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

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Abstract

We show that the 2014 U.S. liquidity coverage ratio (LCR), which gave the maximum liquidity weights to mortgage-backed securities backed by Ginnie Mae (GNMA), has led to a higher FHA market share for nonbanks. The mechanism is a general equilibrium effect: the LCR policy created a premium for GNMA-backed MBS relative to GSE-backed MBS. This premium attracted nonbanks and originate-to-sell lenders towards GNMA MBS. It also led to increased supply of credit for risky borrowers. LCR explains 26% of nonbanks rise from 2013-2015.

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

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1 Introduction

There is a growing consensus that non-depository institutions ("nonbanks" for short) played an important role in the last financial crisis.[1] For example, Demyanyk and Loutskina (2016) and Huszar and Yu (2017) show that their activities contributed to a deterioration of lending standards in mortgage markets. Most of the nonbanks active pre-financial crisis, unable to access the lending of last resort facilities of the Fed, either defaulted or were restructured post-2008.

Nonbanks currently play a larger role in U.S. mortgage markets than before the crisis, as we document in Section 2. For example, they originate around 80% of FHA-insured loans and more than 50% of all mortgage loans. This fact worries some economists and policymakers (Pinto and Oliner 2015, Wallace 2016, Wall Street Journal 2017). Moreover, given that nonbanks usually hold little capital, in the next recession the FHA will likely be unable to recover from nonbanks any losses on the loans that they are originating.[2]

The previous facts motivate several important questions: why are nonbanks gaining market share in U.S. mortgage markets? Why especially among FHA loans? What are the consequences in terms of lending standards or risk taking? Buchak et al. (2017) show that shadow banks are significantly more likely to enter markets where traditional banks faced more regulatory constraints. In this paper, we propose an alternative and complementary explanation for the raise in nonbanks. The general equilibrium effects triggered by the U.S. Liquidity Coverage Ratio (LCR) requirements can account for around 26% of the growth in nonbanks in FHA from 2013 to 2015. Moreover, this policy induced higher risk taking in the form of high loan-to-income loans and lower denial rates for minorities (this variable is very correlated with lower FICO scores, Bhutta and Ringo 2016).

The Liquidity Coverage Ratio is likely the most important policy response to the runs that destabilized the financial system during the 2008 financial crisis (Diamond and Kashyap 2016 discuss the rationale for the LCR). 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). The rule gave preferential liquidity weights to mortgage-backed securities backed by Ginnie Mae (GNMA), relative to those backed by Fannie Mae (FNMA) or Freddie Mac (FHLMC).[3] That is, the liquidity weight for GNMA-backed MBS

[1] To keep the language simple, we refer to depository institutions as "banks" and non-depository institutions as "nonbanks", although, 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] FHA mortgagors usually have higher default rates over the business cycle (Frame, Gerardi and Tracy 2016).

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

is 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 LCR requirements were announced in October 2013 and finalized in September 2014.

The theory that we test is as follows: 1) The LCR rule has increased demand from the institutions affected by the rule (and from other institutions potentially affected) for GNMA-MBS. This caused higher prices and market liquidity; 2) Higher prices have increased the collateral properties of MBS. That is, it is cheaper to borrow in repo markets (or from a warehouse line of credit) using the MBS as collateral because this collateral is more valuable; 3) Some mortgage lenders are more exposed to MBS than others. For example, nonbanks, which cannot fund their loans with deposits, rely on repo borrowings and warehouse lines of credit that are repaid once the loan is securitized and sold as a MBS (Echeverry, Stanton and Wallace 2016). For these lenders, the effective origination costs depend on how cheap is to obtain repo-funding against the MBS and how easy is to sell the MBS in the secondary market. Thus, for lenders which heavily rely on securitization, LCR rules have decreased origination costs; 3) Lower origination costs subsequently attracted lenders more prone to securitize (nonbanks) to FHA, raised issuance of GNMA-backed MBS, and led to more relaxed lending standards among FHA loans.

First, we provide evidence that LCR policies increased GNMA-MBS prices relative to GSE-backed MBS. A variety of price measures, including option-adjusted spread (OAS), suggest that LCR policies have increased relative prices in favor of GNMA-backed MBS.[4] For example, we find that the announcement of the LCR policy in October 2013 raised the OAS-based premium by 10% relative to the GSEs.

Second, our main identification strategy exploits pre-LCR cross-sectional differences across lenders in their funding sources. Nonbanks are more exposed than banks to securitization because they do not collect deposits. A parallel trends analysis and multiple placebo tests provide support for our identification. 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.

Using data sources that are publicly available and easy to replicate, we show that, after the LCR finalization, borrowers who apply to a nonbank are less likely to be denied than

Level 2 assets.

[4]The OAS is equal to a weighted average of future expected returns after hedging for interest rate risk. A positive OAS compensates investors for additional sources of risk like shifts in prepayments that are not driven by interest rates alone, and factors such as liquidity (Boyarchenko, Fuster, and Lucca 2015).

when applying to a depository institution. This holds conditional on the borrower's quality, and multiple fixed effects. The effects are stronger for black and Hispanic borrowers, which are variables highly correlated with low credit scores, 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.

In terms of market share, nonbanks would have comprised 74.5% of FHA originations in 2015 as opposed to their actual share of 77.1%. Put differently, nonbank market share grew 9.9 percentage points from 2013 to 2015, but their share would have grown 2.6 percentage points less, or 26% less, in the absence of the LCR policy.

Thus, our paper shows that regulations to prevent runs in secondary mortgage markets seem to have increased the credit risk borne by U.S. taxpayers. LCR policy has caused general equilibrium effects in MBS markets that contributed to the expansion of nonbanks in FHA and to more relaxed lending standards among FHA-insured loans.

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 paper contributes to a growing literature that studies the effects of post-2008 regulations in mortgage markets. For example, Buchak et al. (2017) discussed above. 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. Di Maggio, Kermani, and Korgaonkar (2015) show that relaxed state regulations for OCC regulated banks are associated with lower lending standards for both OCC and non-OCC regulated banks. Fuster, Lo and Willen (2017) find evidence of higher regulatory costs and risks over 2008-2014. Gete and Reher (2017) show that a credit contraction associated with Dodd-Frank caused higher housing rents.

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. We also confirm Bech and Keister (2015) and Keister (2017) prediction that LCR will create regulatory premiums. Keister (2017) studies interbank loans with maturity above 30-days that improve the LCR positon of the borrowing bank and the implications for the monetary transmission mechanism.

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) uncover a positive effect on mortgage originations from MBS purchases by the GSEs.

The rest of the paper is organized as follows. Section 2 documents recent dynamics of nonbanks in mortgage markets. Section 3 discusses the changes in MBS prices induced by the LCR policies. Section 4 contains our core analysis of the cross-sectional impact of the LCR rule. We check the robustness of the results in Section 5. Section 6 contains an aggregate analysis. Section 7 concludes. The online appendix has supplementary results.

2 Nonbanks in Mortgage Markets

Since all depository institutions are subject to a federal supervisor, we use the HMDA codes and identify nonbanks as lenders without a federal supervisor (that is, lenders not under the regulatory oversight of OCC, FRS, FDIC, NCUA, or OTS). Demyanyk and Loutskina (2016) and Huszar and Yu (2017) follow the same criteria. We cross-checked that our sample, which covers all originators, is consistent with Buchak et al. (2017), which manually define nonbanks as non-depository institution and focus on the largest lenders (50% of total originations). Table A1 in the online appendix provides a list of the top 50 nonbanks in our data based on their FHA originations in 2013 and 2014.

Figure 1 shows that nonbanks' for-purchase mortgage origination share has increased dramatically since the financial crisis. In the top panel, we see that nonbanks historically comprised around 50% of the FHA market. Their share grew during the crisis, fell around 2010, and has seen sustained rapid growth since then. The bottom panel shows how nonbanks historically held a smaller share of the overall mortgage market, although their share grew markedly during the boom period. Since the crisis their share has grown and now they comprise over half of all

for-purchase mortgage originations.

Consistent with the theory that we test below, Figure 2 documents that FHA loans saw an increase in securitization around the date when the LCR rules were proposed (October 24th, 2013), an effect not seen among either conventional or jumbo loans.

To support the rest of the paper, Online Appendix Figure A5 contains a parallel trend analysis. It shows that pre-LCR the denial rates followed similar trends for banks and nonbanks. However, after the LCR policy the denial rates decreased faster for nonbanks.

3 Theory and General Equilibrium Effects

Our story is a general equilibrium one, that is, it operates indirectly. First, Online Appendix Figure A1 shows the direct effect of LCR, that is, it plots the portfolio holdings of banks affected by the LCR rule. Affected banks substantially increased the amount of GNMA MBS on their balance sheets.

Second, we document the changes in MBS prices that are the key for general equilibrium. Our analysis relies on multiple data sources, including the option-adjusted spread computed by Bloomberg and S&P, ETFs that target exposure to GNMA and GSE MBS, and security-level prices in the TBA market from FINRA's TRACE database. We use these various data sources to provide visual evidence that the behavior of GNMA and GSE MBS changed around the LCR proposal date in October 2014, and, in particular, led to a higher premium for GNMA MBS.

We first consider the option-adjusted spread (OAS) of GNMA and GSE MBS, based on Bloomberg's GNMA, FNMA, and FHLMC MBS indices.[5] The OAS is the spread between the yield to maturity on a bond and the risk-free rate after accounting for the probability of prepayment and default.[6] Thus, the OAS strips out any hedgeable prepayment or default risk.[7] In the top panel of Figure 3, we see that the LCR proposal saw a fall in the OAS of both GNMA and GSE MBS, consistent with the preferable regulatory status given to both securities.

The bottom panel shows how the LCR announcement came with a greater relative fall in GNMA's OAS compared to the GSEs. This is consistent with the higher liquidity weight the LCR proposal gave to GNMA MBS (weight = 1) over GSE MBS (weight = 0.85). Since the

[5] We define the GSE OAS the average of the OAS on the FNMA and FHLMC indices.

[6] Boyarchenko, Fuster, and Lucca (2015), Gabaix, Krishnamurthy and Vigneron (2007) and Diep, Eisfeldt and Richardson (2017) show that the risk of homeowner prepayment is priced in the MBS market.

[7] While the OAS capture risks which can be hedged using a derivatives strategy (e.g. interest rate risk), it does not capture risks for which there are no hedging instruments (e.g. government solvency risk).

OAS is model-dependent, we cross-check our results against Standard & Poor's OAS in Figure A2 of the online appendix, the results are similar.

Moving to a higher frequency, Figure 4 considers average weekly prices for iShares' GNMA ETF and its MBB ETF, which tracks an index of predominantly GSE MBS (70%), but also has some GNMA exposure (26%).[8]

The figure shows how both the GNMA and GSE-based ETFs had similar price dynamics until the LCR rule was announced. Since then, the ETF tracking GNMA MBS traded at a premium relative to that which primarily tracks GSE MBS. This is again consistent with the favorable liquidity weights LCR gave to GNMA MBS.

In Figure A3 in the Online Appendix we provide extra support for the previous patterns. Following Echeverry, Stanton, and Wallace (2016), we focus on the To-Be-Announced (TBA) market.[9] The TBA market characterizes MBS 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 on a given day among single-family, 30-year fixed-rate mortgages.[10] Figure A3 shows that the prices of GNMA, FNMA, and FHLMC MBS all increased following the LCR proposal, but, in line with the previous evidence, the price of GNMA MBS increased by more than the GSEs'.

Moreover, Figure A4 of the online appendix looks at the standard deviation of security-level prices in the TBA market as a measure of market thickness and liquidity. This price volatility declined especially for GNMA MBS after the LCR proposal, and it remained at this lower level long after the announcement date.

In the online appendix, we describe a methodology to quantify the GNMA premium implied by the various exercises of this section. Historically, GNMA MBS have always traded at higher prices than GSE MBS because GNMA has the explicit government backing. Our analysis suggests that LCR made both GNMA and GSE MBS more valuable. Moreover, LCR raised the GNMA premium by 10% more than the GSEs'. In the next section, we estimate how these secondary market effects of liquidity regulation spilled over to the primary market.

[8] There is not an iShares ETF which solely tracks FNMA or FHLMC MBS.

[9] Data source is the TRACE database from FINRA. Because securities change from day to day, we smooth the data by taking the monthly average MBS price in the TBA market.

[10] See Vickery and Wright (2013) and Gao, Schultz and Song (2017) for a thorough discussion of the TBA market.

4 Cross-Sectional Analysis

4.1 Data

For our core analysis, we merge HMDA data, which contain information on the borrower and outcome of almost all mortgage applications in the U.S., with bank Call Reports. Table 1 contains summary statistics of our data.

Our core data consist of FHA loan applications for the purchase of an owner-occupied, single-family dwelling. Moreover, we focus on lenders which received at least 10 applications in each year, and which have a record in HMDA from 2011 through 2015.[11] This gives a sample of 396 lenders, 123 of which are non-depository institutions.

4.2 Nonbanks and LCR

We consider how higher demand for GNMA MBS may have impacted credit supply through lenders' incentives to lower denial rates on FHA loans. HMDA results on denial rates are consistent with survey evidence from banks on lending standards (Driscoll, Kay and Vojtech 2016).

First, we estimate the following specification on the sample of FHA loan applications:

$$Y_{i,l,t} = \beta \left(M_t^{GNMA} \times F_l \right) + \text{PostLCR}_t + \delta Z_{l,m,t} + \gamma X_{i,t} + \alpha_l + u_{i,l,t}, \tag{1}$$

where i, l, m and t denote borrowers, lenders, MSA and years, respectively, and PostLCR_t indicates whether the LCR policy has been announced ($t \geq 2014$). The outcomes $Y_{i,l,t}$ are whether the application from borrower i to lender l in year t was denied. Below we also check originations obtaining similar results.

F_l measures lender l's exposure to securitization and M_t^{GNMA} measures the collateral and liquidity of GNMA MBS. In theory, higher demand for GNMA MBS should have a greater impact on the behavior of lenders which fund more of their mortgages through securitization. We employ two measures of F_l. First, we use an indicator of whether lender l is a non-depository institution (NDI). Second, we use the ratio of securitized loans to total originations in 2011 of lender l.

[11] 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 (2017).

We measure M_t^{GNMA} using: 1) 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; 2) the log OAS spread between GNMA and FNMA MBS studied in Table A2 of the online appendix; 3) same than 2) but for FHLMC MBS.

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 $\text{Minority}_{i,t}$. The lender controls in $Z_{l,m,t}$ are MSA-lender fixed effects 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, and total equity to total assets.

We estimate (1) over the period 2012-2015. This choice of sample window ensures that we do not confound reliance on securitization with regulatory arbitrage (e.g. Buchak et al 2017), since the major U.S. financial regulations had already been passed in 2010. In the online appendix we re-perform our analysis on the narrowest possible window, 2013-2014, and find similar results.

Table 2 contains the results for mortgage denials when F_l is an indicator of whether lender l is a non-depository institution. Table 3 redoes the exercise when F_l equals the securitization ratio. The two tables give the same result, which is consistent with our theory, and robust across measures of M_t^{GNMA}. Lenders with more reliance on funding from securitization responded to the higher value of GNMA MBS by denying fewer loans.

The coefficient of PostLCR×NDI from Table 2 suggests that, because of LCR rules, borrowers who apply to a non-depository institution are around 1 percentage point less likely to be denied. This holds conditional on the borrower's quality, and joint lender-MSA effects. It is also economically meaningful, given the average denial rate of 14%. The coefficient of PostLCR $\times$ Sec Rate in Table 3 is -0.029 and it is significant at the 1% level. Given that one standard deviation in the securitization rates is around 11%, then the estimated coefficient suggests a 2.2% decrease relative to average denial rates ($\frac{-0.029*0.105}{0.136}$).

One might wonder whether nonbanks and lenders more exposed to securitization increased denial rates in conventional loans to compensate for their laxer standards in FHA loans. Table 4 considers this possibility by replicating our baseline analysis on the sample of conventional loans (non-jumbo, non-FHA loans). The results suggest that, because LCR amplified the GNMA premium relative to GSEs MBS, this encouraged lenders to substitute from conventional loans to FHA-insured loans.

4.3 Risk Taking

Here we ask whether the post-LCR shift in origination behavior differed by borrower characteristics that proxy for risk-taking. In Tables 5 and 6 we interact our measures of lender l's exposure to securitization with, respectively, an indicator of whether the applicant is black or Hispanic, and with the borrower's requested loan-to-income ratio. These loans are usually associated with higher default rates.

The results suggest that LCR policies encouraged nonbanks and lenders more exposed to securitization to relax their lending standards and increase their risk-taking in FHA loans. From a welfare perspective this is not necessarily bad, and in Section 6.2 we will evaluate the consequences for the homeownership rate.

5 Robustness of Identification

Our identification assumptions in Section 4 are those of a standard difference-in-difference exercise: the LCR proposal, and subsequent increase in the relative value of GNMA MBS, did not coincide with other shocks that would have affected the treatment group (lenders with less funding liquidity) differently from the control group. In this section we consider reasons that could violate that assumption, and we modify our specification accordingly. In all cases, we are unable to find evidence that contradict the results from the previous section. Moreover, we conduct several placebo tests.

5.1 Regulatory Arbitrage

First, as documented by Buchak et al. (2017), regulatory arbitrage has been a key driver of nonbanks' increasing market share. Thus, a potential concern is that in Section 4 we capture differential costs of regulation across lenders rather than a response to regulation-induced changes in MBS prices and liquidity. This is unlikely given our results on securitization-reliant lenders in Table 3. However, Table A5 of the online appendix addresses this concern directly.

We make use of the fact that the major regulatory overhaul occurred in 2010 and 2011, before the start of our sample.[12] Thus, in Table A5 we re-estimate our baseline specification over the narrow window 2013-2014.

[12]Dodd-Frank was passed in 2010, implemented in 2011, and 2011 was the year when bank stress tests had the greatest impact on real activity (Calem, Correa, and Lee 2016).

Table A5 shows that relative to the baseline counterpart, Table 2, the results for 2013-2014 convey a similar message: the LCR policy reduced nonbanks' propensity to deny a mortgage. Columns two and three of Table A5, which are based on OAS spreads, confirm that this works through the channel of secondary market liquidity. In terms of magnitude, the point estimates are stronger, so that the baseline estimates from Table 2 may be interpreted as conservative.

5.2 Net Stable Funding Ratio

In this subsection we evaluate another potential concern with our identification. The Basel III accords involved not only a Liquidity Coverage Ratio (LCR), but also a complementary Net Stable Funding Ratio (NSFR). The NSFR aimed to ensure that banks "maintain sufficient levels of stable funding, thereby reducing liquidity risk in the banking system".[13] However, the NFSR was not proposed in the U.S. until May 2016, more than two years after the LCR proposal. It is thus unlikely that the NSFR is affecting the results. Nonetheless, it is possible that lenders updated their expectations following the LCR announcement, and that banks with less funding liquidity subsequently aimed to shrink their balance sheets.

The previous logic contradicts Table A6 in the online appendix which uses banks' securitization rates to capture their exposure to LCR. Specifically, Table A6 re-estimates the specification of Table 3 using only banks and a rich set of bank balance sheet controls.

Consistent with the results from Section 4, Table A6 shows that banks with greater reliance on securitization denied fewer FHA applicants after LCR (first column) and when the corresponding GNMA spread increased (second and third columns).

5.3 Changing Pool of FHA Applicants

Since our core analysis is at the application level, it takes as given the distribution of borrower quality across different loan types. If FHA loan applicants are becoming less risky, this alone would not generate our results. One would further need that lenders with more exposure to GNMA MBS have some cost of adjusting to the new quality of FHA borrowers. However, Figure A6 in the online appendix shows that our two measures of credit risk (requested loan-to-income ratio and minority status) have steadily grown at about the same rate for both FHA and non FHA applicants.

If anything, the top panel of Figure A6 suggests that FHA applicants have become slightly

[13] See the Federal Reserve's press release on May 3, 2016.

riskier, in terms of LTI, relative to non FHA applicants. Thus, it does not seem that changes in the pool of borrowers can drive the core results of Section 4.

5.4 Changing Pool of Nonbank Applicants

Similar to the previous concern, one might wonder whether the pool of applicants to nonbanks is changing over time. If it is, then our estimates may reflect the improving quality of applicants to nonbanks. However, Figure A7 in the online appendix provides evidence to the contrary.

The top panel of Figure A7 shows how the gap in the loan-to-income ratio of applicants to banks versus nonbanks has been remarkably stable over time. Turning to the bottom panel, the fraction of applications from minorities to banks versus nonbanks have been on parallel trends, at least through 2014. In 2015, the minority share of bank applicants fell relative to nonbanks. If anything, this is consistent with a relative increase in the risk pool of nonbank applicants, making the baseline results from Section 4 conservative.

5.5 Originations, Placebo and the Ratio of Total Deposits to Total Assets

Table A7 confirms that the result is robust when instead of denials we look at originations. Lenders that are more sensitive to secondary mortgage markets approve and subsequently originate more applications when the GNMA premium rises.[14]

Table A8 contains a placebo test in the 2007-2010 period pre-LCR policies. The results are insignificant for securitization rate, and the wrong sign for nonbank. Thus, we can say that our results are not driven by pre trends.

Finally, in Table A9, for banks only, we use the ratio of total deposits to total assets in 2011 to measure F_l. The idea is that such banks rely more on secondary markets to finance their originations. The results get confirmed when we use the OAS as proxies for the LCR.

[14]Denial rates are not the complement of origination rates because some borrowers may choose to turn down the lender's offer.

6 Aggregate Effects

6.1 Dynamics of Nonbanks' Market Share

While the granularity of our data in Section 4 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.[15] We then estimate

$$\Delta \log \left(\text{Originations}_{k,t}\right) = \beta \left(M_t^{GNMA} \times F_{k,t}\right) + \text{PostLCR}_t + \gamma X_{k,t} + \alpha_k + u_{k,t}, \tag{2}$$

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 (4) . $F_{k,t}$ is the average of lenders' exposure to securitization (F_l) weighted by applications from census tract k in year t. We use two 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 weighted average of lenders' loan securitization rate in 2011, with weights determined by application share in tract k and year 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 median house price, based on the Zillow Home Value Index.

Consistent with the borrower-level results from Section 4, Table 7 shows that census tracts dominated by lenders more exposed to secondary mortgage markets saw greater credit growth following the LCR policy. To interpret, the estimates for β suggest that LCR policies raised loan origination growth by 19 percentage points in census tracts in which nonbanks are the only lenders relative to tracts where there are no nonbanks, and 28 percentage points higher in tracts where all lenders tend to finance originations through securitization relative to tracts where no lenders do so.

Table 7 allows to estimate the dynamics of nonbanks' market share. The estimate β in Table 7 captures the sum of growth in origination rates and applications.[16] Table 7 suggests that in the absence of the LCR policy, nonbank originations would have been 19 percentage points less per year in census tracts where the fraction of applications to nonbanks is 100%. The

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

[16] The estimates in 2 are at the application level and do not capture application growth, which is important given the efforts that nonbanks have put into raising applications (see for example Rocket Mortgage advertising during the Super Bowls).

average application share is 50%, thus the average effect is 9.5 less percentage points. Thus, given that nonbank FHA originations in 2013 were 358,394, this means that two years later, that is, in 2015, without LCR the nonbanks would have made 68,094 fewer loans (0.095 * 2 * 358,394). This would have lowered nonbanks market share in 2015 from 77.1% to 74.5% of FHA originations.[17] Put differently, nonbank market share grew 9.9 percentage points from 2013 to 2015, but but their share would have grown 2.6 percentage points, or 26% less, in the absence of the LCR policy.[18]

6.2 Homeownership Rates

In this subsection, we study whether the increasing market share of the non-depository institutions can influence homeownership rates. We estimate

$$\Delta \text{ Homeownership}_{m,t} = \beta \left(M_t^{GNMA} \times \text{Nonbank Market Share}_{m,t} \right) + \text{PostLCR}_t + \gamma X_{m,t} + \alpha_m + u_{m,t}, \tag{3}$$

where m indexes MSAs and t indexes years. $\Delta\text{Homeownership}_{m,t}$ denotes the change of homeownership rate in MSA m and year t. We measure M_t^{GNMA} using an indicator of whether $t \geq 2014$ as in Section (4). $\text{Nonbank Market Share}_{m,t}$ denotes the fraction of originations to non-depository institutions from MSA m in year t. MSA controls $X_{m,t}$ are the fraction of applicants which are minorities, the log of average borrower income, the log of average requested loan-to-income ratio, and the log of the MSA's median house price. The sample includes all originated FHA loans for the purchase of an owner-occupied single-family dwelling from 2012 through 2015.

The results in Table 8 suggest that nonbanks have facilitated access to homeownership in a period when the U.S. homeownership rate has collapsed to historic lows. Thus, the welfare evaluation of the role of nonbanks requires to weigh the benefits from homeownership versus the costs from higher default risks.

[17] In 2015, among FHA originations, 156,404 were from banks and 525,872 from nonbanks. Thus, the 77.1% share for nonbanks. Substracting the 68,094 loans due to LCR we obtain the counterfactual 74.5% as $\left(\frac{525{,}872-68{,}094}{525{,}872-68{,}094+156{,}404}\right)$.

[18] To arrive at these numbers, nonbanks and banks originated 358,394 and 175,044 FHA loans in 2013, respectively. Thus, nonbanks market share was 67.2%. Thus, the 9.9 percentage points change between 2013 and 2015, which, absent LCR policy would have been only 7.3 percentage points.

7 Conclusions

In this paper we have shown that LCR policies, designed to prevent runs in secondary mortgage markets, seem to have increased the credit risk borne by the U.S. taxpayers that insure the FHA loans. LCR policy has created demand for GNMA-backed MBS and increased their price and liquidity in secondary markets. These general equilibrium channels attracted to FHA lending those lenders more sensitive to securitization, that is, the nonbanks. Lending standards loosened among FHA loans and risk-taking (as proxied by loans to minorities and by loan-to-income) increased.

Our paper shows that liquidity regulations can have important effects on credit risk by altering the structure of the lenders in the market and their incentives to originate and securitize. It remains open the question of whether that risk-taking is welfare enhancing or not. For example, we show that nonbanks and LCR policies have increased homeownership in a period when the U.S. homeownership rate has been at historic lows.

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Figures

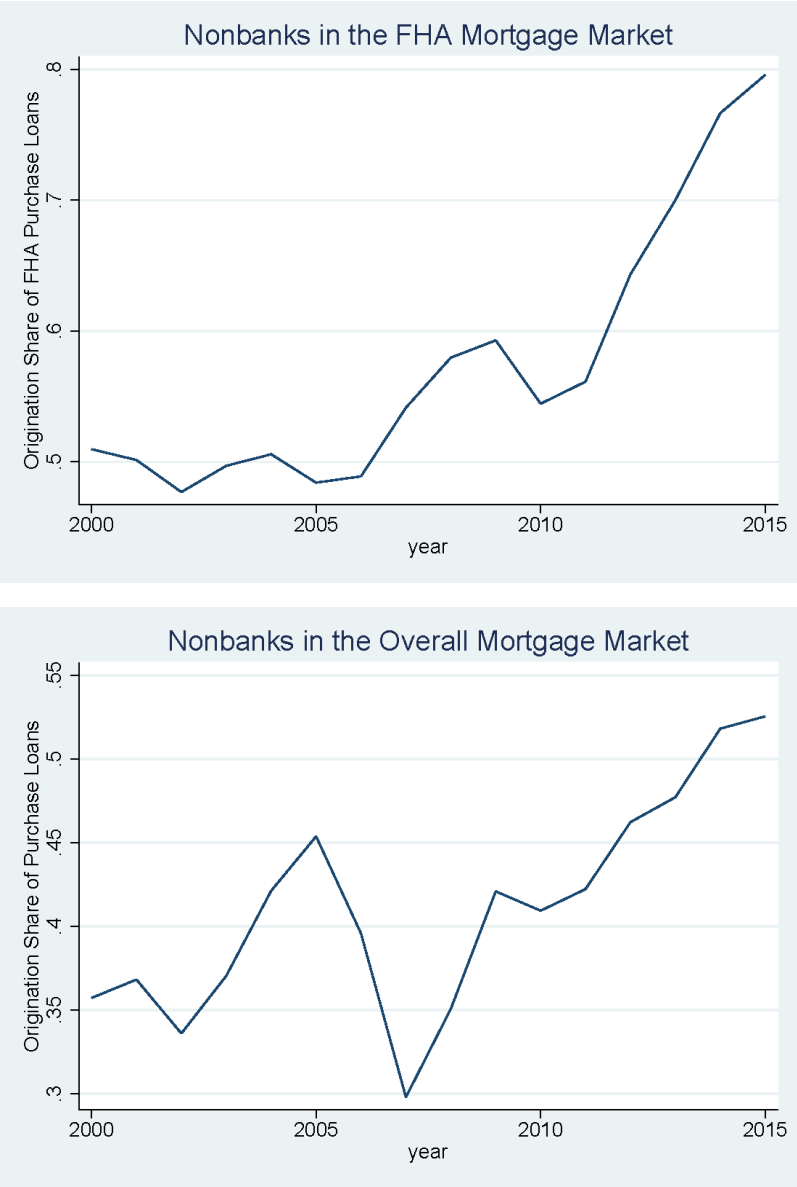


Figure 1. Market Share of Non-depositary Institutions Among FHA and All Loans for Home Purchases. The figure shows the percentage of FHA mortgage dollar volume (top) and all of mortgage dollar volume (bottom) originated by non-depository institutions (nonbanks) for home purchases. Source: HMDA.

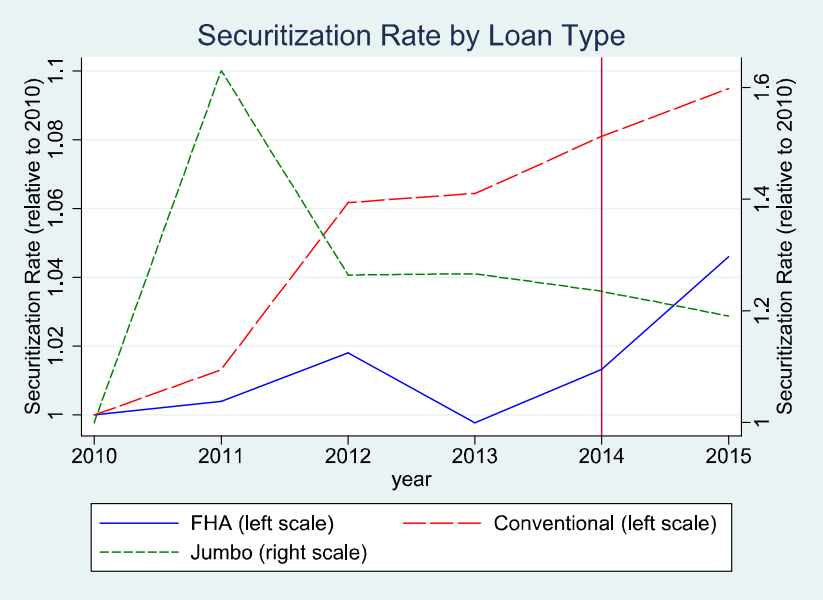


Figure 2. Securitization by Loan Type. This figure shows the fraction of mortgage applications which are originated for FHA loans, conventional loans, and jumbo loans. The vertical line is when the LCR rules were proposed (October 24th, 2013). Source: HMDA.

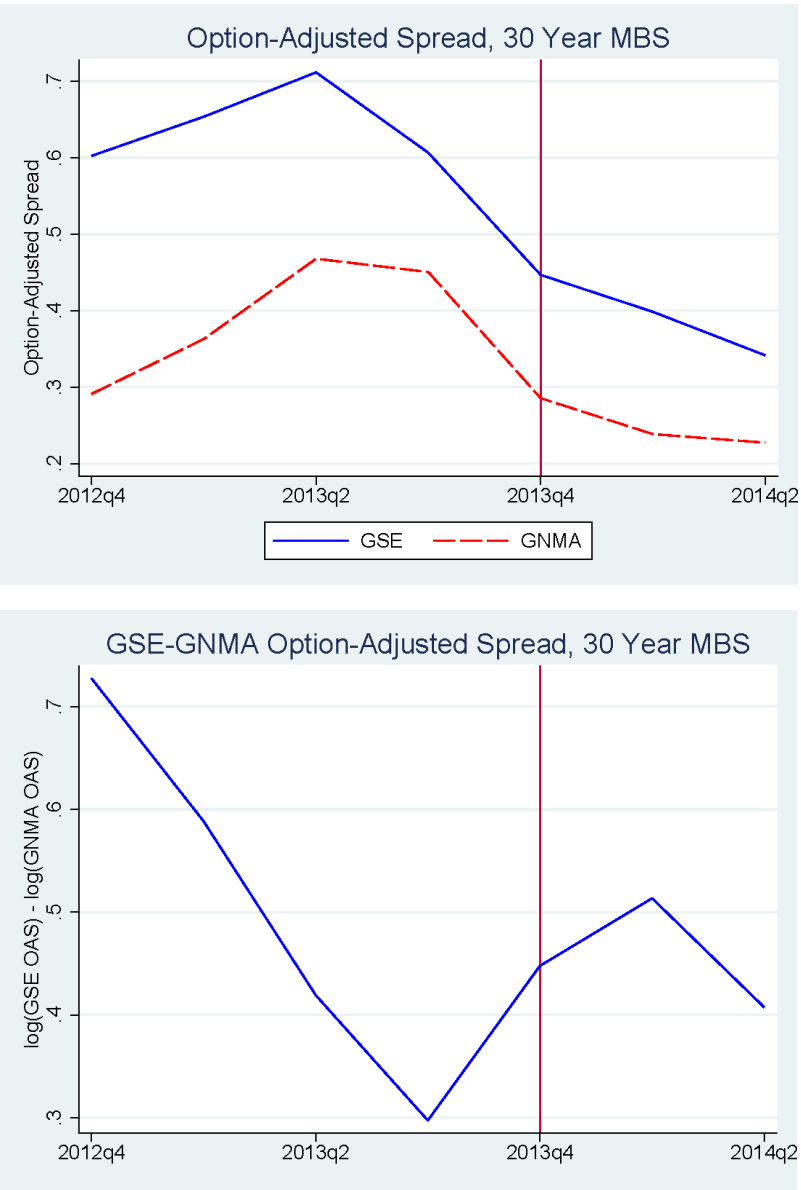


Figure 3. Option-Adjusted Spread (OAS) of GNMA and GSE Mortgage Backed Securities. The top panel plots the average quarterly OAS for GNMA and GSE MBS indices, where the GSE index is defined as the average of the FNMA and FHLMC indices. The vertical line corresponds to the date when the LCR rules were proposed (October 24th, 2013). Source: Bloomberg.

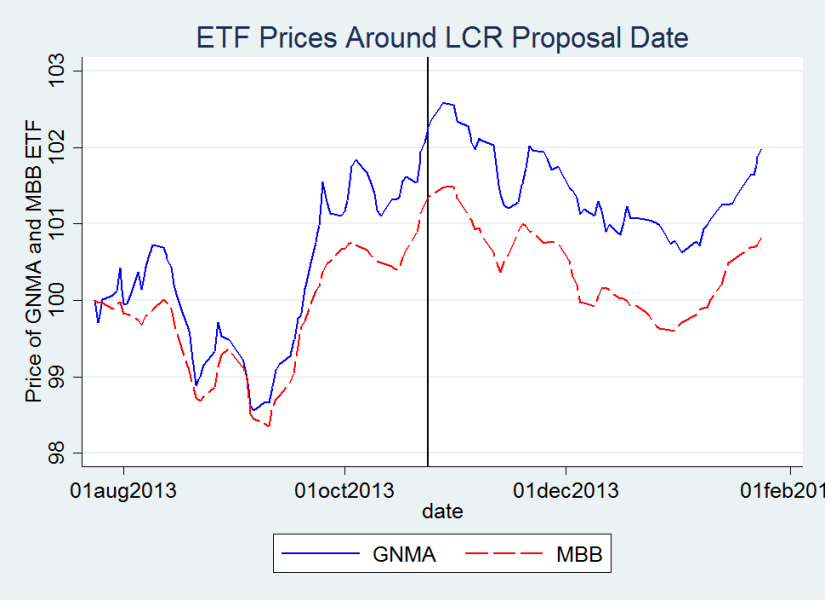


Figure 4. ETF Price Index of GNMA and GSE MBS. The figure plots the price of an ETF that invests in GNMA MBS and of another ETF (MBB) that invests in MBS guaranteed by all the U.S. government agencies (weights are FNMA 44%, FHLMC 27%, GNMA 28%). The prices are normalized to 100 on July 24th, 2013. The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

Tables

Table 1: Summary Statistics

Variable	Number of Observations	Mean	Standard Deviation
HMDA Variables:			
Denied	2,809,984	0.136	0.343
Minority	2,809,984	0.312	0.463
Loan-to-Income	2,809,984	3.043	2.188
Depository Institution	2,809,984	0.316	0.465
Securitization Rate	1,980,562	0.939	0.105
GNMA Securitization Rate	1,980,562	0.386	0.391
Call Report Variables:			
Total Deposit Ratio	639,437	0.763	0.061
Liquid Asset Ratio	463,017	0.105	0.071
Equity Ratio	639,437	0.113	0.02
Loan Provision Ratio	639,437	0.002	0.003
Net Income Ratio	639,437	0.012	0.006
Rebooked GNMA Ratio	172,805	0.04	0.023
log(Assets)	639,437	18.1	3.13

Note: This table contains summary statistics of the variables used in the regressions. Each observation corresponds to an FHA loan application for the purchased of an owner-occupied single-family dwelling over the 2012-2015 period. Variables describing lenders (Depository Insitution, Securitization Rate, GNMA Securitization Rate, and all Call Report variables) 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 2: LCR, FHA Denials and Nonbanks.

	$\text{Denied}_{i,l,t}$		
$M_t^{GNMA}=$	PostLCR_t	$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right)$	$\log\left(\frac{OAS_t^{FHLMC}}{OAS_t^{GNMA}}\right)$
$M_t^{GNMA}\times\text{NDI}_l$	-0.006	-0.044	-0.040
	(0.000)	(0.000)	(0.000)
Borrower Controls	Yes	Yes	Yes
Lender-MSA FE	Yes	Yes	Yes
Post-LCR Indicator	Yes	Yes	Yes
R-squared	0.108	0.108	0.108
Number of Observations	2,809,984	2,809,984	2,809,984

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 $t \geq 2014$. OAS denotes the option-adjusted spread computed by Bloomberg. 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 consists of applications for FHA loans for the purchase of an owner-occupied single-family dwelling from 2012 through 2015. Standard errors are heteroskedasticity robust.

Table 3: LCR, FHA Denials and Securitization Rate

	Denied$_{i,l,t}$		
$M_t^{GNMA} =$	PostLCR$_t$	$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right)$	$\log\left(\frac{OAS_t^{FHLMC}}{OAS_t^{GNMA}}\right)$
$M_t^{GNMA}\times$Sec Rate$_{l,2011}$	-0.012	-0.057	-0.053
	(0.002)	(0.000)	(0.000)
Borrower Controls	Yes	Yes	Yes
Lender-MSA FE	Yes	Yes	Yes
Post-LCR Indicator	Yes	Yes	Yes
R-squared	0.107	0.107	0.107
Number of Observations	2,777,149	2,777,149	2,777,149

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. Sec Rate is the ratio of securitized loans to total originations in 2011. The remaining notation, controls, sample, and standard errors are the same as in Table 2.

Table 4: LCR and Conventional Loan Denials

Outcome:	$\text{Denied}_{i,l,t}$	$\text{Denied}_{i,l,t}$
$\text{PostLCR}_t \times$ NDI_l	0.011	
	(0.000)	
$\text{PostLCR}_t \times$ $\text{Sec Rate}_{l,2011}$		0.007
		(0.000)
Sample	All	All
Borrower Controls	Yes	Yes
Lender-MSA FE	Yes	Yes
Post-LCR Indicator	Yes	Yes
R-squared	0.095	0.094
Number of Observations	6,982,398	6,891,243

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. The sample consists of applications for conventional (non-FHA, non-jumbo) loans for the purchase of an owner-occupied single-family dwelling from 2012 through 2015. The notation, controls, and standard errors are the same as in Tables 2 and 3.

Table 5: LCR, FHA Denials and Minority Borrowers.

Outcome:	$\text{Denied}_{i,l,t}$	$\text{Denied}_{i,l,t}$
$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right) \times \text{NDI}_l$	-0.032	
	(0.000)	
$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right) \times \text{NDI}_l \times \text{Minority}_i$	-0.034	
	(0.000)	
$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right) \times \text{Sec Rate}_{l,2011}$		-0.054
		(0.000)
$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right) \times \text{Sec Rate}_{l,2011} \times \text{Minority}_i$		-0.010
		(0.003)
Sample	All	All
Borrower Controls	Yes	Yes
Lender-MSA FE	Yes	Yes
Post-LCR Indicator	Yes	Yes
R-squared	0.108	0.107
Number of Observations	2,809,984	2,777,149

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. Minority indicates whether the borrower is black or Hispanic. Sec Rate is the ratio of securitized loans to total originations in 2011. The remaining notation, controls, and standard errors are the same as in Tables 2 and 3.

Table 6: LCR, FHA Denials and Borrowers' Loan-to-Income.

Outcome:	$\text{Denied}_{i,l,t}$	$\text{Denied}_{i,l,t}$
$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right) \times \text{NDI}_l$	-0.034	
	(0.000)	
$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right) \times \text{NDI}_l \times \text{High LTI}_{i,t}$	-0.020	
	(0.000)	
$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right) \times \text{Sec Rate}_{l,2011}$		-0.052
		(0.000)
$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right) \times \text{Sec Rate}_{l,2011} \times \text{High LTI}_{i,t}$		-0.013
		(0.000)
Sample	All	All
Borrower Controls	Yes	Yes
Lender-MSA FE	Yes	Yes
Post-LCR Indicator	Yes	Yes
R-squared	0.108	0.108
Number of Observations	2,809,984	2,777,149

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. $\text{High LTI}_{i,t}$ denotes whether borrower i had an above-median requested loan-to-income ratio in year t. The remaining notation, controls, and standard errors are the same as in Tables 2 and 3.

Table 7: LCR, and FHA Originations at Census Tract Level.

Outcome:	$\Delta \log\left(\text{Orig}_{k,t}\right)$	$\Delta \log\left(\text{Orig}_{k,t}\right)$
PostLCR$_t\times$ NDI$_{k,t}$	0.190	
	(0.000)	
PostLCR$_t\times$ Sec Rate$_{2011,k,t}$		0.241
		(0.050)
Sample	All	All
Tract Controls	Yes	Yes
Tract FE	Yes	Yes
Post-LCR Indicator	Yes	Yes
R-squared	0.031	0.028
Number of Observations	117,184	114,139

Note: Subscripts k and t denote census tract and year, respectively. P-values are in parentheses. The sample includes all originated FHA loans for the purchase of an owner-occupied single-family dwelling from 2012 through 2015. PostLCR denotes whether $t \geq 2014$. Orig$_{k,t}$ denotes the number of originated loans in census tract k and year t. NDI$_{k,t}$ denotes the fraction of applications to non-depository institutions from census tract k in year t. Sec Rate$_{2011,k,t}$ is a weighted average of lenders' loan securitization rate in 2011, with weights determined by 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, and the log of the MSA's median house price. Standard errors are double clustered by census tract and year.

Table 8: LCR, Nonbanks and Homeownership

	ΔHomeownership$_{m,t}$
PostLCR$_t\times$ NDI$_{m,t}$	0.059
	(0.000)
MSA FE	Yes
MSA controls	Yes
Post-LCR Indicator	Yes
R-squared	0.050
Number of Observations	258

Note: subscripts m and t denote MSA and year, respectively. P-values are in parentheses. PostLCR denotes whether $t \geq 2014$. ΔHomeownership$_{m,t}$ denotes the change of homeownership rate in MSA m and year t. NDI$_{m,t}$ denotes the fraction of applications to non-depository institutions from MSA m in year t. MSA 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, and the log of the MSA's median house price. The sample includes all FHA applications for the purchase of an owner-occupied single-family dwelling from 2012 through 2015. Standard errors are double clustered by MSA and year.

ONLINE APPENDIX. NOT FOR PUBLICATION

Quantifying the Liquidity Premium

To assess the quantitative importance of the LCR proposal for MBS spreads, we now turn to a more formal regression analysis. We take as our baseline outcome the OAS computed by Bloomberg as well as the difference in log OAS between GNMA and each of the GSE's MBS. We focus on the OAS because it is already adjusted for prepayment and default risk. Given that our ultimate outcome of interest is mortgage origination activity, which moves at a lower frequency than security prices, we collapse the OAS to the quarterly level. Table A4 confirms that the results are robust if instead we use a higher frequency and MBS prices from the TBA market.

We estimate both a panel regression,

$$\log(\text{OAS}_{s,t}) = \alpha_s + \beta_1(\text{PostLCR}_t \times \text{GNMA}_s) + \gamma X_{s,t} + \tau_t + u_{s,t}, \tag{4}$$

and a purely time-series regression

$$\log\left(\frac{\text{OAS}_{s,t}}{\text{OAS}_{\text{GNMA},t}}\right) = \alpha + \beta\text{PostLCR}_t + X_t + u_t, \tag{5}$$

where $s \in \{\text{GNMA}, \text{FNMA}, \text{FHLMC}\}$ denotes the type of MBS, t denotes the quarter, τ_t is a quarter fixed effect, PostLCR_t indicates whether quarter t equals or follows 2013Q4, and GNMA_s indicates whether is a GNMA MBS ($s = \text{GNMA}$). Although the OAS, already adjusts for prepayment risk, our controls $X_{s,t}$ in (4) include the effective duration of security s at quarter t, as computed by a separate broker-dealer (Standard & Poor's) than our OAS data provider. By analogy, X_t in (5) includes GNMA effective duration and the effective duration of the security in the denominator. Over our sample period (2012Q4-2014Q2) there is effectively no credit risk premium since the GSEs were already in conservatorship.

The first column of Table A2 contains the estimates from our panel specification (4). Consistent with the graphical evidence discussed in Section 3, the LCR announcement reduced the spread on GNMA MBS by 12.8% more than for the GSEs' MBS. Taking each of the GSEs separately, the estimates of (5) in the second and third columns suggest increases in the relative spread of 8.5% for FNMA and 11.4% for FHLMC. Online appendix Table A3 produces very similar point estimates using Standard & Poor's OAS. Given the similarity of results across

specifications and the extensive use of controls, we conclude that the LCR policy reduced spreads on GNMA MBS by around 10% compared to GSE MBS. Collectively, the evidence from this section points to a significant increase in the value of agency MBS, especially GNMA MBS, due to their preferential regulatory weights.

Additional Figures and Tables

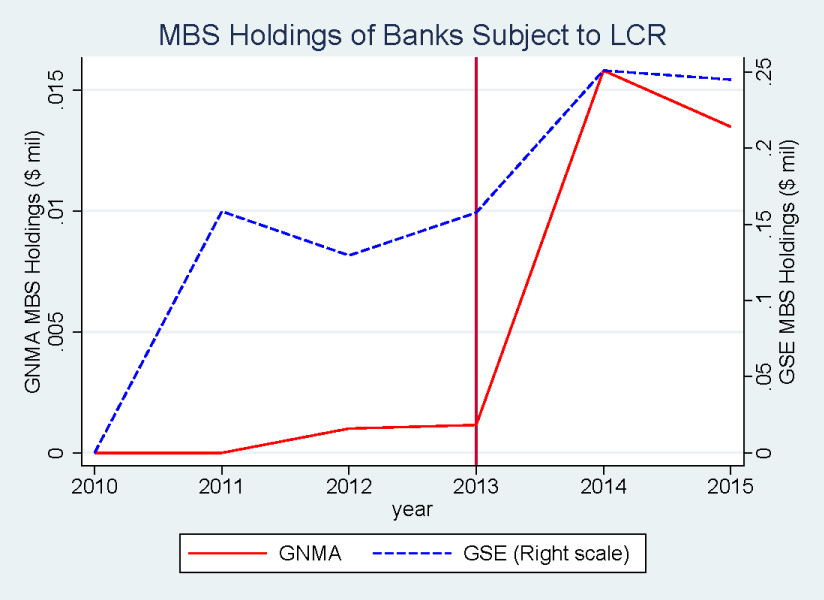


Figure A1. MBS Holdings of Institutions Affected by Liquidity Regulation. This figure plots the holdings of GNMA backed MBS (solid line) and of FNMA and FHLMC backed MBS by financial institutions subject to the LCR policy. Source: Call Reports (FR Y-9C)

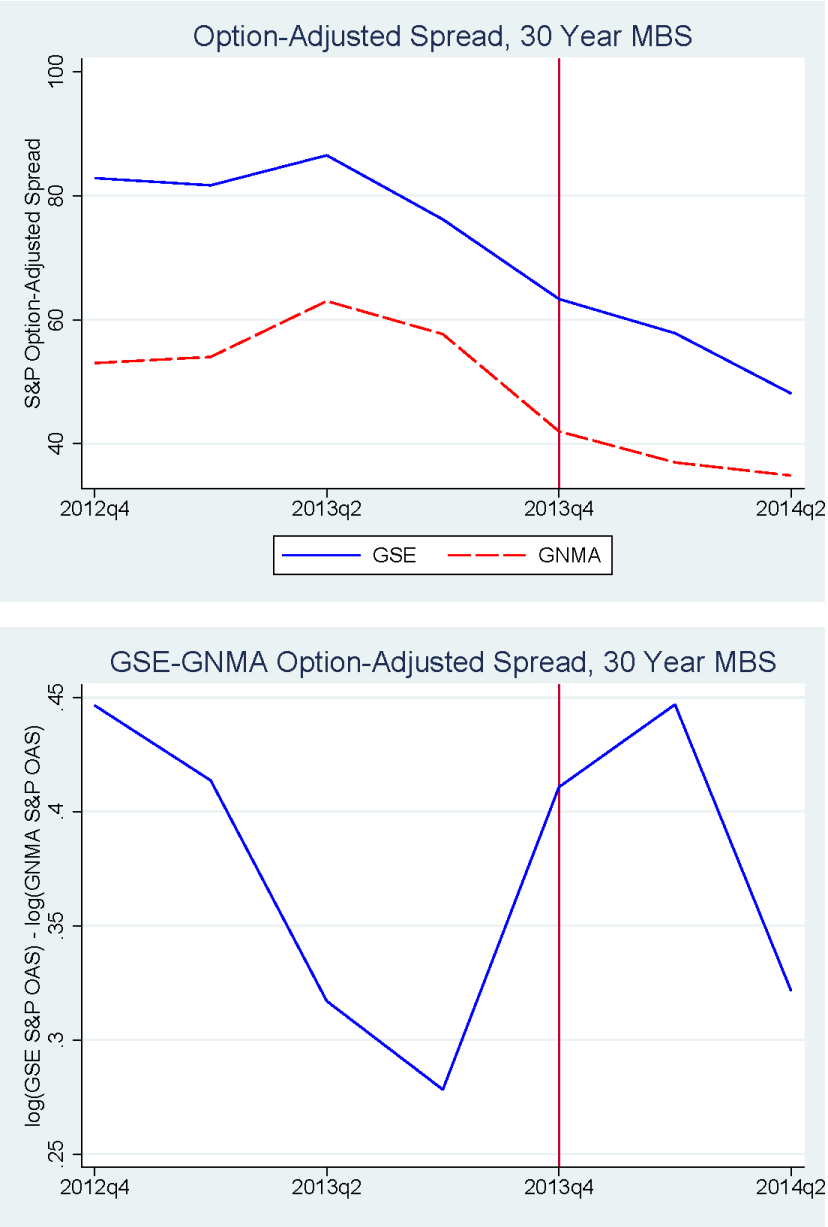
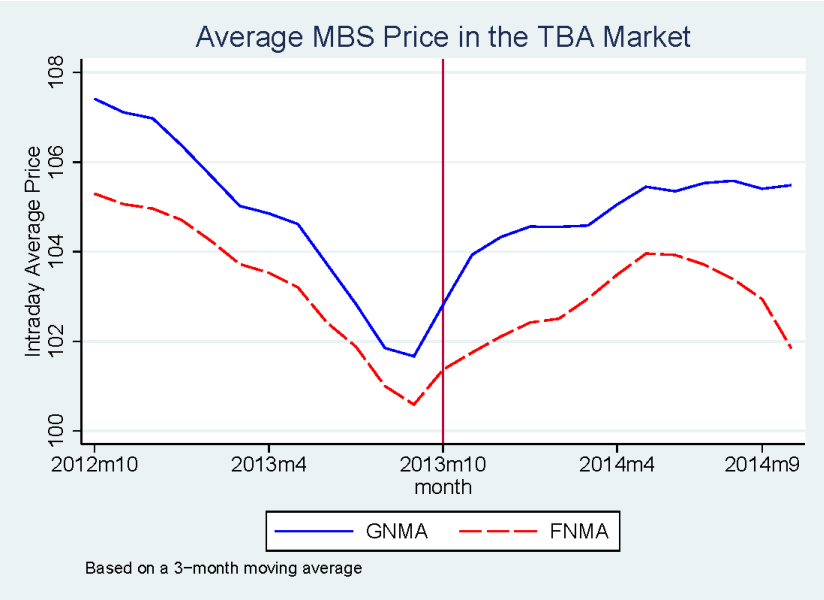


Figure A2. Option-Adjusted Spread (OAS) of GNMA and GSE MBS (Alternative Data Source). The vertical line corresponds to the date when the LCR rules were proposed (October 24, 2013). Source: Standard & Poor's.



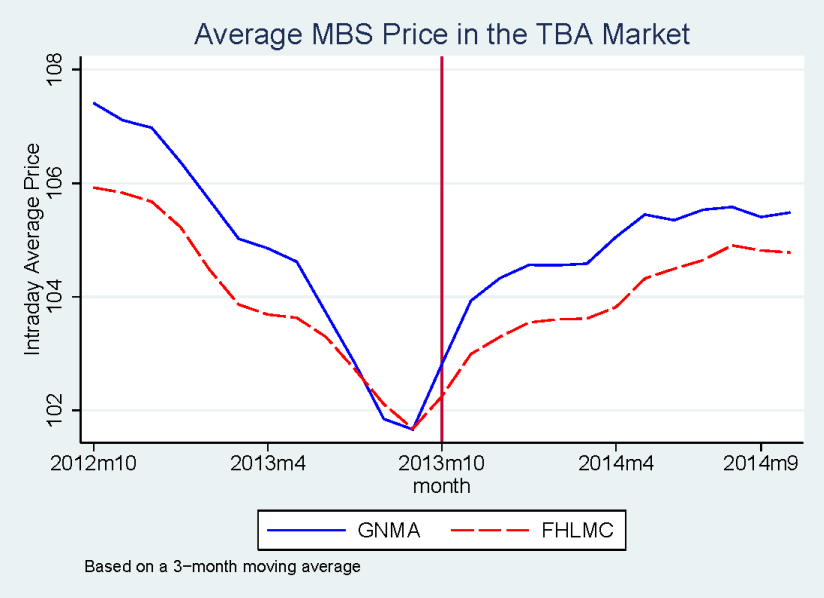
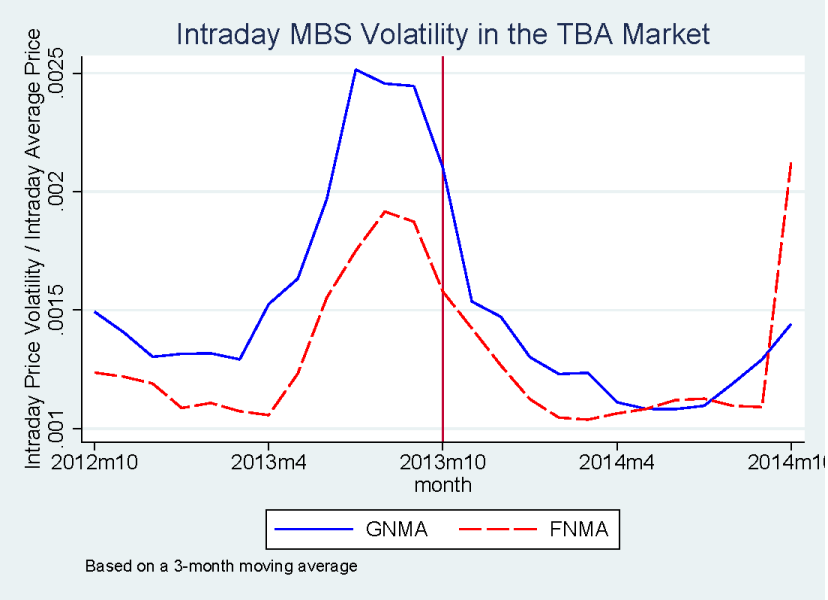


Figure A3. Prices of GNMA, FNMA and FHLMC MBS. The price corresponds to the monthly average of the most-commonly traded bond on a given day. The vertical line corresponds to October 24th, 2013, when the LCR rules were proposed. Source: Trade Reporting and Compliance Engine (TRACE).



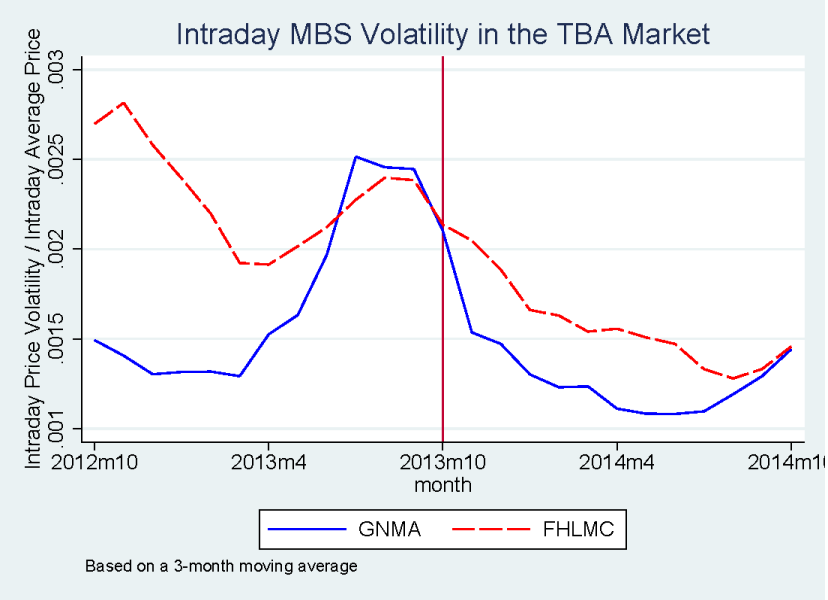


Figure A4. Ratio of Intraday Standard Deviation to Price for GNMA, FNMA and FHLMC MBS. The price corresponds to the most-commonly traded bond on a given day. The vertical line corresponds to October 24th, 2013, when the LCR rules were proposed. Source: FINRA's TRACE database.

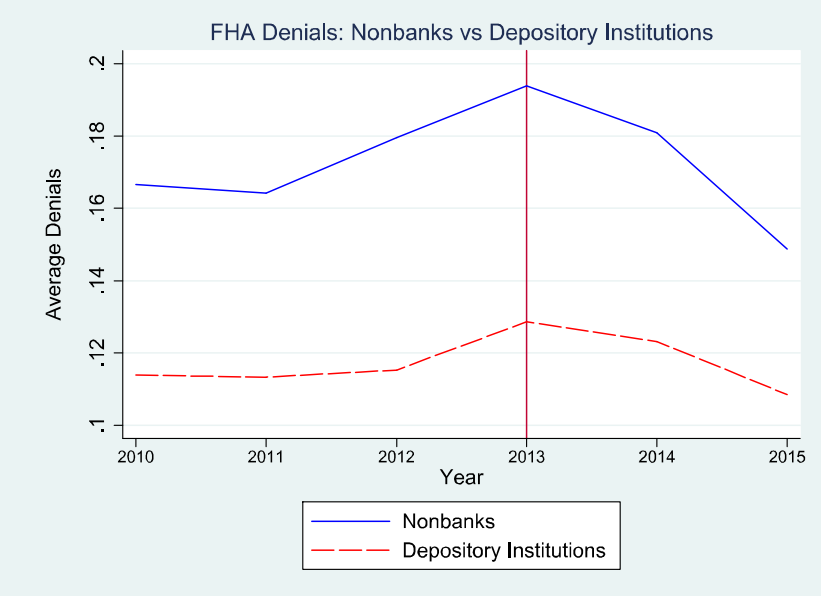
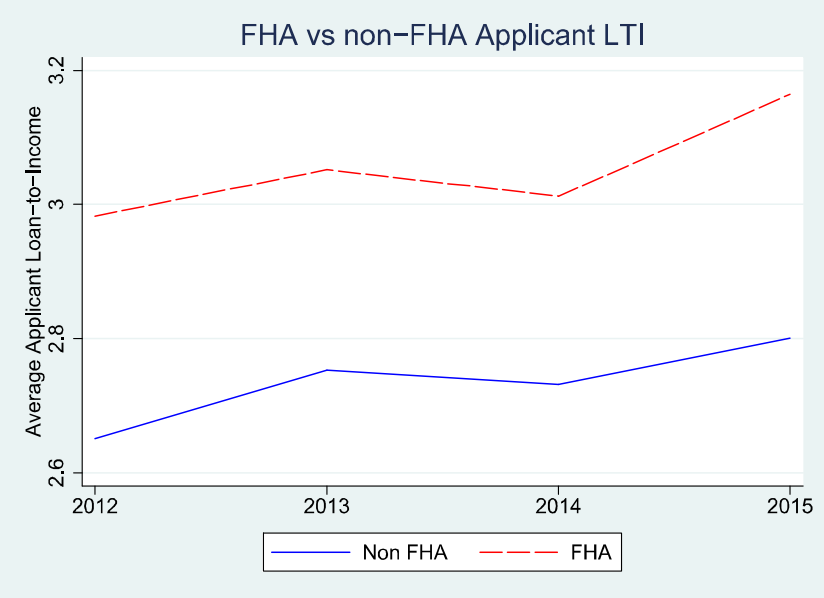


Figure A5. Average Denial Rates for Nonbanks and Depository Institutions in FHA loans. Source: HMDA



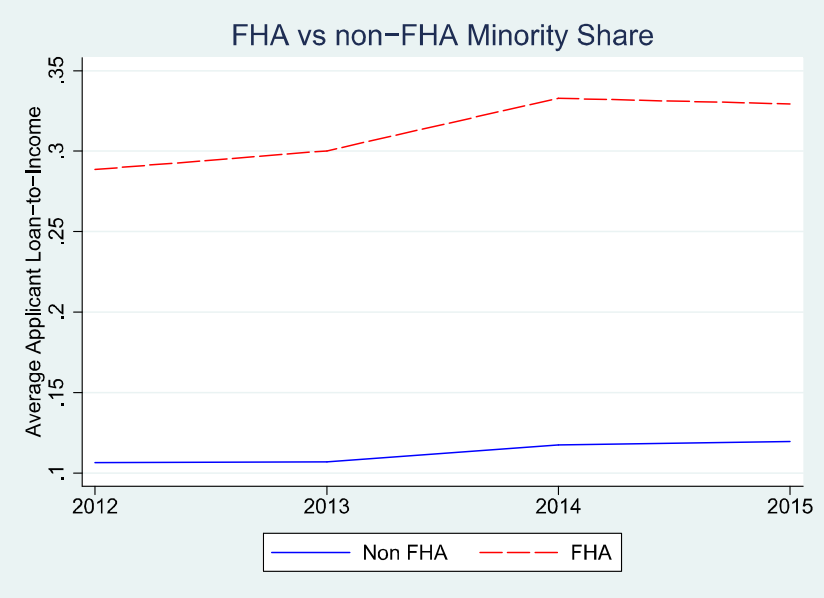


Figure A6. Credit Quality of FHA Applicants. The top panel plots the average loan-to-income ratio. The bottom panel plots the fraction of minorities among applicants for FHA versus non FHA loans over our main sample period.

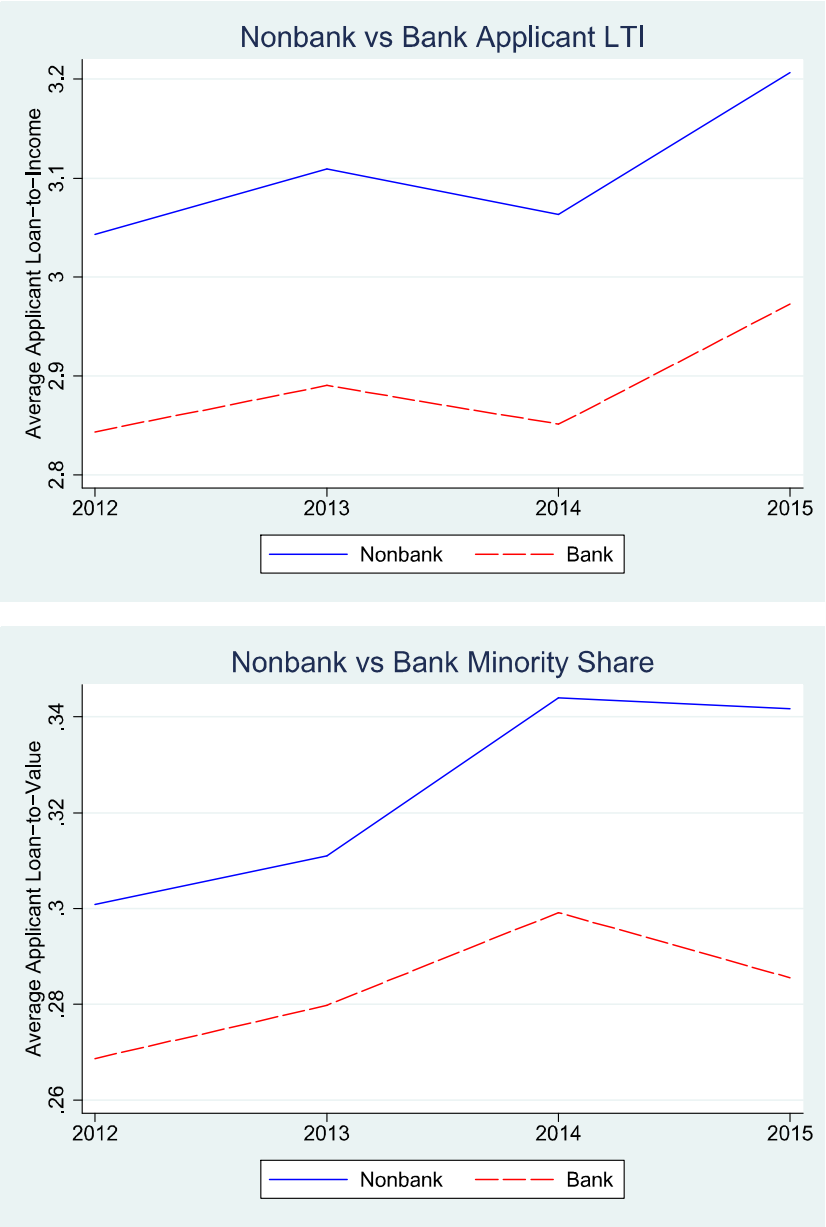


Figure A7. Credit Quality of Applicants to Banks and Nonbanks. The top panel plots the average loan-to-income ratio. The bottom panel plots fraction of minorities among applicants to banks versus nonbanks over our main sample period.

Table A1: Nonbanks in FHA

Name	*Number of Originations in 2013 and 2014*
QUICKEN LOANS	20,905
GUILD MORTGAGE COMPANY	15,692
PRIMARY RESIDENTIAL MORTGAGE	13,321
STEARNS LENDING	12,185
HOMEBRIDGE FINANCIAL SERVICES,	12,029
PROSPECT MORTGAGE LLC	11,477
FAIRWAY INDEPENDENT MORT CORP	10,399
STONEGATE MORTGAGE CORPORATION	9,352
PACIFIC UNION FINANCIAL, LLC	9,327
MOVEMENT MORTGAGE, LLC	9,113
CORNERSTONE HOME LENDING, INC.	8,946
PLAZA HOME MORTGAGE, INC.	8,936
EVERETT FINANCIAL INC	8,547
FRANLKIN AMERICAN MORTGAGE CO	8,518
ACADEMY MORTGAGE CORPORATION	8,187
DHI MORTGAGE COMPANY LIMITED	7,984
GUARANTEED RATE INC	7726
UNIVERSAL AMERICAN MTG. CO.LLC	7,602
PINNACLE CAPITAL MORTGAGE	7,397
CALIBER HOME LOANS	7,342
SECURITYNATIONAL MORTGAGE COMP	7,113
UNITED SHORE FINANCIAL SERVICE	7,111
PARAMOUNT RESIDENTIAL MORTGAGE	7,087
LOANDEPOT.COM, LLC	6,927
CARRINGTON MORTGAGE SERVICES	6,457
PHH HOME LOANS	6,057
NOVA HOME LOANS	5,930
FREEDOM MORTGAGE CORPORATION	5,888
NTFN, INC.	5,346
AMERICAN PACIFIC MORTGAGE CORP	5,294
SIERRA PACIFIC MORTGAGE	5,196
SUN WEST MORTGAGE COMPANY, INC	4,968
AMCAP MORTGAGE LTD	4,706
CMG FINANCIAL, INC	4,671
SWBC MORTGAGE CORPORATION	4,658
W. J. BRADLEY MORTGAGE CAPITAL	4,487
IMORTGAGE.COM, INC.	4,395
FIRST MORTGAGE CORP	4,118
MICHIGAN MUTUAL, INC.	4,053
WR STARKEY MORTGAGE, LLP	3,992
MORTGAGE 1 INCORPORATED	3,820
RESIDENTIAL MORTGAGE SERVICES	3,654
NATIONSTAR MORTGAGE LLC	3,641
COBALT MORTGAGE INC	3,623
NETWORK FUNDING LP	3,573
BROKER SOLUTIONS, INC.	3,550
CITYWIDE HOME LOANS, A UTAH CO	3,507
DAS ACQUISITION COMPANY, LLC	3,360
ENVOY MORTGAGE, LTD.	3,357
CALIBER FUNDING LLC	3,354

Table A2: Liquidity Premium and the LCR Announcement

Outcome:	$\log(\text{OAS}_{s,t})$	$\log(\frac{\text{OAS}_{\text{FN},t}}{\text{OAS}_{\text{GN},t}})$	$\log(\frac{\text{OAS}_{\text{FH},t}}{\text{OAS}_{\text{GN},t}})$
$\text{PostLCR}_t \times$ GNMA_s	-0.128		
	(0.000)		
PostLCR_t		0.085	0.114
		(0.000)	(0.007)
Agency FE	Yes	No	No
Quarter FE	Yes	No	No
Prepayment Controls	Yes	Yes	Yes
R-squared	0.996	0.974	0.894
Number of Observations	21	7	7

Note: Subscript s denotes whether the MBS corresponds to GNMA, FNMA, or FHLMC, and t denotes the quarter. P-values are in parentheses. $\text{OAS}_{s,t}$ denotes the average quarterly option-adjusted spread for security s, as computed by Bloomberg. PostLCR_t denotes whether the quarter coincides with or follows October 24, 2013, when the LCR rules were proposed. GNMA_s denotes whether the security is backed by GNMA. In column 1 our sample includes GNMA, FNMA, and FHLMC securities. Columns 2 and 3 consider relative prices as the outcome. The sample period is 2012Q4 through 2014Q2. The prepayment controls are the effective duration of security s, as computed by Standard & Poor's for its corresponding MBS index using a model to estimate prepayment risk; columns 2 and 3 also control for the duration of FNMA and FHLMC MBS. Standard errors are HAC robust up to 3 quarters.

Table A3: Liquidity Premium and the LCR Announcement (Alternative Data Source)

Outcome:	$\log(\text{OAS}_{s,t})$	$\log(\frac{\text{OAS}_{\text{FN},t}}{\text{OAS}_{\text{GN},t}})$	$\log(\frac{\text{OAS}_{\text{FH},t}}{\text{OAS}_{\text{GN},t}})$
$\text{PostLCR}_t \times$ GNMA_s	-0.119		
	(0.000)		
PostLCR_t		0.058	0.074
		(0.020)	(0.099)
Agency FE	Yes	No	No
Quarter FE	Yes	No	No
Prepayment Controls	Yes	Yes	Yes
R-squared	0.991	0.865	0.675
Number of Observations	21	7	7

Note: P-values are in parentheses. The notation, sample period, controls and standard errors are the same as in Table A2. The difference is that the $\text{OAS}_{s,t}$ and effective duration data now come from Standard & Poor's.

Table A4: MBS Prices for TBA Market and Alternative Sample Periods

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, based on TRACE data. $PostLCR_t$ 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 effective duration of FNMA and FHLMC MBS. Standard errors are HAC robust up to 9 months.

Table A5: Robustness: LCR, FHA Denials and Nonbanks 2013 to 2014

	$\text{Denied}_{i,l,t}$		
$M_t^{GNMA}=$	PostLCR_t	$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right)$	$\log\left(\frac{OAS_t^{FHLMC}}{OAS_t^{GNMA}}\right)$
$M_t^{GNMA}\times\text{NDI}_l$	-0.059	-0.208	-0.138
	(0.048)	(0.000)	(0.000)
Borrower Controls	Yes	Yes	Yes
Lender-MSA FE	Yes	Yes	Yes
Post-LCR Indicator	Yes	Yes	Yes
R-squared	0.024	0.028	0.028
Number of Observations	1,387,277	1,387,277	1,387,277

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 $t = 2014$. OAS denotes the option-adjusted spread computed by Bloomberg. 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 consists of applications for FHA loans for the purchase of an owner-occupied single-family dwelling from 2013 through 2014. Standard errors are heteroskedasticity robust.

Table A6: Robustness: LCR, FHA Denials and Securitization Rate Among Depository Institutions

	$\text{Denied}_{i,l,t}$		
$M_t^{GNMA} =$	PostLCR_t	$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right)$	$\log\left(\frac{OAS_t^{FHLMC}}{OAS_t^{GNMA}}\right)$
$M_t^{GNMA} \times \text{Sec Rate}_{l,2011}$	0.018	-0.096	-0.094
	(0.033)	(0.000)	(0.000)
Borrower Controls	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes
Lender-MSA FE	Yes	Yes	Yes
Post-LCR Indicator	Yes	Yes	Yes
R-squared	0.089	0.089	0.089
Number of Observations	617,221	617,221	617,221

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. Sec Rate is the ratio of securitized loans to total originations in 2011. The remaining notation, controls, sample, and standard errors are the same as in Table 2. The sample only includes depository institutions.

Table A7: Robustness: LCR and FHA Originations

	$\text{Originations}_{i,l,t}$	
$\text{PostLCR}_t \times$ NDI_l	0.017	
	(0.000)	
$\text{PostLCR}_t \times \text{Sec Rate}_{l,2011}$		0.031
		(0.000)
Sample	All	All
Borrower Controls	Yes	Yes
Bank Controls	No	No
Lender-MSA FE	Yes	Yes
Post-LCR Indicator	Yes	Yes
R-squared	0.086	0.084
Number of Observations	2,809,984	2,777,149

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. The notation, controls, sample, and standard errors are the same as in Tables 2 and 3.

Table A8: Robustness: Placebo: 2007-2010

	$\text{Denied}_{i,l,t}$	
$\text{Post2009}_t \times$ NDI_l	0.004	
	(0.013)	
$\text{Post2009}_t \times \text{Sec Rate}_{l,2011}$		-0.006
		(0.232)
Borrower Controls	Yes	Yes
Lender-MSA FE	Yes	Yes
Post-2009 Indicator	Yes	Yes
R-squared	0.133	0.132
Number of Observations	1,143,124	1,137,327

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. The sample period is 2007-2010. Post2009 denotes whether $t \geq 2009$. NDI indicates whether the lender is a non-depository institution. Sec rate denotes the fraction of originated loans that a lender subsequently securitized and sold in 2011. The remaining notation, controls, sample, and standard errors are the same as in Tables 2 and 3.

Table A9: Robustness: LCR, FHA Denials and Deposit Ratio

	Denied$_{i,l,t}$		
M_t^{GNMA} =	PostLCR$_t$	$\log\left(\frac{OAS_t^{FNMA}}{OAS_t^{GNMA}}\right)$	$\log\left(\frac{OAS_t^{FHLMC}}{OAS_t^{GNMA}}\right)$
$M_t^{GNMA}\times$ (1 - Dep Ratio$_{l,2011}$)	-0.004	-0.316	-0.306
	(0.790)	(0.000)	(0.000)
Borrower Controls	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes
Lender-MSA FE	Yes	Yes	Yes
Post-LCR Indicator	Yes	Yes	Yes
R-squared	0.088	0.088	0.088
Number of Observations	589,199	589,199	589,199

Note: Subscripts i, l, and t denote borrower, lender, and year, respectively. P-values are in parentheses. Dep Ratio is the ratio of total deposits to total assets in 2011. Bank controls are the lagged log of total assets and the lagged ratios of: net income to total assets, loss provisions to total assets, and total equity to total assets. The remaining notation, controls, sample, and standard errors are the same as in Table 2.