Clogged Intermediation: Were Home Buyers Crowded Out?*

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Abstract

Post-crisis policy interventions significantly increased the demand for mortgage refinancing, but there is an unexplored possibility that the surge in refinancing applications has crowded out the supply of credit to home buyers. In this paper, we examine two frictions that hamper financial intermediation and cause banks to substitute home purchase loans for refinance loans. If banks are constrained by risk capacity, they may prefer safer loans. If banks are constrained by operating capacity, they may prefer applications that require less processing time. We find that following the recent financial crisis, banks constrained by these capacity limits did ration credit to home buyers while supplying greater refinance credit.

Keywords: Credit rationing, mortgage lending, operating capacity, monetary policy 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,[1] despite policy interventions designed to facilitate credit access. The Federal Reserve's monetary stimulus, often referred to as Quantitative Easing (QE), did increase mortgage borrowing, but the increase was driven by refinancing loans instead of home purchase loans. Figure 1 reports the aggregate trend in mortgage applications by loan type using 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 examine the number of mortgages originated or the dollar amount originated, as shown in Figures 2 and 3.

One might naturally ask if this disparity was driven by banks' rationing credit to home buyers during this period, not just by weaker demand for such credit. We look to examine what caused the credit rationing. More specifically, we examine whether the increase in mortgage originations for refinances during this period crowded out credit availability for potential home buyers because of frictions in the credit supply. This question not only has implications for the distribution of credit to different borrowers, but also has an important macroeconomic implication—if home buyers' marginal propensity to consume is greater than that of refinancing borrowers,[2] this financial intermediation frictions, which cause the crowding-out effect, could impede the transmission of monetary policy and dampen the policy's intended effect of stimulating aggregate output.

In this paper, we propose and test two channels that are likely to have impeded the

[1]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."

[2]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.

financial intermediation process and contributed to this crowd-out effect: the risk capacity channel and the operating capacity channel. When facing these capacity constraints, banks try to substitute home purchase loans with refinance loans. We argue that both of these capacity limits became more constrained after 2008 and examine whether constrained banks *choose to decrease* home purchase loans while on the contrary *increasing* refinance loans.

With frictionless financial intermediation, a lender should be able to originate any mortgage, regardless of whether it is for a home purchase or refinance, as long as it is with positive NPV. Thus, 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 because of, for instance, capital depletion or strict 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 constant, because riskier lending would require more economic (or regulatory) capital to hold against. As refinance mortgages are less risky than home purchase mortgages for banks due to the availability of borrowers' payment history and soft information (Gilje et al. (2016)), a bank with limited risk capacity would tilt its mortgage portfolio toward refinance 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 operating capacity binds such that a loan officer is sitting on a pile of (unfinished) applications, they would prefer the applications that take the least time to screen, tilting their preference toward less labor intensive refinance loans.

We implement our empirical analyses using bank-level quarterly panel data from 2004 to 2013, matching the mortgage application and 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, where we consider thinly capitalized banks to be constrained. In testing the operating capacity channel, we construct a novel measure of banks' operating capacity using unique features of the confidential version of the HMDA data managed by the Federal Reserve Board. The confidential version provides information on two important dates for each loan application: the application date and the action (origination decision) date. Knowing these two dates enables us to observe how many days a lender spent screening a given application, as well as the ratio of "unfinished" applications to received applications at any given point in time. This allows us to capture differences in operating capacity across banks. We exploit cross-sectional variation in this "operating slack," which we formally define as the ratio of unfinished applications at the end of each quarter to the total number of applications received in that quarter. We consider banks with a large fraction of unfinished applications to be constrained.

We argue that both of these capacity limits became critical particularly after 2008 Q4. Risk capacity becomes constrained due to banks' lowered risk appetite, stricter risk management, and increased regulatory burden. Operating capacity becomes constrained due to the surge in mortgage applications in response to policy interventions (e.g., monetary stimulus) as well as stricter risk management that requires more careful screening of the loan applications. Therefore, we test whether banks more constrained by risk or operating capacity *decreased* home purchase originations but *increased* refinance originations post-crisis compared to banks that are less constrained in those capacities. We find that the substitution effect—preferring refinance loans to home purchase loans—is substantially stronger for the constrained banks, both for risk and operating capacity.

In examining the credit supply effect, it is crucial to control for any factors that might reflect the demand side effect. For the risk capacity channel, it is possible that undercapitalized banks that lent less to home purchasers mainly operate in local markets that have been affected by the housing bust, and thus, are simply facing lower demand for home purchases, instead of *actively* avoiding these loans. We address this identification challenge in several ways. First,

note that this demand factor would bias against our prediction for refinance originations, because banks facing weaker home purchase demand should tend to face weaker refinance demand in their local markets as well. On the contrary, we find that these banks originated *more* refinance loans. Second, we compare banks in the same local markets (states), by including $HQ \times Year$ fixed effects in our panel regressions, where HQ stands for the location of banks' headquarters. We also limit our sample to small banks that mostly operate in a single market. Our findings are robust. We lastly estimate loan-level regressions of approval decisions (approved or denied), comparing origination decisions across banks within the same county. We find that banks more constrained by risk capacity were about 8% more likely to approve refinance mortgages while 5% less likely to approve home purchase mortgages.

To isolate the operating capacity channel, we first control for average screening times for mortgage applications at the bank-quarter level, which allows us to compare banks with different levels of unfinished applications but the same processing time per application. We also analyze *within-bank* variations by examining the lending behavior of the same bank across different counties belonging to the same MSA. When testing if a bank lends differently in its "busy" counties as opposed to "non-busy" counties in the same MSA, we find that in their busy counties, banks originated 6 percentage points more refinance loans but 4 percentage points fewer home purchase loans compared to in their non-busy counties after 2008.

Our findings have important implications on monetary policy transmission through bank lending.[3] Firstly, they imply that banks constrained by the capacities try to substitute credit for potential home buyers with credit for refinancing borrowers (who are existing home owners). Note that, all else being equal, this substitution effect is greater in the case of an exogenous increase in refinancing demand, such as monetary stimulus; the monetary stimulus would increase both refinancing and home purchase demand, but the constrained banks might substitute further toward refinance originations and away from home purchase originations. This substitution exacerbates the credit access of certain borrowers, possibly those who are

[3]For the broad literature on monetary policy transmission through the bank lending channel, see Bernanke and Blinder (1992); Kashyap and Stein (1995); Peek and Rosengren (2000); and Kashyap and Stein (2000).

younger or less wealthy. On top of this distributional effect, there could also be macroeconomic effects if these rationed borrowers have a greater marginal propensity to consume. Secondly, recent literature on the risk taking channel (Peydró and Maddaloni (2011); Borio and Zhu (2012); Dell'Ariccia et al. (2013); and Jiménez et al. (2014)) suggests that banks lend more to "riskier" borrowers in response to monetary loosening, but we find that this is not always the case if banks' risk capacity is limited. As the banks face an increase in credit demand from safer borrowers, riskier borrowers actually get crowded out. Hence, in order for the risk taking channel to be operative, monetary stimulus should be complemented with bank (re)capitalization.

Our first contribution is to the emerging literature that analyzes distributional effects of post-crisis policy interventions. Beraja et al. (2017), which focuses 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. Di Maggio et al. (2017) and Ippolito et al. (2015) study the transmission of monetary policy across heterogenous agents in the economy by examining the responses of heterogenously indebted agents. Auclert (2015), Choi et al. (2017), and Kaplan et al. (2016) build a theoretical model of monetary transmission with heterogenous agents.

This paper also relates 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) find that the expansion in banks' mortgage lending during QE crowded out commercial lending. We study the crowd-out effect of refinance mortgages on home purchase mortgages, which may hamper the stimulus effect through heterogeneity in agents' marginal propensity to consume. Sharpe and Sherlund (2016) and Fuster et al. (2017) also study the role of operating capacity in monetary transmission. These two papers analyze the interme-

diary sector as a whole, but our main focus is on micro-level variation to identify the channel of action by constructing a novel measure of operating capacity.

Our paper proceeds as follows. In Section 2, we develop our empirical hypothesis. In Section 3, we discuss our data. Section 4 presents the empirical findings. 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 lender should be able to originate any mortgage, regardless of whether it is for home purchases or refinances, as long as it is with positive NPV. Therefore, loan origination decisions should be independent across different applications and be made solely based on loan and borrower characteristics. With financial frictions, however, origination decisions across loans might not be independent from each other, since the lender faces certain capacity limits. We suggest and test two frictions that might have impeded the intermediation process, leading banks to substitute away from home purchase originations and toward 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 is thinly capitalized or that its risk appetite is constrained because of, 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 constant, 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 binds, this could affect banks' preferences on the margin between the two mortgage types, i.e., home

purchase and refinance loans. Between the two types of mortgage originations, the latter can be less risky than the former from the lender's perspective, as the bank can observe the borrower's payment history and obtain soft information about the borrower and the local area (Berger and Udell (2002), Berger et al. (2005), Gilje et al. (2016)). Therefore, all else being equal, a bank with limited risk capacity would tilt its mortgage loan portfolio toward refinances over home purchases. We thus have the following prediction:

Hypothesis 1*: If a bank is constrained by its risk capacity, it will choose to reduce home purchase mortgage originations and increase refinance mortgage originations compared to banks with excess risk capacity.*

If a bank has unlimited risk capacity, it should in principle be able to originate all profitable mortgages. Loan origination decisions would then be independent across loans. On the other hand, a bank with a strictly binding risk capacity limit would not be able to take on any additional risk. However, it could still substitute riskier loans (home purchases) for less risky loans (refinance loans) to increase the number of originated loans without overstepping the capacity limit. This substitution effect would become more pronounced if a bank faced an exogenous surge in refinancing applications, because of, for instance, policy interventions such as monetary stimulus.

Regarding the recent financial crisis and the recession following Lehman Brothers' failure in the fourth quarter of 2008, we posit that risk capacity mattered more during the post-crisis period ("*post* period") compared to the pre-crisis period ("*pre* period"). Possible causes include stricter capital requirements, changes in risk perception and appetite, more illiquid secondary markets and greater putback risk, and increased risk in mortgage origination itself due to less valuable collateral. Therefore, the substitution effect should be more pronounced during the *post* period than the *pre* period. While this overall effect during the *post* period would apply to all banks, since it is driven by changes in the overall economic climate, note

that risk capacity is more likely to bind on thinly capitalized banks. Therefore, we make the following prediction:

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

2.2. Operating capacity channel

The second constraint, which we refer to as the operating capacity channel, arises from lenders' limited capacity for processing and screening mortgage applications. All else being equal, a loan officer not constrained by the operating capacity should be indifferent between the two types of mortgage applications. However, if operating capacity is limited such that a loan officer is sitting on a pile of (unfinished) applications, they would be expected to prioritize applications that take less time to screen (Sharpe and Sherlund (2016)).

Figure 4 shows a 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 bank's loan processing time for the quarter. Panel *B* of Figure 4 compares the average processing time of home purchase mortgages to that of refinance mortgages from 2004 to 2014. As the figure clearly shows, refinance applications usually take less time to screen than home purchase applications.[4]

Again, this difference could be due to previously acquired credit information and soft information about the borrower and the local area, particularly if the lender is the current servicer of the loan. Or it could simply be that less "labor" is required for refinance applications, as the legal process is much simpler.[5] Therefore, all else being equal, banks constrained by op-

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

[5]For instance, Buchak et al. (2017) note that for refinancing screening, the "lender benefits from many on-the-ground activities, such as a title check, structural examination, negotiations between buyer and seller,

erating capacities should tilt their mortgage portfolios toward refinance mortgages, compared to banks with sufficient operating capacity. Hence, we have the following prediction:

Hypothesis 2: *If a bank is constrained by its operating capacity, it will prefer processing refinance mortgage applications, thus resulting in more refinance originations and fewer home purchase originations.*

We now compare operating capacity before and after 2008 Q4. As can be seen in Figure 1, total mortgage applications partly recovered following the crisis, likely driven by an increase in refinance applications in response to policy interventions such as Quantitative Easing (QE) and Home Affordable Refinance Program (HARP). However, Figure 4 suggests that the average screening time per application increased significantly after 2008, indicating that more banks reached their operating capacities during this period (Sharpe and Sherlund (2016), Fuster et al. (2017)). Therefore, this capacity constraint may have led to refinance originations crowding out home purchase originations during this period. Furthermore, this substitution effect should be particularly pronounced among banks more constrained by operating capacity limit. We thus make the following prediction:

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

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having already taken place at the time of purchase."

3. Data and Summary Statistics

We use confidential HMDA loan application data from 2004:Q1 to 2013:Q4[6] to construct a bank-quarter panel of banks' mortgage origination activities. According to the HMDA reporting guide, which is published by the Federal Financial Institutions Examination Council (FFIEC), the confidential HMDA provides the exact loan application and decision (approved or denied) date, while the publicly available HMDA only reports the year of origination.[7] Having these two dates enables us to construct a measure to capture bank operating capacity. We include conventional mortgages for one-to-four family homes and aggregate banks' mortgage originations by loan purpose (refinance or home purchase).[8]

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 by RSSD ID. 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.[9] For banks that do not have the RSSD9348 field populated, we use their Call Report data and interpret them as stand-alone commercial banks. For each quarter, our sample consists of 3,250 banks on average.[10]

Table 1 reports summary statistics at the bank level. Panel *A* reports summary statistics based on all sample observations. Refinance(#) is the number of refinance mortgages originated by a bank in a quarter, with a mean of 200.12 and a standard deviation of 3,070.67. Refinance($) is the dollar amount of refinance mortgages originated by a bank in a quarter, with a mean of $35.90 million and a standard deviation of $662.27 million. Purchase(#) is the

[6]On December 18, 2013, the FOMC announced the "tapering" of QE3.

[7]See https://www.ffiec.gov/hmda/pdf/2013guide.pdf or https://www.federalreserve.gov/files/pia_hmda.pdf.

[8]Home purchase loans are the loans with home purchase as the loan purpose in HMDA. Refinance loans are loans with refinance and home improvement as the loan purpose in HMDA.

[9]We drop bank-quarter observations when the top holder ID changes to minimize the effect from merge and acquisition activities.

[10]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.

number of home purchase mortgages originated by a bank in a quarter, with a mean of 94.31 and a standard deviation of 1,635.80. Purchase($) is the dollar amount of home purchase mortgage originated by a bank in a quarter, with a mean of $19.96 million and a standard deviation of $380.41 million.

We report bank characteristics that we control for in our analysis. These variables are winsorized at the 0.5% and 99.5% levels. *Assets* is a bank's total assets in millions of US dollars, with a mean of $3.2 billion and 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, with a mean of 0.28 and a standard deviation of 0.13. This measure allows us to control for asset liquidity. *Loan to Deposit Ratio* is the ratio of total loans to total deposits, with a mean of 0.82 and a standard deviation of 0.18. *RE Loan to Total Loan Ratio* is the ratio of real estate loans to total loans, with a mean of 0.76 and a standard deviation of 0.14. *CI Loan to Total Loan Ratio* is the ratio of CI loans to total loans, with a mean of 0.06 and a standard deviation of 0.09. *NPL Ratio* is the ratio of non-performing loans to total loans, with a mean of 0.02 and a standard deviation of 0.02. *Tier 1 Capital Ratio*, which is to control for bank soundness, is the ratio of a bank's tier 1 capital to total assets, with a mean of 0.14 and a standard deviation of 0.4.

In addition, we construct a measure of operating capacity using the application and decision dates. We calculate the ratio of "uncompleted" applications at the end of each quarter to the total number of applications received in that quarter, enabling us to capture the "slack" in each bank's *Operating Capacity*. That is, we associate a higher fraction of uncompleted applications with lower operating capacity for that bank since more applications are unfinished. *Operating Capacity* has a mean of 0.31 with a standard deviation of 0.17. That is, on average, 31% of loan applications are not fully processed in the quarter of the application date. We also calculate the average number of days spent screening an application, *Loan Processing Time*, for a given bank in a given 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 equals 0 otherwise. In our sample, 69% of applications are for refinances and 31% of applications are for home purchases. *I_Loan Approval* is a dummy variable that equals 1 if the loan is approved and equals 0 otherwise. On average, 52% of loan applications are approved. *log Income* is the log of household income at the time of the 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 county-level control variables that are associated with mortgage application. The average population is about 380,000, with average Income per Capita of $39,000 and average Unemployment rate of 6.66%. The average CoreLogic home price index (HPI) is 153.32.

Panel *B* reports summary statistics by Tier 1 Capital level. *Low Tier 1 Capital* is a dummy variable for the 25% of banks with the lowest Tier 1 Capital Ratio. The top panel reports summary statistics of banks in the *Low Tier 1 Capital* group and the bottom panel reports summary statistics for 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 the *Low Tier 1 Capital* group are, on average, larger in asset 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 the *Low Tier 1 Capital* group reject more applications, while other loan characteristics are quite similar.

Panel *C* reports summary statistics by *Operating Capacity*. *Low Operating Capacity* is a dummy variable for the top 25% of banks with the highest *Operating Capacity*. The top panel reports summary statistics for banks in the *Low Operating Capacity* group, and the bottom panel reports summary statistics for 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 the *Low Operating Capacity* group are, on average, larger in size and longer in loan processing 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 dollar amount of originations for refinance and home purchase mortgages using HMDA data. Panel A includes all lenders in HMDA whereas Panel B includes bank lenders only. One of the main differences between the two panels is in originations right 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 in this study is bank lenders. Panel B of Figures 2 and 3 show that home purchase mortgage originations by banks plunged in 2008 and stayed low afterward, but 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 quickly after the crisis, as shown in Panel B of Figure 5. These two figures suggest that lenders were more likely to approve and originate refinance 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 to confirm this overall trend. Specifically, we estimate the following quarterly panel regression:

$$Y_{it} = \alpha_q + \alpha_i + \beta \cdot I\_Post + \gamma \cdot X_{i,t-1} + \epsilon_{it}, \tag{1}$$

where *I_Post* equals 1 for the *post* period of 2009 Q1 to 2013 Q4 and equals 0 for the *pre* period. The dependent variables are total mortgage originations by bank i in period t for (i) refinances, (ii) home purchases, and (iii) the difference between the two. Bank controls $X_{i,t-1}$ are lagged by one quarter and include bank characteristics such as log *Assets*; *Liquid Asset Ratio*, which reflects asset liquidity; *Loan to Deposit Ratio* which reflects the asset-liability maturity mismatch as well as loan demand; real estate (*RE*) and C&I (*CI*) *Loans to Total Loan Ratio* which reflect business models; non-performing loan (*NPL) Ratio* and

Tier 1 Capital Ratio which reflect financial soundness. We include bank fixed effects α_i and quarter fixed effects α_q to account for differences between individual banks and for seasonality in mortgage origination. All standard errors are clustered by bank.

Our coefficient of interest is β, 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 results. Panel *A* reports the results using the total dollar amount of mortgage originations as the dependent variable. All observations are taken at the bank-quarter level. Column (1) uses the log of the total dollar amount of refinance originations (*logRefi$*), column (2) uses the log of the total dollar amount of home purchase originations (*logP$*), and column (3) uses the difference between the two mortgage originations (i.e., (1) − (2)). This last dependent variable can be interpreted as the "business mix" of the bank, reflecting the ratio of refinance originations to home purchase originations. We find that refinance originations significantly increased, while home purchase originations significantly decreased in the *post* period relative to the *pre* period. The estimate of the difference between the two originations is also positive and significant. The specifications in columns (4)-(6) are the same as columns (1)-(3) except for the inclusion of bank fixed effects, and the estimation results are similar; compared to the *pre* period, banks increased refinance originations by 22 percentage points, but decreased home purchase originations by 21 percentage points. Panel *B* reports the estimation results using the total number of mortgage originations as the dependent variable (*logRefi#*, *logP#*). These estimation results are also similar.

Overall, our results suggest that, relative to the *pre* period of 2004–2008, banks originated more refinance mortgages but fewer 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 do not control for the demand-side factors. For instance, after 2008 Q4, refinancing demand could have surged while home purchase demand plunged. If this were to be the case, these results are possible even if banks did not actively adjust their lending practices. To decouple the bank supply channel from the demand channel, in the following sections, we focus on the cross-sectional variation in bank characteristics that reflects frictions in financial intermediation, such as risk capacity and operating capacity, and examine how these frictions affect banks' lending behavior.

4.1. Testing the Risk Capacity Channel

We first test *Hypothesis 1'* of Section 2, examining whether banks' risk capacity affects the types of loans they choose to originate. We expect thinly-capitalized banks to have shifted their lending toward refinances and away from home purchases relative to better-capitalized banks after 2008 Q4. We conduct a bank-level analysis augmenting the previous regression specifications. In particular, we estimate the following panel regression:

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

where $\textit{Low Tier 1 Capital}_{i,t-1}$ equals 1 if a bank's tier 1 capital ratio belongs to the bottom quartile in the previous quarter, and equals 0 otherwise. As before, *I_Post* equals 1 for the *post* period of 2009 Q1 to 2013 Q4, and equals 0 otherwise. α_y is year fixed effects, α_q is quarter fixed effects, α_i is bank fixed effects, and $\alpha_{HQ,y}$ is $Headquarter\ State \times Year$ fixed effects based on banks' headquarter state. $X_{i,t-1}$ includes controls for bank characteristics lagged by one quarter 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 β, the coefficient on the interaction between *I_Post* and $\textit{Low Tier 1 Capital}_{i,t-1}$. As risk capacity becomes more binding during the *post* period, we expect a positive β for originations

of refinance mortgages, a negative β for originations of home purchase mortgages, and a positive β for the difference between originations of the two types of mortgages.

[Table 3 here]

Table 3 reports the estimation results. In Panel A, we use the total dollar amount of mortgage originations as the dependent variable. Column (1) uses the log of the total dollar amount of refinance originations at the bank-quarter level (*logRefi$*). We include year fixed effects (α_y) and quarter fixed effects (α_q). Due to the year fixed effects, we cannot identify *I_Post* and thus only report its interaction with *Low Tier 1 Capital*$_{i,t-1}$. We find that during the *post* period, thinly-capitalized banks increased refinance originations more than better-capitalized banks did, relative to their lending patterns during the *pre* period. Column (2) uses the log of the total dollar amount of home purchase mortgages at the bank-quarter level (*logP$*). The estimate suggests that thinly-capitalized banks originated fewer home purchase loans than better capitalized banks did during the *post* period, although the effect is statistically insignificant. Column (3) uses the difference between the two types of mortgage originations. Here, we have a statistically significant and positive β demonstrating that the substitution effect was larger for thinly-capitalized banks compared to well-capitalized banks.

There is 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. We address this identification challenge in several ways. First, to account for potential differences in local demand across regions, we add bank fixed effects and $Headquarter\ State \times Year$ fixed effects ($\alpha_{HQ,y}$) in columns (4)-(6), allowing us to compare banks in the same state.[11] Here, we test whether thinly capitalized banks, compared to other well-capitalized banks in the same local market, originated more refinance mortgages but fewer home purchase mortgages during

[11] We note that this control is not ideal 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 using only local banks, defined as banks that collect more than 90% of their loan applications from a single state. We find the same results.

the *post* period.

In column (4), we find that thinly-capitalized banks indeed originated significantly more refinance loans (about 8 percentage points) compared to their counterparts in the same state during the *post* period, relative to their lending patterns during the *pre* period. On the other hand, their home purchase originations were significantly (about 5 percentage points) lower than their better-capitalized local peers, as shown in column (5). These results mitigate some of the concern about confounding demand effects. Suppose that our results are driven by demand-side effects 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, we should observe βs with the *same* signs for refinance and home purchase originations. On the contrary, we observe a positive β for refinances and a negative β for home purchases, indicating active portfolio adjustments by banks with limited risk capacities.

In column (6), we use the difference between two origination types as the dependent variable, providing a direct measure of substitution between the two. We find a positive and statistically significant β. Again, this coefficient should be insignificant if the thinly-capitalized banks are indifferent between the two types of mortgages, so our results suggest that the supply side factor, operationally through the risk capacity channel, affected banks' lending behaviors.

Panel B reports the estimation results using the total number of mortgage originations (instead of the total dollar amount) as the dependent variable. The estimation results are similar, showing that the substitution effect is stronger in magnitude.

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 limit, 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 it is lagged, could be endogenous. In our alternative specification, we define the treatment group as banks with low capital as of 2008Q4, right before the treatment period. In this difference

in difference specification, we analyze how banks that were thinly capitalized at the start of the *post* period adjusted their lending behavior during the *post* period compared to their counterparts with greater capital buffer.

The estimation results are presented in Panel C and D. The specifications are the same as those in Panels 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 banks that were thinly capitalized at the end of 2008 originated significantly fewer home purchase mortgages during the *post* period of 2009-2013 compared to their better capitalized counterparts in the same market. We would naturally expect the same decrease in refinance originations for these banks (i.e., a negative β for columns 1 and 4) *unless* they had actively tilted their preferences towards refinance loans and away from home purchase loans. We do find that this is not the case—in both Panels C and D, the βs are positive, though the coefficient is statistically significant only in column (1) and not in column (4) with the full fixed effects. These results suggest that the risk capacity channel was indeed operative and that our results were not being driven by endogeneity of the capital ratio. In sum, banks with limited risk capacity preferred refinance mortgages to home purchase mortgages.[12]

We next implement a loan-level analysis that allows us to compare origination decisions across banks within the same county to better control for different local demand. Our loan level analysis focuses on the approval and denial decisions of individual mortgage applications as a measure of lending behavior. We examine whether, during the *post* 2008 Q4 period, banks with limited risk capacity (i) loosened lending standards for refinance mortgages while (ii) tightening lending standards for home purchase mortgages relative to their well-capitalized

[12] 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.

counterparts. Specifically, we estimate the following linear probability model:

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

where for loan l in county c from bank i at time t, *I_Loan Approval* equals 1 if approved and equals 0 if denied. In addition to controlling for the bank characteristics $X_{i,t-1}$, we also control for loan characteristics X_l, which include income and loan to income ratio, and the local economic characteristics $X_{c,t-1}$, which include log *Population*, log *Income per Capita*, *Unemployment Rate*, and *Home Price Index*. We also include county fixed effects (α_c) so as to compare banks within county. By thoroughly controlling for local economic conditions, we attempt to isolate changes in risk appetite that should be reflected in lending standards for the two types of mortgage applications. Our coefficient of interest is β, the coefficient 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), and (5) report loan approvals for refinance mortgages, whereas columns (2), (4), and (6) report loan approvals for home purchase mortgages. Columns (1)-(2) include only 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), our preferred specification, we find results similar to the bank-level results. During the *post* period, banks with low risk capacities were about 8% more likely to approve refinance mortgages (positive and statistically significant β), while they were about 5% less likely to approve home purchase mortgages (negative and statistically significant β) compared to banks with no binding risk capacity limits and relative to their *pre* period behaviors. In other words, banks constrained by risk capacity tightened their lending standards for home purchase mortgages but loosened the standards for refinance mortgages.

Panel B reports similar regression results, except we use *Low Tier 1 Capital*$_{2008.Q4}$ instead of *Low Tier 1 Capital*$_{i,t-1}$, so as to have a fixed treatment group. Results for this within-bank comparison are similar to the results in Panel A.

4.2. Testing the Operating Capacity Channel

We first examine the time series variation in the average screening time for mortgage originations. We plot the average number of days spent between the application date and the decision date (approved or denied) in Figure 4. We find two interesting patterns regarding 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 "unfinished" applications at the end of each quarter out of the total number of mortgage applications received in that quarter. That is, we associate a higher fraction of unfinished applications with a lower operating capacity, since the bank is rolling over more of its applications unfinished to the next quarter. Note that this measure is particularly well-suited to our natural experiment that studies the effect after 2008 Q4—if banks face relatively low volumes of incoming mortgage applications or screen applications rapidly, 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) or the average screening time gets longer as in the *post* period, then the measure would more effectively capture cross-sectional variations in the 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 *post* period. To do so, we estimate the following regression:

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

where $Low\ Operating\ Capacity_{i,t-1}$ is a dummy variable that equals 1 for the top quartile banks in terms of the fraction of uncompleted applications in the previous quarter, and equals 0 otherwise. As before, *I_Post* equals 1 for the *post* period of 2009Q1 to 2013Q4, and equals 0 otherwise. α_y is year fixed effects, α_q is quarter fixed effects, α_i is bank fixed effects, and $\alpha_{HQ,y}$ is $Headquarter\ State \times Year$ fixed effects. $X_{i,t-1}$ is a vector of bank characteristics lagged by one quarter including *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*, which reflects the average processing time for mortgage originations. Our coefficient of interest β, the coefficient on the interaction of *I_Post* and $Low\ Operating\ Capacity_{i,t-1}$.

Note that risk capacity could also affect operating capacity, as more careful risk management or tighter lending standards requires 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 *Loan Processing Time*, the four-quarter moving average of processing time at the bank level.

[Table 5 here]

Table 5 presents the estimation results for all the banks in our sample. Panels A and B use all banks in our sample. Panel A reports the results with the total dollar amount of mortgage originations and Panel B reports the results with the total number of mortgage originations. Since the results are similar, we will only discuss Panel A. Columns (1) - (3) only include year and quarter fixed effects. Column (1) reports estimates for the log of the dollar amount of refinance mortgage originations, column (2) reports estimates for the log of the dollar amount of home purchase mortgage originations, and column (3) reports estimates

for the difference between the two dependent variables in columns (1)-(2). We find that, during the *post* period, banks with lower operating capacity increase refinance originations (about 29 percentage points) but decrease home purchase originations (about 7 percentage points) compared to the comparison group. The difference between the two types of mortgage originations is statistically significant and positive.

Columns (4)-(6) are the same as columns (1)-(3) but include bank fixed effects and $Headquarter\ State \times Year$ fixed effects. As discussed earlier, it could be important to control for local loan demand to isolate supply-side effects. Hence, we control for potential differences in mortgage demand by adding fixed effects for banks' headquarter state-by-year. That is, we compare banks with low operating capacity to banks with high operating capacity that are headquartered in the same state in the same calendar year. The results are similar to those in columns (1)-(3). Compared to their *pre* period lending behavior, banks with low operating capacity increased more refinance originations (about 16 percentage points) but decreased home purchase originations (about 5 percentage points) relative to their peers in the same local market during the *post* period.

However, there could still be local factors affecting our measure of low operating capacity that we were unable to account for. For instance, operating capacity would have been lower if banks faced stronger demand during the *post* period because of policy interventions such as monetary stimulus. Under the assumption that stronger local mortgage demand implies greater borrowing demand for *both* refinances and home purchases, this unexplained factor should affect the originations of the two loans in the same direction. We, on the contrary, predict that operating capacity constraint should affect the two in the opposite directions. Therefore, the bias from the local demand factor would work *against* our crowd-out hypothesis. In that regard, our estimates for home purchase loans can be considered as the lower bound of the actual effect of low operating capacity.

Nonetheless, we next limit our sample to only *local* banks to better control for local economic factor, and presents results in Panels 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 regression specifications in Panel A and B, we add MSA-level controls including log *Population*, log *Income per Capita*, *unemployment rate*, and *home price index*. The results are similar to what we find in Panels A and B, but the substitution effects are more pronounced, reflecting clearer cross-sectional comparisons after controlling for local factors that might have demand-side effects on mortgage applications.

We next examine within-bank differences in order to better mitigate other 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 bank operates in. We first calculate the quarterly county-level operating capacity as we did for the bank-level operating capacity. For each bank at each time period, we sort the bank's "regions," i.e., counties that the bank lends to, into two groups using the bank's median county operating capacity—high operating capacity (supposedly less busy) counties and low operating capacity (busy) counties. We then examine whether the bank, during the *post* period, increased refinance originations while also reducing home purchase originations in counties with limited operating capacity relative to non-busy counties. We thus run the following regression:

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

where the dependent variables are mortgage originations (refinances, home purchases, or the differences between the two) by bank i in county c at time t. Busy County Within $\text{Bank}_{i,t-1}$ is a dummy variable that equals 1 if the county is below the median county operating capacity for the bank, and equals 0 otherwise. *I_Post* equals 1 for the *post* period of 2009 Q1 to 2013 Q4, and equals 0 otherwise. $X_{i,t-1}$ is a vector of bank characteristics lagged by one quarter including *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*

that reflects loan demand changes at the bank level. $X_{c,t-1}$ is a vector of county-level controls from the previous year, including characteristics such as *log Population*, *log Income per Capita*, *Unemployment Rate*, and *Home Price Index*.

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

[Table 6 here]

Table 6 reports the estimation results. If operating capacity has no effect on banks' preference regarding loan type, then variations in operating capacity (i.e., "busyness") across counties should reflect simply differences in local loan demand. That is, we should observe, for a given bank, busier "branches" in counties with stronger loan demand, and correspondingly, demand for both mortgage types should concurrently be stronger. However, we find the opposite to be true – during the *post* period, banks originated about 4 percentage points *fewer* home purchase mortgages in counties where they had limited operating capacity, as shown in columns (2) and (5). However, they originated 4 to 6 percentage points *more* refinance mortgages in the same counties, as shown in column (1) and (4).[13] The difference between the two types of originations is wider in counties with tighter operating capacity, as shown in columns (3) and (6). These results support our view that the operating capacity channel contributes to the crowding out of home purchase loans.

[13]Note that β in column (1) based on the dollar amount is positive but statistically insignificant. However, we think that the number of originations in column (4) is a more accurate measurement of the impact of operating capacity, since loan officers care more about finishing the uncompleted application files on their to-do lists.

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, these bank-level findings do not necessarily imply that capacity constraints limited home purchasers' access to credit; other lenders, such as banks without capacity constraints or non-bank lenders, could have stepped in.

Recall that most of the changes in originations were driven by bank lenders, as shown in Figures 2 and 3. Moreover, non-bank mortgage lenders' market share goes down significantly after the financial crisis. Nonetheless, we examine county-level aggregate lending to find the total credit supply effect of risk and operating capacity constraints. We create a measure of county-level aggregate mortgage originations that includes both banks and non-banks and analyze how aggregate lending in counties with a constrained banking sector (either in risk capacity or operating capacity) changed during the *post* period relative to counties with a less constrained banking sector.

We define counties with a constrained banking sector based on county-level risk capacity and county-level operating capacity measures. County-level risk capacity is the average of banks' Tier 1 Capital Ratios, weighted by banks' number of mortgage applications in the county. *Low Tier 1 Capital*$_{c,t-1}$ is a dummy variable that equals 1 for counties in the bottom 25% in terms of county-level risk capacity and equals 0 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 the inverse of the average fraction of banks' mortgage applications that are uncompleted, again weighted by banks' number of mortgage applications in the county. Again, *Low Operating Capacity*$_{c,t-1}$ is a dummy variable that equals 1 for counties in the bottom 25% of county-level operating capacity, and equals 0 for counties in the top 25% of the same measure.

We run the following yearly panel regressions:

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

for the risk capacity channel and

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

for the operating capacity channel. *I_Post* equals 1 for the *post* period of 2009 Q1 to 2013 Q4, equals 0 otherwise. $X_{c,t-1}$ is a vector of county-level controls from the previous year, including characteristics such as *log Population*, *log Income per Capita*, *Unemployment Rate*, and *Home Price Index*. We include county fixed effects and State × Year fixed effects. The latter allows us to compare different counties in the same state. Our coefficient of interest is β, which compares counties in the top quartile to counties in the bottom quartile of county-level bank capitalization in terms of aggregate mortgage originations during the *post* period.

[Table 7 here]

Table 7 reports the regression results for the risk capacity channel. Panel A reports the results for the total dollar amount of mortgage originations. Column (1) reports the regression results for the log of the dollar amount of refinance originations, column (2) reports the results for the log of the dollar amount of home purchase originations, and column (3) reports the results for the difference between the two dependent variables in columns (1)-(2). We find that counties with low risk capacity had more refinance mortgage originations but fewer home purchase mortgage originations compared to the counties with high risk capacity in the same state. Moreover, the difference between the two is positive and statistically significant, as shown in column (3), indicating that refinance mortgages crowded out home purchase mort-

gages. The specifications in columns (4)-(6) are the same as those in columns (1)-(3) except for the addition of the county-level controls. The results are similar but increase in statistical significance, suggesting the these findings are not being driven by county-level differences. Panel B reports the same results but use the total number of mortgage originations, finding stronger effects in terms of statistical significance.

Panels C and D report the results from an alternative measure of county-level risk capacity. We use banks' Tier 1 Capital Ratio as of 2008 Q4 to construct $Low\ Tier\ 1\ Capital_{c,2008.Q4}$, which is time invariant. Our findings are robust and statistically significant.

[Table 8 here]

Table 8 reports the regression results for the operating capacity channel. Panel A reports the results for the total dollar amount of mortgage originations. Column (1) reports the regression results on the log amount of refinance originations, column (2) reports the results for the log of the dollar amount of home purchase originations, and column (3) reports the results for the difference between the two dependent variables in columns (1)-(2). We find that counties with low operating capacity had more refinance originations but fewer home purchase originations compared to counties with high risk capacity in the same state. Note that the aggregate effect on home purchase lending in column (2) is relatively weak compared to the aggregate effect on refinance lending in column (1). This finding could be due to the fact that the operating capacity effect of substitution competes with the effect of strong loan demand. The difference between the two originations is positive and significant, as shown in column (3), indicating that the gap between refinance originations and home purchase originations widened more in counties with more constrained operating capacity. The specifications in columns (4)-(6) are the same as those in columns (1)-(3) but add the vector of county-level controls. The results are similar but increase in statistical significance, demonstrating the robustness of more estimates. Panel B reports the same results but uses the total number of mortgage originations and, finding similar results with more statistical significance.

5. Conclusion

In this paper, we proposed and examined two potential sources of frictions in banks' financial intermediation: risk capacity, arising from banks' limited capacity for risk taking, and operating capacity, arising from loan officers' limited capacity to process and screen loan applications. When banks are constrained, they substitute home purchase loans with refinance loans because refinance originations are both less risky and quicker to process. Monetary stimulus would increase both refinancing and home purchase borrowing demand, but the aforementioned substitution effect might actually outweigh and thus reduce home purchase originations.

Substituting home purchase loans with refinance loans essentially limits certain borrowers access to credit, particularly for younger and less wealthy first-time home buyers. Additionally, there could be macroeconomic effects if these rationed borrowers have a greater marginal propensity to consume. Hence, while our analysis mainly focuses on the distributional impact of these frictions, our proposed mechanism of action also has novel macroeconomic implications in terms of monetary policy transmission 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. I_Refinance is a dummy variable that equals to 1 if the loan type is refinance mortgage and 0 otherwise. I_Loan 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.

Panel A: All Samples						
	Obs	Mean	Std.Dev.	p25	p50	p75
Bank-level Variables						
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
Loan-level Variables						
I_Refinance	3223338	0.69	0.46	0	1	1
I_Loan 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

Low Tier 1 Capital = 1	Obs	Mean	Std.Dev.	p25	p50	p75
Bank-level Variables						
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
Loan-level Variables						
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 ($000)	2599021	193	180	76	146	252
Low Tier 1 Capital = 0	Obs	Mean	Std.Dev.	p25	p50	p75
Bank-level Variables						
Refinance(#)	85541	62.98	472.18	7	18	45
Refinance($ 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
Loan-level Variables						
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

Low Operating Capacity = 1	Obs	Mean	Std.Dev.	p25	p50	p75
Bank-level Variables						
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
Loan-level Variables						
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 ($000)	997672	225	189	105	177	290
Low Operating Capacity = 0	Obs	Mean	Std.Dev.	p25	p50	p75
Bank-level Variables						
Refinance(#)	92865	158.77	2215.38	8	20	51
Refinance($ 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
Loan-level Variables						
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 (*logRefi$*). The main independent variable is the time dummy for 2009 Q1 to 2013 Q4 (I_Post). Other independent variables include 1 quarter lagged bank-level characteristics such as log Assets, Liquid Asset Ratio, Loan to Deposit Ratio, RE Loan to Total Loan Ratio, CI Loan to Total Loan Ratio, NPL Ratio, and Tier 1 Capital Ratio. We do not report bank-level controls for brevity. We also include Quarter fixed effects. Column (2) reports the result on log amount of home purchase mortgage originations (*logP$*). 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) 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 (*logRefi#*, *logP#*). 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.

Panel A: Total Amount of Mortgage Originations

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	*logRefi$*	*logP$*	*(1)-(2)*	*logRefi$*	*logP$*	*(4)-(5)*
I_Post	0.297***	-0.094***	0.391***	0.223***	-0.211***	0.434***
	(15.55)	(-5.89)	(25.82)	(12.58)	(-13.91)	(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

Panel B: Total Number of Mortgage Originations

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	*logRefi#*	*logP#*	*(1)-(2)*	*logRefi#*	*logP#*	*(4)-(5)*
I_Post	0.013	-0.119***	0.132***	0.021	-0.208***	0.228***
	(0.72)	(-7.64)	(9.45)	(1.38)	(-15.27)	(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 (*logRefi$*). 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 (*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) except the additional Bank fixed effects and Headquarter (state) × 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 (*logRefi#*, *logP#*). 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.

Panel A: Total Amount of Mortgage Originations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	*logRefi$*	*logP$*	*(1)-(2)*	*logRefi$*	*logP$*	*(4)-(5)*	*logRefi$*	*logP$*	*(7)-(8)*
I_Post × Low Tier 1 Capital $_{t-1}$	0.110***	-0.049	0.159***	0.075***	-0.053**	0.127***	0.094***	-0.009	0.103***
	(2.81)	(-1.41)	(5.26)	(2.65)	(-1.98)	(5.01)	(3.17)	(-0.32)	(3.95)
Low Tier 1 Capital $_{t-1}$	-0.171***	-0.061**	-0.111***	-0.087***	0.022	-0.109***	-0.083***	0.041**	-0.124***
	(-5.80)	(-2.12)	(-5.01)	(-4.22)	(1.16)	(-6.11)	(-3.90)	(2.09)	(-6.66)
I_Post							0.211***	-0.202***	0.412***
							(11.40)	(-12.81)	(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 × Year FE	No	No	No	Yes	Yes	Yes	No	No	No

Table 3 Continues

Panel B: Total Number of Mortgage Originations									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	*logRefi#*	*logP#*	*(1)-(2)*	*logRefi#*	*logP#*	*(4)-(5)*	*logRefi#*	*logP#*	*(7)-(8)*
I_Post × Low Tier 1 Capital $_{t-1}$	0.089**	-0.078**	0.167***	0.063***	-0.080***	0.143***	0.091***	-0.025	0.117***
	(2.34)	(-2.22)	(5.80)	(2.60)	(-3.18)	(6.03)	(3.56)	(-0.96)	(4.76)
Low Tier 1 Capital $_{t-1}$	-0.240***	-0.091***	-0.149***	-0.077***	0.036**	-0.113***	-0.073***	0.053***	-0.127***
	(-7.69)	(-3.01)	(-6.65)	(-4.45)	(2.08)	(-6.96)	(-4.11)	(2.96)	(-7.47)
I_Post							0.006	-0.197***	0.204***
							(0.40)	(-14.29)	(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 × Year FE	No	No	No	Yes	Yes	Yes	No	No	No

Panel C: Total Amount of Mortgage Originations									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	*logRefi$*	*logP$*	*(1)-(2)*	*logRefi$*	*logP$*	*(4)-(5)*	*logRefi$*	*logP$*	*(7)-(8)*
I_Post × Low Tier 1 Capital $_{2008.4Q}$	0.110***	-0.010	0.120***	0.030	-0.090***	0.120***	0.056	-0.067*	0.123***
	(2.70)	(-0.27)	(3.63)	(0.80)	(-2.73)	(3.87)	(1.48)	(-1.94)	(3.85)
Low Tier 1 Capital $_{2008.4Q}$	-0.116***	-0.040	-0.077**						
	(-2.62)	(-0.93)	(-2.46)						
I_Post							0.217***	-0.199***	0.416***
							(11.22)	(-12.22)	(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 × 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

Panel D: Total Number of Mortgage Originations									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	*logRefi#*	*logP#*	*(1)-(2)*	*logRefi#*	*logP#*	*(4)-(5)*	*logRefi#*	*logP#*	*(7)-(8)*
I_Post × Low Tier 1 Capital $_{2008.4Q}$	0.124***	-0.016	0.140***	0.015	-0.126***	0.142***	0.057*	-0.089***	0.146***
	(3.26)	(-0.46)	(4.38)	(0.48)	(-3.98)	(4.77)	(1.72)	(-2.71)	(4.78)
Low Tier 1 Capital $_{2008.4Q}$	-0.197***	-0.072	-0.125***						
	(-4.36)	(-1.63)	(-3.94)						
I_Post							0.018	-0.190***	0.208***
							(1.11)	(-13.14)	(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 × 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 (I_Post), 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 I_Post. 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

	Refinance	*Purchase*	*Refinance*	*Purchase*	*Refinance*	*Purchase*	*Refinance*	*Purchase*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	I_Loan Approval							
I_Post × Low Tier 1 Capital $_{t-1}$	-0.020	-0.211***	0.080***	-0.053*	0.079***	-0.053*	0.076***	-0.052**
	(-0.44)	(-3.83)	(4.18)	(-1.93)	(4.06)	(-1.95)	(5.44)	(-2.57)
Low Tier 1 Capital $_{t-1}$	0.037	0.133***	-0.053***	0.018	-0.052***	0.019	-0.041***	0.018
	(0.81)	(2.87)	(-5.00)	(1.27)	(-4.97)	(1.30)	(-3.97)	(1.38)
I_Post							-0.040***	0.031***
							(-4.35)	(3.18)
log Income	0.058***	0.033***	0.050***	0.035***	0.048***	0.035***	0.047***	0.034***
	(6.34)	(4.31)	(5.50)	(7.61)	(5.31)	(7.62)	(4.97)	(7.73)
Loan to Income	-0.004	-0.004	-0.009***	-0.008***	-0.010***	-0.009***	-0.010***	-0.009***
	(-1.57)	(-1.14)	(-3.03)	(-3.34)	(-3.84)	(-3.68)	(-4.03)	(-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

Panel B: Using Banks' Risk Capacity as of 2008 Q4

	Refinance	*Purchase*	*Refinance*	*Purchase*	*Refinance*	*Purchase*	*Refinance*	*Purchase*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	I_Loan Approval							
I_Post × Low Tier 1 Capital $_{2008.Q4}$	0.063***	-0.085***	0.062***	-0.064**	0.061***	-0.064**	0.055***	-0.065***
	(2.82)	(-2.86)	(2.90)	(-2.14)	(2.81)	(-2.14)	(3.04)	(-3.02)
Low Tier 1 Capital $_{2008.Q4}$	-0.050**	0.034*						
	(-2.32)	(1.78)						
I_Post							-0.019	0.047***
							(-1.43)	(4.59)
log Income	0.060***	0.040***	0.050***	0.040***	0.048***	0.040***	0.046***	0.039***
	(5.56)	(5.97)	(4.63)	(11.32)	(4.47)	(11.12)	(4.17)	(11.17)
Loan to Income	-0.002	-0.004	-0.008***	-0.006***	-0.009***	-0.007***	-0.010***	-0.008***
	(-0.97)	(-1.12)	(-2.65)	(-2.73)	(-3.52)	(-3.12)	(-3.67)	(-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 (*logRefi$*). 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 (*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) except the addition of Bank fixed effects and Headquarter (state) × 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 (*logRefi#*, *logP#*). 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 MSA 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.

Panel A: All Banks, Total Amount of Mortgage Originations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	*logRefi$*	*logP$*	*(1)-(2)*	*logRefi$*	*logP$*	*(4)-(5)*	*logRefi$*	*logP$*	*(7)-(8)*
I_Post × Low Operating Capacity $_{t-1}$	0.291***	-0.067**	0.357***	0.157***	-0.049**	0.206***	0.193***	-0.034	0.227***
	(8.33)	(-2.14)	(12.66)	(6.57)	(-2.13)	(8.46)	(7.81)	(-1.46)	(9.15)
Low Operating Capacity $_{t-1}$	-0.159***	0.123***	-0.282***	0.199***	0.223***	-0.024	0.179***	0.222***	-0.043**
	(-6.13)	(4.78)	(-13.37)	(11.58)	(14.33)	(-1.36)	(10.17)	(13.78)	(-2.38)
I_Post							0.194***	-0.223***	0.417***
							(10.65)	(-14.11)	(25.62)
Loan Processing Time $_{t-1}$	0.060***	0.079***	-0.019***	0.008*	0.019***	-0.012***	0.011***	0.033***	-0.021***
	(8.85)	(12.02)	(-3.26)	(1.93)	(5.08)	(-2.87)	(2.70)	(7.81)	(-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 × 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

Panel B: All Banks, Total Number of Mortgage Originations

Variables	(1) *logRefi#*	(2) *logP#*	(3) *(1)-(2)*	(4) *logRefi#*	(5) *logP#*	(6) *(4)-(5)*	(7) *logRefi#*	(8) *logP#*	(9) *(7)-(8)*
I_Post × Low Operating Capacity $_{t-1}$	0.334***	-0.023	0.357***	0.205***	-0.017	0.222***	0.227***	0.003	0.224***
	(9.02)	(-0.69)	(13.10)	(9.74)	(-0.86)	(10.72)	(10.13)	(0.16)	(10.33)
Low Operating Capacity $_{t-1}$	-0.498***	-0.145***	-0.353***	0.083***	0.185***	-0.102***	0.079***	0.186***	-0.107***
	(-16.73)	(-5.22)	(-15.80)	(5.66)	(13.42)	(-6.87)	(5.07)	(12.65)	(-6.93)
I_Post							0.002	-0.214***	0.215***
							(0.05)	(-15.33)	(15.27)
Loan Processing Time $_{t-1}$	0.002	0.033***	-0.031***	-0.002	0.013***	-0.015***	0.002	0.026***	-0.024***
	(0.31)	(5.26)	(-5.38)	(-0.54)	(4.07)	(-4.43)	(0.56)	(7.45)	(-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 × 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

Panel C: Local Banks, Total Amount of Mortgage Originations									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	*logRefi$*	*logP$*	*(1)-(2)*	*logRefi$*	*logP$*	*(4)-(5)*	*logRefi$*	*logP$*	*(7)-(8)*
I_Post × Low Operating Capacity $_{t-1}$	0.222***	-0.118***	0.340***	0.128***	-0.079***	0.207***	0.144***	-0.066**	0.210***
	(5.57)	(-3.43)	(9.69)	(4.50)	(-3.17)	(6.80)	(5.00)	(-2.56)	(6.71)
Low Operating Capacity $_{t-1}$	-0.144***	0.150***	-0.294***	0.211***	0.240***	-0.029	0.201***	0.240***	-0.039*
	(-4.97)	(5.68)	(-11.29)	(10.11)	(13.27)	(-1.29)	(9.48)	(12.98)	(-1.68)
I_Post							0.156***	-0.246***	0.402***
							(6.67)	(-12.43)	(18.60)
Loan Processing Time $_{t-1}$	0.051***	0.059***	-0.008	0.004	0.015***	-0.011**	0.006	0.026***	-0.019***
	(6.44)	(8.80)	(-1.26)	(0.83)	(3.58)	(-2.20)	(1.26)	(5.82)	(-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 × 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

Panel D: Local Banks, Total Number of Mortgage Originations									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	*logRefi#*	*logP#*	*(1)-(2)*	*logRefi#*	*logP#*	*(4)-(5)*	*logRefi#*	*logP#*	*(7)-(8)*
I_Post × Low Operating Capacity $_{t-1}$	0.278***	-0.058	0.336***	0.177***	-0.043**	0.219***	0.180***	-0.026	0.206***
	(6.72)	(-1.62)	(10.36)	(7.38)	(-2.05)	(8.96)	(7.10)	(-1.17)	(7.78)
Low Operating Capacity $_{t-1}$	-0.469***	-0.109***	-0.360***	0.092***	0.200***	-0.108***	0.094***	0.199***	-0.105***
	(-14.35)	(-3.78)	(-13.37)	(5.44)	(13.33)	(-6.12)	(5.24)	(12.53)	(-5.47)
I_Post							-0.018	-0.220***	0.202***
							(-1.00)	(-13.19)	(11.48)
Loan Processing Time $_{t-1}$	0.006	0.021***	-0.016**	-0.004	0.010***	-0.015***	-0.002	0.021***	-0.023***
	(0.72)	(3.30)	(-2.48)	(-1.20)	(3.13)	(-3.84)	(-0.61)	(5.76)	(-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 × 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 (I_Post), 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 × Quarter fixed effects, Bank × County fixed effects, and MSA × 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.

	Total Amount of Mortgage			Total Number of Mortgage		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	*logRefi$*	*logP$*	*(1)-(2)*	*logRefi#*	*logP#*	*(4)-(5)*
I_Post × Busy County Within Bank $_{t-1}$	0.038	-0.044*	0.082***	0.057**	-0.040*	0.097***
	(1.507)	(-1.77)	(3.68)	(2.43)	(-1.70)	(3.71)
I_Post	0.539***	-0.160***	0.699***	0.315***	-0.212***	0.527***
	(9.62)	(-3.02)	(12.19)	(6.07)	(-5.37)	(9.35)
Busy County Within Bank $_{t-1}$	0.002	0.046***	-0.044***	-0.031**	0.022*	-0.053***
	(0.14)	(3.41)	(-3.76)	(-2.32)	(1.80)	(-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 × Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank × County FE	Yes	Yes	Yes	Yes	Yes	Yes
MSA × 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 (*logRefi$*). 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 × Year 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 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×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 (*logRefi#*, *logP#*). 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.

Panel A: Total Amount of Mortgage Originations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	*logRefi$*	*logP$*	*(1)-(2)*	*logRefi$*	*logP$*	*(4)-(5)*	*logRefi$*	*logP$*	*(7)-(8)*
I_Post × Low Tier 1 Capital $_{t-1}$	0.037	-0.053	0.100***	0.005	-0.142***	0.147***	-0.047	-0.212***	0.165***
	(1.27)	(-1.58)	(3.47)	(0.14)	(-5.14)	(5.57)	(-1.63)	(-7.29)	(7.07)
Low Tier 1 Capital $_{t-1}$	-0.032	0.037	-0.107**	-0.052	-0.009	-0.043	-0.028	-0.117	0.089
	(-0.86)	(0.81)	(-2.35)	(-0.90)	(-0.13)	(-0.96)	(-0.41)	(-1.26)	(1.47)
I_Post							0.425***	-0.628***	1.053***
							(14.30)	(-19.80)	(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 × 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

Panel B: Total Number of Mortgage Originations

Variables	(1) *logRefi#*	(2) *logP#*	(3) *(1)-(2)*	(4) *logRefi#*	(5) *logP#*	(6) *(4)-(5)*	(7) *logRefi#*	(8) *logP#*	(9) *(7)-(8)*
I_Post × Low Tier 1 Capital $_{t-1}$	0.063**	-0.124***	0.193***	0.036	-0.196***	0.232***	-0.003	-0.240***	0.236***
	(2.51)	(-4.11)	(7.55)	(1.06)	(-7.12)	(9.13)	(-0.12)	(-8.24)	(10.03)
Low Tier 1 Capital $_{t-1}$	-0.117***	0.008	-0.154***	-0.109*	-0.025	-0.085*	-0.090	-0.134	0.044
	(-3.91)	(0.21)	(-4.19)	(-1.89)	(-0.37)	(-1.85)	(-1.34)	(-1.37)	(0.77)
I_Post							0.224***	-0.671***	0.895***
							(7.92)	(-20.35)	(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 × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
State FE	No	No	No	No	No	No	Yes	Yes	Yes

Panel C: Total Amount of Mortgage Originations

Variables	(1) *logRefi$*	(2) *logP$*	(3) *(1)-(2)*	(4) *logRefi$*	(5) *logP$*	(6) *(4)-(5)*	(7) *logRefi$*	(8) *logP$*	(9) *(7)-(8)*
I_Post × Low Tier 1 Capital $_{2008.Q4}$	0.023	-0.091***	0.109***	-0.047	-0.147***	0.100***	-0.159***	-0.265***	0.107***
	(0.76)	(-2.67)	(4.08)	(-1.35)	(-4.50)	(3.75)	(-5.67)	(-9.69)	(4.92)
I_Post							0.509***	-0.567***	1.076***
							(19.07)	(-20.87)	(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 × 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

Panel D: Total Number of Mortgage Originations									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	*logRefi#*	*logP#*	*(1)-(2)*	*logRefi#*	*logP#*	*(4)-(5)*	*logRefi#*	*logP#*	*(7)-(8)*
I_Post × Low Tier 1 Capital $_{2008.Q4}$	0.031	-0.138***	0.169***	-0.038	-0.199***	0.161***	-0.133***	-0.285***	0.153***
	(1.14)	(-4.46)	(6.79)	(-1.20)	(-6.38)	(6.03)	(-4.90)	(-10.66)	(7.05)
I_Post							0.321***	-0.630***	0.951***
							(12.56)	(-24.01)	(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 × 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 (*logRefi$*). 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×Year 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 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×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 (*logRefi#*, *logP#*). 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.

Panel A: Total Amount of Mortgage Originations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	*logRefi$*	*logP$*	*(1)-(2)*	*logRefi$*	*logP$*	*(4)-(5)*	*logRefi$*	*logP$*	*(7)-(8)*
I_Post × Low Operating Capacity $_{t-1}$	0.120***	-0.034	0.159***	0.113*	-0.111	0.224***	0.125***	0.004	0.121***
	(2.75)	(-0.72)	(3.40)	(1.65)	(-1.48)	(4.66)	(4.80)	(0.10)	(4.54)
Low Operating Capacity $_{t-1}$	0.007	0.071*	-0.074*	-0.122**	-0.053	-0.069*	-0.067*	-0.067	0.0003
	(0.17)	(1.91)	(-1.82)	(-2.19)	(-1.19)	(-1.91)	(-1.75)	(-1.54)	(0.01)
I_Post							0.195***	-0.911***	1.106***
							(6.76)	(-22.54)	(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 × 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

Panel B: Total Number of Mortgage Originations

Variables	(1) *logRefi#*	(2) *logP#*	(3) *(1)-(2)*	(4) *logRefi#*	(5) *logP#*	(6) *(4)-(5)*	(7) *logRefi#*	(8) *logP#*	(9) *(7)-(8)*
I_Post × Low Operating Capacity $_{t-1}$	0.152***	-0.096**	0.247***	0.144**	-0.149*	0.293***	0.179***	0.020	0.159***
	(4.12)	(-2.20)	(6.02)	(2.22)	(-1.82)	(5.24)	(7.08)	(0.58)	(5.83)
Low Operating Capacity $_{t-1}$	-0.043	0.075**	-0.124***	-0.138***	-0.028	-0.111***	-0.114***	-0.084*	-0.030
	(-1.28)	(2.28)	(-3.80)	(-2.82)	(-0.68)	(-2.84)	(-3.05)	(-1.95)	(-1.00)
I_Post							0.013	-0.964***	0.977***
							(0.46)	(-22.85)	(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 × 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.

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.

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.

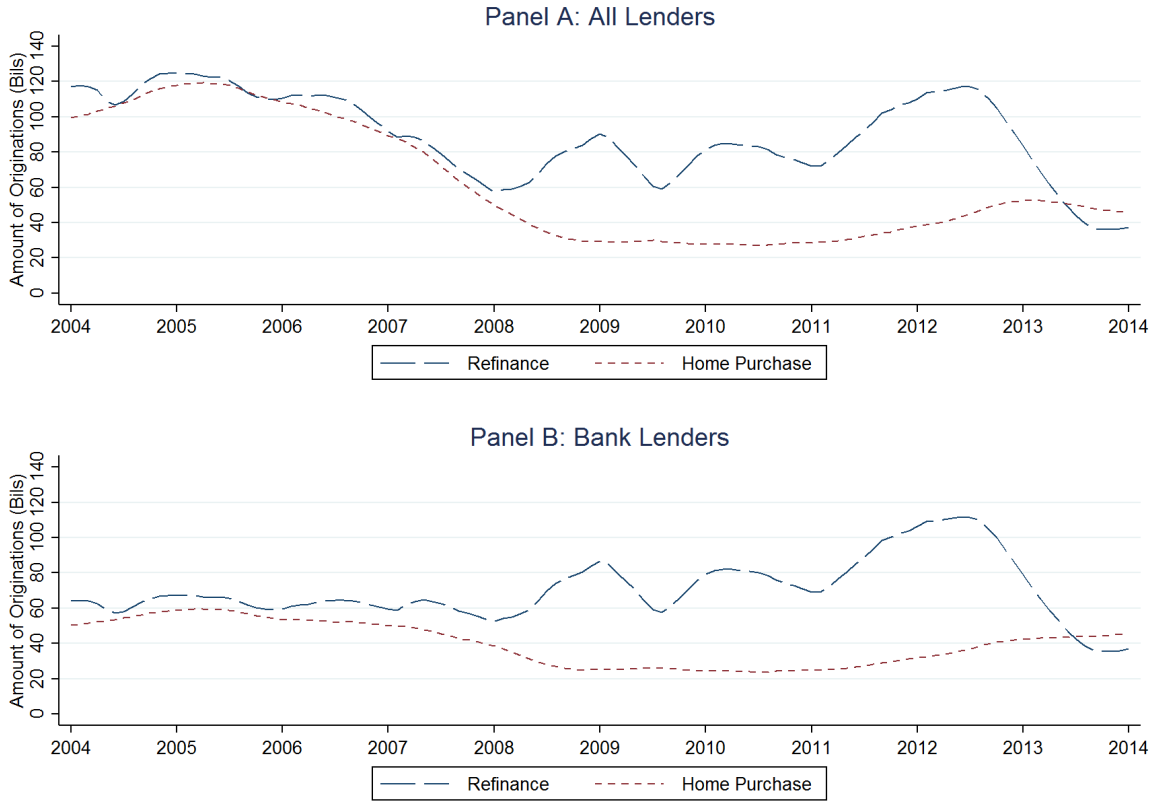

Figure 4: Average Loan Processing Times by Loan Type

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.

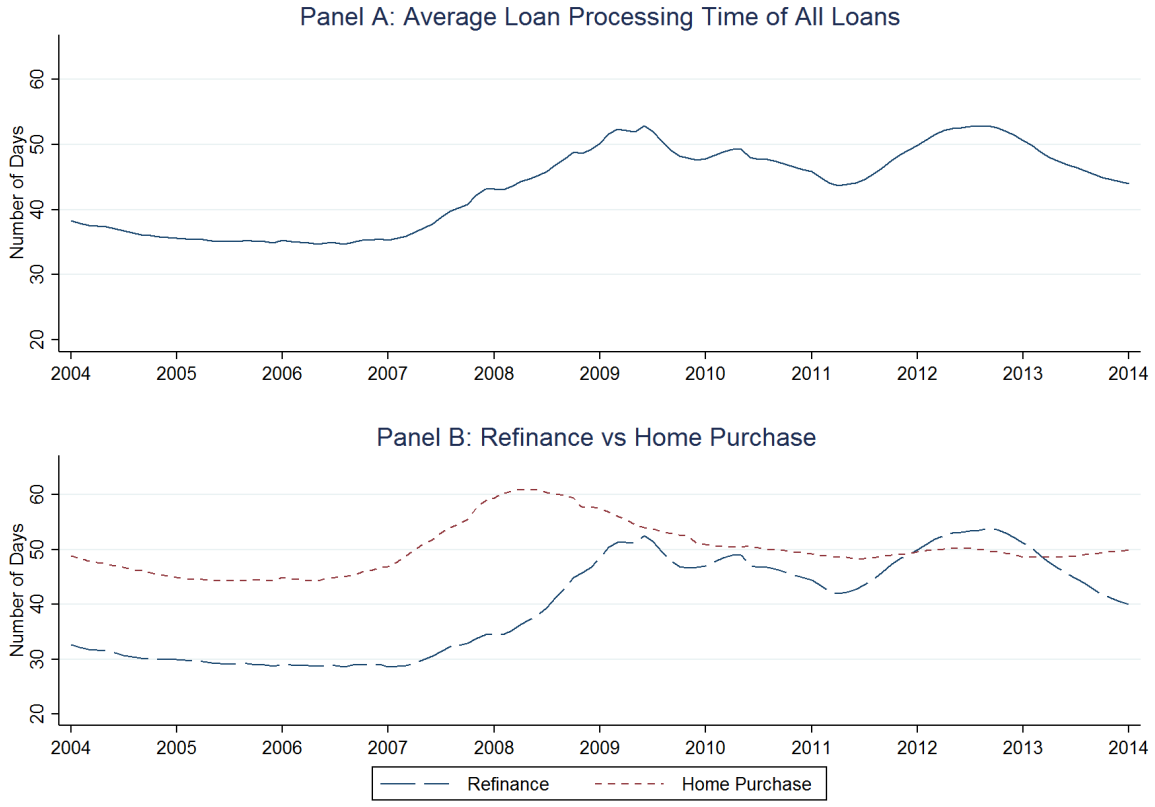

Figure 5: Mortgage Approval Rate by Loan Type

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.