Nonbanks and Lending Standards in Mortgage Markets. The Spillovers from Liquidity Regulation.*

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This Draft: April 2017

Abstract

The 2014 U.S. liquidity coverage ratio (LCR) gave preferential liquidity weights to mortgage-backed securities (MBS) backed by GNMA versus those backed by the Government Sponsored Entreprises (GSEs). We show that this policy created a liquidity premium for GNMA-backed MBS relative to GSE-backed MBS. Then, exploiting cross-sectional differences in funding sources across lenders, we show that LCR policy has led to a higher market share for nonbanks and lenders reliant on securitization. It also led to increased supply of credit for risky borrowers and to tighter standards among loans eligible for purchase by the GSEs.

Keywords: Lending Standards, LCR, Liquidity, Mortgages, Nonbanks, FHA, GSEs, MBS.

JEL Classification: G12, G18, G21, G23, E32, E44.

*We appreciate the comments of George Akerlof, Elliot Anenberg, Jennie Bai, Morris Davis, Behzad Diba, David Echeverry, Jesus Fernandez-Villaverde, Douglas Gale, Carlos Garriga, Lei Ge, Adam Guren, Robert Kurtzman, Sylvain Leduc, Tim McQuade, Kurt Mitman, Charles Nathanson, Steve Ross, Nancy Wallace, Susan Wachter and the participants at the 2017 HULM-St.Louis Fed.

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1 Introduction

In 2006, non-depository institutions ("nonbanks" for short) accounted for 43% of total subprime loans (Lux and Greene 2015).[1] Nearly all of these institutions, which are unable to access the lending of last resort facilities of the Fed, either defaulted or were restructured post-2007. Moreover, Demyanyk and Loutskina (2016) show that their activities contributed to a deterioration of lending standards in mortgage markets.

Figure 1 shows that originations by nonbanks comprised the majority of the FHA market for new purchase loans right before the crisis, at the peak of the subprime boom. By 2016 they have even surpassed those levels. This fact worries economists and policymakers (Pinto and Oliner 2015, Wallace 2016, Wall Street Journal 2017) because FHA mortgagors usually have higher loan-to-value ratios, lower credit scores and higher default rates over the business cycle (Frame, Gerardi and Tracy 2016).

Insert Figure 1 around here

In this paper, we show that the U.S. Liquidity Coverage Ratio (LCR) requirements, announced in October 2013 and finalized in September 2014, have contributed to the expansion of nonbanks in FHA. Moreover, we show that the LCR policy has led to more relaxed lending standards among FHA-insured loans and to tighter standards among non-FHA conventional loans, which are eligible for purchase by the GSEs. Thus, our paper shows that regulations to prevent runs in secondary mortgage markets (Diamond and Kashyap 2016 discuss the rationale for the LCR) seem to have increased the credit risk borne by U.S. taxpayers.

The LCR rule requires sufficiently large financial institutions to hold enough high quality liquid assets to cover cash outflows over a 30-day stress period (Basel Committee on Bank Supervision 2013).[2] The rule gave preferential liquidity weights to mortgage-backed securities (MBS) backed by the Government National Mortgage Association (Ginnie Mae or GNMA), relative to those backed by the Government Sponsored Enterprises (GSEs) such as Fannie Mae (FNMA) or Freddie Mac (FHLMC).[3] That is, the liquidity weight for GNMA-backed MBS is

[1] To keep the language simple, we refer to depository institutions as "banks" and non-depository institutions as "nonbanks", although we understand that, strictly speaking, there are lenders, such as credit unions, which are nonbank depository institutions. However, such cases comprise less than 5% of our data.

[2] The rule generally applies to depository institutions with over $250 billion in assets and their subsidiary depository institutions with over $10 billion in assets. A less stringent rule pertains to depository institutions with over $50 billion in assets.

[3] GNMA were considered Level 1 assets with government guarantee while FNMA and FHLMC were considered Level 2 assets.

1, compared to 0.85 for GSE-backed MBS. By law, only loans insured by the U.S. government (FHA, Veterans Affairs, Rural Development and Public and Indian Housing) can be securitized into a GNMA-backed product.

The theory that we test is as follows: 1) mortgage lenders fund their loans either with deposits, or with repo borrowings that are repaid once the loan is securitized and sold as a MBS (Echeverry, Stanton and Wallace 2016). Mortgages lenders which heavily rely on securitization are exposed both to a collateral channel (that is, the ability to borrow in repo markets using the MBS as collateral) and to market liquidity (that is, the ability to sell the MBS quickly in the secondary mortgage market). 2) The LCR rule increased both the collateral properties and the market liquidity of GNMA-backed MBS relative to GSE-backed MBS. These changes decreased the effective origination costs of FHA for lenders which heavily rely on securitization; 3) Lower origination costs subsequently increased originations of FHA loans, raised issuance of GNMA-backed MBS, and led to more relaxed lending standards among FHA loans.

First, we provide evidence that LCR policies increased both the collateral properties and the market liquidity of GNMA-backed MBS relative to GSE-backed MBS. A variety of price measures suggest that LCR policies have increased relative prices in favor of GNMA-backed MBS. For example, we find that the announcement of the LCR policy in October 2013 raised the price of GNMA-backed MBS by one point relative to GSE MBS, that is, a 1.6 and 2.1 increase in the spread relative to the two GSEs.[4] Moreover, the price volatility of GNMA-backed MBS fell much more than for GSE-backed MBS. This suggests higher market liquidity for GNMA-backed MBS.

Second, our main identification strategy exploits cross-sectional differences across lenders in their funding sources. Lenders that rely less on securitization are less affected by market and funding liquidity and should react less to the LCR policy. We measure this exposure in three ways: 1) an indicator of whether the lender is a non-depository institution (nonbanks); 2) the fraction of originations that the lender securitized in 2011; and 3) for banks, one minus the ratio of deposits to assets in 2011.[5]

We show that, after the LCR finalization, borrowers who apply to a nonbank are 2 percentage points less likely to be denied than when applying to a depository institution. This holds conditional on the borrower's quality, and joint lender-MSA effects. It is also economically meaningful, given the average denial rate of 15%. The effects are stronger for black and Hispanic

[4]Over the period prior to the LCR announcement, GNMA MBS already traded at a premium of 1.6 points relative to FNMA, on a par value of 100, and 0.9 points relative to FHLMC.

[5]We only have balance sheet data for depository institutions. Nonbanks are not in the call reports. Moreover, since most of them are private we cannot rely on SEC information.

borrowers, which are variables highly correlated with low credit scores (Bhutta and Ringo 2016), and for borrowers with higher loan-to-income ratios. Moreover, it appears that LCR contributed to the increase in the share of FHA mortgages because it encouraged lenders to substitute from conventional loans to FHA-insured loans.

To confirm that securitization is the key mechanism we show that borrowers applying to a lender which relies heavily on securitization are less likely to be denied in the post-LCR period. Moreover, for banks, a 20 percentage point reduction in the bank's reliance on deposits, about the difference between the 10th and 90th percentiles in our data, reduces a borrower's probability of denial by 4.7 percentage points.

Relating our estimates to nonbanks' market share, we ask how many fewer nonbank originations would have occurred in the absence of the LCR policy. Nonbank market share grew 13 percentage points from 2013 to 2015, but their share would have grown 4 percentage points, or 31% less, in the absence of the LCR policy. That is, nonbanks would have comprised 56% of originations in 2015 as opposed to their actual share of 60%.

This paper complements Buchak et al. (2017). They show that shadow banks were significantly more likely to enter markets where traditional banks faced more regulatory constraints. This suggests that traditional banks retreated from markets with a larger regulatory burden, and that shadow banks filled this gap. This paper proposes an alternative and complementary explanation for the raise in nonbanks. The general equilibrium effects caused by LCR policies have reduced origination costs for lenders more prone to securitize (nonbanks) and attracted them to FHA.

The paper contributes to a growing literature that studies the effects of post-2008 regulations in mortgage markets. For example, Ambrose, Conklin and Yoshida (2016) suggest that regulatory changes that have essentially eliminated low-doc loans would result in credit rationing against self-employed borrowers. Bhutta and Ringo (2016) show that lowering the FHA mortgage insurance premiums in 2015 increased the number of loans to lower credit score and high LTV borrowers. Gete and Reher (2016) show that a credit contraction associated with Dodd-Frank caused higher housing rents. To our knowledge, this is the first paper that studies liquidity regulations as a driver of the composition of mortgage lenders and their lending standards.

The theory that we test is related to Echeverry, Stanton and Wallace (2016). They develop a model of mortgage origination funded by warehouse lines of credit and show that securitization hazards are priced in MBS.

Our focus on LCR policies connects with a growing literature that analyzes the effects of

liquidity in MBS markets on credit supply. For example, Cornett et al. (2011) show that during the financial crisis of 2007–2009 banks that relied more heavily on core deposit and equity capital financing contracted credit less than other banks. Dagher and Kazimov (2015) find that banks that were more reliant on wholesale funding curtailed their credit significantly more than retail-funded banks during the financial crisis. Loutskina (2011) shows that securitization increased banks' ability to lend. Keys et al. (2010) show that securitization caused less screening effort by originators of sub-prime mortgages.

This paper also connects with papers that exploit cross-sectional variation to analyze the effect of the Federal Reserve's large-scale MBS purchases after the financial crisis. For example, Di Maggio, Kermani and Palmer (2016), Chakraborty, Goldstein and MacKinlay (2016), Darmouni and Rodnyanski (2016) and Kurtzman, Luck and Zimmermann (2017) find a positive impact on mortgage lending. Fieldhouse, Mertens and Ravn (2017) use VARs identified with a narrative analysis to uncover a positive effect on mortgage originations from MBS purchases by the GSEs.

The rest of the paper is organized as follows. Section 2 discusses the changes in MBS prices induced by the LCR policies. Section 3 contains our core analysis of the cross-sectional impact of the LCR rule. Section 4 redoes Section 3 at the census tract, as opposed to borrower level. Section 5 concludes. The Appendix explains our data sources, that are publicly available and easy to replicate. We put supplementary results in an Online Appendix.

2 LCR regulation and GNMA Liquidity

In this section, we provide evidence that the LCR policies have increased the prices of GNMA-backed MBS relative to GSE-backed MBS. Higher prices increase the collateral value of the security and thus the originator can borrow more against it in repo markets. We also study standard deviation of prices as indicator of increased market liquidity in secondary mortgage markets.

First, Figure 2 shows that LCR policies motivated financial institutions affected by the rules to dramatically increase their holdings of GNMA-backed MBS.

Insert Figure 2 around here

Second, following Echeverry, Stanton, and Wallace (2016), we focus on the to-be-announced (TBA) market and consider the price of the most-commonly traded bond on a given day

among single-family, 30-year fixed-rate mortgages.[6] Our data source is the Trade Reporting and Compliance Engine (TRACE) from the Financial Industry Regulatory Authority (FINRA). In Figure 3, we plot the price for MBS backed by GNMA, FHLMC and FNMA around the LCR announcement date.

Insert Figure 3 around here

The LCR rule assigned favorable liquidity weights to both GNMA and GSE-backed MBS, but the weights assigned to GNMA securities were superior. To the extent that this policy increased the regulatory benefits of the securities in question, one might expect the price of GNMA and GSE-backed MBS to have increased around the announcement date, and that the price for GNMA securities would have increased by more. Consistent with this prediction, Figure 3 suggests a sharp increase in the price of all agency-backed MBS, but the effect appears stronger for securities backed by GNMA. We verify this behavior using a formal empirical specification below.

We also look at ETFs that invest in MBS. Figure 4 plots iShares GNMA ETF versus iShares MBB ETF, which tracks both GSE-backed MBS (70%) and GNMA-backed MBS (26%). The frequency is weekly.

Insert Figure 4 around here

Figure 4 shows that both ETFs had similar price dynamics until the LCR rule was announced. Since then, the ETF tracking GNMA-backed MBS traded at a premium relative to that which primarily tracks GSE-backed MBS.

To measure market liquidity, that is, how easy is to sell the MBS, we look at price dispersion. When market liquidity increases price dispersion falls. Figure 5 shows this pattern for GNMA, FNMA, and FHLMC mortgage backed securities. GNMA price volatility drops by more after the LCR announcement.

Insert Figure 5 around here

To explore the previous evidence more rigorously, we consider specifications of the form

$$\log(\text{Price}_{s,t}) = \alpha_s + \beta_1(\text{PostLCR}_t \times \text{GNMA}) + \beta_2 \text{PostLCR}_t + \gamma \text{Prepayment controls}_{s,t} + u_{s,t}, \quad (1)$$

$$\log(\frac{\text{Price}_{\text{GNMA},t}}{\text{Price}_{\text{FNMA or FHLMC},t}}) = \alpha_s + \beta \text{PostLCR}_t + \gamma \text{Duration}_{s,t} + u_{s,t}, \quad (2)$$

[6]The TBA market characterizes bonds according to the issuer, maturity, coupon, price, par amount, and settlement date. We consider the most-commonly traded bond in terms of settlement date and coupon. See Vickery and Wright (2013) and Gao, Schultz and Song (2016) for a thorough discussion of the TBA market.

where $s \in \{\text{GNMA}, \text{FNMA}, \text{FHLMC}\}$ denotes the security prices displayed in Figure 3, t denotes the month, PostLCR_t indicates whether month t equals or follows October 2013, GNMA indicates whether it is a GNMA MBS. We control for a security's effective duration, as computed by Standard and Poor's.[7] This variable controls for the possibility that expectations of rising short-term rates differentially altered prepayment risk for GNMA and GSE-backed securities. Given the government guarantee for GNMA and GSE-backed MBS, there is no credit risk premium for these securities over our sample period. Liquidity and prepayment risk are the determinants of MBS spreads (Boyarchenko, Fuster, and Lucca 2015).

We estimate (1) using the 12 months before and after the LCR announcement in October 2013. We also consider a specification which replaces PostLCR_t with month fixed effects to control for any market-wide shocks, and we estimate this alternative specification over the longer window from January 2012 through April 2015. As alternative outcome variables, in (2) we consider the price of GNMA MBS relative to that of the GSE-backed securities. The results are in Table 1.

Insert Table 1 around here

In columns 1 and 2, the coefficient of greatest interest is β_1, corresponding to $\text{PostLCR}_t \times$ GNMA. The estimate is consistently positive, significant, and around 0.007, which implies a relative price increase of 0.7% for GNMA MBS after the LCR announcement compared to GSE MBS. In column 1, we restrict our sample to the 12 months before and after the LCR announcement. Note that the estimated coefficient for PostLCR_t suggests a 1.8% increase in the price of all agency MBS. In column 2, we expand our sample to the window from January 2012 through April 2015, and we again find a similar point estimate for our coefficient of interest.

Columns 3 and 4 of Table 1 study relative prices directly as an outcome variable, that is, specification (2). Now there is one observation per time period, and thus the outcome of interest is the coefficient on PostLCR_t. The estimates suggest a 1.3% increase in the price of GNMA-backed MBS relative to FNMA-backed MBS, and a 0.6% increase relative to FHLMC-backed MBS. Collectively, our results from Table 1 indicate a 0.6% to 1.3% increase in the price of GNMA-backed MBS relative to those backed by GSEs following the LCR announcement. This suggests a liquidity premium for GNMA MBS generated by the LCR policy.

To put the estimates in perspective, the average price of GNMA MBS from January 2012 to the LCR announcement was 105.0, on a par value of 100. Our point estimates of between 0.006 and 0.013 therefore suggest an increase in the price of around 1 point (0.0095×105) relative to GSE MBS. Given that GNMA MBS already traded at a premium of 1.6 points relative to

[7]Specifically, we control for the effective duration of the S&P Mortgage-Backed Securities GNMA (SPMBGNT), FNMA (SPMBFNT), and FHLMC (SPMBFLMT) Indices.

FNMA and 0.9 points relative to FHLMC over the period prior to the LCR announcement, this increase is non-trivial.[8] The results are robust to using time fixed effects to capture market-wide shocks such as the "Taper Tantrum" of May 2013. In the next section, we turn to the real effects of this premium.

3 MBS Liquidity and Credit Supply

3.1 Data

For our core analysis, we merge Home Mortgage Disclosure Act (HMDA) data, which contain information on the borrower and outcome of almost all mortgage applications in the U.S., with bank Call Reports. Table 2 contains summary statistics of our data.

Insert Table 2 around here

We focus on FHA loan applications for the purchase of an owner-occupied, single-family dwelling. Moreover, we focus on lenders which received at least 100 applications in each year, and which have a record in HMDA from 2011 through 2015.[9] This gives a sample of 396 lenders, 123 of which are non-depository institutions. The Data Appendix contains more detail on our data sources and cleaning procedure.

3.2 Denial rates

We consider how increased GNMA liquidity may have impacted credit supply through lenders' incentives to lower denial rates on FHA loans.[10] In theory, one would expect GNMA liquidity to have a greater impact on the behavior of lenders which fund more of their mortgages through securitization. To assess this hypothesis, we estimate the following specification on the sample of FHA loan applications:

$$\text{outcome}_{i,l,t} = \beta \left(M_t^{GNMA} \times F_l \right) + \delta Z_{l,\tau} + \gamma X_{i,t} + \tau_t + \alpha_l + u_{i,l,t}, \tag{3}$$

[8] That is, the average prices for FNMA and FHLMC MBSs from January 2012 to October 2013 were 103.4 and 104.1, respectively.

[9] We start in 2011 to have a balanced sample around the LCR dates. Moreover, we avoid the "structural break" associated with Dodd-Frank in 2010 and discussed in Gete and Reher (2016).

[10] HMDA results on denial rates are consistent with survey evidence from banks on lending standards (Driscoll, Kay and Vojtech 2016).

where i, l, and t denote borrowers, lenders, and years, respectively. Outcome is mortgage denials and originations.

Our focus is on the interaction of M_t^{GNMA}, which is a measure of the collateral and liquidity of GNMA MBS, and F_l, which is a measure of lender l's exposure to securitization. We measure M_t^{GNMA} using an indicator of whether $t \geq 2014$, since the LCR rule was proposed in October 2013 and finalized in September 2014, with few changes to the proposed rule. We also use the ratio of MBS prices studied in Table 1.

We employ three measures of F_l, lender l's exposure to securitization. First, we use an indicator of whether lender l is a non-depository institution. Second, we use the fraction of originations that lender l securitized in 2011. Third, for banks, we use one minus the ratio of deposits to assets in 2011.

The borrower controls in $X_{i,t}$ are log income, the ratio of requested loan to income, and an indicator of whether the borrower is black or Hispanic, which we call $\text{Minority}_{i,t}$. This variable is very correlated with FICO scores (Bhutta and Ringo 2016). The lender controls in $Z_{l,\tau}$ are an MSA-lender fixed effect and, when considering banks, the lagged log of total assets and the lagged ratios of net income to total assets, loss provisions to total assets, total equity to total assets, total deposits to total assets, and liquid assets to total assets, where we define liquid assets as Treasury securities, cash, non interest-bearing balances, and interest-bearing balances at depository institutions.

Table 3 contains the results for mortgage denials when F_l is an indicator of whether lender l is a non-depository institution. Table 4 redoes the exercise when F_l is the fraction of originations that lender l securitized in 2011.

Insert Tables 3 and 4 around here

Lenders with less reliance on funding from securitization responded to the increase in GNMA MBS market liquidity by denying fewer loans. To interpret the coefficient in the first column of Table 3, after the LCR finalization, borrowers who apply to a non-depository institution are 2 percentage points less likely to be denied than when applying to a depository institution. This holds conditional on the borrower's quality, and joint lender-MSA effects. It is also economically meaningful, given the average denial rate of 15%. The results are robust across measures of M_t^{GNMA}.

Table 4 suggests that borrowers applying to a lender which relies heavily on securitization are less likely to be denied in the post-LCR period.

Finally, Table 5 shows that looking at originations instead of mortgage denials gives a similar result. Lenders that are more sensitive to secondary mortgage markets originate more applications when the GNMA premium rises.

Insert Table 5 around here

3.3 Substitution between FHA and Conventional Loans

One might suppose that lenders respond to increased GNMA liquidity by substituting away from conventional loans towards FHA loans. Table 6 considers this possibility by replicating our baseline analysis on the sample of non-jumbo, non-FHA loans. Our results suggest that lenders with less funding liquidity denied more conventional loans in the post-LCR period. Thus, it appears that the LCR-induced liquidity encouraged lenders to substitute from conventional loans to FHA-insured loans.

Insert Table 6 around here

3.4 Risk taking

Next, we ask whether the post-LCR shift in origination behavior differed by borrower. In Tables 7 and 8 we interact our measures of lender l's exposure to securitization with, respectively, an indicator of whether the applicant is black or Hispanic, the borrower's requested loan-to-income ratio, and the requested loan-to-value, which we estimate using the average house price in the borrower's MSA based on the Zillow Home Value Index. Our results suggest that the effects above were stronger for minority borrowers, with negative and significant coefficients on all interaction terms in Table 7. In Table 8, we find a similar shift towards more highly levered borrowers, relative to income, in all specifications except when using the deposit ratio to measure sensitivity to securitization.

Insert Tables 7 and 8 around here

4 Aggregate effects

While the granularity of our data in Section 3 allows us to control for a rich set of factors at the borrower level, it is difficult to map the estimates into an aggregate effect because our data are at the application level. In this section, we aggregate our data to the level of the

census tract, which is the most granular unit of geography we can identify.[11] We then estimate

$$\Delta \log \left(\text{Originations}_{k,t}\right) = \beta \left(M_t^{GNMA} \times F_{k,t}\right) + \gamma X_{k,t} + \alpha_k + \tau_t + u_{k,t}, \tag{4}$$

where k indexes census tracts and t indexes years. $\text{Originations}_{k,t}$ denotes the number of originated loans in census tract k and year t. We measure M_t^{GNMA} using an indicator of whether $t \geq 2014$ as in Section (3) . $F_{k,t}$ is the average of lenders' exposure to securitization, F_l, weighted by applications from census tract k in year t. Again we use three proxies: 1) the fraction of applications to non-depository institutions from census tract k in year t (denoted as $\text{NDI}_{k,t}$); 2) the fraction of originated loans that a lender subsequently securitized and sold in 2011, weighted by the lender's application share in tract k and year t (denoted as Sec Rate $2011_{k,t}$); 3) One minus the weighted average of bank's ratio of total deposits to total assets, weighted by the bank's application share in tract k and year t (this is denoted 1−Deposit $\text{Ratio}_{2011,k,t}$). Our controls in $X_{k,t}$ include the change in the share of minority applicants in the tract, the average of borrowers' requested loan-to-income ratio, and the log of average borrower income. We also control for the change in the log of the MSA's median income and house price level, based on the Zillow Home Value Index. When F_l is measured using one minus a bank's deposit-to-asset ratio, we also include the application-weighted lenders' controls used in $Z_{l,t}$ when estimating (3) above.

Insert Table 9 around here

Our results in Table 9 are consistent with the borrower-level results from Section 3. To interpret, the estimates for β suggest that LCR policies induced 28 percentage higher loan origination growth in census tracts in which nonbanks are the only lenders relative to tracts where there are no nonbanks; 21 percentage points higher in tracts where all lenders finance originations through securitization relative to tracts where no lenders do so; and 57 percentage points higher where banks do not have any deposit funding relative to where banks are fully funded by deposits. That is, census tracts dominated by lenders with little funding liquidity saw greater credit growth following the LCR policy.

Relating our estimates to nonbanks' market share, we ask how many fewer nonbank originations would have occurred in the absence of the LCR policy. Taking nonbanks' average application share of around 50% and the estimates for β in the first row of Table 9, nonbank originations would have grown 28 percentage points less from 2013-2015, corresponding to 24,143 fewer loans. In terms of market share, nonbanks would have comprised 56% of originations in 2015 as opposed to their actual share of 60%. Put differently, nonbank market share

[11] Census tracts generally have a population between 1,200 and 8,000 with a target size of 4,000.

grew 13 percentage points from 2013 to 2015, but their share would have grown 4 percentage points, or 31% less, in the absence of the LCR policy.

5 Conclusions

The business model of lenders whose funding relies on securitization consists on: 1) borrowing in repo markets to fund the loans to the homebuyers, these loans to be securitized serve as collateral; 2) securitizing the loans and selling the MBS to repay the repo borrowings. In this paper we have shown that LCR policies have created demand for GNMA-backed MBS and increased their price and liquidity in secondary markets. This lowers the costs of lenders whose funding relies on securitization because higher MBS prices increase the collateral value of the security and because it takes less time to sell it.

We show that LCR policies have attracted lenders whose funding relies more on securitization (mostly nonbanks) towards FHA loan originations, which are most of the loans securitized in GNMA-backed MBS. Lending standards have loosened among FHA loans and risk-taking (as proxied by loans to minorities and by loan-to-income) have increased. We show a crowding-out effect that has led to tightened standards among conventional loans, which are eligible for GSE-backed securitization.

Our paper shows that liquidity regulations can have important effects on credit risk by altering the structure of the dominant lenders in the market and their incentives to originate and securitize. Thus, regulations to enhance financial stability and reduce runs in MBS may have increased the exposure of U.S. taxpayers to credit risk.

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Figures

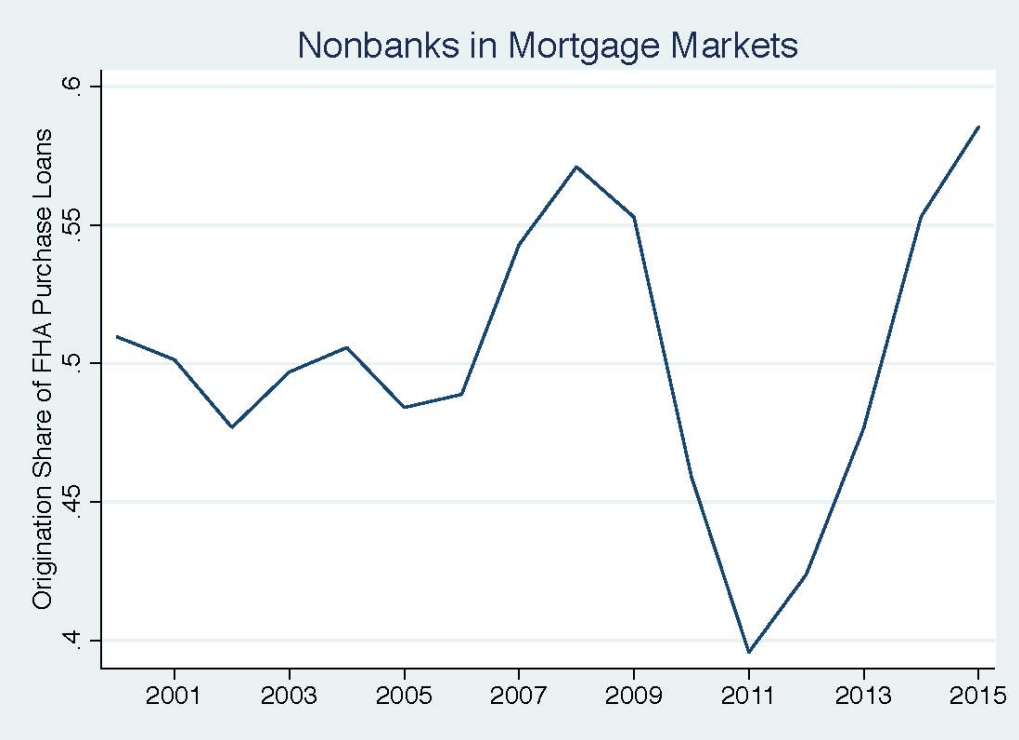


Figure 1. Market share of non-depositary institutions among FHA loans for home purchases. The figure shows the percentage of FHA mortgage loans originated by non-depository institutions for home purchases. Source: HMDA.

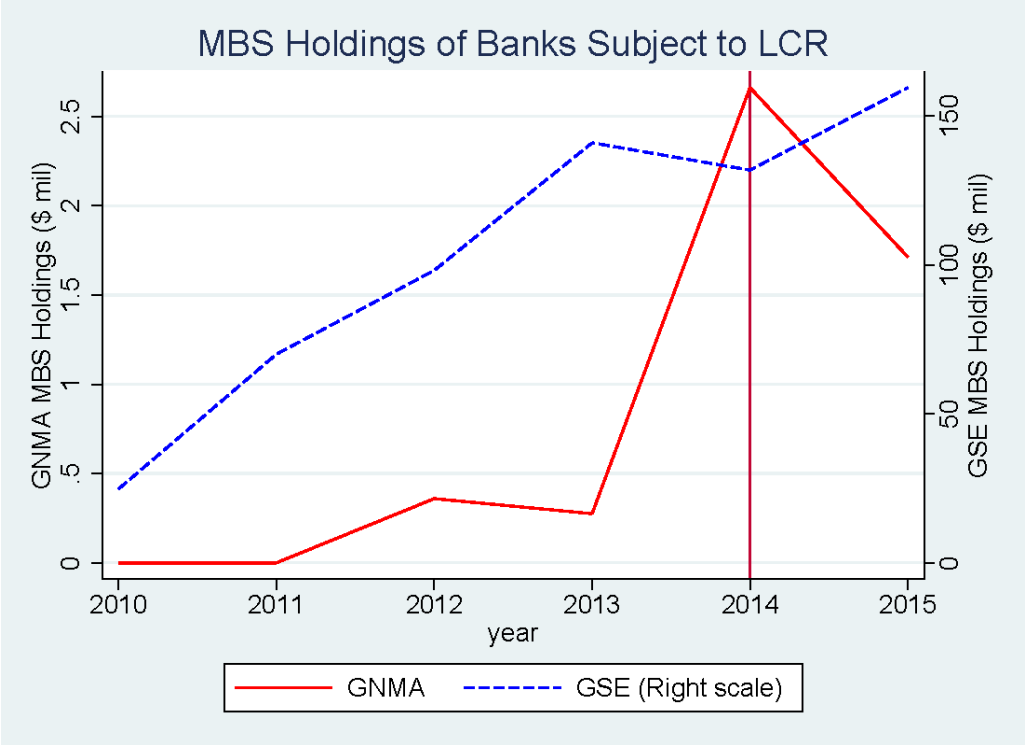


Figure 2. MBS Holdings of Institutions Affected by Liquidity Regulation. This figure plots the holdings of GNMA backed MBS (solid line) and of FNMA and FHLMC backed MBS by financial institutions subject to the LCR policy. Source: Call Reports (FR Y-9C)

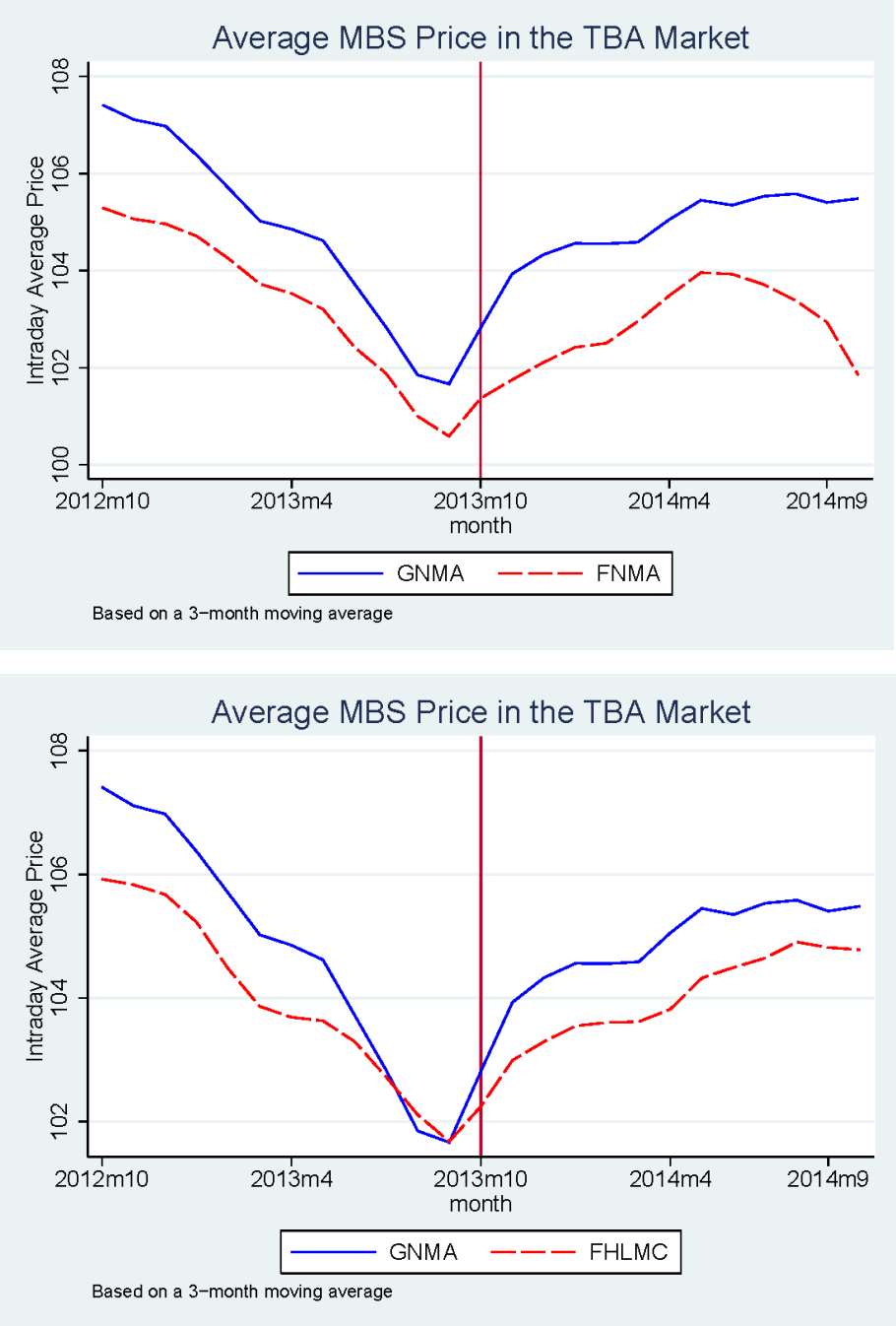


Figure 3. Prices of GNMA, FNMA and FHLMC Mortgage Backed Securities. The price corresponds to the monthly average of the most-commonly traded bond on a given day. The vertical line corresponds to October 24th, 2013, when the LCR rules were proposed. Source: Trade Reporting and Compliance Engine (TRACE).

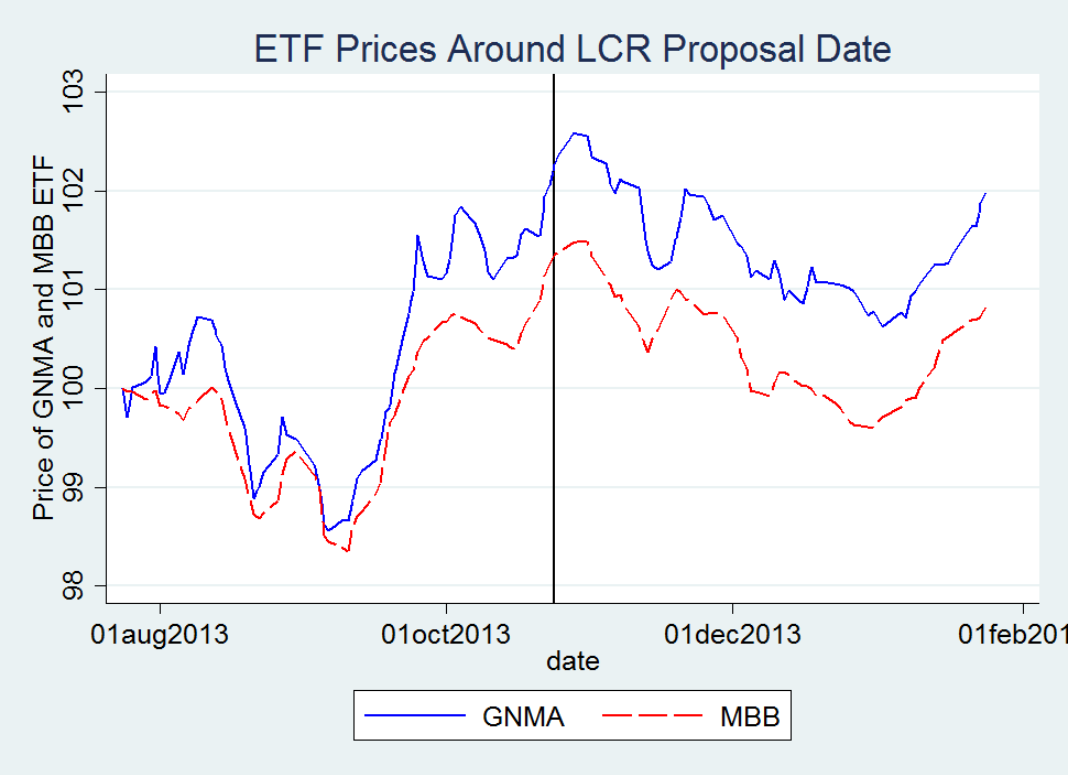
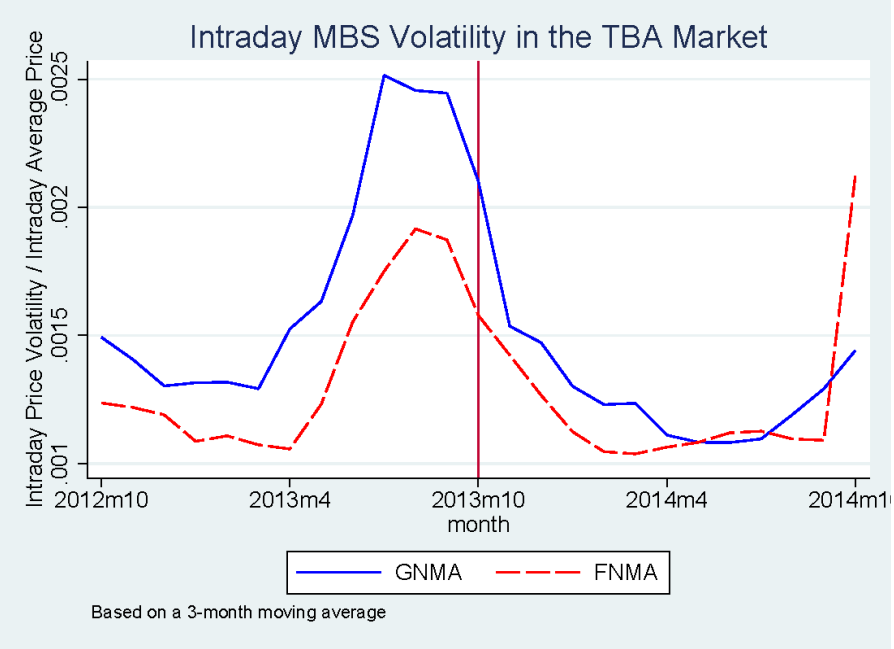


Figure 4. ETF Price Index of GNMA and GSE Mortgage Backed Securities. The figure plots the price of an ETF that invests in GNMA MBS and of another ETF that invests in MBS guaranteed by all the U.S. government agencies (weights are FNMA 44%, FHLMC 27%, GNMA 28%). The prices are normalized to 100 on July 24th, 2013. The vertical line corresponds to October 24th, 2013, when the LCR rules were proposed. Source: Yahoo Finance.



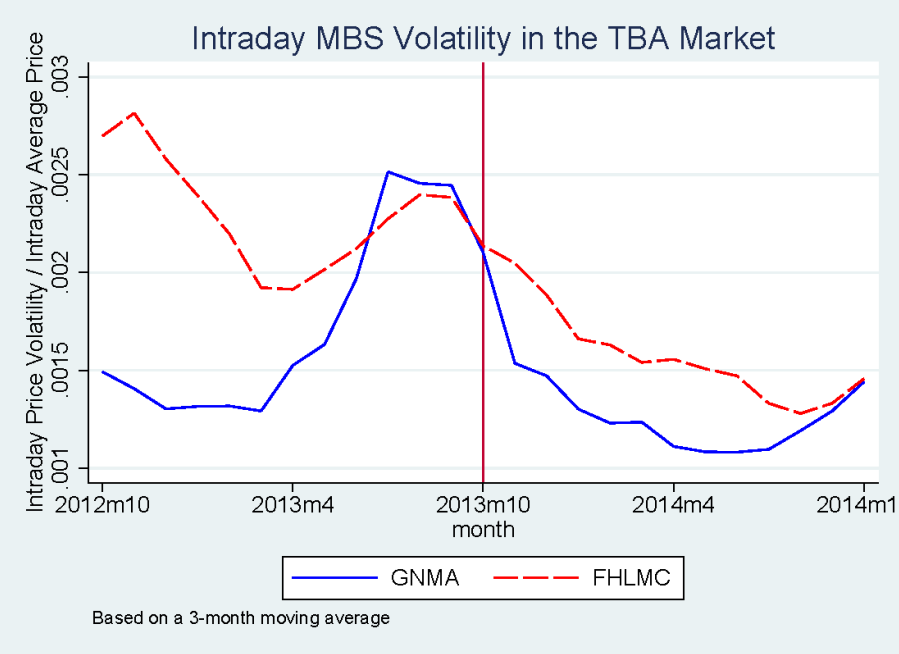


Figure 5. Ratio of Intraday Standard Deviation to Price for GNMA, FNMA and FHLMC Mortgage Backed Securities. The price corresponds to the most-commonly traded bond on a given day. The vertical line corresponds to October 24th, 2013, when the LCR rules were proposed. Source: FINRA's TRACE database.

Tables

Table 1: Liquidity Premium and the LCR Announcement

Outcome:	$\log(P_{s,t})$	$\log(P_{s,t})$	$\log(\frac{P_{GN,t}}{P_{FN,t}})$	$\log(\frac{P_{GN,t}}{P_{FH,t}})$
$PostLCR_t$	0.018		0.013	0.006
	(0.000)		(0.000)	(0.001)
$PostLCR_t \times GNMA_s$	0.007	0.007		
	(0.031)	(0.003)		
Agency FE	Yes	Yes	No	No
Month FE	No	Yes	No	No
Sample	Oct 12 - Oct 14	Jan 12 - Apr 15	Oct 12 - Oct 14	Oct 12 - Oct 14
Prepayment Controls	Yes	Yes	Yes	Yes
R-squared	0.717	0.896	0.556	0.281
Number of Observations	75	120	25	25

Note: Subscript s denotes whether the MBS corresponds to GNMA, FNMA, or FHLMC, and t denotes the month. P-values are in parentheses. $P_{s,t}$ denotes the price of the monthly average of the most commonly traded bond on the TBA market. $PostLCR_t$ denotes whether the month is or follows October 2013, when the LCR rules were proposed. $GNMA_s$ denotes whether the security is backed by GNMA. In columns 1 and 2, our sample includes GNMA, FNMA, and FHLMC securities. Columns 3 and 4 consider relative prices as the outcome. Column 2 is based on a longer sample and so includes month fixed effects instead of the $PostLCR_t$ indicator. The prepayment controls are the duration of security s, as computed by Standard & Poor's for its corresponding MBS index using a model to estimate prepayment risk; columns 3 and 4 also control for the duration of FNMA and FHLMC MBS. Standard errors are HAC robust up to 9 lags.

Table 2: Summary Statistics

Variable	Number of Observations	Mean	Standard Deviation
HMDA Variables:			
Denied	2,255,447	0.154	0.361
Minority	2,255,447	0.293	0.455
Loan-to-income	2,255,447	2.963	2.082
Depository Institution	2,255,447	0.574	0.494
Securitization Rate	1,567,648	0.91	0.129
GNMA Securitization Rate	1,567,648	0.46	0.396
Call Report Variables:			
Total Deposit Ratio	1,150,589	0.727	0.074
Liquid Asset Ratio	698,493	0.096	0.062
Equity Ratio	1,150,589	0.114	0.018
Loan Provision Ratio	1,150,589	0.006	0.005
Net Income Ratio	1,150,589	0.01	0.006
Rebooked GNMA Ratio	389,078	0.039	0.02
log(Assets)	1,150,589	19.021	2.746

Note: This table contains summary statistics of the variables used in our regressions. Each observation corresponds to an FHA loan application for the purchased of an owner-occupied single-family dwelling over the 2010-2015 period. Means and standard deviations are weighted by application share. Denied indicates whether the application was denied. Minority indicates whether the applicant is black or Hispanic. Loan-to-income is the ratio of the applicant's requested loan to her reported annual income. Depository institution indicates whether the lender is a depository institution. Securitization rate is the fraction of originations that the lender sold in a given year, and GNMA Securitization Rate is the fraction of originations that the lender sold as a GNMA-insured security in a given year. Total Deposit Ratio, Equity Ratio, Loan Provision Ratio, Net Income Ratio, and Rebooked GNMA ratios are, respectively, the ratios of total deposits, total equity, loan loss provisions, net income, and rebooked GNMA securities to total assets. Liquid Asset Ratio is the ratio of Treasury securities, interest and non-interest bearing balances, and cash to total assets.

Table 3: FHA Denials and Nonbanks.

	$\text{Denied}_{i,l,t}$		
$M_t^{GNMA}=$	PostLCR_t	$\log\left(\frac{P_t^{GNMA}}{P_t^{FNMA}}\right)$	$\log\left(\frac{P_t^{GNMA}}{P_t^{FHLMC}}\right)$
$M_t^{GNMA}\times\text{NDI}_l$	-0.020	-2.148	-1.757
	(0.000)	(0.000)	(0.000)
Borrower Controls	Yes	Yes	Yes
Lender-MSA FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R-Squared	0.093	0.094	0.094
Number of Observations	2,255,447	2,255,447	2,255,447

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. Denied denotes whether the loan application was denied. PostLCR denotes whether $t \geq 2014$. NDI indicates whether the lender is a non-depository institution. Borrower controls are requested loan-to-income ratio, log income, and an indicator of whether the borrower is black or Hispanic. The sample includes all applications for FHA loans for the purchase of an owner-occupied single-family dwelling from 2010 through 2015. Standard errors are clustered by lender-MSA bins.

Table 4: FHA Denials and Securitization Rate

	$\text{Denied}_{i,l,t}$		
$M_t^{GNMA} =$	PostLCR_t	$\log\left(\frac{P_t^{GNMA}}{P_t^{FNMA}}\right)$	$\log\left(\frac{P_t^{GNMA}}{P_t^{FHLMC}}\right)$
$M_t^{GNMA} \times \text{Securitization Rate}_{l,2011}$	-0.037	-4.211	-3.310
	(0.027)	(0.000)	(0.000)
Borrower Controls	Yes	Yes	Yes
Lender-MSA FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R-Squared	0.093	0.093	0.093
Number of Observations	2,255,447	2,255,447	2,255,447

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. Denied denotes whether the loan application was denied. Securitization Rate denotes the fraction of originated loans that a lender subsequently securitized and sold in 2011. Borrower controls are requested loan-to-income ratio, log income, and an indicator of whether the borrower is black or Hispanic. The sample includes all applications for FHA loans for the purchase of an owner-occupied single-family dwelling from 2010 through 2015. Standard errors are clustered by lender-MSA bins.

Table 5: FHA Originations and MBS Liquidity

	$\text{Originations}_{i,l,t}$		
$\text{PostLCR}_t \times$ NDI_l	0.034		
	(0.000)		
$\text{PostLCR}_t \times \text{Securitization Rate}_{l,2011}$		0.045	
		(0.000)	
$\text{PostLCR}_t \times (\text{1-Deposit Ratio}_{l,2011})$			0.045
			(0.184)
Sample	All	All	Banks
Borrower Controls	Yes	Yes	Yes
Bank Controls	No	No	Yes
Lender-MSA FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R-Squared	0.071	0.071	0.063
Number of Observations	2,255,447	2,255,447	465,404

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. Denied denotes whether the loan application was denied. PostLCR denotes whether $t \geq 2014$. NDI indicates whether the lender is a non-depository institution. Securitization rate denotes the fraction of originated loans that a lender subsequently securitized and sold in 2011. Deposit Ratio denotes the ratio of total deposits to total assets. Borrower controls are requested loan-to-income ratio, log income, and an indicator of whether the borrower is black or Hispanic. Bank controls are the lagged log of total assets and the lagged ratios of: net income to total assets, loss provisions to total assets, total equity to total assets, total deposits to total assets, and liquid assets to total assets. Liquid assets are defined as Treasury securities, cash, non interest-bearing balances, and interest-bearing balances at depository institutions. The sample includes all applications for FHA loans for the purchase of an owner-occupied single-family dwelling from 2010 through 2015. Standard errors are clustered by lender-MSA bins.

Table 6: Conventional Loan Denials and MBS liquidity.

Outcome:	$\text{Denied}_{i,l,t}$	$\text{Denied}_{i,l,t}$	$\text{Denied}_{i,l,t}$
$\text{PostLCR}_t \times \text{NDI}_l$	0.019		
	(0.000)		
$\text{PostLCR}_t \times \text{Securitization Rate}_{l,2011}$		0.026	
		(0.000)	
$\text{PostLCR}_t \times (1 - \text{Deposit Ratio}_{l,2011})$			-0.084
			(0.004)
Sample	All	All	Banks
Borrower Controls	Yes	Yes	Yes
Bank Controls	No	No	Yes
Lender-MSA FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R-squared	0.085	0.085	0.067
Number of Observations	4,538,495	4,538,495	1,492,922

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. Denied denotes whether the loan application was denied. PostLCR denotes whether $t \geq 2014$. NDI indicates whether the lender is a non-depository institution. Securitization Rate denotes the fraction of originated loans that a lender subsequently securitized and sold in a given year. Deposit Ratio denotes the ratio of total deposits to total assets. Borrower controls are requested loan-to-income ratio, log income, and an indicator of whether the borrower is black or Hispanic. Bank controls are the lagged log of total assets and the lagged ratios of: net income to total assets, loss provisions to total assets, total equity to total assets, total deposits to total assets, and liquid assets to total assets. Liquid assets are defined as Treasury securities, cash, non interest-bearing balances, and interest-bearing balances at depository institutions. The sample includes all applications for non-jumbo conventional loans for the purchase of an owner-occupied single-family dwelling from 2010 through 2015. Standard errors are clustered by lender-MSA bins.

Table 7: FHA Denials and MBS liquidity. Minority Borrowers.

Outcome:	$\text{Denied}_{i,l,t}$	$\text{Denied}_{i,l,t}$	$\text{Denied}_{i,l,t}$
$\text{PostLCR}_t \times \text{NDI}_l$	-0.015		
	(0.000)		
$\text{PostLCR}_t \times \text{NDI}_l \times \text{Minority}_i$	-0.015		
	(0.000)		
$\text{PostLCR}_t \times \text{Securitization Rate}_{l,2011}$		-0.035	
		(0.036)	
$\text{PostLCR}_t \times \text{Securitization Rate}_{l,2011} \times \text{Minority}_i$		-0.012	
		(0.000)	
$\text{PostLCR}_t \times (1 - \text{Deposit Ratio}_{l,2011})$			-0.221
			(0.000)
$\text{PostLCR}_t \times (1 - \text{Deposit Ratio}_{l,2011}) \times \text{Minority}_i$			-0.041
			(0.002)
Sample	All	All	Banks
Borrower Controls	Yes	Yes	Yes
Bank Controls	No	No	Yes
Lender-MSA FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R-squared	0.094	0.093	0.074
Number of Observations	2,255,447	2,255,447	465,404

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. Denied denotes whether the loan application was denied. PostLCR denotes whether $t \geq 2014$. NDI indicates whether the lender is a non-depository institution. Securitization Rate denotes the fraction of originated loans that a lender subsequently securitized and sold in a given year. Deposit Ratio denotes the ratio of total deposits to total assets. Minority indicates whether the borrower is black or Hispanic. Borrower controls are requested loan-to-income ratio, log income, and an indicator of whether the borrower is black or Hispanic. Bank controls are the lagged log of total assets and the lagged ratios of: net income to total assets, loss provisions to total assets, total equity to total assets, total deposits to total assets, and liquid assets to total assets. Liquid assets are defined as Treasury securities, cash, non interest-bearing balances, and interest-bearing balances at depository institutions. The sample includes all applications for FHA loans for the purchase of an owner-occupied single-family dwelling from 2010 through 2015. Standard errors are clustered by lender-MSA bins.

Table 8: FHA Denials and MBS liquidity. Borrowers' Loan-to-Income.

Outcome:	$\text{Denied}_{i,l,t}$	$\text{Denied}_{i,l,t}$	$\text{Denied}_{i,l,t}$
$\text{PostLCR}_t \times \text{NDI}_l$	-0.009		
	(0.036)		
$\text{PostLCR}_t \times \text{NDI}_l \times \text{LTI}_i$	-0.003		
	(0.004)		
$\text{PostLCR}_t \times \text{Securitization Rate}_{l,2011}$		-0.023	
		(0.172)	
$\text{PostLCR}_t \times \text{Securitization Rate}_{l,2011} \times \text{LTI}_i$		-0.004	
		(0.001)	
$\text{PostLCR}_t \times (1 - \text{Deposit Ratio}_{l,2011})$			-0.216
			(0.000)
$\text{PostLCR}_t \times (1 - \text{Deposit Ratio}_{l,2011}) \times \text{LTI}_i$			-0.006
			(0.354)
Sample	All	All	Banks
Borrower Controls	Yes	Yes	Yes
Bank Controls	No	No	Yes
Lender-MSA FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R-squared	0.094	0.094	0.074
Number of Observations	2,255,447	2,255,447	465,404

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. Denied denotes whether the loan application was denied. PostLCR denotes whether $t \geq 2014$. NDI indicates whether the lender is a non-depository institution. Securitization Rate denotes the fraction of originated loans that a lender subsequently securitized and sold in a given year. Deposit Ratio denotes the ratio of total deposits to total assets. LTI denotes the borrower's requested loan-to-income ratio. Borrower controls are requested loan-to-income ratio, log income, and an indicator of whether the borrower is black or Hispanic. Bank controls are the lagged log of total assets and the lagged ratios of: net income to total assets, loss provisions to total assets, total equity to total assets, total deposits to total assets, and liquid assets to total assets. Liquid assets are defined as Treasury securities, cash, non interest-bearing balances, and interest-bearing balances at depository institutions. The sample includes all applications for FHA loans for the purchase of an owner-occupied single-family dwelling from 2010 through 2015. Standard errors are clustered by lender-MSA bins.

Table 9: FHA originations and MBS liquidity at census tract level.

Outcome:	$\Delta \log\left(\text{Orig}_{k,t}\right)$	$\Delta \log\left(\text{Orig}_{k,t}\right)$	$\Delta \log\left(\text{Orig}_{k,t}\right)$
$\text{PostLCR}_t \times$ $\text{NDI}_{k,t}$	0.279		
	(0.000)		
$\text{PostLCR}_t \times$ $\text{Securitization Rate}_{2011,k,t}$		0.206	
		(0.000)	
$\text{PostLCR}_t \times$ $(1 - \text{Deposit Ratio}_{2011,k,t})$			0.567
			(0.000)
Sample	All	All	Banks
Tract Controls	Yes	Yes	Yes
Bank Controls	No	No	Yes
Tract FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R-squared	0.098	0.098	0.162
Number of Observations	124,728	124,728	83,169

Note: Subscripts k and t denote census tract and year, respectively. P-values are in parentheses. PostLCR denotes whether $t \geq 2014$. $\text{Orig}_{k,t}$ denotes the number of originated loans in census tract k and year t. $\text{NDI}_{k,t}$ denotes the fraction of applications to non-depository institutions from census tract k in year t. Securitization $\text{Rate}_{2011,k,t}$ denotes the fraction of originated loans that a lender subsequently securitized and sold in 2011, weighted by the lender's application share in tract k and year t. Similarly, Dep $\text{Ratio}_{2011,k,t}$ denotes a bank's ratio of total deposits to total assets, weighted by the bank's application share in tract k and year t. Tract controls are the change in: the fraction of applicants which are minorities, the log of average borrower income, the log of average requested loan-to-income ratio, the log of the MSA's median income, and the log of the MSA's median house price. Bank controls are the application-weighted lagged log of total assets and the lagged ratios of: net income to total assets, loss provisions to total assets, total equity to total assets, total deposits to total assets, and liquid assets to total assets. Liquid assets are defined as Treasury securities, cash, non interest-bearing balances, and interest-bearing balances at depository institutions. The sample includes all originated FHA loans for the purchase of an owner-occupied single-family dwelling from 2010 through 2015. Standard errors are clustered by census tract.