured Deposits, and Long and Short Maturity Borrowings, as Shares of Bank Assets: LCR and non-LCR Banks

The figure shows the changes in book values of insured and uninsured deposits in the top panel and other borrowed money of less than or equal to one-year maturity (OBM<=Y1), and greater than one-year maturity (OBM>Y1) in the bottom panel, by size group for consolidated bank holding companies. Banks with assets $\geq$ \$50 billion are required to implement the LCR rule. Full-banks are internationally active or have assets $\geq$ \$250 billion. Mod-banks have assets $\geq$ \$50 billion and less than \$250 billion. Midsized banks with assets between \$3 billion and \$50 billion are not subject to the LCR rule. The sample is 2009 Q1 to 2017 Q4.

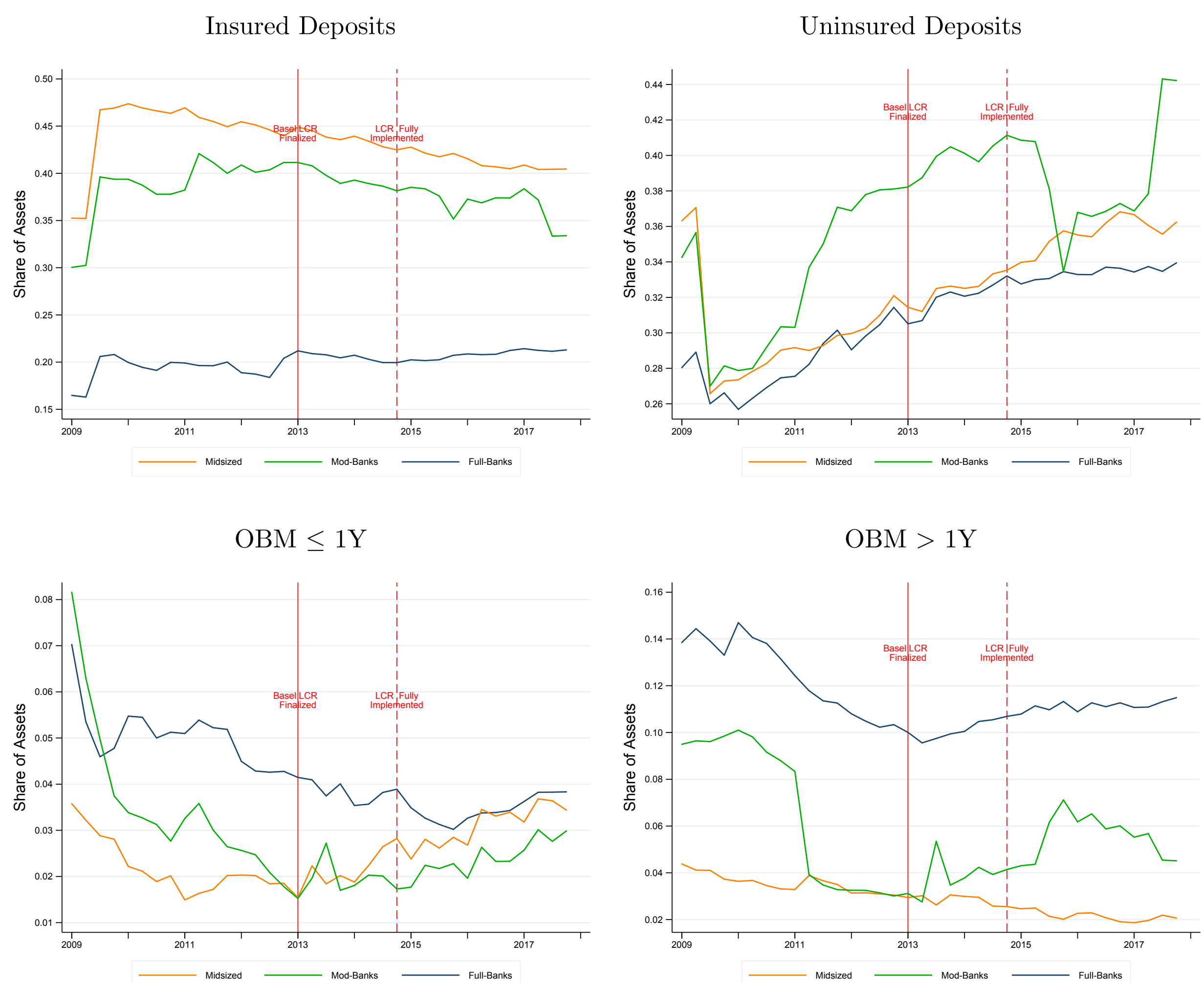


Figure 3: Lending Standards and Regulation: C&I Loans to Small and Large Firms

The blue shaded bars in the figure show the share of banks that indicated that they either tightened or eased lending standards to small firms (top panel) or large firms (bottom panel) for C&I loans in the SLOOS survey. The green-shaded areas show the share of banks indicating regulatory, supervisory or accounting changes as the reason for tightening or easing. "LCR Banks" have assets $\geq$ \$50 billion and are required to implement the LCR rule. Midsized banks with assets between \$3 billion and \$50 billion are not subject to the LCR rule. The sample is 2009 Q1 to 2017 Q4.

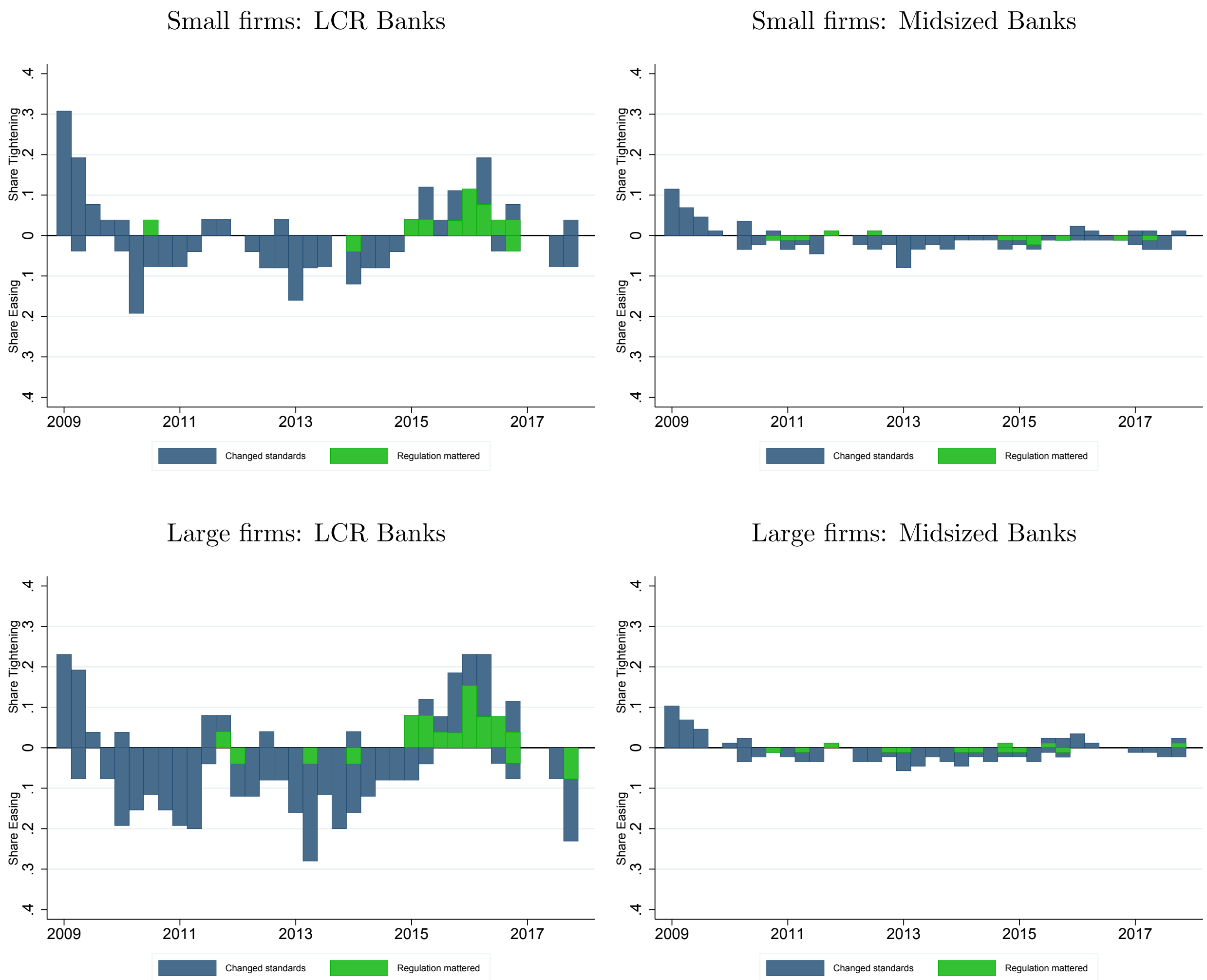


Figure 4: Systemic Risk, as Shares of Bank Assets: LCR and non-LCR Banks

The figure shows sytemic risk measures as shares of bank assets by size group for consolidated bank holding companies. The top panel shows the average contribution of a bank to fire-sale losses in the banking sector and SRISK, the capital loss conditional on a systemic event. The bottom panel shows complexity, as measured by the number of subsidiaries of BHCs. Banks that have assets $\geq$ \$50 billion are required to implement the LCR rule. Full-banks are internationally active or have assets $\geq$ \$250 billion. Mod-banks have assets $\geq$ \$50 billion and less than \$250 billion. Midsized banks with assets between \$3 billion and \$50 billion are not subject to the LCR rule. The sample is 2009 Q1 to 2017 Q4.