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# Clogged Intermediation: Were Home Buyers Crowded Out?\*

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## Abstract

Post-crisis policy interventions significantly increased the demand for mortgage refinancing, but could this surge in refinancing applications have crowded out the supply of credit to home buyers? In this paper, we examine two frictions that hamper financial intermediation and result in banks' substitution of home purchase loans for refinance loans: The risk capacity channel through which banks with limited risk appetites prefer safer loans over riskier loans, and the operating capacity channel through which banks with limited operating capacities prefer applications that require less screening time. We find that following the recent financial crisis, banks facing these capacity constraints indeed rationed credit to home purchase borrowers.

**Keywords:** Credit rationing, mortgage lending, post-crisis slump, monetary transmission, distributional effects

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# 1. Introduction

It is widely documented that home buyers had limited access to credit during and after the Great Recession,<sup>1</sup> despite the policy interventions that were put in place to lower the bars for credit access. The Federal Reserve’s monetary stimulus, often referred to as Quantitative Easing (QE), did result in an increase in mortgage borrowing, but the increase was driven by refinancing loans instead of loans for home purchases. Figure 1 reports the aggregate trend in mortgage applications by loan type using the Home Mortgage Disclosure Act (HMDA) data. The figure clearly shows that the increase in loan applications after 2008 Q4 was mostly due to the increase in mortgage applications for refinances not for home purchases. The difference between refinance mortgages and home purchase mortgages becomes even more dramatic when we compare the number of mortgages originated or the amounts of mortgages originated as in Figure 2 and 3.

A natural question is whether it was due to the credit rationing to home buyers during this period, not merely due to the weaker demand for credit, and if so, what frictions contributed to the credit rationing on the supply side. More specifically, is it possible that the increase in mortgage originations for refinance during this period crowded out the credit availability to potential home buyers due to some frictions in credit supply? This question not only has implications on the distribution of credit to different borrowers, but also has a macroeconomic implication—if home buyers’ marginal propensities to consume are greater than that of refinancing borrowers,<sup>2</sup> then this crowd-out effect caused by the financial intermediation frictions could impede the transmission of monetary policy and dampen the policy impact on stimulating aggregate output.

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<sup>1</sup>For instance, “Lopsided Housing Rebound Leaves Millions of People Out in the Cold” from the Wall Street Journal (<https://www.wsj.com/articles/lopsided-housing-rebound-leaves-millions-of-people-out-in-the-cold-1470852996>) notes that “The housing recovery that began in 2012 has lifted the overall market but left behind a broad swath of the middle class, threatening to create a generation of permanent renters and sowing economic anxiety and frustration for millions of Americans.”, and “The lopsided recovery has shut out millions of aspiring homeowners who have been forced to rent because of damaged credit, swelling student loans, tough credit standards and a dearth of affordable homes, economists said.”

<sup>2</sup>The marginal propensity to consume is documented to be higher for poorer (Mian et al. (2013)), lower income (Di Maggio et al. (2017)), and lower credit scores (Agarwal et al. (2015)) households.

In this paper, we propose and test two channels that are likely to have impeded the financial intermediation function of banks and contributed to this crowd-out effect: the risk capacity channel and the operating capacity channel. When banks face these capacity constraints, they would try to substitute home purchase loans with refinance loans. We argue that both of these capacity constraints became more binding after 2008, and examine whether banks with more limited capacities during this period chose to originate more refinance loans but limited the origination of home purchase loans.

With frictionless financial intermediation, a lending bank should be able to originate any mortgages, regardless of whether they are for home purchases or refinances, as long as they are profitable. Here, loan origination decisions would be made based solely on loan and borrower characteristics. With intermediation frictions imposing certain capacity limits, however, the origination decisions across loans might not be independent: the addition of one loan could affect the origination decisions of the others.

The first friction, referred to as the risk capacity channel, arises when banks have limited capacity for risk taking, due to, for instance, depleted capital and/or stricter regulations. When this is the case, a bank should on the margin prefer less risky loans to riskier loans, holding the profitability of those loans fixed, because riskier lending would require more economic (or regulatory) capital to hold against. As refinance mortgages are less risky than home purchase mortgages for lending banks with access to the borrowers' credit information and/or soft information about the local areas (Gilje et al. (2016)), a bank with limited risk capacity would tilt its mortgage portfolio towards refinance loans over home purchase loans.

The second friction, referred to as the operating capacity channel, arises from loan officers' limited capacity for processing and screening loan applications (Sharpe and Sherlund (2016), Fuster et al. (2017)). If the operating capacity binds such that a loan officer is sitting on a pile of (unfinished) applications, she would select applications that take less time to screen, which would tilt her preference towards less labor intensive refinance loans to home purchase loans.

We implement our empirical analyses using the bank-level quarterly panel data from 2004 to 2013, matching the mortgage application/origination information in HMDA data with bank characteristics in Call Reports. In testing the risk capacity channel, we exploit cross-sectional variation in banks' capitalization, measured by the tier 1 capital ratio. In testing the operating capacity channel, we construct a measure of banks' "operating capacity" using the unique feature of the confidential HMDA data managed by the Federal Reserve Board, providing information on two important dates for each loan application: application date and action (origination decision) date. First of all, knowing these two dates enables us to match the banks' loan origination activities to quarterly bank characteristics at a frequency that links the two more closely than the annual frequency provided in the public version of HMDA. Second, we are able to capture how many days a lender spent screening a given application, as well as the fraction of "uncompleted" applications at a certain point in time, which supposedly captures the degrees of operating capacity faced by different banks. We exploit cross-sectional variation in banks' "operating slack" as explained above, measured by the fraction of uncompleted applications at the end of each quarter out of the total applications received in that quarter, after controlling for bank-level average screening time per application.

We argue that both of these capacity constraints would bind for (at least certain) banks after 2008 Q4. Risk capacity binds more due to banks' low risk appetite, stricter risk management, and regulatory burden. Operating capacity binds more due to the surge in mortgage applications, as well as stricter risk management requiring more careful screening of the loan applications. Therefore, we test whether, relative to their lending patterns during 2004-08, banks with limited risk/operating capacity *increased* refinance originations but *decreased* home purchase originations in comparison with banks that have more slack in these capacities. We find that the substitution effect—preferring refinance loans to home purchase loans—is indeed stronger for banks with limited capacities (both risk capacity and operating capacity) during 2009-13.

In examining the credit supply channel, it is critical to control for any factors that might be

related to the demand side for identification. For the risk taking channel, it is possible that the undercapitalized banks mainly operate in local markets that have been affected more heavily by the housing bust, and thus face lower demand for home purchases, instead of *actively* avoiding these loans. However, if this differential demand factor drives our results, then it should not explain why these banks originated *more* refinance loans as the refinancing demand in these local markets, which is a function of LTV, would also have been weaker. Nonetheless, we include  $HQ \times Year$  fixed effects in our bank-level panel regressions to control for the variations in local economic conditions, where  $HQ$  stands for the location (state) of a bank's headquarter, hence comparing banks with varying capacities within their local markets. We further estimate mortgage application-level regressions on the loan approval decision (approved or denied) where we can control for local (county level) economic characteristics more tightly. Our findings are robust.

The operating capacity channel would also be affected by the risk-taking capacity as banks with limited risk capacity would implement more careful screening processes. We attempt to isolate the operating capacity channel from the tighter risk capacity channel by identifying the operating capacity that was mainly affected through increased loan applications stimulated by policy interventions. Specifically, we control for quarterly bank-level average screening times, which allows us to compare banks with different levels of “uncompleted” applications while requiring the same processing time per application. We further analyze *within-bank* variations by comparing the counties with limited operating capacity to the counties with sufficient operating capacity for the *same* bank. Assuming a bank would impose the same lending standards across different markets, this within-bank analysis helps us isolate the operating capacity channel from the risk capacity channel.

Our results imply that banks with limited capacities would try to substitute the credit to potential home buyers with the credit to refinancing borrowers, who are existing home owners. Note that, all else being equal, this substitution would prevail more often if there is an exogenous increase in refinancing demand, e.g. monetary policy stimulus. When banks are

facing binding capacity, the monetary stimulus would induce an increase in both refinancing and home purchase demand, but banks might substitute toward refinance originations and away from home purchase originations. This not only limits the credit access of certain borrowers, possibly those that are younger or less wealthy, but there could be a macroeconomic effect if these rationed borrowers have a greater marginal propensity for consumption.

Our first contribution is to the emerging literature that analyzes distributional effects of post-crisis policy interventions. Beraja et al. (2017), focusing on monetary policy transmission, find that the Federal Reserve's QE amplified existing regional disparities, while Agarwal et al. (2015) and D'Acunto and Rossi (2017) analyze credit redistribution among heterogeneous households after the recent financial crisis. More generally, examining the transmission of monetary policy across the heterogeneous agents in the economy, Di Maggio et al. (2017) and Ippolito et al. (2015) empirically document the responses of heterogeneously indebted agents. Auclert (2015), Choi et al. (2017), Kaplan et al. (2016) build a theoretical model of monetary transmission with heterogenous agents. We study the distributional effect of post-crisis policy interventions by the tenure status of households.

This paper is also related to recent studies examining the effect of post-crisis monetary stimulus on mortgage supply (Scharfstein and Sunderam (2016), Chakraborty et al. (2016), Rodnyansky and Darmouni (2017), and Di Maggio et al. (2016)). Scharfstein and Sunderam (2016) find that market frictions (limited competition) hamper the stimulus effects, and Chakraborty et al. (2016) document a crowd-out effect that the expansion in banks' mortgage lending during the QE periods reduced commercial lending. We study the crowd-out effect from refinance mortgages to home purchase mortgages, which may hamper the stimulus effect through the heterogeneity in marginal propensity to consumption. Sharpe and Sherlund (2016) and Fuster et al. (2017) study the role of operating capacity in monetary transmission. These two papers analyze the intermediary sector as a whole, while we focus on the micro level variation for an identification of this channel.

More broadly, this paper is related to the literatures on monetary policy transmission

through the bank lending channel (Bernanke and Blinder (1992); Kashyap and Stein (1995); Peek and Rosengren (2000); and Kashyap and Stein (2000)). Recent literature on risk taking channel (Peydró and Maddaloni (2011); Borio and Zhu (2012); Dell’Ariccia et al. (2013); and Jiménez et al. (2014)) suggests that banks would *lend more* to “riskier” borrowers in response to monetary loosening, while we find that this is not the case when banks’ risk capacity is limited—riskier borrowers could on the contrary get *crowded out* as banks face an increase in credit demand of “safer” borrowers. Hence, while our analysis mainly focuses on the distributional impact, this mechanism has novel implications on monetary policy transmission through the banking sector, both with the bank lending channel and the risk taking channel.

Our paper proceeds as follows. In Section 2, we develop our empirical hypothesis. In Section 3, we discuss our data. The empirical findings are presented in Section 4. We conclude in Section 5.

## 2. Empirical Hypothesis

In this section, we develop our testable hypotheses on bank mortgage credit supply. In a frictionless economy, a lending bank should be able to originate all mortgages, regardless of whether they are for home purchase or refinance, as long as they are profitable. Therefore, loan origination decisions should be independent across different applications, and be made solely based on loan and borrower characteristics. With financial frictions, however, the origination decisions across loans might not be independent from each other, as the lender would face certain capacity limits. In some cases, when considering refinance loans and home purchase loans, lenders might prefer one to the other. We suggest and test two frictions that could have impeded the intermediation process that lead banks to substitute home purchase originations with refinance originations during and after the Great Recession.



## 2.1. Risk capacity channel

The first constraint, the risk capacity channel, stems from banks' limited capacity for risk taking. Suppose that a bank becomes thinly capitalized, or its risk appetite becomes constrained due to, for instance, more careful risk management or stricter regulatory requirements. Then, the bank should on the margin prefer less risky loans to riskier loans, holding the profitability of those loans fixed, because the bank would be required to hold more economic (or regulatory) capital against riskier lending.

Mortgage origination adds risk to banks' balance sheets. When the "risk capacity" for banks binds, this could affect banks' preferences on the margin between the two mortgage types, i.e., home purchase and refinance. Between the two types of mortgage originations, the latter can be less risky than the former from the lending banks' perspectives, as banks can observe the previous payment history and/or obtain soft information about the borrowers and local areas (Gilje et al. (2016)). Therefore, all else being equal, a bank with limited risk capacity would tilt its mortgage loan portfolio towards refinances over home purchases. We thus have the following prediction:

***Hypothesis 1:** If a bank's risk capacity is binding, it would choose to reduce home purchase mortgage originations and increase refinance mortgage originations, compared to banks with non-binding risk capacity.*

If a bank's risk capacity is perfectly slack, it should in principle be able to originate all profitable mortgages. Here, loan origination decisions are independent across the loans. On the other hand, a bank wouldn't be able to take on any additional risk when faced with strictly binding risk capacity. However, it could still substitute riskier loans (home purchases) for less risky loans (refinancing loans) to increase the number of originated loans given the binding constraint. This substitution effect would become more pronounced if a bank faces an exogenous surge in refinancing applications, for instance due to monetary loosening.

Regarding the recent financial crisis and the recession following Lehman Brothers' failure in the fourth quarter of 2008, we suppose that risk capacity mattered more during the post-crisis period (“*post* period”) after Lehman’s failure compared to the pre-crisis period (“*pre* period”). This could be due to stricter capital requirements, changes in risk perception and appetite, more illiquid secondary markets and greater putback risk, or increased risk in mortgage origination itself with less valuable collateral. Therefore, the substitution effect should become more pronounced during the post period than the pre period. Note that this change would apply to all banks as it is driven by the change in the aggregate environment. In addition, note that risk capacity would more likely to bind if a bank is thinly capitalized. Therefore, we have the following predictions:

***Hypothesis 1’:** Banks would have a stronger preference for refinance mortgages over home purchase mortgages in the post period relative to the pre period. This substitution effect would be more pronounced for under-capitalized banks.*

## **2.2. Operating capacity channel**

The second constraint, denoted as the operating capacity channel, arises from loan officers’ limited capacities for processing and screening mortgage applications. All else equal, a loan officer without a binding operating constraint should be indifferent between the two types of mortgage applications. However, if the operating capacity binds such that a loan officer is sitting on a pile of (unfinished) applications, she would wish to process more applications per unit hour and would choose applications that takes less time to screen (Sharpe and Sherlund (2016)). This would result for her to processing loan applications that require less screening time first.

Figure 4 shows the time series of average loan processing time by loan type using HMDA. We define the average difference between the loan application date and the decision date in a quarter as the banks’ loan processing time for the quarter. Panel *B* of Figure 4 compares the

average processing time of home purchase mortgages and refinance mortgages from 2004 to 2014. As presented in the figure, refinance applications usually take less time to screen than home purchase applications.<sup>3</sup>

Again, this could be in part due to previously acquired credit information and soft information about the borrower and the local areas, particularly so if the lenders are current servicers of the loans. Or it could be simply due to less “labor” required for refinance applications for not having to check multiple legal issues.<sup>4</sup> Therefore, all else being equal, banks with limited operating capacities would tilt their mortgage portfolios towards refinance mortgages over home purchase mortgages, compared to banks with sufficient operating capacity. Hence, we have the following prediction:

***Hypothesis 2:*** *If a bank’s operating capacity binds, it would prefer processing refinance mortgage applications first, thus resulting in a higher volume of refinance originations and fewer home purchase originations.*

We now focus on the comparison of operating capacity before and after 2008 Q4. As can be seen in Figure 1, total mortgage applications partly recovered following the crisis, which were likely driven by an increase in refinance applications in response to policy interventions such as QE (Quantitative Easing) or HARP (Home Affordable Refinance Program). However, Figure 4 suggests that the average screening time per application increased significantly after 2008, indicating that more banks had reached their operating capacities during this period (Sharpe and Sherlund (2016), Fuster et al. (2017)). Hence, this capacity concern could have led to more refinance originations that further crowded out home purchase originations during this period. Furthermore, this substitution effect would be particularly pronounced among banks

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<sup>3</sup>This interpretation should come with the caveat that we do not control for loan and/or lender characteristics. The average screening time for refinancing loans increases rapidly in 2012 and 2013, possibly reflecting the rapid increase in the refinance applications during this time period (see Figure 1).

<sup>4</sup>For instance, Buchak et al. (2017) note that for refinancing screening, “lender benefits from many on-the-ground activities, such as a title check, structural examination, negotiations between buyer and seller, having already taken place at the time of purchase”.

faced with binding operating capacity constraints. We thus have the following predictions:

***Hypothesis 2’:** Banks would have a stronger preference for refinance mortgages over home purchase mortgages in the QE-period relative to the pre-QE period. This substitution effect would be more pronounced for banks with limited operating capacity.*

### 3. Data and Summary Statistics

We use confidential HMDA loan application data from 2004:I to 2013:IV<sup>5</sup> in order to construct bank-quarter data on banks’ mortgage origination activities. According to the HMDA reporting guide by the Federal Financial Institutions Examination Council (FFIEC), the confidential HMDA provides the exact loan application dates and decision dates (approved or denied) while the publicly available HMDA only reports the year of mortgage originations.<sup>6</sup> Having these two dates information enables us to link banks’ loan origination activities to quarterly bank characteristics. We include conventional mortgages for the property type of one-to-four family to aggregate banks’ mortgage originations by loan purpose: refinance and home purchase.<sup>7</sup>

To construct variables for quarterly bank characteristics, we collect quarterly data from the Federal Reserve’s Report of Condition and Income (“Call Reports”). First, we merge the Call Report data with HMDA through the RSSD IDs. We then aggregate all subsidiaries of a bank into a top holder. For banks that have the Call Report item RSSD9348 (RSSD ID of the top holder) populated, we aggregate the bank-level variables by RSSD9348.<sup>8</sup> For banks that do not have the RSSD9348 field populated, we use their Call Report data and interpret

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<sup>5</sup>On December 18, 2013 FOMC announced the “tapering” of QE3.

<sup>6</sup>See <https://www.ffiec.gov/hmda/pdf/2013guide.pdf>, or [https://www.federalreserve.gov/files/pia\\_hmda.pdf](https://www.federalreserve.gov/files/pia_hmda.pdf).

<sup>7</sup>Home purchase loans include the loans with home purchase as the loan purpose in HMDA. Refinance loans include the loans with refinance and home improvement as the loan purpose field in HMDA.

<sup>8</sup>We drop bank-quarter observations when the top holder ID changes to minimize the effect from merge and acquisition activities.

these as stand-alone commercial banks. For each quarter, our sample consists of 3250 banks on average.<sup>9</sup>

Table 1 reports the summary statistics of variables at the bank-level. Panel *A* reports the summary statistics based on all sample observations. Refinance(#) is the number of mortgage origination for refinance by a bank in a quarter, which has a mean of 200.12 and a standard deviation of 3070.67. Refinance(\$) is the amount of mortgage origination for refinance by a bank in a quarter, which has a mean of 35.90 mils and a standard deviation of 662.27 mils. Purchase(#) is the number of mortgage origination for home purchase by a bank in a quarter, which has a mean of 94.31 and a standard deviation of 1635.80. Purchase(\$) is the amount of mortgage origination for home purchase by a bank in a quarter, which has a mean of 19.96 mils and a standard deviation of 380.41 mils.

Bank characteristics we mainly control in our analysis are reported. Quarterly bank control variables are winsorized at 0.5% and 99.5% levels. Assets is the bank's total assets in millions US dollar, which has a mean of 3.2 billion with a standard deviation of 47 billion. Liquid Asset Ratio is the ratio of liquid assets (sum of cash, fed funds lending and reverse repo, and securities holding) to bank assets to control for asset liquidity, which has a mean of 0.28 with a standard deviation of 0.13. Loan to Deposit Ratio is the ratio of total loan to total deposit, which has a mean of 0.82 with a standard deviation of 0.18. RE Loan to Total Loan Ratio is the ratio of real estate loans to total loans, which has a mean of 0.76 with a standard deviation of 0.14. CI Loan to Total Loan Ratio is the ratio of CI loans to total loans, which has a mean of 0.06 with a standard deviation of 0.09. NPL Ratio is the ratio of non-performing loan in total loan, which has a mean of 0.02 with a standard deviation of 0.02. Tier 1 Capital Ratio is the ratio of a bank's tier 1 asset to total assets to control for bank soundness, which has a mean of 0.14 with a standard deviation of 0.4.

In addition, we construct variables for measuring operating capacity using the unique feature of confidential HMDA having exact date of application and decision. We calculate the

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<sup>9</sup>We drop bank-quarter samples if the bank had more than a 10% change in total assets in a quarter, following Campello (2002). We only include banks with all control variables.

fraction of “uncompleted” applications as of the last date of each quarter out of the total applications received in that quarter, which enables us to capture the measure of Operating Capacity faced by different banks. That is, we associate a higher fraction of incomplete applications with a lower operating capacity for that bank since it is rolling over most of its applications unfinished to the next quarter. Operating Capacity has a mean of 0.31 with a standard deviation of 0.17. That is, on average, 31% of loans applied are not fully processed in that quarter. We also calculate the average number of days spent screening an application as the Loan Processing Time for a bank in a quarter. Loan Processing Time has a mean of 33.66 with a standard deviation of 16.04. That is, on average, it takes 33.66 days to make a decision on a loan application.

Loan-level characteristics are also reported. *I*\_Refinance is a dummy variable that equals 1 if the loan type is refinance mortgage and 0 otherwise. In our sample, 69% of applications are for refinance and 31% of applications are for home purchase. *I*\_Loan Approval is a dummy variable that equals to 1 if the loan is being approved and 0 otherwise. On average, 52% of applied loans are approved. *log* Income is the log of household income as of mortgage application. Loan to Income is the ratio of loan amount to income, where the mean is 2.07 with a standard deviation of 1.5. We also report the county level control variables that is associated with mortgage application. Average population of counties are about 380,000, with average Income per Capita of \$39,000, average Unemployment rate of 6.66%. Average home price index (HPI) is 153.32 using county level HPI from the CoreLogic.

Panel *B* reports the summary statistics by the Tier 1 Capital level. Low Tier 1 Capital is a dummy variable for bottom 25% banks with low Tier 1 Capital Ratio. The top panel reports the summary statistics of banks in Low Tier 1 Capital group and bottom panel reports the summary statistics of the others. The average Tier 1 Capital Ratio in the top panel is 0.09 whereas the average Tier 1 Capital Ratio in the bottom panel is 0.16. Banks in Low Tier 1 Capital groups are on average, larger in size, lower in Liquid Asset Ratio, higher in Loan to Deposit Ratio and higher in CI Loan to Total Loan Ratio. We also find that the banks in

Low Tier 1 Capital groups reject more application while other loan characteristics are quite similar.

Panel *C* reports the summary statistics by the Operating Capacity. Low Operating Capacity is a dummy variable for top 25% banks with high Operating Capacity. The top panel reports the summary statistics of banks in Low Operating Capacity group and the bottom panel reports the summary statistics of the others. The average Operating Capacity in the top panel is 0.57 whereas the average Operating Capacity in the bottom panel is 0.26. Banks in Low Operating Capacity groups are on average, larger in size and longer in loan process time.

## 4. Empirical Results

We start with a visual inspection of the aggregate trend in mortgage originations. Figures 2 and 3 present the time series of the number and the amount of originations for refinance and home purchase mortgages from HMDA data. Panel *A* includes all lenders in HMDA whereas Panel *B* includes bank lenders only. One of the main differences in two Panels is the originations before 2008: originations decline before 2008 in Panel *A* but not in Panel *B*. After 2008, most of the changes in originations come from bank lenders.

Our main interest of this study is in bank lenders and Panel *B* of Figure 2 and 3 show that home purchase mortgage originations by banks plunged in 2008 and stayed low afterwards, while refinance mortgage originations picked up relatively quickly. While this difference may be due to relatively weak demand for home purchase mortgages, we find that the approval rate for refinancing applications also rebounded much more sharply after the crisis as in Panel *B* of Figure 5. These two figures suggest a possible interpretation that lenders were more likely to approve and originate refinance loans than home purchase loans after the crisis and during the QE period, that is, after 2008 Q4, which we refer to as the *post* period.

We analyze bank-level lending activity and find a similar relation. Specifically, we estimate

the following quarterly panel regression:

$$Y_{it} = \alpha_q + \alpha_i + \beta \cdot \text{I.Post} + \gamma \cdot X_{i,t-1} + \epsilon_{it} \quad (1)$$

where I.Post equals 1 for the *post* period of 2009 Q1 to 2013 Q4, and zero otherwise, which we refer to as the *pre* period. The dependent variables are total mortgage originations by bank  $i$  at period  $t$ , for (i) refinances, (ii) home purchases, or (iii) the difference between the two. Bank controls  $X_{i,t-1}$  include 1 quarter lagged bank characteristics such as log Assets, Liquid Asset Ratio reflecting asset liquidity, Loan to Deposit Ratio reflecting the asset-liability maturity mismatch as well as loan demand, real estate (RE) and C&I (CI) Loans to Total Loan Ratio to reflect business models, non-performing loan (NPL) Ratio, and Tier 1 Capital Ratio to reflect financial soundness. We include bank fixed effects  $\alpha_i$  and quarter fixed effects  $\alpha_q$ , a dummy for each quarter of the year to account for seasonality in mortgage origination. All standard errors are clustered by bank.

Our main variable of interest is the coefficient  $\beta$ , and we are particularly interested in its sign which indicates whether banks (i) increased their refinance mortgage originations, and (ii) decreased their home purchase mortgage originations during the *post* period, relative to their lending during the *pre* period. We also examine whether the divergence in bank lending between refinances and home purchases widened during the *post* period.

[ Table 2 here ]

Table 2 reports the panel regression estimation results. Panel A reports the results using the total amount of mortgage originations as a dependent variable. Column (1) uses the log total amount of refinance mortgage originations by a bank in a quarter ( $\log\text{Refi}\$$ ), column (2) uses the log total amount of home purchase mortgage originations by a bank in a quarter ( $\log\text{P}\$$ ), and column (3) uses the difference of the two mortgage originations, i.e., (1)-(2). We find that refinance origination significantly increased but home purchase origination significantly decreased during the *post* period relative to the *pre* period. The coefficient for the



difference between the two originations is also positive and significant. The specifications in columns (4)-(6) are similar to columns (1)-(3) except for the inclusion of bank fixed effects, and we find similar changes in mortgage origination practices within banks during the *post* period. Panel *B* reports the estimation results using the total number of mortgage originations as the dependent variable ( $\log Refi\#$ ,  $\log P\#$ ). The estimation results are similar.

Overall, the table suggests that, relative to the *pre* period of 2004–2008, banks originated more refinance mortgages but less home purchase mortgages during the *post* period of 2009–2013. However, it is not clear how much of this change is driven by the credit supply channel as we don’t control for the demand side factors. For instance, refinancing demand could have surged after 2008 Q4 while home purchase demand plunged. And the passive response from banks to this change in credit demand could have resulted in the findings from the above regressions, even without banks’ active adjustment in their lending practices between two types of loans. To identify the bank supply channel from the demand channel, in the following sections, we focus on the cross-sectional variations in bank characteristics that could reflect frictions in financial intermediation, such as risk capacity and operating capacity, and examine how these associate with banks’ lending behavior.

#### 4.1. Testing the Risk Capacity Channel

We first test *Hypothesis 1*’ of Section 2, examining whether banks’ risk taking capabilities affect their origination decisions between refinance and home purchase mortgages. We expect that thinly-capitalized banks would shift their lending toward more refinances while limiting lending for home purchases after 2008 Q4, relative to better-capitalized banks. We conduct a bank-level analysis augmenting the previous regression specification. In particular, we estimate the following panel regression:

$$Y_{it} = \alpha_y + \alpha_q + \alpha_i + \alpha_{HQ,y} + \beta \cdot \text{I.Post} \times \text{Low Tier 1 Capital}_{i,t-1} + \phi \cdot \text{Low Tier 1 Capital}_{i,t-1} + \gamma \cdot X_{i,t-1} + \epsilon_{it} \quad (2)$$

where Low Tier 1 Capital $_{i,t-1}$  equals 1 if a bank’s tier 1 capital ratio belongs to the bottom quartile in the previous quarter, and zero otherwise. As before, I\_Post equals 1 for the *post* period of 2009 Q1 to 2013 Q4, and zero otherwise.  $\alpha_y$  is the year fixed effect,  $\alpha_q$  is the quarter fixed effect,  $\alpha_i$  is the bank fixed effect, and  $\alpha_{HQ,y}$  is the *Headquarter State*  $\times$  *Year* fixed effect based on banks’ headquarter locations (states).  $X_{i,t-1}$  includes 1 quarter lagged controls for bank characteristics such as log Assets, Liquid Asset Ratio, Loan to Deposit Ratio, RE Loan to Total Loan Ratio, CI Loan to Total Loan Ratio, and NPL Ratio. Again, our coefficient of interest is  $\beta$ , the coefficient on the interaction between I\_Post and Low Tier 1 Capital $_{i,t-1}$ . As risk capacity measured by banks’ capitalization becomes binding during the *post* period, we expect a positive  $\beta$  for the origination of refinance mortgages, a negative  $\beta$  for the origination of home purchase mortgages, and a positive  $\beta$  for the difference between the originations of the two types of mortgages.

[ Table 3 here ]

Table 3 reports the estimation results. In Panel *A*, we use the total amount of mortgage originations as the dependent variable. Column (1) uses the log total amount of mortgage originations of refinance loans by a bank in a quarter (*logRefi\$*). We include year fixed effects ( $\alpha_y$ ) and quarter fixed effects ( $\alpha_q$ ). Due to the year fixed effects, we cannot identify I\_Post and only report its interaction with Low Tier 1 Capital $_{i,t-1}$ . We find that during the *post* period, thinly-capitalized banks originated more refinance loans than better capitalized banks. Column (2) uses the log total amount of mortgage originations of home purchase loans by a bank in a quarter (*logP\$*). We find that during the *post* period, thinly-capitalized banks originated less home purchase loans than better capitalized banks although the effect is statistically insignificant. Column (3) uses the difference in the two mortgage originations in columns (1)-(2). This can be interpreted as “business mix” captured by the ratio of refinancing originations to home purchase originations. We find statistically significant and positive  $\beta$ , which shows that the substitution effect was larger in thinly-capitalized banks during the *post* period than well-capitalized banks.

Note that there exists a confounding factor if local economic conditions affect both mortgage demand and banks' capital ratio in a certain way. That is, deteriorating local economic conditions could damage banks' capitalization and shrink demand for mortgages at the same time. To account for potential differences in local demand across states, in columns (4)-(6) we additionally control for bank fixed effects and *Headquarter State*  $\times$  *Year* fixed effects ( $\alpha_{HQ,y}$ ), which allows us to compare banks within a state.<sup>10</sup> Here, we test whether thinly capitalized banks, compared to other well-capitalized banks in the same local market, originated more refinance mortgages but less home purchase mortgages during the *post* period.

In column (4), we find that thinly-capitalized banks indeed originated significantly more refinancing mortgages than their counterparts in the same state during the *post* period. On the other hand, their home purchase originations were significantly lower than their better capitalized local peers as shown in column (5). This result mitigates some of the concern of the confounding effect through the demand channel. Suppose our results are driven by the demand effect, and also suppose that banks facing greater local refinancing demand also face greater local home purchase demand. In this case, if the Low Tier 1 Capital $_{i,t-1}$  banks are not actively choosing one type of mortgage over the other, then we should observe  $\beta$ s with the same signs for refinance and home purchase originations. On the contrary, we observe a positive  $\beta$  for refinances and negative  $\beta$  for home purchases, indicating the active portfolio adjustments by banks with limited risk capacities.

In column (6), we use the difference of two origination types as the dependent variable, which is a direct measure of shifts in lending practices. We find a positive and statistically significant  $\beta$ . Again, this coefficient should be insignificant if the thinly-capitalized banks are indifferent between the two types of mortgages, suggesting that the supply side through the risk capacity channel was affecting banks' lending behaviors.

Panel B reports the estimation results using the total number of mortgage originations as

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<sup>10</sup>We note that this is not an ideal control for large banks who operate in multiple states. However, most of our banks are small enough to be operating locally. For robustness, we run the same regression only using local banks, defined as banks that collect more than 90% of their loan applications from a single state to find the same results.

the dependent variable. The estimation results are similar and the substitution effect gets stronger.

Note that Low Tier 1 Capital $_{i,t-1}$  in Panel A and B defines the treatment group, i.e. banks with binding risk capacity, in each quarter by the lagged bank capital ratio and it allows the treatment group to vary over time. However, the capital ratio, even though we use a lagged variable, could be endogenous. In our alternative specification, we define the treatment group as those with low capital right before the treatment period, which is as of the end of 2008 Q4. In this diff-in-diff specification, we analyze how the thinly capitalized bank at the initiation of the *post* period adjusted their lending behavior during the *post* period, compared to their counterparts with more of a capital cushion.

The estimation results are in Panel C and D. Specifications are the same as in Panel A and B except we use Low Tier 1 Capital $_{2008,Q4}$  instead of Low Tier 1 Capital $_{i,t-1}$ . In column (5) of Panel C, we find that the thinly capitalized banks at the end of 2008 originated significantly fewer home purchase mortgages during the *post* period of 2009-2013 compared to their counterparts in the same market. We would naturally expect the same decrease in refinance originations for these banks (i.e. a negative  $\beta$  for columns 1 and 4), *unless* they have actively tilted their preferences to refinancing over home purchase loans. We indeed find that this is not the case—in both Panel C and D, the  $\beta$ s are positive, significant at the 1% level in column (1) although not statistically significant in column (4) with the full fixed effects. This result suggests that the risk capacity channel was operative even when we sort banks by capital ratio as of the end of 2008 Q4 to focus on the *within-bank* variation. In sum, banks with limited risk capacities preferred refinance mortgages to home purchase mortgages.<sup>11</sup>

We next implement a loan-level analysis which allows us to directly control local characteristics using the loan locations. Our loan level analysis focuses on approval/denial decisions of individual mortgage applications as a measure of lending behaviors. We examine whether during the *post* period after 2008 Q4, banks with limited risk capacities (i) loosened the

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<sup>11</sup>An overreaching speculation implies that new purchases could have been crowded out to a lesser extent if QE had not been implemented to stimulate the refinancing demand.

lending standard for refinance mortgages, while (ii) tightening the lending standard for home purchase mortgages, relative to their well-capitalized counterparts. Specifically, we estimate the following linear probability model:

$$\begin{aligned} \text{I\_Loan Approval}_{ilct} = & \alpha_y + \alpha_q + \alpha_i + \alpha_c + \beta \cdot \text{I\_Post} \times \text{Low Tier 1 Capital}_{i,t-1} \\ & + \phi \cdot \text{Low Tier 1 Capital}_{i,t-1} + \theta \cdot X_l + \gamma \cdot X_{i,t-1} + \kappa \cdot X_{c,t-1} + \epsilon_{ilct} \quad (3) \end{aligned}$$

where for loan  $l$  in county  $c$  by bank  $i$  at time  $t$ , I\\_Loan Approval equals 1 if approved and 0 if denied. In addition to the bank characteristics  $X_{i,t-1}$ , we also control for loan characteristics  $X_l$  such as income and loan to income ratio, and local economic characteristics  $X_{c,t-1}$ , i.e., log Population, log Income per Capita, unemployment rate, and Home Price Index, and county fixed effects ( $\alpha_c$ ). By thoroughly controlling for local economic conditions, we attempt to isolate changes in risk appetite across banks within a local area between the two types of mortgage applications. Our variable of interest is the coefficient  $\beta$  on the interaction of I\\_Post and Low Tier 1 Capital $_{i,t-1}$ .

[ Table 4 here ]

Panel A of Table 4 reports the regression results. Columns (1), (3), (5) report the loan approval for refinance mortgages whereas columns (2), (4), (6) report the loan approval for home purchase mortgages. Columns (1)-(2) only include year fixed effects and quarter fixed effects, columns (3)-(4) include additional bank fixed effects, and columns (5)-(6) include additional county fixed effects. In columns (5)-(6), which is our preferred specification with a full set of fixed effects, we find similar results to the bank-level results. During the *post* period after 2008 Q4, banks with low risk capacities were more willing to approve refinance mortgages (positive and statistically significant  $\beta$ ) while less willing to approve home purchase mortgages (negative and statistically significant  $\beta$ ) compared to banks with no binding risk capacity. In other words, they tightened their lending standards for home purchase mortgages while loosening the standards for refinance mortgages.

Panel B reports similar regression results except we use  $\text{Low Tier 1 Capital}_{2008.Q4}$ , a dummy variable that equals 1 for banks with bottom 25% tier 1 capital ratio right before the treatment period, instead of  $\text{Low Tier 1 Capital}_{i,t-1}$  as before. Results for this within-bank comparison are similar to Panel A.

## 4.2. Testing the Operating Capacity Channel

We first examine the time series variation in the average screening time for mortgage originations in Figure 4. Here, we plot the average number of days taken for an application to be approved/denied after the application dates. We find two interesting patterns regarding the screening time: (1) the average screening time per application increased rapidly after the Lehman failure in 2008 Q4 and also after the announcement of QE3 in September 2012, and (2) refinance loan screening is usually faster than home purchase loan screening.

Our main measure of bank-level operating capacity is the fraction of “incomplete” applications at the end of each quarter out of the total mortgage applications received in that quarter. That is, we associate a higher fraction of incomplete applications with a lower operating capacity for that bank since it is rolling over most of its applications unfinished to the next quarter. Note that this measure is particularly well-suited to our experiment setup, studying the effect after 2008 Q4—if banks face a relatively low volume of incoming mortgage applications and/or have a low average screening time, then the measure would be less informative in capturing cross-sectional variations in operating capacity. However, if banks face a surge in mortgage applications (e.g. due to the QE) and/or the average screening time gets longer as in the *post* period after 2008 Q4, then the measure would more effectively capture the cross-sectional variations in operating capacity of different banks.

We compare banks with ample operating capacity to banks with limited operating capacity, particularly examining how the lending patterns of the two groups differed in the *pre* period

and the the *post* period. Concretely, we estimate the following regression:

$$Y_{it} = \alpha_y + \alpha_q + \alpha_i + \alpha_{HQ,y} + \beta \cdot \text{I\_Post} \times \text{Low Operating Capacity}_{i,t-1} + \phi \cdot \text{Low Operating Capacity}_{i,t-1} + \gamma \cdot X_{i,t-1} + \epsilon_{it} \quad (4)$$

where  $\text{Low Operating Capacity}_{i,t-1}$  is a dummy variable that equals 1 for the top quartile banks in terms of the fraction of incomplete applications in the previous quarter, and zero otherwise. As before,  $\text{I\_Post}$  equals 1 for the *post* period of 2009Q1 to 2013Q4, and zero otherwise.  $\alpha_y$  is the year fixed effect,  $\alpha_q$  is the quarter fixed effect,  $\alpha_i$  is the bank fixed effect, and  $\alpha_{HQ,y}$  is the *Headquarter State*  $\times$  *Year* fixed effect.  $X_{i,t-1}$  includes 1 quarter lagged controls for bank characteristics such as log Assets, Liquid Asset Ratio, Loan to Deposit Ratio, RE Loan to Total Loan Ratio, CI Loan to Total Loan Ratio, NPL Ratio, and Loan Processing Time reflecting the average time to process mortgage originations. Our variable of interest is the coefficient  $\beta$  on the interaction of  $\text{I\_Post}$  and  $\text{Low Operating Capacity}_{i,t-1}$ .

Note that risk capacity could also affect the degree of operating capacity, as more careful risk management or tighter lending standards would require more careful screening all else being equal, and thus would consume extra operating capacity. Therefore, we control for the effect of changes in risk capacity on operating capacity by adding bank-level 4-quarter moving average loan processing times (Loan Processing Time).

[ Table 5 here ]

Table 5 presents the estimation results with all banks in our sample. Panel A and B use all banks in our sample. Panel A reports the results with the total amount of mortgage originations and Panel B reports the results with the total number of mortgage originations. Since the results are similar, we will discuss Panel A. Column (1) reports the regression results on the log amount of refinance mortgage originations, column (2) reports the results on the log amount of home purchase mortgage originations, and column (3) reports the results on the difference between the two dependent variables in columns (1)-(2). We find that, during

the *post* period, banks with low operating capacity increase refinance originations more but decrease home purchase originations more compared to the control groups. The difference between the two types of mortgage originations is statistically significant and positive.

Columns (4)-(6) are similar to columns (1)-(3) except with the addition of bank fixed effects and *Headquarter State*  $\times$  *Year* fixed effects. As discussed earlier, it would be important to control for the loan demand in local markets to isolate the supply-side effect. Hence, we control for the potential differences in mortgage demand by adding fixed effects for the banks' headquarter state by year. That is, we are comparing banks with low operating capacities to other banks with high operating capacities that are headquartered in the same state within a calendar year. Results are similar to columns (1)-(3). Compared to their *pre* period lending behaviors, banks with low operating capacities increased more refinancing originations but decreased more home purchase originations than their peers in similar local markets during the *post* period.

Nonetheless, there still can be local factors that might have affected our measure of low operating capacity and haven't been entirely controlled for. For instance, operating capacity will be lower if banks face stronger demand during the *post* period through monetary stimulus. Under the assumption that stronger local mortgage demand implies greater borrowing demand for *both* refinances and home purchases, this unexplained factor should work *against* our prediction of more originations in home purchase as well as refinancing for such banks. However, we find contrary results on home purchase originations. In that regard, our finding of the reduction in home purchase loans for banks with low operating capacity can be considered the lower bound of the actual effect.

To better control for local economic factors, we next limit our sample to *local* banks in Panel C and D. Here, we define local banks as those that collect more than 70% of their loan applications from a single MSA on average. On top of the same regression specification in Panel A and B, we then add county-level controls including log Population, log Income per Capita, unemployment rate, and home price index. Results are similar to what we find



in Panel A and B but the substitution effects are more pronounced, reflecting clearer cross-sectional comparisons after controlling for local factors that might have affected demand side effects on mortgage applications.

We next examine within-bank differences in order to better mitigate the confounding effects, such as differential demand across banks or changes in lending standards. Here, we compare a bank’s lending practices across different counties that the given bank operates in. We first calculate the county level operating capacity analogously as we did for the bank level operating capacity. For each bank at each time period, we then sort this bank’s “markets”, i.e., counties that this bank lends to, into two groups using the bank’s median operating capacity in counties—high operating capacity (supposedly less busy) counties and low operating capacity (busy) counties. We then examine whether a bank, during the *post* period, increased refinance originations but reduced home purchase originations in counties with limited operating capacity relative to its other non-busy counties. We thus run the following regression:

$$\begin{aligned}
 Y_{ict} = & \alpha_{i,t} + \alpha_{i,c} + \alpha_{MSA,t} + \beta \cdot \text{I.Post} \times \text{Busy County Within Bank}_{i,t-1} \\
 & + \phi \cdot \text{Busy County Within Bank}_{i,t-1} + \gamma \cdot X_{i,t-1} + \kappa \cdot X_{c,t-1} + \epsilon_{ict} \quad (5)
 \end{aligned}$$

where the dependent variables are the mortgage originations (refinances, home purchases, or the differences between the two) by bank  $i$  in county  $c$  at time  $t$ .  $\text{Busy County Within Bank}_{i,t-1}$  is a dummy variable that equals 1 if the county is below the median operating capacity among counties where the bank operates, and zero otherwise.  $\text{I.Post}$  equals 1 for the *post* period of 2009 Q1 to 2013 Q4, and zero otherwise.  $X_{i,t-1}$  includes 1 quarter lagged controls for bank characteristics such as log Assets, Liquid Asset Ratio, Loan to Deposit Ratio, RE Loan to Total Loan Ratio, CI Loan to Total Loan Ratio, NPL Ratio, and log Change in Total Application which reflects loan demand changes at the bank level.  $X_{c,t-1}$  includes county-level controls of the previous year such as log Population, log Income per Capita,

Unemployment Rate, and HPI.

We include several layers of fixed effects:  $\alpha_{i,t}$  is the bank-year-quarter fixed effect,  $\alpha_{i,c}$  is the bank-county fixed effect, and  $\alpha_{MSA,t}$  is the MSA-year-quarter fixed effect. The first effect takes out variations in lending behavior of a given bank over time, and the second effect takes out the differences in mean origination volumes across the different counties for a bank. The third effect takes out the variations in MSA-level activities, so that we can analyze different lending behaviors across the counties within a MSA for a given bank, which should face similar local economic conditions.

[ Table 6 here ]

Table 6 reports the estimation results. Without the effect of operating capacity on banks' preferences over the types of mortgages, we naturally expect that the variations in operating capacity (i.e. "busyness") across counties should reflect the differences in local loan demand. That is, we should observe tighter operating capacity in the counties with stronger loan demand, and in these regions, demand for both mortgage types should be stronger. However, our results are the opposite – during the *post* period after 2008 Q4, banks originated *less* home purchase mortgages in the counties where they have tight operating capacity as in columns (2) and (5), while originated *more* refinance mortgages in the same counties as in column (1) and (4).<sup>12</sup> The difference in the two types of originations is wider in counties with tighter operating capacity as in columns (3) and (6). These results support our view that the operating capacity channel contributes to the crowding out of home purchase loans.

### 4.3. Was There an Aggregate Effect?

So far, we find two supply side channels that contribute to banks' substitution of home purchase loans for refinance loans. However, this bank-level finding does not always imply that

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<sup>12</sup>Note that  $\beta$  in column (1) based on \$ amount is positive but insignificant. However, we think that the number of originations in column (4) should be a more accurate measure to examine the impact of operating capacity since loan officers care more about finishing incomplete application files that are in their to-do lists.

home purchase borrowers had less access to credit in their local markets—the limited credit supply by banks with binding capacity constraints could have been filled by other lenders in local markets, e.g., other banks with unconstrained capacity or non-banks.

Although the activity of non-bank lenders significantly declined after the financial crisis and most of the changes in originations were due to the changes in origination by bank lenders as in Figures 2 and 3, we further examine the county-level aggregate lending variations to analyze this possibility. We create county-level aggregate mortgage originations, including both banks and non-banks, and analyze how aggregate lending in a county with a constrained banking sector (either limited risk capacity or operating capacity) changed during the *post* period after 2008 Q4, compared to a county with a less constrained banking sector.

To define counties with a constrained banking sector, we calculate county-level risk capacity and county-level operating capacity measures. County-level risk capacity is a weighted average of banks' Tier 1 Capital Ratios, weighted by the number of mortgage applications of banks in the county. Low Tier 1 Capital $_{c,t-1}$  is a dummy that equals to 1 for counties in the bottom 25% in terms of county-level risk capacity, and zero for counties in the top 25% of the same measure. Hence, we compare counties in the bottom quartile to those in the top quartile. County-level operating capacity is an inverse of the weighted average fraction of banks' unprocessed mortgage applications, weighted by the number of mortgage applications of banks in the county. Again, Low Operating Capacity $_{c,t-1}$  is a dummy that equals 1 for counties in the bottom 25% in terms of county-level operating capacity, and zero for counties in the top 25% of the same measure.

We run the following yearly panel regressions:

$$Y_{ct} = \alpha_c + \alpha_{state,t} + \beta \cdot \text{LPost} \times \text{Low Tier 1 Capital}_{c,t-1} + \phi \cdot \text{Low Tier 1 Capital}_{c,t-1} + \gamma \cdot X_{c,t-1} + \epsilon_{ct} \quad (6)$$

for the risk capacity channel, and

$$Y_{ct} = \alpha_c + \alpha_{state,t} + \beta \cdot \text{I\_Post} \times \text{Low Operating Capacity}_{c,t-1} + \phi \cdot \text{Low Operating Capacity}_{c,t-1} + \gamma \cdot X_{c,t-1} + \epsilon_{ct} \quad (7)$$

for the operating capacity channel. I\_Post equals 1 for the *post* period of 2009 Q1 to 2013 Q4, and zero otherwise.  $X_{c,t-1}$  includes county-level controls from the previous year such as log Population, log Income per Capita, Unemployment Rate, and HPI. We include county fixed effects and State  $\times$  Year fixed effects. Our variable of interest is  $\beta$ , by which we compare well-capitalized counties (top quartile) to thinly capitalized counties (bottom quartile) on how aggregate mortgage originations of the two types changed during the *post* period.

[ Table 7 here ]

Table 7 reports regression results on the county-level risk capacity channel. Panel A reports results on the total amount of mortgage originations. Column (1) reports the regression results on the log amount of refinance mortgage originations, column (2) reports the results on the log amount of home purchase mortgage originations, and column (3) reports the results on the differences of the two dependent variables in columns (1)-(2). We find that the counties with low risk capacity had more refinance mortgage originations, but less home purchase mortgage originations than the counties with high risk capacity in the same state. The difference of the two in column (3) is positive and significant, which indicates the crowding out effect from refinance mortgages to home purchase mortgages. Columns (4)-(6) are similar to columns (1)-(3) except with the addition of county control variables. The results are similar but more significant. Panel B reports results on the total number of mortgage originations and finds similar but stronger effects.

Panel C and D also report regression results on the county-level risk capacity channel but with a different measure of county-level risk capacity. We use banks' Tier 1 Capital Ratio as

of 2008 Q4 to construct a dummy of Low Tier 1 Capital $_{c,2008.Q4}$ . Our findings are robust and significant.

[ Table 8 here ]

Table 8 reports regression results on the county-level operating capacity channel. Panel A reports results on the total amount of mortgage originations. Column (1) reports the regression results on the log amount of refinance mortgage originations, column (2) reports the results on the log amount of home purchase mortgage originations, and column (3) reports the results on the differences of the two dependent variables in columns (1)-(2). We find that the counties with low operating capacity had more refinance mortgage originations but less home purchase mortgage originations than the counties with high risk capacity in the same state. Note that the aggregate effect on home purchase lending is rather weaker in column (2) while the aggregate effect on refinance lending is strongly positive in column (1). This could be due to the fact that the operating capacity effect might have been dampened by strong loan demand. The difference of the two originations in column (3) is significant and positive indicating that the gap between refinance originations and home purchase originations widened more in the counties with limited operating capacity. Columns (4)-(6) are similar to columns (1)-(3) except for the addition of county control variables. The results are similar and more significant. Panel B reports results on the total number of mortgage originations and finds similar but stronger effects.

## 5. Conclusion

We propose and examine two channels that impede banks' financial intermediation: the risk capacity channel that arises when banks have limited capacity for risk taking, and the operating capacity channel that arises from loan officers' limited capacity for processing and screening loan applications. When banks face these capacity constraints, which is particularly the case after 2008, they would try to substitute home purchase loans with refinance

loans. Our results imply that banks with limited capacities would try to substitute loans to potential home buyers with loans to refinancing borrowers, who are existing home owners. This substitution would prevail more if there is an exogenous increase in refinancing demand, e.g. stimulated by monetary policy. When banks are facing binding capacity, the monetary stimulus would induce an increase in both refinancing and home purchase borrowing demand, but banks might show this substitution behavior by reducing home purchase originations. This not only limits the credit access of certain borrowers, possibly younger and with lower wealth, but there could be a macroeconomic effect if these rationed borrowers have a greater marginal propensity for consumption. Hence, while our analysis mainly focuses on the distributional impact, this mechanism also has novel macroeconomic implications on monetary transmissions through the bank lending channel.

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**Table 1: Summary Statistics**

We report the summary statistics of variables. Panel A reports the summary statistics based on full sample. We report bank-level and loan-level variables. Refinance(#) is the number of mortgage originations for refinance by a bank in a quarter, Refinance(\$ mils) is the amount of mortgage originations for refinance by a bank in a quarter, Purchase(#) is the number of mortgage originations for home purchase by a bank in a quarter, and Purchase(\$ mils) is the amount of mortgage originations for home purchase by a bank in a quarter. Bank characteristics includes Assets, Liquid Asset Ratio, Loan to Deposit Ratio, RE Loan to Total Loan Ratio, CI Loan to Total Loan Ratio, NPL Ratio, and Tier 1 Capital Ratio. Operating Capacity is the fraction of “uncompleted” applications as of the last date of each quarter out of the total applications received in that quarter. Loan Processing Time is the average number of days spent screening an application for a bank in a quarter. IRefinance is a dummy variable that equals to 1 if the loan type is refinance mortgage and 0 otherwise. ILoan Approval is a dummy variable that equals to 1 if the loan is being approved and 0 otherwise. log Income is the log of household income as of mortgage application. Loan to Income is the ratio of loan amount to income. Loan Size is the size of loan in thousand dollars. County-level control variables include log Population, log Income per Capita, Unemployment Rate, and the HPI from the CoreLogic. Panel B reports the summary statistics by the Tier 1 Capital level. Low Tier 1 Capital is a dummy variable for the bottom 25% banks with low Tier 1 Capital Ratio. The top panel reports the summary statistics of banks in Low Tier 1 Capital group and the bottom panel reports the summary statistics of the others. Panel C of Table 1.1 reports the summary statistics by the Operating Capacity. Low Operating Capacity is a dummy variable for top 25% banks with high Operating Capacity. The top panel reports the summary statistics of banks in Low Operating Capacity group and the bottom panel reports the summary statistics of the others. Quarterly bank control variables are winsorized at 0.5% and 99.5% levels.

<b>Panel A: All Samples</b>	Obs	Mean	Std.Dev.	p25	p50	p75
<i>Bank-level Variables</i>						
Refinance(#)	114669	200.12	3070.67	7	20	52
Refinance(\$ mils)	114669	35.90	662.27	0.69	2.11	6.33
Purchase(#)	114669	94.31	1635.80	4	11	27
Purchase(\$ mils)	114669	19.96	380.41	0.53	1.47	4.28
Assets	114669	3228	47077	128	255	568
Liquid Asset Ratio	114669	0.28	0.13	0.18	0.26	0.36
Loan to Deposit Ratio	114669	0.82	0.18	0.71	0.83	0.94
RE Loan to Total Loan Ratio	114669	0.76	0.14	0.67	0.78	0.86
CI Loan to Total Loan Ratio	114669	0.06	0.09	0.00	0.00	0.10
NPL Ratio	114669	0.02	0.02	0.00	0.01	0.02
Tier 1 Capital Ratio	114669	0.14	0.06	0.11	0.13	0.16
Operating Capacity	111656	0.31	0.17	0.20	0.30	0.40
Loan Processing Time	100242	33.66	16.04	23.20	31.74	41.46
<i>Loan-level Variables</i>						
IRefinance	3223338	0.69	0.46	0	1	1
ILoan Approval	3223338	0.52	0.50	0	1	1
log Income	2923942	11.29	0.74	10.82	11.28	11.749
Loan to Income	2923942	2.07	1.50	0.94	1.84	2.86
Loan Size (\$000)	3223338	189	178	74	142	248
log Population	3123474	12.85	1.51	11.84	13.02	13.81
log Income per Capita	3123474	10.57	0.27	10.38	10.55	10.73
Unemployment Rate	3120886	6.66	2.56	4.71	6.10	8.26
HPI	2872501	153.3	40.5	124.8	142.9	173.7

Table 1 Continues

**Panel B:** By Tier 1 Capital

<i>Low Tier 1 Capital = 1</i>	Obs	Mean	Std.Dev.	p25	p50	p75
<i>Bank-level Variables</i>						
Refinance(#)	29128	602.87	6020.65	8	25	82
Refinance(\$ mils)	29128	111.73	1296.90	0.97	3.29	11.19
Purchase(#)	29128	278.21	3196.91	5	15	49
Purchase(\$ mils)	29128	62.12	747.3	0.76	2.42	8.09
Assets	29128	10982	92899	188	402	1016
Liquid Asset Ratio	29128	0.20	0.09	0.14	0.19	0.25
Loan to Deposit Ratio	29128	0.90	0.14	0.82	0.91	0.99
RE Loan to Total Loan Ratio	29128	0.74	0.15	0.65	0.76	0.85
CI Loan to Total Loan Ratio	29128	0.09	0.10	0.00	0.06	0.16
NPL Ratio	29128	0.02	0.03	0.00	0.01	0.03
Tier 1 Capital Ratio	29128	0.09	0.03	0.09	0.10	0.10
Operating Capacity	28338	0.32	0.17	0.21	0.31	0.41
Loan Processing Time	25470	34.99	15.86	24.56	33.26	43.00
<i>Loan-level Variables</i>						
I.Refinance	2599021	0.69	0.46	0	1	1
I.Loan Approval	2599021	0.49	0.50	0	0	1
log Income	2342313	11.30	0.74	10.82	11.28	11.74
Loan to Income	2342313	2.10	1.50	0.97	1.87	2.90
Loan Size (\$000)	2599021	193	180	76	146	252
<i>Low Tier 1 Capital = 0</i>	Obs	Mean	Std.Dev.	p25	p50	p75
<i>Bank-level Variables</i>						
Refinance(#)	85541	62.98	472.18	7	18	45
Refinance(\$ mils)	85541	10.08	112.32	0.63	1.85	5.26
Purchase(#)	85541	31.68	302.53	4	10	23
Purchase(\$ mils)	85541	8.85	153.43	0.48	1.28	3.45
Assets	85541	588	2190	116	223	475
Liquid Asset Ratio	85541	0.31	0.14	0.21	0.29	0.39
Loan to Deposit Ratio	85541	0.79	0.18	0.67	0.80	0.91
RE Loan to Total Loan Ratio	85541	0.76	0.14	0.68	0.78	0.87
CI Loan to Total Loan Ratio	85541	0.04	0.08	0.00	0.00	0.07
NPL Ratio	85541	0.02	0.02	0.00	0.01	0.02
Tier 1 Capital Ratio	85541	0.16	0.06	0.12	0.14	0.17
Operating Capacity	83318	0.31	0.17	0.19	0.29	0.40
Loan Processing Time	74772	33.20	16.08	22.78	31.21	40.89
<i>Loan-level Variables</i>						
I.Refinance	624317	0.66	0.47	0	1	1
I.Loan Approval	624317	0.65	0.48	0	1	1
log Income	581629	11.26	0.74	10.78	11.24	11.70
Loan to Income	581629	1.94	1.45	0.84	1.71	2.72
Loan Size (\$000)	624317	171	167	62	128	225

Table 1 Continues

**Panel C: By Operating Capacity**

<i>Low Operating Capacity = 1</i>	Obs	Mean	Std.Dev.	p25	p50	p75
<i>Bank-level Variables</i>						
Refinance(#)	18791	412.86	5710.88	5	16	54
Refinance(\$ mils)	18791	91.56	1274.67	0.74	2.63	9.6
Purchase(#)	18791	143.23	2141.46	4	11	31
Purchase(\$ mils)	18791	37.07	529.18	0.67	2.15	6.67
Assets	18791	6898	81195	134	292	707
Liquid Asset Ratio	18791	0.28	0.14	0.18	0.26	0.36
Loan to Deposit Ratio	18791	0.83	0.20	0.71	0.84	0.96
RE Loan to Total Loan Ratio	18791	0.78	0.16	0.69	0.81	0.91
CI Loan to Total Loan Ratio	18791	0.06	0.09	0.00	0.00	0.10
NPL Ratio	18791	0.02	0.03	0.00	0.01	0.03
Tier 1 Capital Ratio	18791	0.15	0.07	0.11	0.13	0.17
Operating Capacity	18791	0.57	0.15	0.47	0.53	0.62
Loan Processing Time	16360	47.88	19.63	35.65	45.79	56.62
<i>Loan-level Variables</i>						
I.Refinance	997672	0.73	0.44	0	1	1
I.Loan Approval	997672	0.52	0.50	0	1	1
log Income	923341	11.40	0.74	10.92	11.37	11.84
Loan to Income	923341	2.32	1.49	1.28	2.07	3.05
Loan Size (\$000)	997672	225	189	105	177	290
<i>Low Operating Capacity = 0</i>	Obs	Mean	Std.Dev.	p25	p50	p75
<i>Bank-level Variables</i>						
Refinance(#)	92865	158.77	2215.38	8	20	51
Refinance(\$ mils)	92865	25.18	456.25	0.7	2.06	5.90
Purchase(#)	92865	85.29	1528.86	5	11	26
Purchase(\$ mils)	92865	16.80	347.72	0.52	1.40	3.94
Assets	92865	2534	37205	129	251	550
Liquid Asset Ratio	92865	0.28	0.13	0.18	0.26	0.36
Loan to Deposit Ratio	92865	0.82	0.18	0.71	0.83	0.94
RE Loan to Total Loan Ratio	92865	0.75	0.14	0.67	0.77	0.86
CI Loan to Total Loan Ratio	92865	0.06	0.09	0.00	0.00	0.10
NPL Ratio	92865	0.02	0.02	0.00	0.01	0.02
Tier 1 Capital Ratio	92865	0.14	0.06	0.11	0.13	0.16
Operating Capacity	92865	0.26	0.12	0.17	0.26	0.34
Loan Processing Time	83673	30.85	13.46	21.92	29.81	38.15
<i>Loan-level Variables</i>						
I.Refinance	2166951	0.67	0.47	0	1	1
I.Loan Approval	2166951	0.52	0.50	0	1	1
log Income	1948324	11.25	0.74	10.78	11.23	11.70
Loan to Income	1948324	1.96	1.48	0.79	1.71	2.78
Loan Size (\$000)	2166951	173	171	61	127	228

**Table 2: Banks' Mortgage originations by Loan Purpose during 2009 to 2013**

We report the panel regression results of the banks' mortgage originations by loan purpose during 2009-2013. We use bank-quarter observations from 2004 to 2013. Panel A reports the results using the total amount of mortgage originations by a bank in a quarter as a dependent variable. Column (1) reports the result on log amount of refinance mortgage originations ( $\log Refi\$$ ). The main independent variable is the time dummy for 2009 Q1 to 2013 Q4 (LPost). Other independent variables include 1 quarter lagged bank-level characteristics such as log Assets, Liquid Asset Ratio, Loan to Deposit Ratio, RE Loan to Total Loan Ratio, CI Loan to Total Loan Ratio, NPL Ratio, and Tier 1 Capital Ratio. We do not report bank-level controls for brevity. We also include Quarter fixed effects. Column (2) reports the result on log amount of home purchase mortgage originations ( $\log P\$$ ). Column (3) reports the result on the difference of two dependent variables ( $(1)-(2)$ ) in columns (1) and (2). Columns (4)-(6) are similar to columns (1)-(3) except the additional Bank fixed effects. Panel B reports the results using the total number of mortgage originations by a bank in a quarter as a dependent variable ( $\log Refi\#$ ,  $\log P\#$ ). Specifications are the same as in Panel A. The table reports point estimates with t-statistics in parentheses. All the standard errors are clustered at the bank level. \*\*\*, \*\*, \* denotes 1%, 5%, and 10% statistical significance.

<b>Panel A: Total Amount of Mortgage Originations</b>						
Variables	(1) $\log Refi\$$	(2) $\log P\$$	(3) $(1)-(2)$	(4) $\log Refi\$$	(5) $\log P\$$	(6) $(4)-(5)$
LPost	0.297*** (15.55)	-0.094*** (-5.89)	0.391*** (25.82)	0.223*** (12.58)	-0.211*** (-13.91)	0.434*** (28.00)
Observations	114,669	114,669	114,669	114,518	114,518	114,518
R-squared	0.500	0.564	0.047	0.788	0.793	0.385
Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes	Yes
<b>Panel B: Total Number of Mortgage Originations</b>						
Variables	(1) $\log Refi\#$	(2) $\log P\#$	(3) $(1)-(2)$	(4) $\log Refi\#$	(5) $\log P\#$	(6) $(4)-(5)$
LPost	0.013 (0.72)	-0.119*** (-7.64)	0.132*** (9.45)	0.021 (1.38)	-0.208*** (-15.27)	0.228*** (16.95)
Observations	114,669	114,669	114,669	114,518	114,518	114,518
R-squared	0.445	0.490	0.031	0.843	0.822	0.495
Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes	Yes

**Table 3: Banks' Risk Capacity and Loan Substitution**

We report the panel regression results of the effect of bank's risk capacity on the bank's mortgage originations by loan purpose. We use bank-quarter observations from 2004 to 2013. Panel A and B report the results using time-varying measure of banks' risk capacity. In Panel A, the dependent variables are the total amount of mortgage originations by a bank in a quarter. Column (1) reports the result on log amount of refinance mortgage originations ( $\log Refi\$$ ). Main independent variables are a time dummy for 2009 Q1 to 2013 Q4 (I.Post), a dummy for the bottom 25% banks with low Tier 1 Capital Ratio in the previous quarter (Low Tier 1 Capital  $t_{-1}$ ), and the interaction between the two variables. Other independent variables include 1 quarter lagged bank-level characteristics such as log Assets, Liquid Asset Ratio, Loan to Deposit Ratio, RE Loan to Total Loan Ratio, CI Loan to Total Loan Ratio, and NPL Ratio. We do not report the bank-level controls for brevity. We also include Year fixed effects and Quarter fixed effects. Column (2) reports the result on log amount of home purchase mortgage originations ( $\log P\$$ ). Column (3) reports the result on the difference of two dependent variables ((1)-(2)) in columns (1) and (2). Columns (4)-(6) are similar to columns (1)-(3) except the additional Bank fixed effects and Headquarter (state)  $\times$  Year fixed effects. Columns (7)-(9) are similar to columns (1)-(3) except excluding Year fixed effect but including Bank FE, Headquarter FE, and I.Post. In Panel B, the dependent variables are the total number of mortgage originations by a bank in a quarter ( $\log Refi\#$ ,  $\log P\#$ ). Specifications are the same as in Panel A. Panel C and D report the results using the measure of banks' risk capacity as of 2008 Q4. Regression specifications are same as in Panel A and B. The table reports point estimates with t-statistics in parentheses. All the standard errors are clustered at the bank level. \*\*\*, \*\*, \* denotes 1%, 5%, and 10% statistical significance.

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<b>Panel A: Total Amount of Mortgage Originations</b>									
Variables	(1) $\log Refi\$$	(2) $\log P\$$	(3) $(1)-(2)$	(4) $\log Refi\$$	(5) $\log P\$$	(6) $(4)-(5)$	(7) $\log Refi\$$	(8) $\log P\$$	(9) $(7)-(8)$
I.Post $\times$ Low Tier 1 Capital $t_{-1}$	0.110*** (2.81)	-0.049 (-1.41)	0.159*** (5.26)	0.075*** (2.65)	-0.053** (-1.98)	0.127*** (5.01)	0.094*** (3.17)	-0.009 (-0.32)	0.103*** (3.95)
Low Tier 1 Capital $t_{-1}$	-0.171*** (-5.80)	-0.061** (-2.12)	-0.111*** (-5.01)	-0.087*** (-4.22)	0.022 (1.16)	-0.109*** (-6.11)	-0.083*** (-3.90)	0.041** (2.09)	-0.124*** (-6.66)
I.Post							0.211*** (11.40)	-0.202*** (-12.81)	0.412*** (25.32)
Observations	114,669	114,669	114,669	114,515	114,515	114,515	114,518	114,518	114,518
R-squared	0.505	0.571	0.059	0.797	0.803	0.409	0.788	0.793	0.386
Other Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No	No	No	No
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Headquarter FE	No	No	No	No	No	No	Yes	Yes	Yes
Headquarter $\times$ Year FE	No	No	No	Yes	Yes	Yes	No	No	No

Table 3 Continues

<b>Panel B: Total Number of Mortgage Originations</b>									
Variables	(1) <i>logRefi#</i>	(2) <i>logP#</i>	(3) <i>(1)-(2)</i>	(4) <i>logRefi#</i>	(5) <i>logP#</i>	(6) <i>(4)-(5)</i>	(7) <i>logRefi#</i>	(8) <i>logP#</i>	(9) <i>(7)-(8)</i>
L.Post $\times$ Low Tier 1 Capital $t_{-1}$	0.089** (2.34)	-0.078** (-2.22)	0.167*** (5.80)	0.063*** (2.60)	-0.080*** (-3.18)	0.143*** (6.03)	0.091*** (3.56)	-0.025 (-0.96)	0.117*** (4.76)
Low Tier 1 Capital $t_{-1}$	-0.240*** (-7.69)	-0.091*** (-3.01)	-0.149*** (-6.65)	-0.077*** (-4.45)	0.036** (2.08)	-0.113*** (-6.96)	-0.073*** (-4.11)	0.053*** (2.96)	-0.127*** (-7.47)
L.Post							0.006 (0.40)	-0.197*** (-14.29)	0.204*** (14.64)
Observations	114,669	114,669	114,669	114,515	114,515	114,515	114,518	114,518	114,518
R-squared	0.451	0.498	0.049	0.854	0.834	0.522	0.844	0.822	0.496
Other Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No	No	No	No
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Headquarter FE	No	No	No	No	No	No	Yes	Yes	Yes
Headquarter $\times$ Year FE	No	No	No	Yes	Yes	Yes	No	No	No
<b>Panel C: Total Amount of Mortgage Originations</b>									
Variables	(1) <i>logRefi\$</i>	(2) <i>logP\$</i>	(3) <i>(1)-(2)</i>	(4) <i>logRefi\$</i>	(5) <i>logP\$</i>	(6) <i>(4)-(5)</i>	(7) <i>logRefi\$</i>	(8) <i>logP\$</i>	(9) <i>(7)-(8)</i>
L.Post $\times$ Low Tier 1 Capital $_{2008.4Q}$	0.110*** (2.70)	-0.010 (-0.27)	0.120*** (3.63)	0.030 (0.80)	-0.090*** (-2.73)	0.120*** (3.87)	0.056 (1.48)	-0.067* (-1.94)	0.123*** (3.85)
Low Tier 1 Capital $_{2008.4Q}$	-0.116*** (-2.62)	-0.040 (-0.93)	-0.077** (-2.46)						
L.Post							0.217*** (11.22)	-0.199*** (-12.22)	0.416*** (24.34)
Observations	97,234	97,234	97,234	97,221	97,221	97,221	97,221	97,221	97,221
R-squared	0.496	0.566	0.061	0.785	0.791	0.396	0.774	0.779	0.372
Other Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No	No	No	No
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Headquarter $\times$ Year FE	No	No	No	Yes	Yes	Yes	No	No	No
Headquarter FE	No	No	No	No	No	No	Yes	Yes	Yes

Table 3 Continues

<b>Panel D: Total Number of Mortgage Originations</b>									
Variables	(1) <i>logRefi#</i>	(2) <i>logP#</i>	(3) <i>(1)-(2)</i>	(4) <i>logRefi#</i>	(5) <i>logP#</i>	(6) <i>(4)-(5)</i>	(7) <i>logRefi#</i>	(8) <i>logP#</i>	(9) <i>(7)-(8)</i>
I.Post $\times$ Low Tier 1 Capital <sub>2008.4Q</sub>	0.124*** (3.26)	-0.016 (-0.46)	0.140*** (4.38)	0.015 (0.48)	-0.126*** (-3.98)	0.142*** (4.77)	0.057* (1.72)	-0.089*** (-2.71)	0.146*** (4.78)
Low Tier 1 Capital <sub>2008.4Q</sub>	-0.197*** (-4.36)	-0.072 (-1.63)	-0.125*** (-3.94)						
I.Post							0.018 (1.11)	-0.190*** (-13.14)	0.208*** (14.19)
Observations	97,234	97,234	97,234	97,221	97,221	97,221	97,221	97,221	97,221
R-squared	0.452	0.501	0.047	0.842	0.821	0.504	0.830	0.807	0.476
Other Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No	No	No	No
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Headquarter $\times$ Year FE	No	No	No	Yes	Yes	Yes	No	No	No
Headquarter FE	No	No	No	No	No	No	Yes	Yes	Yes

**Table 4: Banks' Risk Capacity and Loan Approval**

We report the panel regression results of the effect of bank's risk capacity on the likelihood of loan approval by loan purpose. We use 5% random sample from loan-level HMDA stratified by year and county with 4 bins during 2004 to 2013. The dependent variables are the indicator for approved loans which equals to 1 if the loan is originated and 0 otherwise. Panel A reports the results using the time-varying measure of banks' risk capacity. Main independent variables are a time dummy for 2009 Q1 to 2013 Q4 (LPost), a dummy for the bottom 25% banks with low Tier 1 Capital Ratio in previous quarter (Low Tier 1 Capital  $t_{-1}$ ), and the interaction between the two variables. Other independent variables include applicant's characteristics such as log Income, Loan to Income ratio; 1 quarter lagged bank-level characteristics such as log Assets, Liquid Asset Ratio, Loan to Deposit Ratio, RE Loan to Total Loan Ratio, CI Loan to Total Loan Ratio, NPL Ratio; and county-level controls from previous year such as log Population, log Income per Capita, Unemployment Rate, HPI. We do not report bank-level and county-level controls for brevity. Columns (1)-(2) include Year fixed effects and Quarter fixed effects. Column (1) reports on the likelihood of loan approval for refinance mortgages and column (2) reports on the likelihood of loan approval for home purchase mortgages. Columns (3)-(4) are similar to columns (1)-(2) except the addition of Bank fixed effects. Columns (5)-(6) are similar to columns (1)-(2) except additional Bank fixed effects and County fixed effects. Columns (7)-(8) are similar to columns (5)-(6) except excluding Year fixed effects but including LPost. Panel B reports the results using bank's risk capacity as of 2008 Q4. Regression specifications are same as in Panel A. The table reports point estimates with t-statistics in parentheses. All the standard errors are clustered at the bank level. \*\*\*, \*\*, \* denotes 1%, 5%, and 10% statistical significance.

**Panel A: Using Time Varying Measure of Banks' Risk Capacity**

Variables	<i>Refinance</i>	<i>Purchase</i>	<i>Refinance</i>	<i>Purchase</i>	<i>Refinance</i>	<i>Purchase</i>	<i>Refinance</i>	<i>Purchase</i>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	I.Loan Approval							
LPost $\times$ Low Tier 1 Capital $t_{-1}$	-0.020 (-0.44)	-0.211*** (-3.83)	0.080*** (4.18)	-0.053* (-1.93)	0.079*** (4.06)	-0.053* (-1.95)	0.076*** (5.44)	-0.052** (-2.57)
Low Tier 1 Capital $t_{-1}$	0.037 (0.81)	0.133*** (2.87)	-0.053*** (-5.00)	0.018 (1.27)	-0.052*** (-4.97)	0.019 (1.30)	-0.041*** (-3.97)	0.018 (1.38)
LPost							-0.040*** (-4.35)	0.031*** (3.18)
log Income	0.058*** (6.34)	0.033*** (4.31)	0.050*** (5.50)	0.035*** (7.61)	0.048*** (5.31)	0.035*** (7.62)	0.047*** (4.97)	0.034*** (7.73)
Loan to Income	-0.004 (-1.57)	-0.004 (-1.14)	-0.009*** (-3.03)	-0.008*** (-3.34)	-0.010*** (-3.84)	-0.009*** (-3.68)	-0.010*** (-4.03)	-0.009*** (-3.75)
Observations	1,831,783	761,818	1,831,349	761,318	1,831,349	761,318	1,831,349	761,318
R-squared	0.050	0.073	0.090	0.135	0.092	0.136	0.089	0.135
Other Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
County FE	No	No	No	No	Yes	Yes	Yes	Yes



Table 4 Continues

<b>Panel B: Using Banks' Risk Capacity as of 2008 Q4</b>								
Variables	<i>Refinance</i>	<i>Purchase</i>	<i>Refinance</i>	<i>Purchase</i>	<i>Refinance</i>	<i>Purchase</i>	<i>Refinance</i>	<i>Purchase</i>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	I.Loan Approval							
L.Post × Low Tier 1 Capital <sub>2008.Q4</sub>	0.063*** (2.82)	-0.085*** (-2.86)	0.062*** (2.90)	-0.064** (-2.14)	0.061*** (2.81)	-0.064** (-2.14)	0.055*** (3.04)	-0.065*** (-3.02)
Low Tier 1 Capital <sub>2008.Q4</sub>	-0.050** (-2.32)	0.034* (1.78)						
L.Post							-0.019 (-1.43)	0.047*** (4.59)
log Income	0.060*** (5.56)	0.040*** (5.97)	0.050*** (4.63)	0.040*** (11.32)	0.048*** (4.47)	0.040*** (11.12)	0.046*** (4.17)	0.039*** (11.17)
Loan to Income	-0.002 (-0.97)	-0.004 (-1.12)	-0.008*** (-2.65)	-0.006*** (-2.73)	-0.009*** (-3.52)	-0.007*** (-3.12)	-0.010*** (-3.67)	-0.008*** (-3.17)
Observations	1,485,863	580,456	1,485,803	580,382	1,485,803	580,382	1,485,803	580,382
R-squared	0.057	0.087	0.088	0.133	0.090	0.135	0.088	0.133
Other Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
County FE	No	No	No	No	Yes	Yes	Yes	Yes

**Table 5: Banks' Operating Capacity and Loan Substitution**

We report the panel regression results of the effect of bank's operating capacity on the bank's mortgage originations by loan purpose. We use bank-quarter observations from 2004 to 2013. Panel A and B use all banks in our sample. In Panel A, the dependent variables are the total amount of mortgage originations by a bank in a quarter. Column (1) reports the result on log amount of refinance mortgage originations ( $\log Refi\$$ ). Main independent variables are a time dummy for 2009 Q1 to 2013 Q4 (I.Post), a dummy for the top 25% banks with high fraction of unprocessed mortgage application in previous quarter (Low Operating Capacity  $t_{-1}$ ), and the interaction between the two variables. Other independent variables include 1 quarter lagged bank-level characteristics such as Loan Processing Time, the average date between loan applications to approval by a bank, log Assets, Liquid Asset Ratio, Loan to Deposit Ratio, RE Loan to Total Loan Ratio, CI Loan to Total Loan Ratio, NPL Ratio, Tier 1 Capital Ratio. We do not report bank-level controls for brevity. We also include Year fixed effects and Quarter fixed effects. Column (2) reports the result on log amount of home purchase mortgage originations ( $\log P\$$ ). Column (3) reports the result on the difference of two dependent variables ((1)-(2)) in columns (1) and (2). Columns (4)-(6) are similar to columns (1)-(3) except the addition of Bank fixed effects and Headquarter (state)  $\times$  I.Post fixed effects. Columns (7)-(9) are similar to columns (1)-(2) except excluding Year fixed effect but including Bank FE, Headquarter FE and I.Post. In Panel B, the dependent variables are the total number of mortgage originations by a bank in a quarter ( $\log Refi\#$ ,  $\log P\#$ ). Specifications are the same as in Panel A. Panel C and D only include local banks who get more than 70% loan applications from one state on average. Regression specifications are similar to Panel A and B except additional MSA-level controls from previous year such as log Population, log Income per Capita, Unemployment Rate, HPI. We do not report MSA-level controls for brevity. The table reports point estimates with t-statistics in parentheses. All the standard errors are clustered at the bank level. \*\*\*, \*\*, \* denotes 1%, 5%, and 10% statistical significance.

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<b>Panel A: All Banks, Total Amount of Mortgage Originations</b>									
Variables	(1) $\log Refi\$$	(2) $\log P\$$	(3) (1)-(2)	(4) $\log Refi\$$	(5) $\log P\$$	(6) (4)-(5)	(7) $\log Refi\$$	(8) $\log P\$$	(9) (7)-(8)
I.Post $\times$ Low Operating Capacity $t_{-1}$	0.291*** (8.33)	-0.067** (-2.14)	0.357*** (12.66)	0.157*** (6.57)	-0.049** (-2.13)	0.206*** (8.46)	0.193*** (7.81)	-0.034 (-1.46)	0.227*** (9.15)
Low Operating Capacity $t_{-1}$	-0.159*** (-6.13)	0.123*** (4.78)	-0.282*** (-13.37)	0.199*** (11.58)	0.223*** (14.33)	-0.024 (-1.36)	0.179*** (10.17)	0.222*** (13.78)	-0.043** (-2.38)
I.Post							0.194*** (10.65)	-0.223*** (-14.11)	0.417*** (25.62)
Loan Processing Time $t_{-1}$	0.060*** (8.85)	0.079*** (12.02)	-0.019*** (-3.26)	0.008* (1.93)	0.019*** (5.08)	-0.012*** (-2.87)	0.011*** (2.70)	0.033*** (7.81)	-0.021*** (-5.02)
Observations	100,033	100,033	100,033	99,900	99,900	99,900	99,902	99,902	99,902
R-squared	0.507	0.579	0.064	0.806	0.811	0.422	0.796	0.801	0.399
Other Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No	No	No	No
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Headquarter $\times$ Year FE	No	No	No	Yes	Yes	Yes	No	No	No
Headquarter FE	No	No	No	No	No	No	Yes	Yes	Yes

Table 5 Continues

<b>Panel B: All Banks, Total Number of Mortgage Originations</b>									
Variables	(1) <i>logRefi#</i>	(2) <i>logP#</i>	(3) <i>(1)-(2)</i>	(4) <i>logRefi#</i>	(5) <i>logP#</i>	(6) <i>(4)-(5)</i>	(7) <i>logRefi#</i>	(8) <i>logP#</i>	(9) <i>(7)-(8)</i>
I.Post $\times$ Low Operating Capacity $t_{-1}$	0.334*** (9.02)	-0.023 (-0.69)	0.357*** (13.10)	0.205*** (9.74)	-0.017 (-0.86)	0.222*** (10.72)	0.227*** (10.13)	0.003 (0.16)	0.224*** (10.33)
Low Operating Capacity $t_{-1}$	-0.498*** (-16.73)	-0.145*** (-5.22)	-0.353*** (-15.80)	0.083*** (5.66)	0.185*** (13.42)	-0.102*** (-6.87)	0.079*** (5.07)	0.186*** (12.65)	-0.107*** (-6.93)
I.Post							0.002 (0.05)	-0.214*** (-15.33)	0.215*** (15.27)
Loan Processing Time $t_{-1}$	0.002 (0.31)	0.033*** (5.26)	-0.031*** (-5.38)	-0.002 (-0.54)	0.013*** (4.07)	-0.015*** (-4.43)	0.002 (0.56)	0.026*** (7.45)	-0.024*** (-7.02)
Observations	100,033	100,033	100,033	99,900	99,900	99,900	99,902	99,902	99,902
R-squared	0.456	0.502	0.059	0.860	0.841	0.534	0.851	0.831	0.507
Other Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No	No	No	No
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Headquarter $\times$ Year FE	No	No	No	Yes	Yes	Yes	No	No	No
Headquarter FE	No	No	No	No	No	No	Yes	Yes	Yes

Table 5 Continues

<b>Panel C: Local Banks, Total Amount of Mortgage Originations</b>									
Variables	(1) <i>logRefi</i> \$	(2) <i>logP</i> \$	(3) <i>(1)-(2)</i>	(4) <i>logRefi</i> \$	(5) <i>logP</i> \$	(6) <i>(4)-(5)</i>	(7) <i>logRefi</i> \$	(8) <i>logP</i> \$	(9) <i>(7)-(8)</i>
I.Post $\times$ Low Operating Capacity $t_{-1}$	0.222*** (5.57)	-0.118*** (-3.43)	0.340*** (9.69)	0.128*** (4.50)	-0.079*** (-3.17)	0.207*** (6.80)	0.144*** (5.00)	-0.066** (-2.56)	0.210*** (6.71)
Low Operating Capacity $t_{-1}$	-0.144*** (-4.97)	0.150*** (5.68)	-0.294*** (-11.29)	0.211*** (10.11)	0.240*** (13.27)	-0.029 (-1.29)	0.201*** (9.48)	0.240*** (12.98)	-0.039* (-1.68)
I.Post							0.156*** (6.67)	-0.246*** (-12.43)	0.402*** (18.60)
Loan Processing Time $t_{-1}$	0.051*** (6.44)	0.059*** (8.80)	-0.008 (-1.26)	0.004 (0.83)	0.015*** (3.58)	-0.011** (-2.20)	0.006 (1.26)	0.026*** (5.82)	-0.019*** (-3.78)
Observations	62,022	62,022	62,022	61,912	61,912	61,912	61,921	61,921	61,921
R-squared	0.357	0.452	0.055	0.731	0.727	0.394	0.718	0.714	0.371
Other Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No	No	No	No
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Headquarter $\times$ Year FE	No	No	No	Yes	Yes	Yes	No	No	No
Headquarter FE	No	No	No	No	No	No	Yes	Yes	Yes

Table 5 Continues

<b>Panel D: Local Banks, Total Number of Mortgage Originations</b>									
Variables	(1) <i>logRefi#</i>	(2) <i>logP#</i>	(3) <i>(1)-(2)</i>	(4) <i>logRefi#</i>	(5) <i>logP#</i>	(6) <i>(4)-(5)</i>	(7) <i>logRefi#</i>	(8) <i>logP#</i>	(9) <i>(7)-(8)</i>
I.Post $\times$ Low Operating Capacity $t_{-1}$	0.278*** (6.72)	-0.058 (-1.62)	0.336*** (10.36)	0.177*** (7.38)	-0.043** (-2.05)	0.219*** (8.96)	0.180*** (7.10)	-0.026 (-1.17)	0.206*** (7.78)
Low Operating Capacity $t_{-1}$	-0.469*** (-14.35)	-0.109*** (-3.78)	-0.360*** (-13.37)	0.092*** (5.44)	0.200*** (13.33)	-0.108*** (-6.12)	0.094*** (5.24)	0.199*** (12.53)	-0.105*** (-5.47)
I.Post							-0.018 (-1.00)	-0.220*** (-13.19)	0.202*** (11.48)
Loan Processing Time $t_{-1}$	0.006 (0.72)	0.021*** (3.30)	-0.016** (-2.48)	-0.004 (-1.20)	0.010*** (3.13)	-0.015*** (-3.84)	-0.002 (-0.61)	0.021*** (5.76)	-0.023*** (-5.76)
Observations	62,022	62,022	62,022	61,912	61,912	61,912	61,921	61,921	61,921
R-squared	0.269	0.335	0.051	0.802	0.764	0.506	0.789	0.750	0.479
Other Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA-level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No	No	No	No
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Headquarter $\times$ Year FE	No	No	No	Yes	Yes	Yes	No	No	No
Headquarter FE	No	No	No	No	No	No	Yes	Yes	Yes

**Table 6: Operating Capacity Within Bank and Loan Substitution**

We report the panel regression results of the effect of bank's operating capacity (within bank) on the bank's mortgage originations by loan purpose. We use bank-county-quarter observations from 2004 to 2013. In columns (1)-(3), the dependent variables are the total amount of mortgage originations by a bank in a county during a quarter. Column (1) reports the result on log amount of refinance mortgage originations ( $logRefi\$$ ). Main independent variables are the time dummy for 2009 Q1 to 2013 Q4 (LPost), a dummy for the top 50% counties with high fraction of unprocessed mortgage applications in the previous quarter within a bank (Busy County Within Bank  $t_{-1}$ ), and the interaction between the two variables. Other independent variables include 1 quarter lagged bank-level characteristics such as log Assets, Liquid Asset Ratio, Loan to Deposit Ratio, RE Loan to Total Loan Ratio, CI Loan to Total Loan Ratio, NPL Ratio, and log Change in Total Application, the log difference in total mortgage application for a bank in a county. We also include county-level controls from previous year such as log Population, log Income per Capita, Unemployment Rate, and HPI. We do not report bank-level and county-level controls for brevity. We also include Bank  $\times$  Quarter fixed effects, Bank  $\times$  County fixed effects, and MSA  $\times$  Quarter fixed effects. Column (2) reports the result on log amount of home purchase mortgage originations ( $logP\$$ ). Column (3) reports the result on the difference of two dependent variables ( $(1)-(2)$ ) in columns (1) and (2). Columns (4)-(6) are similar to columns (1)-(3) with the total number of mortgage originations as dependent variables ( $logRefi\#$ ,  $logP\#$ ). The table reports point estimates with t-statistics in parentheses. All the standard errors are clustered at the bank level. \*\*\*, \*\*, \* denotes 1%, 5%, and 10% statistical significance.

Variables	Total Amount of Mortgage			Total Number of Mortgage		
	(1) $logRefi\$$	(2) $logP\$$	(3) $(1)-(2)$	(4) $logRefi\#$	(5) $logP\#$	(6) $(4)-(5)$
LPost $\times$ Busy County Within Bank $t_{-1}$	0.038 (1.507)	-0.044* (-1.77)	0.082*** (3.68)	0.057** (2.43)	-0.040* (-1.70)	0.097*** (3.71)
LPost	0.539*** (9.62)	-0.160*** (-3.02)	0.699*** (12.19)	0.315*** (6.07)	-0.212*** (-5.37)	0.527*** (9.35)
Busy County Within Bank $t_{-1}$	0.002 (0.14)	0.046*** (3.41)	-0.044*** (-3.76)	-0.031** (-2.32)	0.022* (1.80)	-0.053*** (-4.17)
Observations	612,411	612,411	612,411	612,411	612,411	612,411
R-squared	0.503	0.479	0.298	0.462	0.433	0.376
Other Bank-level Controls	Yes	Yes	Yes	Yes	Yes	Yes
County-level Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank $\times$ Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank $\times$ County FE	Yes	Yes	Yes	Yes	Yes	Yes
MSA $\times$ Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes

**Table 7: Risk Capacity and Loan Substitution, by County**

We report the panel regression results of the effect of the county-level risk capacity on the county-level mortgage originations by loan purpose. We construct county-year observations for 2004 to 2013 from bank-county-quarter observations. Panel A and B use the time-varying measure of county-level risk capacity. In Panel A, the dependent variables are the total amount of mortgage originations in a county in a year. We aggregate mortgage originations in a county in a year by loan purpose before we take a log. Column (1) reports the result on log amount of refinance mortgage originations ( $\log Refi\$$ ). Main independent variables are a dummy variable that equals to 1 for counties with the bottom 25% of county-level risk capacity, and zero for counties with top 25% of it (Low Tier 1 Capital  $t_{-1}$ ), where the county-level risk capacity is the weighted average Tier 1 Capital Ratio of banks weighted by the number of mortgage application of banks in a county, the time dummy for 2009 Q1 to 2013 Q4 (I.Post), and the interaction between the two variables. We include County fixed effects and State  $\times$  Year fixed effects. Column (2) reports the result on log amount of home purchase mortgage originations ( $\log P\$$ ). Column (3) reports the result on the difference of two dependent variables ( $(1)-(2)$ ) in columns (1) and (2). Columns (4)-(6) are similar to columns (1)-(3) with additional county-level controls from previous year such as log Population, log Income per Capita, Unemployment Rate, and HPI. We do not report county-level controls for brevity. Columns (7)-(9) are similar to columns (4)-(6) except excluding State $\times$ Year fixed effects but including State FE and I.Post. Panel B reports similar results using the total number of mortgage originations in a county in a year as a dependent variable ( $\log Refi\#$ ,  $\log P\#$ ). Panel C and D use the county-level risk capacity as of 2008 Q4. Regression specifications are same as in Panel A and B except using Low Tier 1 Capital  $2008.Q4$ , which is a dummy variable that equals to 1 for counties with bottom 25% of county-level risk capacity, and zero for counties with the top 25% of it. The county-level risk capacity is the weighted average Tier 1 Capital Ratio of banks as of 2008 Q4 weighted by the number of mortgage application of banks in a county. The table reports point estimates with t-statistics in parentheses. All the standard errors are clustered at the county level. \*\*\*, \*\*, \* denotes 1%, 5%, and 10% statistical significance.

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<b>Panel A: Total Amount of Mortgage Originations</b>									
Variables	(1) $\log Refi\$$	(2) $\log P\$$	(3) $(1)-(2)$	(4) $\log Refi\$$	(5) $\log P\$$	(6) $(4)-(5)$	(7) $\log Refi\$$	(8) $\log P\$$	(9) $(7)-(8)$
I.Post $\times$ Low Tier 1 Capital $t_{-1}$	0.037 (1.27)	-0.053 (-1.58)	0.100*** (3.47)	0.005 (0.14)	-0.142*** (-5.14)	0.147*** (5.57)	-0.047 (-1.63)	-0.212*** (-7.29)	0.165*** (7.07)
Low Tier 1 Capital $t_{-1}$	-0.032 (-0.86)	0.037 (0.81)	-0.107** (-2.35)	-0.052 (-0.90)	-0.009 (-0.13)	-0.043 (-0.96)	-0.028 (-0.41)	-0.117 (-1.26)	0.089 (1.47)
I.Post							0.425*** (14.30)	-0.628*** (-19.80)	1.053*** (43.65)
Observations	14,594	14,480	14,456	5,713	5,713	5,713	5,713	5,713	5,713
R-squared	0.343	0.718	0.649	0.736	0.919	0.911	0.213	0.668	0.741
County-level Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
State FE	No	No	No	No	No	No	Yes	Yes	Yes

Table 7 Continues

<b>Panel B: Total Number of Mortgage Originations</b>									
Variables	(1) <i>logRefi#</i>	(2) <i>logP#</i>	(3) <i>(1)-(2)</i>	(4) <i>logRefi#</i>	(5) <i>logP#</i>	(6) <i>(4)-(5)</i>	(7) <i>logRefi#</i>	(8) <i>logP#</i>	(9) <i>(7)-(8)</i>
I.Post $\times$ Low Tier 1 Capital $t_{-1}$	0.063** (2.51)	-0.124*** (-4.11)	0.193*** (7.55)	0.036 (1.06)	-0.196*** (-7.12)	0.232*** (9.13)	-0.003 (-0.12)	-0.240*** (-8.24)	0.236*** (10.03)
Low Tier 1 Capital $t_{-1}$	-0.117*** (-3.91)	0.008 (0.21)	-0.154*** (-4.19)	-0.109* (-1.89)	-0.025 (-0.37)	-0.085* (-1.85)	-0.090 (-1.34)	-0.134 (-1.37)	0.044 (0.77)
I.Post							0.224*** (7.92)	-0.671*** (-20.35)	0.895*** (37.31)
Observations	14,594	14,480	14,456	5,713	5,713	5,713	5,713	5,713	5,713
R-squared	0.470	0.805	0.701	0.761	0.936	0.908	0.205	0.700	0.751
County-level Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
State FE	No	No	No	No	No	No	Yes	Yes	Yes

<b>Panel C: Total Amount of Mortgage Originations</b>									
Variables	(1) <i>logRefi\$</i>	(2) <i>logP\$</i>	(3) <i>(1)-(2)</i>	(4) <i>logRefi\$</i>	(5) <i>logP\$</i>	(6) <i>(4)-(5)</i>	(7) <i>logRefi\$</i>	(8) <i>logP\$</i>	(9) <i>(7)-(8)</i>
I.Post $\times$ Low Tier 1 Capital $2008.Q4$	0.023 (0.76)	-0.091*** (-2.67)	0.109*** (4.08)	-0.047 (-1.35)	-0.147*** (-4.50)	0.100*** (3.75)	-0.159*** (-5.67)	-0.265*** (-9.69)	0.107*** (4.92)
I.Post							0.509*** (19.07)	-0.567*** (-20.87)	1.076*** (49.57)
Observations	16,211	16,087	16,059	6,620	6,620	6,620	6,620	6,620	6,620
R-squared	0.345	0.723	0.638	0.724	0.913	0.909	0.234	0.694	0.743
County-level Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
State FE	No	No	No	No	No	No	Yes	Yes	Yes



Table 7 Continues

<b>Panel D: Total Number of Mortgage Originations</b>									
Variables	(1) <i>logRefi#</i>	(2) <i>logP#</i>	(3) <i>(1)-(2)</i>	(4) <i>logRefi#</i>	(5) <i>logP#</i>	(6) <i>(4)-(5)</i>	(7) <i>logRefi#</i>	(8) <i>logP#</i>	(9) <i>(7)-(8)</i>
I.Post $\times$ Low Tier 1 Capital <sub>2008.Q4</sub>	0.031 (1.14)	-0.138*** (-4.46)	0.169*** (6.79)	-0.038 (-1.20)	-0.199*** (-6.38)	0.161*** (6.03)	-0.133*** (-4.90)	-0.285*** (-10.66)	0.153*** (7.05)
I.Post							0.321*** (12.56)	-0.630*** (-24.01)	0.951*** (45.90)
Observations	16,211	16,087	16,059	6,620	6,620	6,620	6,620	6,620	6,620
R-squared	0.513	0.811	0.693	0.771	0.935	0.906	0.299	0.738	0.749
County-level Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
State FE	No	No	No	No	No	No	Yes	Yes	Yes

**Table 8: Operating Capacity and Loan Substitution, by County**

We report the panel regression results of the effect of the county-level operating capacity on the county-level mortgage originations by loan purpose. We construct county-year observations for 2004 to 2013 from bank-county-quarter observations. In Panel A, the dependent variables are the total amount of mortgage originations in a county in a year. We aggregate mortgage originations in a county in a year by loan purpose before we take a log. Column (1) reports the result on log amount of refinance mortgage originations ( $\log Refi\$$ ). The main independent variables are a dummy variable that equals to 1 for counties with bottom 25% of county-level operating capacity, and zero for counties with the top 25% of it (Low Operating Capacity  $t_{-1}$ ), where the county-level operating capacity is the inverse of the weighted-average fraction of unprocessed mortgage applications of banks using the number of mortgage applications of banks in a county, the time dummy for 2009 Q1 to 2013 Q4 (I.Post), and the interaction between the two variables. We include County fixed effects and State $\times$ Year fixed effects. Column (2) reports the result on log amount of home purchase mortgage originations ( $\log P\$$ ). Column (3) reports the result on the difference of two dependent variables ((1)-(2)) in columns (1) and (2). Columns (4)-(6) are similar to columns (1)-(3) with additional county-level controls from previous year such as log Population, log Income per Capita, Unemployment Rate, and HPI. We do not report county-level controls for brevity. Columns (7)-(9) are similar to columns (4)-(6) except excluding State $\times$ Year fixed effects but including State FE and I.Post. Panel B reports similar results using the total number of mortgage originations in a county in a year as a dependent variable ( $\log Refi\#$ ,  $\log P\#$ ). The table reports point estimates with t-statistics in parentheses. All the standard errors are clustered at the county level. \*\*\*, \*\*, \* denotes 1%, 5%, and 10% statistical significance.

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<b>Panel A: Total Amount of Mortgage Originations</b>									
Variables	(1) $\log Refi\$$	(2) $\log P\$$	(3) $(1)-(2)$	(4) $\log Refi\$$	(5) $\log P\$$	(6) $(4)-(5)$	(7) $\log Refi\$$	(8) $\log P\$$	(9) $(7)-(8)$
I.Post $\times$ Low Operating Capacity $t_{-1}$	0.120*** (2.75)	-0.034 (-0.72)	0.159*** (3.40)	0.113* (1.65)	-0.111 (-1.48)	0.224*** (4.66)	0.125*** (4.80)	0.004 (0.10)	0.121*** (4.54)
Low Operating Capacity $t_{-1}$	0.007 (0.17)	0.071* (1.91)	-0.074* (-1.82)	-0.122** (-2.19)	-0.053 (-1.19)	-0.069* (-1.91)	-0.067* (-1.75)	-0.067 (-1.54)	0.0003 (0.01)
I.Post							0.195*** (6.76)	-0.911*** (-22.54)	1.106*** (37.64)
Observations	14,594	14,482	14,462	5,091	5,091	5,091	5,091	5,091	5,091
R-squared	0.360	0.715	0.619	0.703	0.912	0.904	0.159	0.616	0.687
County-level Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
State FE	No	No	No	No	No	No	Yes	Yes	Yes

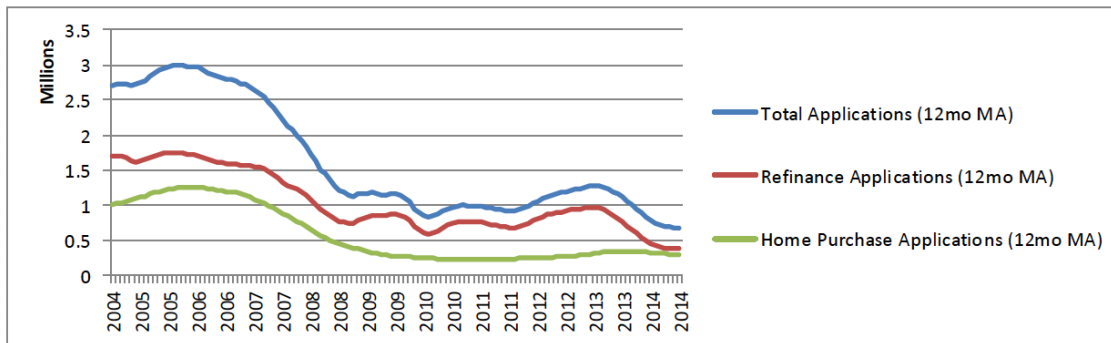
Table 8 Continues

<b>Panel B: Total Number of Mortgage Originations</b>									
Variables	(1) <i>logRefi#</i>	(2) <i>logP#</i>	(3) <i>(1)-(2)</i>	(4) <i>logRefi#</i>	(5) <i>logP#</i>	(6) <i>(4)-(5)</i>	(7) <i>logRefi#</i>	(8) <i>logP#</i>	(9) <i>(7)-(8)</i>
I.Post $\times$ Low Operating Capacity $t_{-1}$	0.152*** (4.12)	-0.096** (-2.20)	0.247*** (6.02)	0.144** (2.22)	-0.149* (-1.82)	0.293*** (5.24)	0.179*** (7.08)	0.020 (0.58)	0.159*** (5.83)
Low Operating Capacity $t_{-1}$	-0.043 (-1.28)	0.075** (2.28)	-0.124*** (-3.80)	-0.138*** (-2.82)	-0.028 (-0.68)	-0.111*** (-2.84)	-0.114*** (-3.05)	-0.084* (-1.95)	-0.030 (-1.00)
I.Post							0.013 (0.46)	-0.964*** (-22.85)	0.977*** (31.80)
Observations	14,594	14,482	14,462	5,091	5,091	5,091	5,091	5,091	5,091
R-squared	0.493	0.803	0.677	0.742	0.931	0.903	0.168	0.651	0.697
County-level Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
State FE	No	No	No	No	No	No	Yes	Yes	Yes

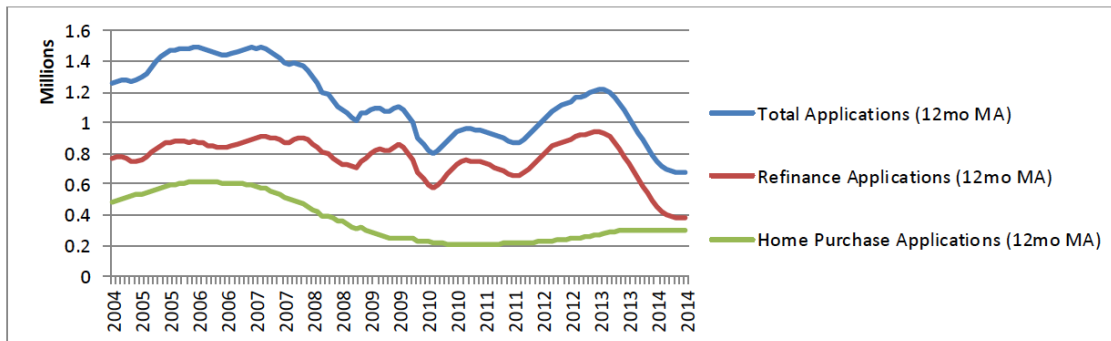
**Figure 1: Total Number of Mortgage Applications by Loan Type**

The figure shows the time series of the aggregate number of loan applications by loan type. We use Home Mortgage Disclosure Act (HMDA) to aggregate loan applications by loan type and by year-month. Panel A reports the aggregate number of loan applications in HMDA data including both bank lenders and non-bank lenders, with 12 month moving average. The blue line shows the number of mortgage applications for all types of loans. The red line shows the number of mortgage applications for refinances and green line shows the number of mortgage application for home purchases. Panel B reports the aggregate number of loan applications in HMDA by bank lenders only, with 12 month moving average.

Panel A: All Lenders



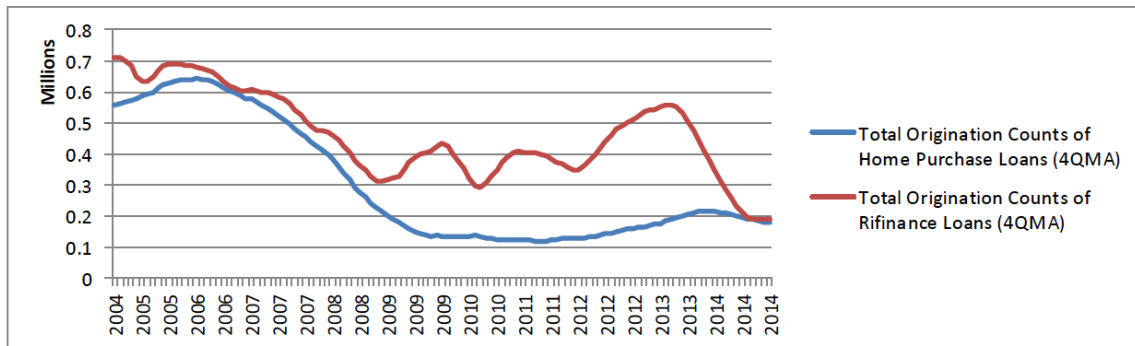
Panel B: Bank Lenders



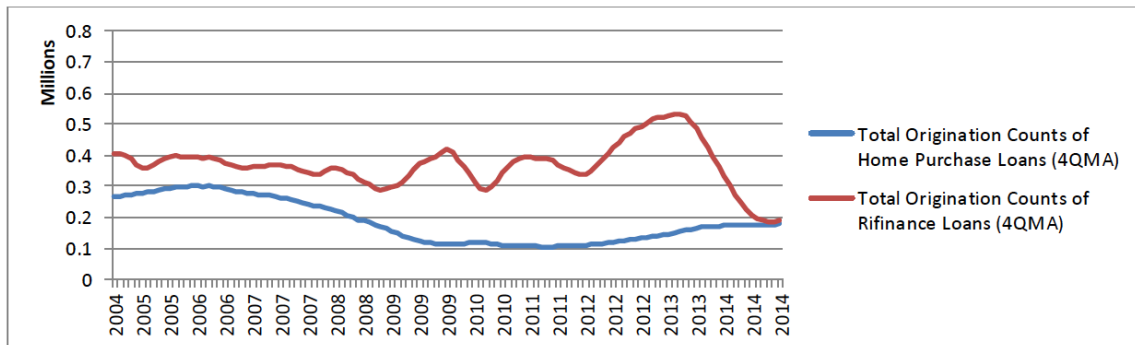
**Figure 2: Total Number of Mortgage Originations by Loan Type**

The figure shows the time series of the aggregate number of loan originations by loan type. We use Home Mortgage Disclosure Act (HMDA) to aggregate the number of mortgage originations by loan type and by year-quarter. Panel A reports the aggregate number of mortgage originations in HMDA data including both bank lenders and non-bank lenders, with 4 quarter moving average. The blue line shows the number of mortgage originations for all types of loans. The red line shows the number of mortgage originations for refinances and green line shows the number of mortgage originations for home purchases. Panel B reports the aggregate number of mortgage originations in HMDA by bank lenders only, with 4 quarter moving average.

Panel A: All Lenders



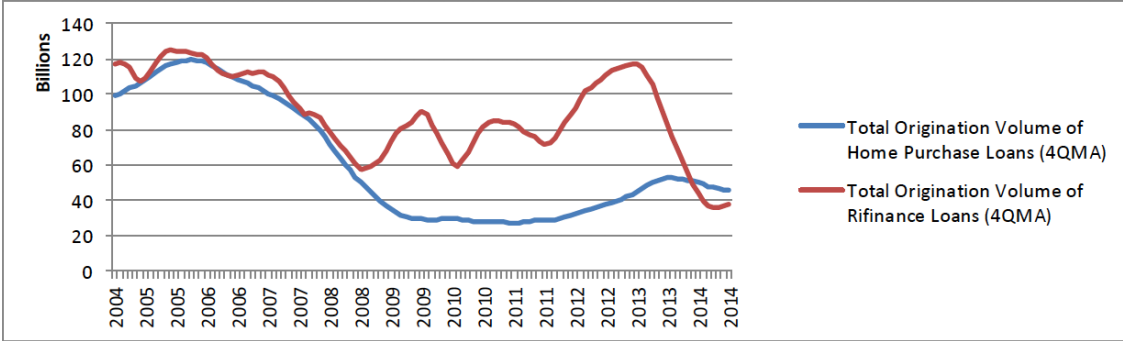
Panel B: Bank Lenders



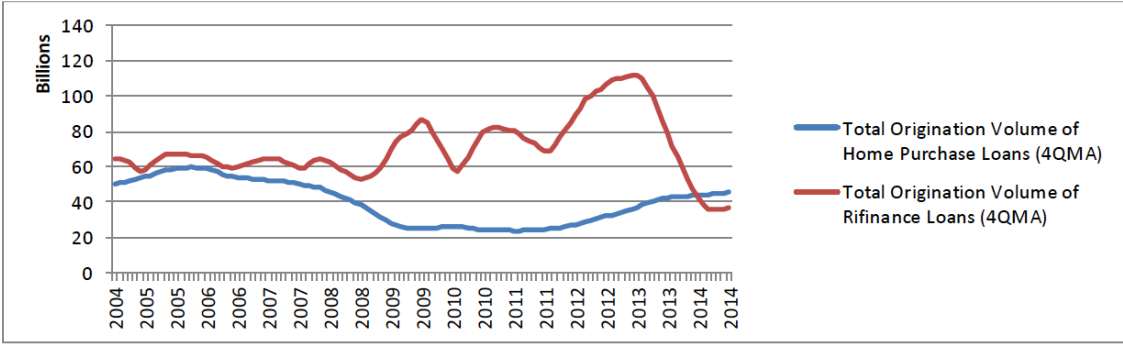
**Figure 3: Total Amount of Mortgage Originations by Loan Type**

The figure shows the time series of the aggregate amount of loan originations by loan type. We use Home Mortgage Disclosure Act (HMDA) to aggregate the amount of mortgage originations by loan type and by year-quarter. Panel A reports the aggregate amount of mortgage originations in HMDA data including both bank lenders and non-bank lenders, with 4 quarter moving average. The blue line shows the amount of mortgage originations for all types of loans. The red line shows the amount of mortgage originations for refinances and green line shows the amount of mortgage originations for home purchases. Panel B reports the aggregate amount of mortgage originations in HMDA by bank lenders alone, with 4 quarter moving average.

Panel A: All Lenders



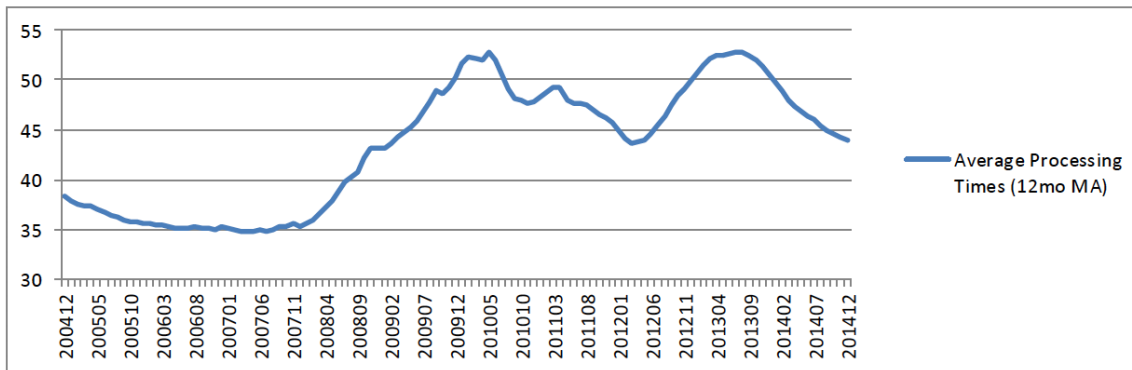
Panel B: Bank Lenders



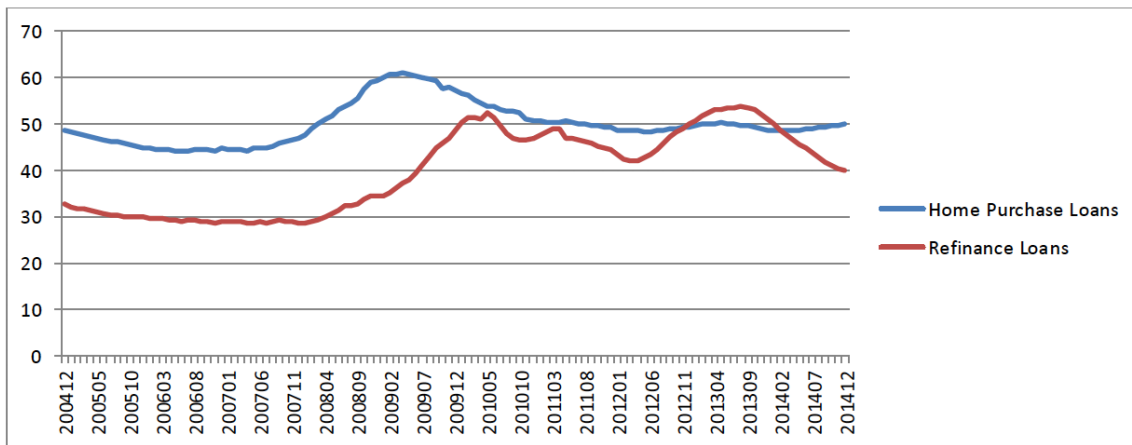
**Figure 4: Average Loan Processing Times by Loan Type**

The figure shows the time series of average loan processing time by loan type. We use Home Mortgage Disclosure Act (HMDA) to compute quarterly bank-level loan processing time as the average difference between the loan application date and the decision date in a quarter. Panel A reports the average loan processing time for all types of loans, with 4 quarter moving average. Panel B reports the average loan processing time by loan type. The blue line shows the average loan processing time for home purchase mortgages and the red line shows the average loan processing time for refinance mortgages.

Panel A: All Loans



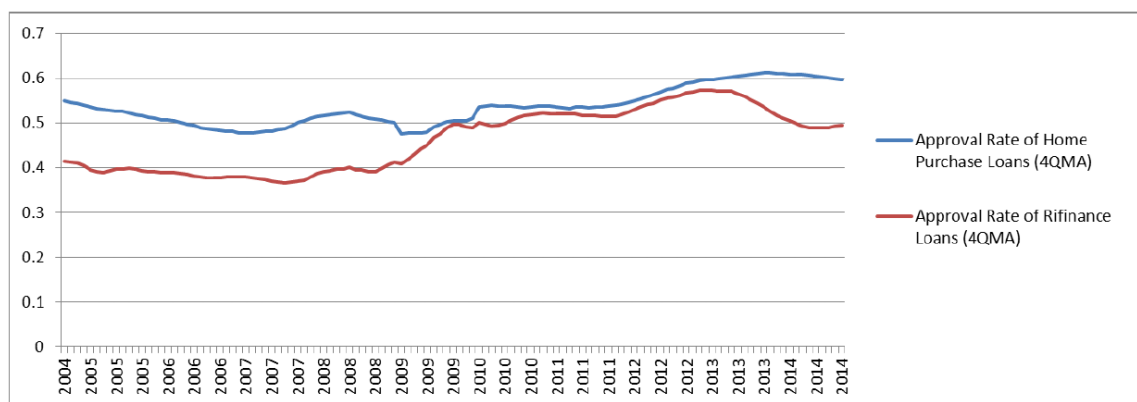
Panel B: Home Purchase Loans VS Refinance Loans



**Figure 5: Mortgage Approval Rate by Loan Type**

The figure shows the time series of mortgage approval rate by loan type. We use Home Mortgage Disclosure Act (HMDA) to aggregate the number of mortgage applications and originations by loan type and by year-quarter to compute mortgage approval rate. Panel A reports the mortgage approval rate in HMDA data including both bank lenders and non-bank lenders, with 4 quarter moving average. The blue line shows the mortgage approval rate for all types of loans. The red line shows the mortgage approval rate for refinances and green line shows the mortgage approval rate for home purchases. Panel B reports the mortgage approval rate in HMDA by bank lenders only, with 4 quarter moving average.

Panel A: All Lenders



Panel B: Bank Lenders

