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 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 away from home purchase loans and toward 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 rationed credit to home buyers while supplying greater refinancing 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), increased mortgage borrowing, but the increase was mainly 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 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.

While this pattern may simply reflect weak demand for home purchases despite the policy interventions, it is also possible that institutional frictions specific to banks hampered the policy transmission (Agarwal et al. (2017a)) to borrowers and produced the disparity,[2] i.e., banks might have actively rationed credit to home buyers during this period due to their internal constraints. In this paper, we propose two such frictions and analyze whether the increase in mortgage originations for refinances during this period crowded out credit availability for potential home buyers due to those frictions. 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,[3] these financial intermediation frictions, which cause the crowding-out effect,

[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] Examining the effect of the 2009 Home Affordable Modification Program (HAMP) on loan renegotiation, Agarwal et al. (2017a) find that intermediaries' organizational capacity to implement HAMP critically affected policy effectiveness.

[3] The marginal propensity to consume is documented to be higher for poorer (Mian et al. (2013)) and lower

could impede the transmission of monetary policy and dampen the policy's intended effect of stimulating aggregate output.

We begin by discussing two channels that are likely to have impeded the financial intermediation process and contributed to this crowding-out effect: the risk capacity channel and the operating capacity channel. When facing these capacity constraints, banks attempt to substitute refinance loans for home purchase loans. We argue that both of these capacity limits became more constrained after 2008 and examine whether constrained banks *chose to decrease* home purchase loans while *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 has a positive net present value (NPV). Thus, loan origination decisions would be made based solely on loan and borrower characteristics. When intermediation frictions impose certain capacity limits, however, the origination decisions across loans might not be independent: the addition of one loan could affect the origination decisions of 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 holding more economic (or regulatory) capital. Because 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 loan officers are sitting on a pile of (unfinished) applications, they would prefer the applications that take the least time to

income (Di Maggio et al. (2017)) households, and those with lower credit scores (Agarwal et al. (2015)).

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 the 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 when banks have a reduced 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) and stricter risk management that requires more careful screening of loan applications. Therefore, we test whether banks more constrained by risk or operating capacity *decreased* home purchase originations but *increased* refinance originations post-crisis relative to banks that were less constrained in those capacities. We find that the substitution effect—preferring refinance loans to home purchase loans—is substantially stronger for constrained banks, both for risk and operating capacity.

In examining the credit supply effect, it is essential to control for changes in credit de-

mand. For the risk capacity channel, it is possible that undercapitalized banks that lent less to home purchasers mainly operate in local markets that were affected by the housing bust and thus simply face 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 our prediction for refinance originations. Because borrowers need sufficient equity to refinance their mortgages, banks that operate in economically distressed markets and thus face weaker home purchase demand are also likely to face weaker refinance demand. 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 finally 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 approximately 8 percentage points more likely to approve refinance mortgages but 5 percentage points 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* variation by examining the lending behavior of the same bank across different counties belonging to the same Metropolitan Statistical Area (MSA). When testing whether 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 for monetary policy transmission through bank lending.[4] First, they imply that capacity-constrained banks attempt to substitute credit to

[4]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).

refinancing borrowers (who are existing home owners) for credit to potential home buyers. 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 (Di Maggio et al. (2016)); monetary stimulus would increase both refinancing and home purchase demand, but constrained banks might substitute further toward refinance originations and away from home purchase originations. This substitution further limits the credit access of certain borrowers, possibly those who are younger or less wealthy. In addition to this distributional effect, there could also be macroeconomic effects if these rationed borrowers have a greater marginal propensity to consume. Second, 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 banks face an increase in credit demand from safer borrowers, riskier borrowers are crowded out. Hence, for the risk taking channel to be operative, monetary stimulus should be complemented with bank (re)capitalization.

Our paper relates to the active literature analyzing the distributional effects of policy interventions. Beraja et al. (2017), who focus 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 heterogeneous agents in the economy by examining the responses of heterogeneously indebted agents. Auclert (2015), Choi et al. (2017), and Kaplan et al. (2016) build a theoretical model of monetary transmission with heterogeneous agents.

Our paper also contributes to the recent literature that examines the effect of post-crisis monetary stimulus on credit 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 stimulus effects.[5] Di Maggio et al. (2016) examine whether the policy spills over across different market segments and evaluate the real effect through a "refinance channel". Chakraborty et al. (2016) find that the expansion in banks' mortgage lending during QE crowded out commercial lending. We study the crowding-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 intermediary sector as a whole, but our main focus is on micro-level variation to identify the effective channel 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 the paper 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 purchase or refinance, as long as it has positive NPV. Therefore, loan origination decisions should be independent across different applications and be made based solely on loan and borrower characteristics. With financial frictions, however, origination decisions across loans might not be independent of one another because 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.

[5] Examining the effect of HAMP, Agarwal et al. (2017a) also find that limited competition impairs stimulus effects.

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 constraint binds, it 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 and away from 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 relative 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 away from riskier loans (home purchases) toward less-risky loans (refinance loans) to increase the number of originated loans without exceeding 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") than during 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 there being less valuable collateral. Therefore, the substitution effect should be more pronounced during the *post* period than during the *pre* period. While this overall effect during the *post* period would apply to all banks because it is driven by changes in the overall economic climate, 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 than during 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 operating capacity should be indifferent between the two types of mortgage applications. However, if the operating capacity is limited such that a loan officer is sitting on a pile of (unfinished) applications, he or she 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 that we calculated using the confidential HMDA data. 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.[6]

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 because, for instance, detailed property appraisals are not necessary or the legal process is much simpler.[7] Therefore, all else being equal, banks with constrained operating capacities should tilt their mortgage portfolios toward refinance mortgages, relative to banks with sufficient operating capacity. Hence, we have the following prediction:

Hypothesis 2: *If a bank's operating capacity is constrained, 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 shown 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 QE and the 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)).[8] 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 that are more constrained by operating capacity limits.

[6]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).

[7]See, e.g., https://www.washingtonpost.com/news/where-we-live/wp/2015/08/10/why-home-appraisals-take-so-long-and-what-you-can-do-about-it. Additionally, 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, having already taken place at the time of purchase."

[8]See also Agarwal et al. (2017a) on the role of operating capacities on the effectiveness of HAMP.

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.*

3. Data and Summary Statistics

We use confidential HMDA loan application data from 2004:Q1 to 2013:Q4[9] 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 data provide the exact loan application and decision (approved or denied) date, while the publicly available HMDA data only report the year of origination.[10] 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).[11]

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 data 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.[12] 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

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

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

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

[12] We drop bank-quarter observations when the top holder ID changes to minimize the effect of merger and acquisition activities.

average.[13]

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 $662.27 million. Purchase(#) is the number of home purchase mortgages originated by a bank in a quarter, with a mean of 94.31 and a standard deviation of 1,635.80. Purchase($) 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 0.06.

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"

[13]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.

in each bank's *Operating Capacity*. That is, we associate a higher fraction of uncompleted applications with lower operating capacity for that bank because 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, 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, 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 applications. The average population is approximately 380,000, with an average income per capita of $39,000 and an average unemployment rate of 6.66%. The average CoreLogic home price index 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 begin 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 the HMDA data, whereas Panel B includes bank lenders only. One of the main differences between the two panels is in originations immediately 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 shows that home purchase mortgage originations by banks plunged in 2008 and remained low thereafter, but refinance mortgage originations recovered 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 esti-

mate 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 from 2009:Q1 to 2013:Q4 and equals 0 for the *pre* period. The dependent variables are the total mortgage originations by bank i in period t for (i) refinances and (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 and loan demand; real estate (*RE*) and C&I (*CI*) *Loans to Total Loan Ratio*, which reflect business models; and non-performing loans (*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 types of 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 origination types is also positive and significant. The specifications in columns (4)-(6) are the same as in columns (1)-(3), except for the inclusion of bank fixed effects, and the estimation results are similar; relative 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, the extent to which this change is driven by the credit supply channel is unclear, as we do not control for demand-side factors. For instance, after 2008:Q4, refinancing demand could have surged while home purchase demand plunged. If this were the case, these results would be 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. For each bank i at time t, we define *Low Tier 1 Capital*$_{i,t}$ that equals 1 if a bank's tier 1 capital ratio belongs to the bottom quartile in that quarter, 0 otherwise. Panel A of Figure 6 plots trends in the composition between refinance mortgage and home

purchase mortgage originations, defined as the log difference between refinance and home purchase originations normalized at the 2008:Q4 level, for banks with *Low Tier 1 Capital*= 1 and *Low Tier 1 Capital*= 0 separately. The trends largely overlap till 2008:Q4, but they diverge afterwards, with the greater increase in the share of refinance mortgages for the low capital banks.

We conduct a bank-level analysis that augments the previous regression specifications. In particular, we estimate the following panel regression:

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

As before, *I_Post* equals 1 for the *post* period of 2009:Q1 to 2013:Q4, 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' headquarters 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 *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 than for to well-capitalized banks.

There is a confounding factor if local economic conditions affect both mortgage demand and banks' capital ratios in a certain way. That is, deteriorating local economic conditions could simultaneously damage banks' capitalization and reduce demand for mortgages. 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.[14] 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 the *post* period.

In column (4), we find that thinly capitalized banks indeed originated significantly more refinance loans (by approximately 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 (approximately 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 credit demand effects such that the thinly capitalized banks mainly operate in the local markets more heavily impacted by the housing bust, which results in an

[14]We note that this control is not ideal for large banks that operate in multiple states. However, most of our banks are small enough to operate 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 obtain the same results.

economic slump, depletion of bank capital, and weaker demand for home purchase credit. In this case, these banks should also face weaker refinancing demand because borrowers with inefficient home equity are not able to refinance their mortgages.[15] Therefore, 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. In contrast, we observe a positive β for refinances and a negative β for home purchases, indicating active portfolio adjustments by banks with limited risk capacity.

In column (6), we use the difference between two origination types as the dependent variable, providing a direct measure of substitution between them. 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, operating 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 Panels A and B defines the treatment group, i.e., banks with a 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 2008:Q4, immediately before the treatment period. In this difference-in-difference specification, we analyze how banks that were thinly capitalized at the beginning of the *post* period adjusted their lending behavior during the *post* period compared to their counterparts with larger capital buffers. Panel B of Figure 6 plots trends in the composition between refinance mortgage and home purchase mortgage originations that are

[15] An important coinciding intervention is HARP, which relaxed the LTV requirement for eligible refinancing borrowers (Di Maggio et al. (2016)). Agarwal et al. (2017b), however, find that a substantial number of eligible borrowers did not participate in the program due to competitive frictions in the refinancing market.

normalized at the 2008:Q4 level, for the treatment group and the control group separately. Again, the trends largely overlap pre-treatment, but diverge afterwards, with the greater increase in the share of refinance mortgages for the treated banks.

The estimation results are presented in Panels 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 toward 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, although 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 driven by endogeneity of the capital ratio. In sum, banks with limited risk capacity preferred refinance mortgages to home purchase mortgages.[16]

To bolster our argument, 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 counterparts. Specifically, we estimate the following linear probability

[16] An overreaching speculation implies that new purchases could have been crowded out to a lesser extent if QE had not been implemented to stimulate refinancing demand.

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 0 if denied. In addition to controlling for bank characteristics $X_{i,t-1}$, we control for loan characteristics X_l, which include income and loan-to-income ratio, and 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) to compare banks within counties. 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 obtain results similar to the bank-level results. During the *post* period, banks with low risk capacities were approximately 8% more likely to approve refinance mortgages (positive and statistically significant β), while they were approximately 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 their 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*$_{i,t-1}$, to have a fixed treatment group. The 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 processing time for mortgage originations. We plot the average number of days between the application date and the decision date (approved or denied) in Figure 4. We find two interesting patterns regarding processing time: (1) the average processing time per application increased rapidly after Lehman Brothers' failure in 2008:Q4 and also after the announcement of QE3 in September 2012 and (2) processing refinance loans usually takes less time than processing home purchase loans.

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, as 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 process 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 QE) or the average processing time increases as in the *post* period, then the measure would more effectively capture cross-sectional variations in the operating capacities 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, 0 otherwise. As before, *I_Post* equals 1 for the *post* period from 2009:Q1 to 2013:Q4, 0 otherwise. Panel C of Figure 6 plots trends in the composition between refinance mortgage originations and home purchase mortgage originations, for banks with *Low Operating Capacity*=1 and *Low Operating Capacity*=0 separately. We can observe that the two trends are largely parallel prior to 2009, but diverge afterwards, with the greater increase in the share of refinance mortgages for banks with *Low Operating Capacity*=1. 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 is 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 additional 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 (by approximately 29 percentage points) but decrease home purchase originations (by approximately 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 above, 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' headquarters 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 exhibited a greater increase in refinance originations (by approximately 16 percentage points) but decreased home purchase originations (by approximately 5 percentage points) relative to their peers in the same local market during the *post* period.

However, there could still be other local factors affecting our measure of low operating capacity for which we were unable to account. 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. As previously discussed, we conjecture that local markets with stronger home purchase demand also tend to have stronger refinance demand (which is a function of home equity values), and thus, this unexplained factor should affect the originations of the two loan types in the same direction. On the contrary, we predict that the operating

capacity constraint should affect the two in opposite directions. Therefore, the bias from the local demand factor would work *against* our crowding-out hypothesis. In that regard, our estimates for home purchase loans can be regarded 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 factors and present the 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. In addition to the regression specifications in Panels 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 further examine within-bank differences to better mitigate other confounding effects, such as differential demand across banks or changes in lending standards. Here, we compare the lending practices of the same bank across different counties in which the bank operates. We first calculate the quarterly county-level operating capacity as we did for the bank-level operating capacity. For each bank in 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:

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

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 Bank$_{i,t-1}$ is a dummy variable that equals 1 if the county is below the median county operating capacity for the bank, 0 otherwise. *I_Post* equals 1 for the *post* period of 2009:Q1 to 2013:Q4, 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 removes variations in lending behavior by a given bank over time, and the second removes the differences in mean origination volumes across different counties for a given bank. The third removes variations in MSA-level activities, allowing us to analyze different lending behaviors across counties within an 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 simply reflect 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 approximately 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 columns (1) and (4).[17] The difference

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

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.

4.3. Was There an Aggregate Effect?

Thus 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 satisfied such demand.

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 decreases 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 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 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, 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 allow 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 than 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 mortgages. 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 that these findings are not driven by county-level differences. Panel B reports the same results but uses the total number of mortgage originations, and here the effects exhibit greater statistical significance.

Panels C and D report the results when using 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 than counties with high operating 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 because the operating capacity effect of substitution competes with the effect of strong loan demand. The difference between the two types of 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), except that the former include 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 yields similar results with greater 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 away from home purchase loans and toward refinance loans because refinance originations are both less risky and quicker to process. Monetary stimulus would increase demand for both refinancing and home purchase borrowing, but the aforementioned substitution effect might actually outweigh and thus reduce home purchase originations.

Substituting away from home purchase loans and toward refinance loans essentially limits certain borrowers' access to credit, particularly 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 operating mechanism 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 our variables. Panel A reports the summary statistics based on the 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 1 if the loan type is a refinance mortgage, 0 otherwise. I_Loan Approval is a dummy variable that equals 1 if the loan is approved, 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 thousands of 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% of banks with a 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 reports the summary statistics by Operating Capacity. Low Operating Capacity is a dummy variable for top 25% of banks with a 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 from 2009 to 2013

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

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 a bank's risk capacity on the bank's mortgage originations by loan purpose. We use bank-quarter observations from 2004 to 2013. Panels A and B report the results using a 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 results for the log amount of refinance mortgage originations (*logRefi$*). The main independent variables are a time dummy for 2009:Q1 to 2013:Q4 (I_Post), a dummy for the bottom 25% of banks with a 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 results for the 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 for the inclusion of additional bank fixed effects and headquarter (state) × year fixed effects. Columns (7)-(9) are similar to columns (1)-(3) except that they exclude the year fixed effect but include the bank fixed effect, headquarter fixed effect, and I_Post. In Panel B, the dependent variables are the total number of mortgage originations by a bank in a quarter (*logRefi#*, *logP#*). The specifications are the same as in Panel A. Panels C and D report the results using the measure of banks' risk capacity as of 2008:Q4. The regression specifications are same as in Panels A and B. The table reports point estimates with t-statistics in parentheses. All standard errors are clustered at the bank level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

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 a bank's risk capacity on the likelihood of loan approval by loan purpose. We use a 5% random sample from loan-level HMDA data stratified by year and county with 4 bins from 2004 to 2013. The dependent variables are the indicator for approved loans, which equals 1 if the loan is originated and 0 otherwise. Panel A reports the results using the time-varying measure of banks' risk capacity. The main independent variables are a time dummy for 2009:Q1 to 2013:Q4 (I_Post), a dummy for the bottom 25% of banks with a 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 applicant 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, and NPL Ratio; and county-level controls from the 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. Columns (1)-(2) include year fixed effects and quarter fixed effects. Column (1) reports the likelihood of loan approval for refinance mortgages, and column (2) reports the likelihood of loan approval for home purchase mortgages. Columns (3)-(4) are similar to columns (1)-(2) except for the addition of bank fixed effects. Columns (5)-(6) are similar to columns (1)-(2) except for the inclusion of additional bank fixed effects and county fixed effects. Columns (7)-(8) are similar to columns (5)-(6) except for the exclusion of year fixed effects and the inclusion of I_Post. Panel B reports the results using a bank's risk capacity as of 2008:Q4. The regression specifications are same as in Panel A. The table reports point estimates with t-statistics in parentheses. All standard errors are clustered at the bank level. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

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

Variables	*Refinance* (1)	*Purchase* (2)	*Refinance* (3)	*Purchase* (4)	*Refinance* (5)	*Purchase* (6)	*Refinance* (7)	*Purchase* (8)
				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 a bank's operating capacity on the bank's mortgage originations by loan purpose. We use bank-quarter observations from 2004 to 2013. Panels 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 results for the log amount of refinance mortgage originations (*logRefi$*). The main independent variables are a time dummy for 2009:Q1 to 2013:Q4 (I_Post), a dummy for the top 25% of banks with a high fraction of unprocessed mortgage applications in the 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, and 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 results for the log amount of home purchase mortgage originations (*logP$*). Column (3) reports the results for the difference between the two dependent variables (*(1)-(2)*) in columns (1) and (2). Columns (4)-(6) are similar to columns (1)-(3) except for the addition of bank fixed effects and headquarter (state) × I_Post fixed effects. Columns (7)-(9) are similar to columns (1)-(2) except for the exclusion of year fixed effects and the inclusion of bank fixed effects, headquarters fixed effects and I_Post. In Panel B, the dependent variables are the total number of mortgage originations by a bank in a quarter (*logRefi#*, *logP#*). The specifications are the same as in Panel A. Panels C and D only include local banks that receive more than 70% of their loan applications from one MSA on average. The regression specifications are similar to those in Panels A and B except for the addition of MSA-level controls from the previous year such as log Population, log Income per Capita, Unemployment Rate, and HPI. We do not report MSA-level controls for brevity. The table reports point estimates with t-statistics in parentheses. All standard errors are clustered at the bank level. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels.

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									
	(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 $_{t-1}$	0.334***	-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 a bank's operating capacity (within the 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 results for the log amount of refinance mortgage originations (*logRefi$*). The main independent variables are the time dummy for 2009:Q1 to 2013:Q4 (I_Post), a dummy for the top 50% of counties with a 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 the 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 results for the log amount of home purchase mortgage originations (*logP$*). Column (3) reports the results for the difference between the 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 standard errors are clustered at the bank level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

	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 county-level risk capacity on county-level mortgage originations by loan purpose. We construct county-year observations for 2004 to 2013 from bank-county-quarter observations. Panels 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 logs. Column (1) reports the results for the log amount of refinance mortgage originations (*logRefi$*). The main independent variables are a dummy variable that equals 1 for counties in the bottom 25% of county-level risk capacity and zero for counties in the top 25% of it (Low Tier 1 Capital $_{t-1}$), where the county-level risk capacity is the weighted average of the Tier 1 Capital Ratio of banks weighted by 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 results for the log amount of home purchase mortgage originations (*logP$*). Column (3) reports the results for the difference between the two dependent variables (*(1)-(2)*) in columns (1) and (2). Columns (4)-(6) are similar to columns (1)-(3) but include additional county-level controls from the 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 that they exclude state × year fixed effects but include state fixed effects and I_Post. Panel B reports similar results using the total number of mortgage originations in a county in a year as the dependent variable (*logRefi#*, *logP#*). Panels C and D use the county-level risk capacity as of 2008:Q4. The regression specifications are same as in Panels A and B except for the inclusion of Low Tier 1 Capital $_{2008.Q4}$, which is a dummy variable that equals 1 for counties in the bottom 25% of county-level risk capacity and zero for counties in 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 applications for banks in a county. The table reports point estimates with t-statistics in parentheses. All standard errors are clustered at the county level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

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 county-level operating capacity on 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 logs. Column (1) reports the results for the log amount of refinance mortgage originations (*logRefi$*). The main independent variable is a dummy variable that equals 1 for counties in the bottom 25% of county-level operating capacity and zero for counties in 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 results for the log amount of home purchase mortgage originations (*logP$*). Column (3) reports the results for the difference between the two dependent variables (*(1)-(2)*) in columns (1) and (2). Columns (4)-(6) are similar to columns (1)-(3) with the addition of county-level controls from the 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 for the exclusion of state × year fixed effects and the inclusion of State fixed effects and I_Post. Panel B reports similar results using the total number of mortgage originations in a county in a year as the dependent variable (*logRefi#*, *logP#*). The table reports point estimates with t-statistics in parentheses. All standard errors are clustered at the county level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

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

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

Figure 2: Total Number of Mortgage Originations by Loan Type

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

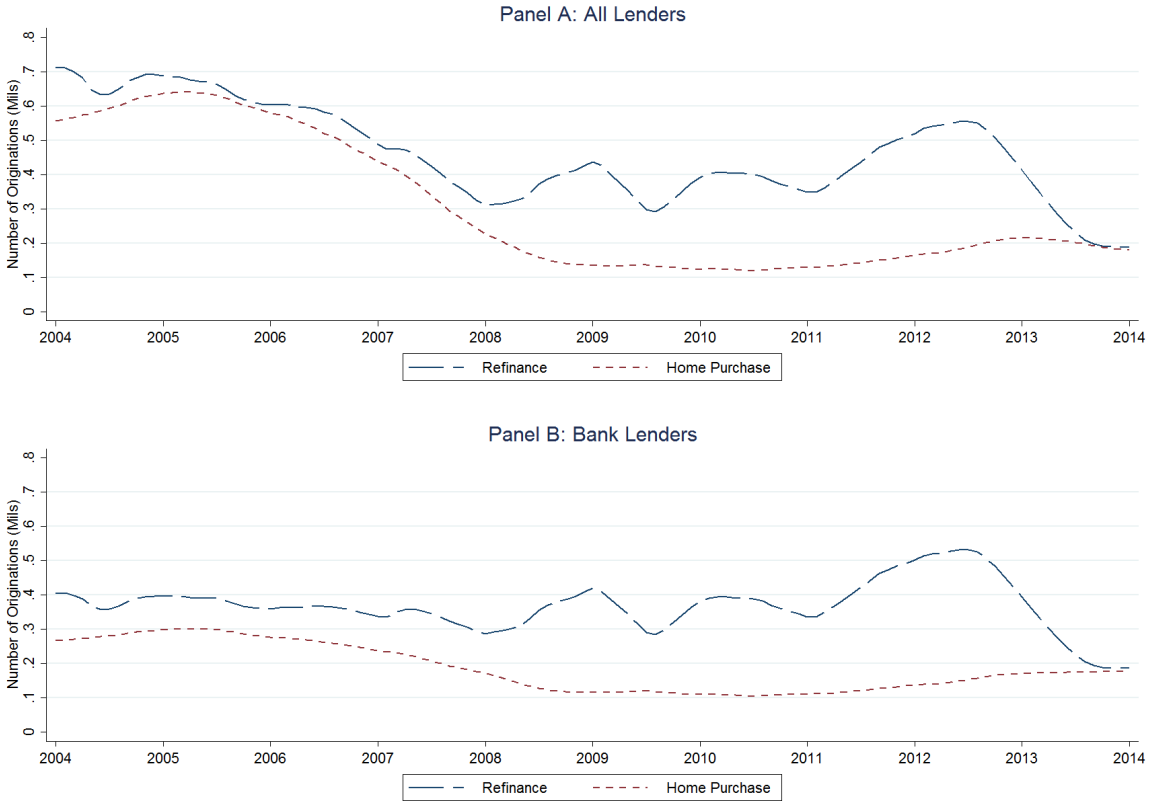


Figure 3: Total Amount of Mortgage Originations by Loan Type

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

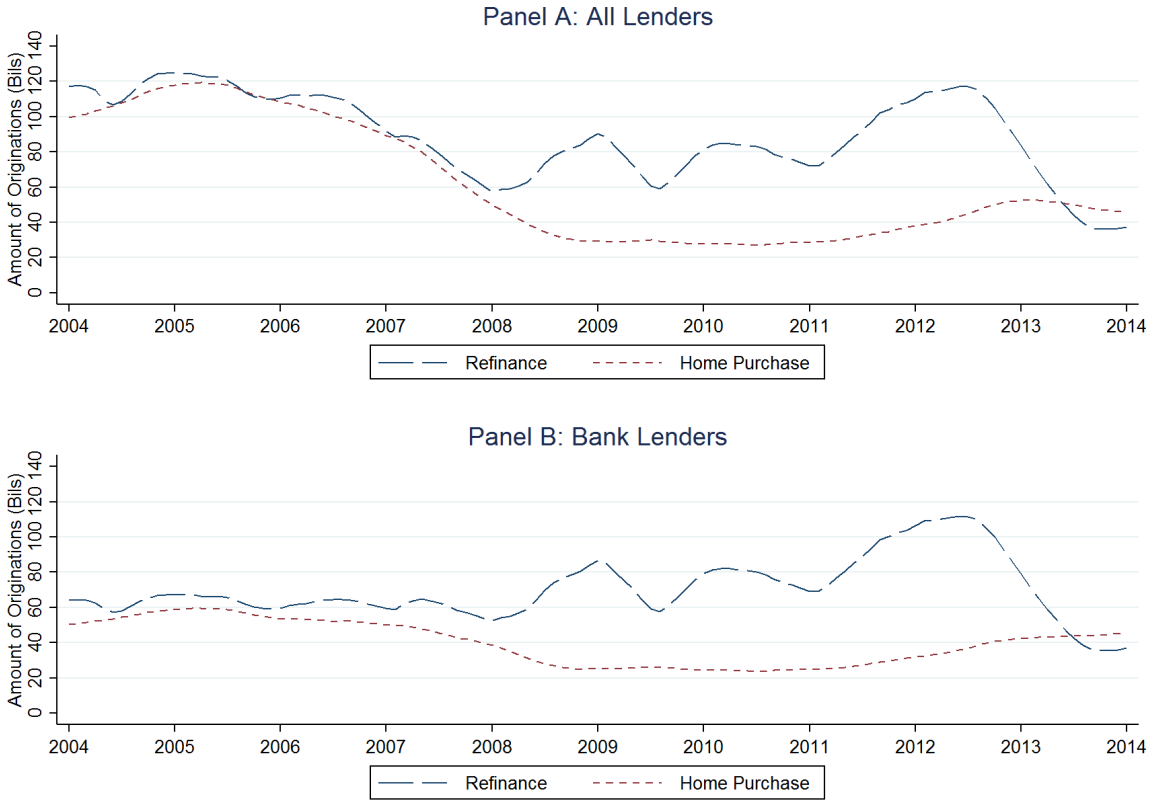


Figure 4: Average Loan Processing Times by Loan Type

We report the time series of average loan processing time by loan type. We use the Home Mortgage Disclosure Act (HMDA) data 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 a 4-quarter moving average. Panel B reports the average loan processing time by loan type. The blue line depicts the average loan processing time for home purchase mortgages, and the red line depicts the average loan processing time for refinance mortgages.

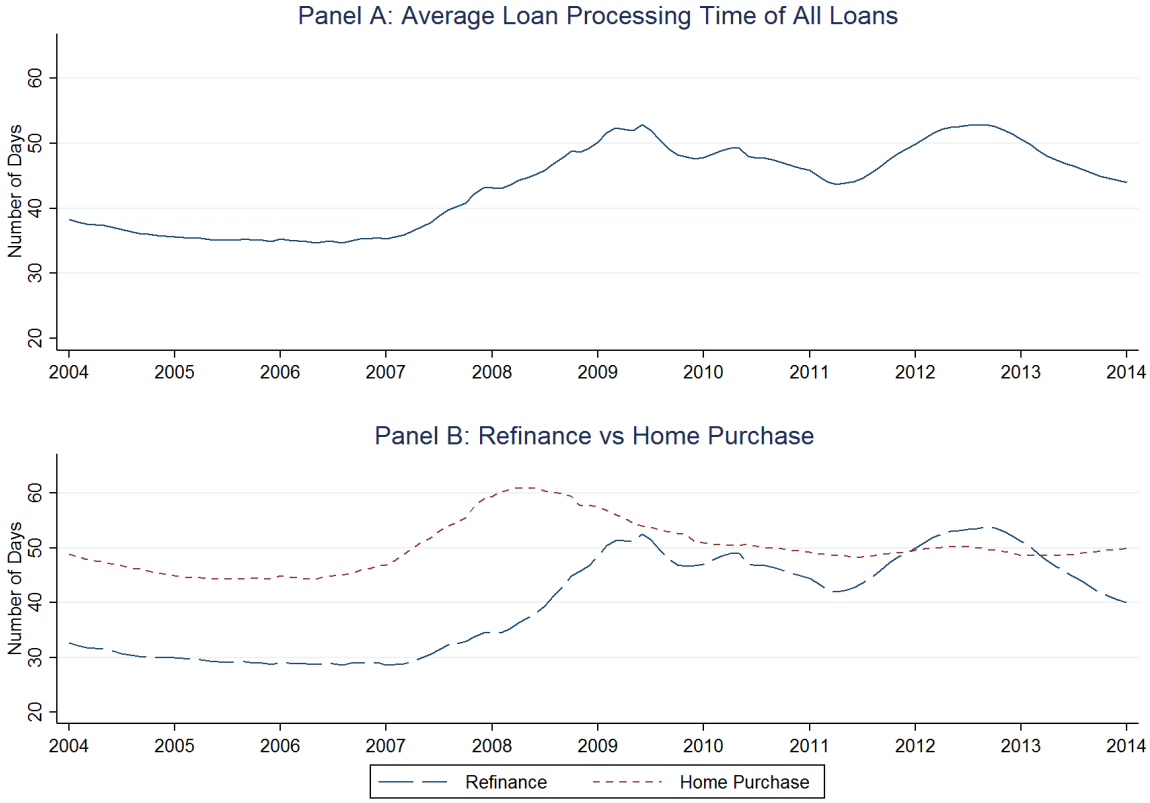


Figure 5: Mortgage Approval Rate by Loan Type

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

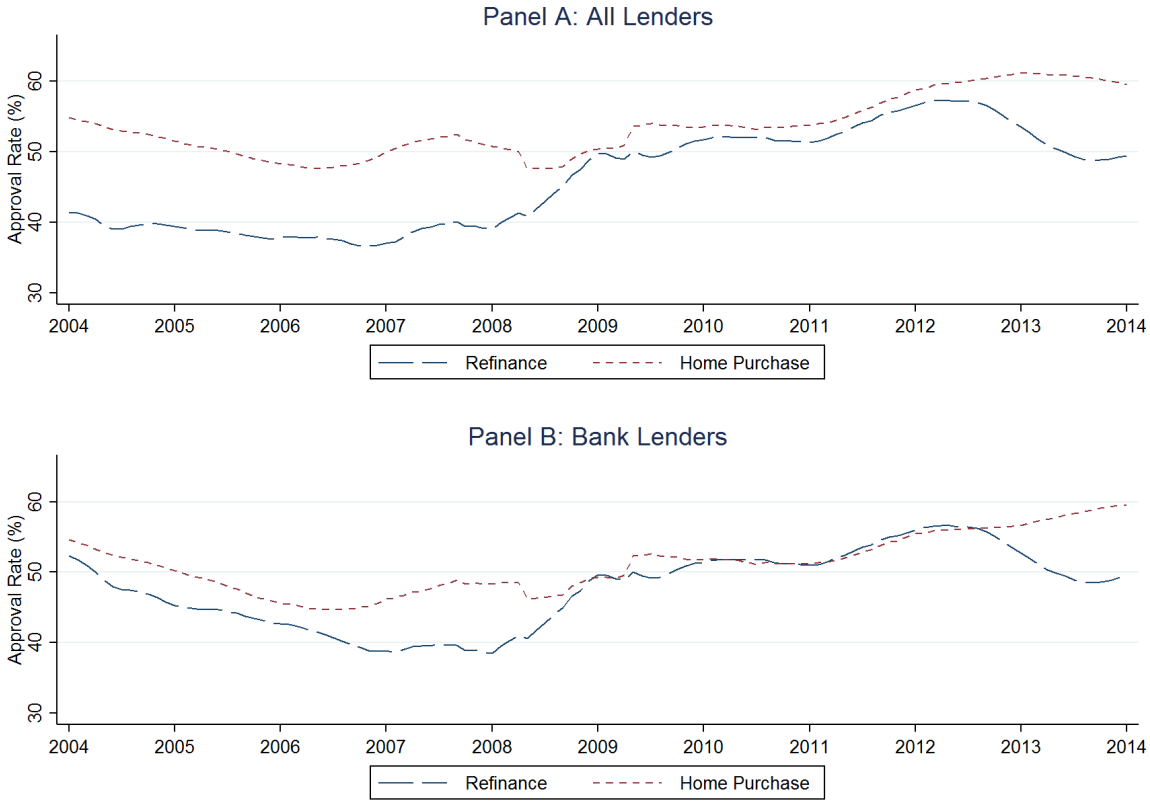
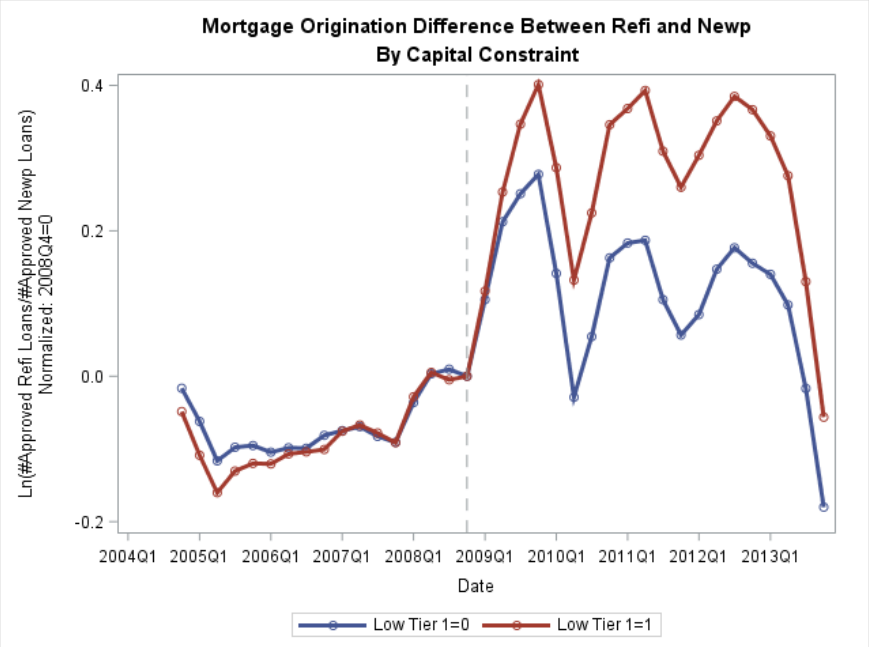


Figure 6: Mortgage Originations by Loan Type and by Bank Type

We report the time series of the difference between refinance originations and home purchase originations by bank type. We calculate the 4Q moving average of the log difference between refinance originations and home purchase originations at each quarter. For each type of banks used in Tables 3, 4 and 5, we average the log differences over banks within groups at each quarter and normalize them at the 2008:Q4 level. Panel A reports the number and amount of originations by *Low Tier 1 Capital*$_{it}$, where we assign the groups at each quarter. Panel B reports the number and amount of originations by *Low Tier 1 Capital*$_{2008.Q4}$ and Panel C reports the number and amount of originations by *Low Operating Capacity*$_{it}$.

Panel A: Mortgage Originations by *Low Tier 1 Capital*$_{it}$



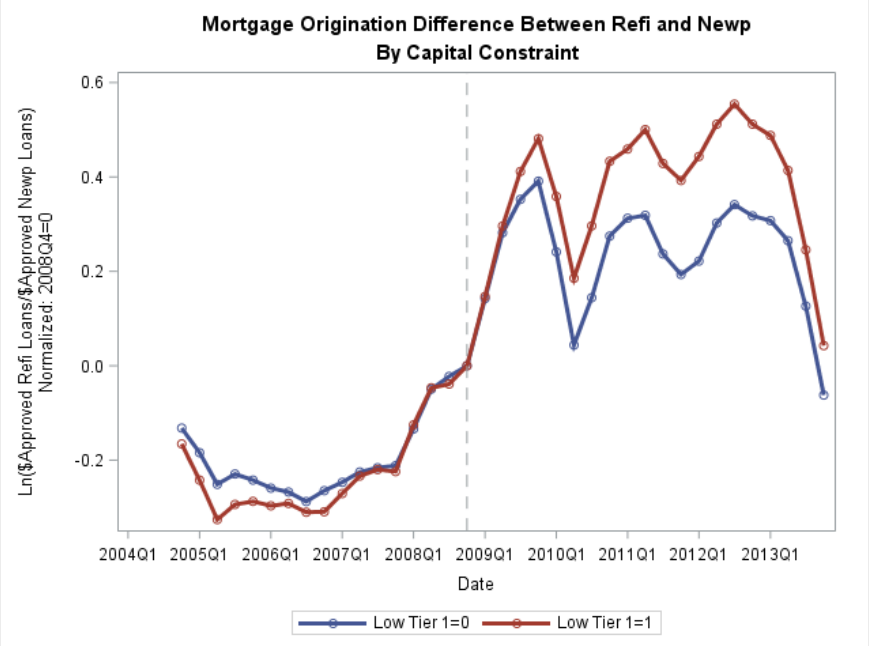
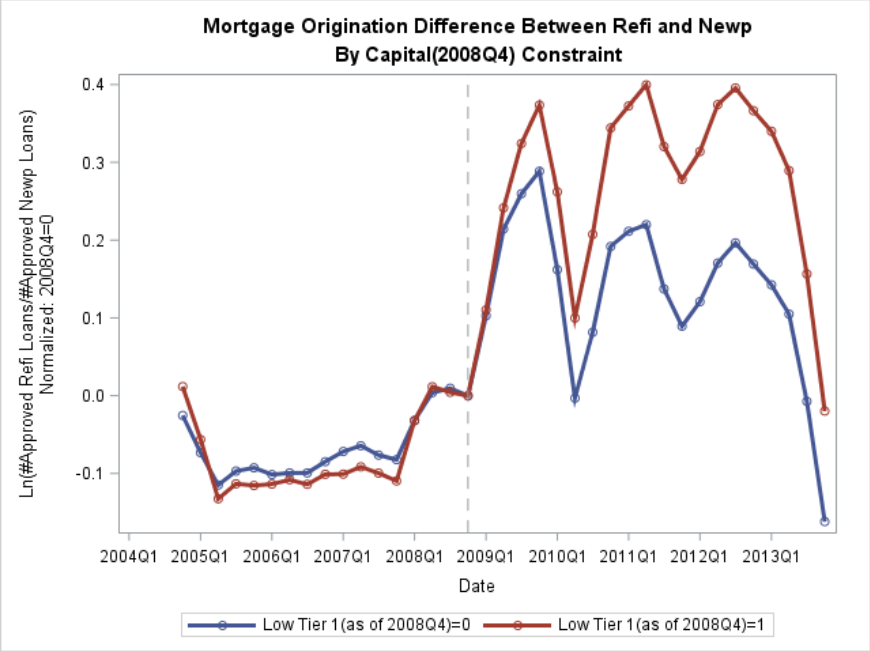


Figure 6 Continues

Panel B: Mortgage Originations by $Low\ Tier\ 1\ Capital_{2008.Q4}$



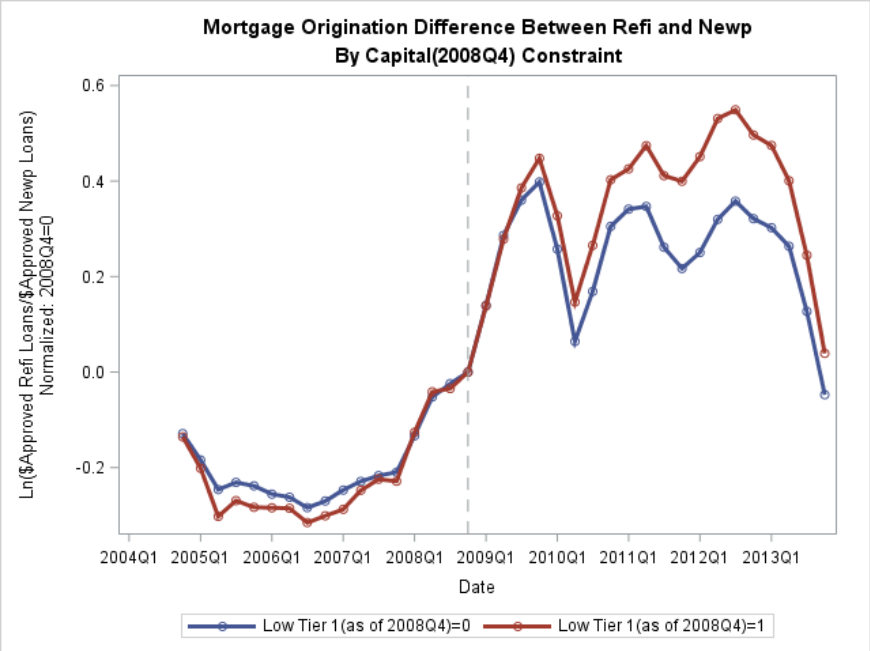


Figure 6 Continues

Panel C: Mortgage Originations by *Low Operating Capacity*$_{it}$