Money and Mortgages, for Rich and Poor Alike? How Changes in the Federal Funds Rate Determine Refinancing, Purchase and Home Improvement Credit across Income Before, During and After the Great Financial Crisis *

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Abstract

We investigate the redistributive effects of monetary conditions for three different types of mortgage loans, i.e., purchase, refinancing, and home improvement loans. We find that the sensitivity of mortgage credit to monetary conditions generally increases with household income during the sample period from 1996 to 2018. This sensitivity remains mostly robust before, during, and after the Great Financial Crisis, and is not affected by actual or expected house price growth, or securitization. In sum, our findings are not consistent with the conventionally held view of "neutrality" of monetary conditions.

JEL Classification: E5, D3, G5, R2

Key words: Monetary Policy, Income Inequality, Household Finance, Refinancing Channel

1 Introduction

How do monetary conditions affect the granting of mortgages to households with different income levels? As monetary conditions are often held to be neutral in the long run, no (or only a limited amount of) redistribution can be expected over this horizon. However, empirical research assessing this conjecture is actually rather scarce. In the short- and medium-run, in contrast, a number of studies (we review below) document that expansionary monetary policy may be somewhat favourable to low-income households in terms of their spending and creditworthiness.

Following this literature, in this paper we investigate the redistributive effects of monetary conditions for three different types of mortgage loans, i.e., purchase, refinancing, and home improvement loans, in the US before, during and after the Great Financial Crisis. By way of preview, we find that the sensitivity of credit to monetary conditions generally increases with household income, but that this sensitivity may vary by loan type and time period.

The "dual mandate" of the Federal Reserve (Fed) is to achieve stable prices and maximum employment. While pursuing this dual mandate, it is possible that monetary policy will partly ignore its impact on other socio-economic outcomes, such as income inequality. However, as the Fed also acts as a bank regulator and supervisor, and as one of the objectives of the prudent bank supervision is to ensure fair lending across income groups, it is not entirely inconceivable that also the redistributive effects of some of its monetary policies would be under consideration when making its decisions.

Concerns regarding the redistributive effects of its policies were raised further during the Great Financial Crisis when the Fed adopted quantitative easing (QE) measures. Since then a lively debate ensued. A major argument in this discussion is that further interest rate cuts may raise the prices of financial assets (such as equity). Since higher-income households are more likely to own equity than lower-income households, the

QE-induced rate cuts may exacerbate income disparity in the US. On the other hand, the existence of these inequalities may be the consequence of long-term trends such as technological developments and/or globalization. Hence periodic shifts in the Fed's policy should not be held ransom to inequality if these shifts in policy serve the greater purpose of fostering financial stability in the system (especially not when pulling out of the Great Financial Crisis). Furthermore, low rates may have helped low-income homeowners as well, because their house equity may have been equally boosted.[1]

This is literally where we pick up the discussion and start our investigation. In particular, we aim to answer the question: How do gains in house equity vary across income groups via their refinancing activity? Borrowing against home equity provides a channel that liquidity-constrained homeowners can exploit to smooth their consumption. Hurst and Stafford (2004) for example document that households with little in terms of liquid assets are more likely to refinance their mortgage to achieve such smoothing. If we find evidence that monetary conditions do not allow for equal access to credit across income groups, then the resulting distortions brought about by the persistence of the monetary conditions can have long-run redistributive effects on household consumption.

Recall that life-cycle models (Modigliani and Brumberg (1954)) and permanent income models (Friedman (1957)) imply that households will smooth their consumption, such that (anticipated) changes in income do not cause any changes in consumption. However, monetary policy innovations can change consumption by altering income and output. While the refinancing channel suggests changes in interest rate affect refinancing activity, an important question is how this effect varies with homeowner income. We conjecture that monetary conditions might affect refinancing activity of homeowners along their income via three different effects: An income effect, a wealth effect, and a portfolio composition effect.

[1] https://www.brookings.edu/blog/ben-bernanke/2015/06/01/monetary-policy-and-inequality/

Income effect: First, refinancing at a lower interest rate can lower future mortgage repayments, given house prices, thereby generating a potential income effect that is likely to boost consumption. The potential income effect is likely to be stronger for (more liquidity-constrained) lower-income homeowners than for higher-income homeowners.

Wealth effect: Second, a change in interest rates affects prices, including house prices. For instance, a lower interest rate puts upward pressure on house prices: This house price inflation generates a potential wealth effect. An increase in the value of house equity as collateral provides homeowners an incentive to refinance with a bigger mortgage. Due to tighter liquidity constraints, the potential wealth effect is likely to be stronger for lower-income homeowners. Thus, relative to higher-income homeowners, lower-income homeowners are more likely to extract some of their wealth gains by refinancing.

Portfolio composition effect: Finally, a change in interest rates also affects non-housing asset prices, such as stocks. Homeowners might also hold those assets; however, the likelihood of lower-income homeowners holding non-housing assets is quite small. A possibility is that higher-income homeowners might consider refinancing at a lower rate to extract a bigger mortgage and invest the proceeds in other financial assets; however, this potential portfolio diversification effect is likely to be weaker for lower-income homeowners. Individual house price can be very volatile carrying high (hard-to-diversify) idiosyncratic risk. Moreover, housing, as an asset class, tends to be less-liquid than stocks. Households hold a large fraction of their wealth in housing. Thus, transferring gains in (illiquid) house equity to other (liquid) assets provides homeowners a diversification strategy to minimize risk (Hurst and Stafford (2004)). Thus, portfolios of higher-income homeowners are likely to be more diversified than those of lower-income homeowners.

In sum, while the income effect and the wealth effect imply that refinancing activity of

lower-income homeowners is likely to be greater than that of higher-income homeowners, the portfolio composition effect suggests a greater refinancing activity of higher-income homeowners.

On the other hand, demand for purchases will respond to both the interest rate (cost of borrowing) and to house prices (affordability). Given that two-thirds of the US households live in owned houses, a possible conjecture is that refinancing activity, in the form of strong sustained demand, can significantly affect the demand for home purchases, by influencing house prices, in the following manner: While a lower interest rate lowers the cost of borrowing for a house purchase, the lower rate also increases the demand for refinancing, thereby increasing house prices, that are likely to depress demand for purchases. Similarly, while an increase in the interest rate raises the cost of borrowing for a purchase, the higher rate depresses the demand for refinancing, pushing house prices down, which might boost the demand for house purchases. Thus, the interaction of monetary conditions and the refinancing channel will affect the demand for purchases. Thus, one conjecture is that the sensitivity of house purchases to monetary conditions increases with income.

A home improvement loan is an alternative to refinancing for borrowing against home equity. In particular, a home improvement loan allows a homeowner to borrow against house equity without switching the principal mortgage contract. Since such loan is a junior claim, a home improvement loan is likely to be costlier than refinancing. Homeowners are likely to opt for a home improvement loan, when gains from refinancing are limited, for example, in the face of rising interest rates. Due to tighter liquidity constraints and fewer borrowing options available to them, lower-income homeowners are more likely to draw a home improvement loan than higher-income homeowners. Thus, we expect that the sensitivity of home improvement credit to monetary conditions decreases with income.

We make use of Home Mortgage Disclosure Act (HMDA) data, which provide information on mortgage credit type, i.e., refinancing, purchase, and home improvement loans, at an annual frequency for our two-decade sample period from 1996 to 2018 at the census tract level (a tract on average comprises less than 5,000 individuals). We employ two alternatives to measure credit at the tract level: The (logarithm of the) total dollar value of newly originated mortgage credit and the number of loans newly originated.

To proxy for the relevant monetary conditions, we obtain interest rate information from a monthly interest rate survey (MIRS) conducted by Federal Housing Finance Agency (FHFA).

Our key variable of interest is income at the census tract level. For policy purposes, housing institutions follow the median family income (MFI) definition which is not available at an annual frequency. As a consequence, family income estimates remain missing in most empirical analyses. Our strategy addresses two empirical challenges: First, we construct annual estimates of MFI, that we extrapolate from income definitions adopted by HMDA, the CRA, and the HUD. Second, our income estimates are constructed at the census tract level, the most granular level in HMDA.

Of course, other factors, such as house price growth, financial intermediation costs, and income, macroeconomic effects, local economic conditions, and regulatory effects, might confound the effect of monetary conditions on credit. Our specifications directly control for those confounding factors.

We regress the level of credit origination for the various loan types on the interaction of the change in the interest rate and the median family income at the tract level. An insignificant coefficient on this interaction term is consistent with the neutrality view of monetary conditions. A positive coefficient on the interaction term implies that a decrease in the interest rate has a positive effect on the credit originated to low-income homeowners, whereas a negative coefficient on the interaction term supports the view

that the change in rate has a positive effect on the credit originated to high-income homeowners.

Our results can be summarized as following: In the first set of our tests, we find that the interaction term is negative for both measures of credit origination and for refinancing and purchase mortgages. This negative coefficient estimate suggests that credit originated to high-income homeowners is more sensitive to monetary conditions than credit to low-income homeowners. Hence, despite the "in-their-favour-working" income and/or wealth effects, the low-income homeowners which also have higher marginal propensities to consume have lower sensitivities to monetary conditions. In particular, a one standard deviation, 50 basis points (bps), decrease in interest rate during the sample period is associated with a 1.4 (2.2) percentage points (pp) higher refinancing volume (number of loan applications) by higher-income homeowner (mean income plus one standard deviation) versus lower-income homeowner (mean income minus one standard deviation). In sum, this finding may reveal a notable monetary policy "distortion".

Next, we decompose our sample period into three sub-periods: 1998-2006 (pre-crisis period), 2007-2011 (crisis period), and 2012-2018 (post-crisis period). For refinancing, the pattern of the results continues to remain unchanged for the three subperiods. For purchase and home improvement loans, we find that although the relationship ceases to hold during the pre-crisis period, the relationship turns negative again for crisis- and post-crisis sub-periods.

The three leading explanations for mortgage credit expansion during the pre-crisis period are house price growth, house price expectations, and securitization. Hence, we assess the impact of these additional factors during the pre-crisis period and find that most of our results continue to hold. In particular, for the refinancing channel, we find that the relationship continues to remain robust to the inclusion of actual or expected house price growth, or securitization. Overall, our findings are not consistent with

the conventionally held view of "neutrality" of monetary conditions across the income distribution.

The rest of the paper is structured as follows: The next section provides a literature review and section 3 explains the empirical strategy. Section 4 describes the data and section 5 presents the results. Finally, section 6 concludes.

2 Related Literature and Contribution

2.1 Related Literature

Interaction of Monetary Conditions and House Prices: Monetary conditions and house prices are correlated and their interaction can have varying effect on refinancing. On the one hand, falling rates stimulate refinancing, while house prices are rising. For instance, while various studies including Mian and Sufi (2011) and Mian and Sufi (2014) show that higher house prices caused an increase in equity extraction, Bhutta and Keys (2016) show that interest rate affects equity extraction independent of house prices; there was a 27% rise in equity extraction in response to a 100 bps decline in interest rate at the peak of credit boom in 2003. On the other hand, falling rates can also restrict refinancing, while house prices are falling. Khandani, Lo, and Merton (2013) show that falling house prices lowered the value of housing collateral, which restricted refinancing activity during the Great Financial Crisis. This study augments this literature by examining the interaction of monetary conditions and household borrowing across income, independent of house prices.

Interaction of Monetary Conditions and Income: This strand of literature examines interaction between monetary conditions and labor income risk and/or heterogenous household income. While Meghir and Pistaferri (2004) examine the role of labor income risk on macroeconomic uncertainty, Guvenen, Ozkan, and Song (2014)

document that labor income risk varies with household income. Glover, Heathcote, Krueger, and Ríos-Rull (2020) model the labor income risk across age groups (in an overlapping generations model) during the Great Financial Crisis and document that although younger cohorts suffer labor income drops, they also benefit from buying assets at depressed prices due to differential portfolio composition. On the one hand, Glaeser, Gottlieb, and Gyourko (2013) document that cheap credit alone can not explain the growth in household borrowing. On the other hand, Chen, Michaux, and Roussanov (2020) stress that both liquidity demand (varying with labor income risk) and liquidity constraints, independent of interest rates, affect household refinancing-based borrowing behavior.

Although much theoretical work in macroeconomics employs representative agent model, that abstracts away from agent (income) heterogeneity, Auclert (2019) models household heterogeneity to assess the redistribution effects of monetary policy on household consumption, and argues that changes in monetary conditions amplify the redistributive effects, by affecting the duration gap between assets and liabilities of heterogeneous households. This study extends the frontier by examining the effect of monetary conditions on mortgage borrowing, while incorporating the role of household income and associated liquidity constraints, via the refinancing channel.

Monetary policy and Mortgage Markets: Several studies have examined the interaction of monetary conditions and financial innovation in mortgage contract design. For instance, an important mortgage contract characteristic is choice between fixed-rate mortgage (FRM) and adjustable-rate mortgage (ARM). Under FRM, lender bears the interest risk, whereas under ARM, borrower bears the interest risk. Campbell and Cocco (2003) model the household choice between FRM and ARM and argue that FRM becomes more attractive when risk increases. An important source of risk is inflation risk, which is intimately tied to monetary conditions. Rubio (2011) assesses welfare gains in

housing market under the two mortgage contracts and finds that FRM is more welfare enhancing in response to changes in interest rate, since ARM sensitivity to monetary policy is higher, changes in interest rate bring greater variability in household consumption. In the face of high inflation risk, Garriga, Kydland, and Šustek (2017) argue that FRM benefits homeowners more than ARM, since FRM is a nominal debt with fixed repayments, while ARM is a real debt with variable repayments. Further, Doepke and Schneider (2006) argue that inflation risk might result in transferring of resources from older (with nominal assets, such as bonds) to younger and middle-income households (with nominal debt, such as FRM). Outside US, using data on Euro area banks, Albertazzi, Fringuellotti, and Ongena (2019) show that the likelihood of FRM contract issuance is higher when inflationary pressures are low. Although ARM's visibility has been rising as mortgage product space grows over time, FRM contract still plays the dominating role in US mortgage markets. This study also examines the effect of monetary conditions on household borrowing across income groups incorporating the role of house price expectations, potentially capturing inflation risk.

Quantitative Easing (QE): During the Great Financial Crisis, Fed started large-scale assets purchase on its balance sheet under its QE policy of rate cuts. A number of papers document various effects of QE policy on refinancing. Fuster and Willen (2010) show that an increase in credit availability, due to the assets purchase program, resulted in an increase in refinancing of borrowers with higher credit scores. Further, Di Maggio, Kermani, and Palmer (2020) document that refinancing activity of QE-eligible mortgages (conforming loans) was higher than that of QE-ineligible mortgages (non-conforming loans). Beraja, Fuster, Hurst, and Vavra (2019) document that regional variation in house prices amplified the effects of the rate cuts, by showing that regions experiencing higher growth in house prices saw greater refinancing activity than regions experiencing lower growth in house prices. In sum, the above-mentioned papers show that the effects

of QE-induced rate cuts on the refinancing activity in both primary mortgage market and secondary mortgage market. This paper documents fresh evidence on short-run as well as long-run effects of monetary conditions on the redistributive effects for refinancing as well as purchase and home improvement loans.

Housing and Asset Pricing: Our paper is also related to asset pricing studies that study the differences in average return and risk between housing and other assets. Flavin and Yamashita (2002) and Campbell and Cocco (2003) show that households hold a large fraction of their portfolio in housing. Piazzesi, Schneider, and Tuzel (2007) argue that housing share can be used to forecast stock returns. Since the likelihood of higher-income homeowners holding equity is greater than that of lower-income households holding equity, the portfolio-composition effect implies that rich households are able to transfer the gains in house equity to other assets since housing provides a better collateral than other securities for individual investors (Hurst and Stafford (2004), Piazzesi and Schneider (2009), and Piazzesi and Schneider (2016)).

Inequality and Housing Credit: For an earlier period (1969-1994), Romer and Romer (1999) document that, while an expansionary monetary policy is welfare-enhancing for lower-income households in short-run, a prudent monetary policy, that maximizes output and lowers inflation, helps lower-income households in long-term. Bertrand and Morse (2016) document demonstration effect "keeping up with joneses", where non-rich households increase their consumption, when exposed to higher income at the top. Incorporating the role of collateral constraints tied to home equity, Iacoviello (2005) argues that an increase in house price boosts consumption by raising the borrowing capacity of the homeowners. Lustig and Van Nieuwerburgh (2010) show that consumption is more sensitive in regions where housing collateral is lower, since risk-sharing (borrowing) also decreases with housing equity. Further, Di Maggio, Kermani, Keys, Piskorski, Ramcharan, Seru, and Yao (2017) show that ARM resets have knock-on effects in other markets;

they show that ARM resets affect auto purchases and household consumption. On the other hand, Hurst, Keys, Seru, and Vavra (2016) stress the role of institutional costs; they show that, while setting mortgage rates, government-sponsored enterprises (GSEs), as opposed to non-GSEs, do not price local economic risks, such as mortgage recourse laws and local lending costs, that carry substantial regional redistributive effects.

For housing credit, a number of papers have documented the role of financial intermediation on redistributive effects. On the one hand, a series of papers document that financial intermediation caused an asymmetric credit growth across households. Mian and Sufi (2009) document that credit growth during the crisis run-up period was due to misaligned incentives in financial intermediation, where lenders affected a larger credit disbursement to lower-income households. Keys, Mukherjee, Seru, and Vig (2010) show that misaligned incentives in the financial sector, in the form of laxity in credit screening, was due to securitization. Purnanandam (2010) shows that lenders with high involvement in secondary mortgage markets originated greater quantity of underpriced loans. On the other hand, Adelino, Schoar, and Severino (2016) document that financial intermediation did not cause an asymmetric credit growth across income groups. They show that credit growth, during the crisis run-up period, was due to house price expectations, where financial sector mechanically lent credit taking house prices as given. However, in a later study incorporating an extended period, Coibion, Gorodnichenko, Kueng, and Silvia (2017) document that lower-income households (vs. higher-income households) face higher credit prices and reduced access to credit. Thus, based on the available evidence, it is not conclusive that credit expansion in mortgage market is symmetric across income groups.

Thus, while the above-mentioned papers enrich our understanding on various interactions between monetary policy and mortgage markets, the redistributive effects of monetary conditions on household borrowing still remain empirically unexamined.

2.2 Contribution

Income inequality in the US has been widening since the 1990s; however, studies examining its redistributive effects on household consumption and access to credit over the period are limited. Thus, to develop a better understanding how economic conditions affect household welfare across income groups, long horizon studies are much needed. To the best of our knowledge, ours is the first study that examines the redistributive effects of monetary conditions on mortgage credit since the mid-1990s, spanning pre-crisis, crisis, and post-crisis periods.

Second, our findings do not support the conventionally held view of "neutrality" of monetary conditions. Romer and Romer (1999) show and Auclert (2019) argues that an expansionary monetary policy is welfare-enhancing for lower-income households in at least in short-run, but, in a sharp contrast, the results in this study suggest the idea that refinancing sensitivity to monetary conditions is persistently "pro-high-income", given that the rate has been largely falling since the mid-1990s.

Finally, our income estimates also allow us to observe the credit outcomes during the pre-crisis period. While Adelino, Schoar, and Severino (2016) document that mortgage credit flowed across income groups during the pre-crisis period, our main finding is that access to gains in house equity (refinancing) accrued more to higher-income than to lower-income homeowners.

3 Empirical Strategy

In order to draw any meaningful inference concerning the redistributive effects of economic conditions, the first and foremost requirement is that household income estimates are available for such an analysis. Although local income can be measured in different ways, for policy purposes, housing institutions employ a local median family income

(MFI) definition. However, a limitation is that local MFI estimates are not available at an annual frequency, and, thus, local family income estimates remain missing in most empirical analyses. US Census provides those estimates, but updates the information only in its decennial surveys.

To get around this lacuna in data, researchers have been employing per capita income instead. Internal Revenue Service (IRS) provides income estimates at zip-code level, but the information is not available for all years. Due to the missing information, studies have been employing annualized per capita income estimates. For instance, both Mian and Sufi (2009) and Adelino, Schoar, and Severino (2016), that use IRS estimates, employ annualized income estimates, due to the missing information for 2003. Thus, the unavailability of an annual series of local family income estimates remains a major empirical challenge.

Our empirical strategy builds on the idea that neighborhood incomes are highly correlated with local economic conditions. Specifically, our empirical strategy is motivated by a federal law, the Community Reinvestment Act, 1977 (the CRA), that was designed to encourage financial institutions to address the credit needs of local communities, particularly lower-income neighborhoods. The scope of the Act has been evolving over time with numerous legislative changes and regulatory amendments since its inception. Nonetheless, the key objective behind the Act has been and still remains to reduce discriminatory credit practices against lower-income neighborhoods. The CRA targets and tracks signatory financial institutions to promote non-discriminatory lending practices into lower-income neighborhoods. Although the CRA is enforced by federal agencies, i.e., the Fed, the Federal Deposit Insurance Corporation, and the Office of the Comptroller of the Currency, that regularly conduct examinations for CRA compliance, these agencies do not publish local income definitions. Thus, as a starting point, the implementation of the CRA requires income classification of local neighborhoods, which

is exactly what we exploit to identify local household income.

Our empirical strategy addresses this data challenge by constructing annual estimates of MFI at census tract level, the most granular level in HMDA, as following: Whereas the HUD publishes annual estimates of MFI for metropolitan areas, the HUD also provides the ratio of census tract MFI to the corresponding metropolitan statistical areas (MSA) MFI. Tract MFI classifications correspond to income definitions adopted by the CRA and HMDA regulations: If the income ratio is less than 50%, then the tract is classified as low income, if the ratio is between 50% and 80%, then the tract is classified as moderate income, if the ratio is between 80% and 120%, then the tract is classified as middle income, and if the ratio is above 120%, then the tract is classified as high income. A limitation of this strategy is that our income estimates are only available for those census tracts, that are nested in the corresponding MSA. As a consequence, our strategy focuses on urban areas. The CRA applies in rural areas as well; however, Bhutta (2011) note HMDA data are unreliable in rural areas. For our purposes, these census tract income classification are "institutionally exogenous". We make use of the HUD's estimated MFI(MSA) and MFI(Tract)/MFI(MSA) ratio to extrapolate annual estimates of MFI for the census tracts.

4 Data and Summary Statistics

4.1 Data and Sample Selection

We use various publicly available databases. Our primary data come from HMDA, which was enacted by Congress in 1975 to be implemented by the Federal Reserve Board's Regulation C requiring lending institutions to report public loan data. HMDA provides loan data for different purposes, purchase, refinancing, and home improvement at an annual frequency to the census tract level. We drop those observations where

information on location and/or credit amount are missing.

The US mortgage market is considered highly competitive, where numerous lenders offer a variety of mortgage products. We make use of interest rate data from the FHFA's monthly interest rate survey (MIRS) since this survey is the most comprehensive source of information on conventional mortgage rates and terms. MIRS provided information on a monthly basis on mortgage rates, by loan type (FRM or ARM), that were reported by various lenders such as commercial banks, savings banks, savings associations, and mortgage companies. About 80% of US mortgage lending institutions rely on the Federal Home Loan Bank system (FHLB), and hence, many reporting mortgage lenders are likely to be the member institutions. Since the FHLB functions like a cooperative, we believe that MIRS rate would not favor any particular income group.

Admittedly, the ARM rate will comove with the federal funds rate more closely than FRM, but since FRM contract continues to remain the dominant mortgage contract in the US, we employ FRM rates. We take annual average of monthly FRM rates in order to construct our annual series of mortgage rates. Finally, to compute the change in the rate, we take the yearly difference between consecutive annual interest rates.

Financial intermediation costs include for example application fees, loan origination fees, appraisal fees, legal costs, title search costs, survey fees, and private mortgage insurance (if applicable). Some financial intermediation costs are fixed, while others are variable. Financial intermediation costs tend to fall proportionally with loan size. In a given location, the house value of a lower-income household is likely to be lower than that of higher-income household due to affordability differences. Thus, a lower-income homeowner might face relatively higher financial intermediation costs associated with loan origination. Although loan origination costs typically accrue at the inception of the loan, homeowners might choose to also amortize the costs along with the principal amount which makes such costs permanent. MIRS also provides monthly estimates of

lending fees and charges, reported by the above-mentioned lenders.

Bennett, Peach, and Peristiani (2001) document that competition in primary mortgage market and technological improvements have enhanced financial awareness concerning refinancing starting the 1990s. On the other hand, Attanasio (1995) argues that transaction costs can add to liquidity constraints, especially those of lower-income households. Following this reasoning, we construct our measure of financial intermediation costs in two steps. First, we take annual average of monthly lending fees and charges estimates to construct a measure of lending fees. In the second step, since our measure of financial intermediation (fees and charges) does not vary cross-sectionally in a given year, we take the ratio of fees and charges (in bps) to natural logs of average size of the loan at tract level, that brings a rich cross-sectional variation in our measure of financial intermediation costs. The data on house prices are from the FHFA. We use county-level house price indices to compute annual house price growth.

Finally, the sample period spans the period from 1996 to 2018.[2] Favara and Imbs (2015) show that banking deregulation, starting 1994, affected mortgage credit supply. By starting our sample horizon in 1996, we avoid any confounding effect due to banking deregulation. The sample ends in 2018 since MIRS was discontinued in 2019. Due to the sample size concern, we aggregate (originated) conventional loans by purpose-type to the census tract.

4.2 Summary Statistics

Table 1 presents the descriptive statistics for the variables, that we use in subsequent analyses. The mean and median change in rate is -19 bps and -18 bps, suggesting that the rate has been falling over time. The mean logged tract MFI is 3.94, which is close to its median at 3.93, with a relatively low standard deviation at 0.34. The mean fees

[2]In fact, the sample starts from 1995 and ends in 2019. Since we make use of realized and expected changes in house prices, we lose the first and the last observations.

and charges is 16.1 bps, which is pretty close to its median at 16.8 bps, with a standard deviation at 6.7 bps; however, there is a wide gap between its minimum, at 16.84 bps, and its maximum, at 54.82 bps, suggesting a significant variation of financial intermediation across the census tracts.

While individual house price can be very volatile, house price indices tend to be less volatile (Glaeser and Nathanson (2015) and Piazzesi and Schneider (2016)). The mean and median house price growth at the county level is 2.68% and 2.66%, with a standard deviation at 5.58%. The house price growth ranges from -44.72% to 56.12%, suggesting a wide variation in regional house prices. The mean (median) expected house price growth at the county level is 2.73% (2.70%), with a standard deviation at 5.6%. Expected house price growth statistics are slightly higher than realized house price growth statistics. We provide definitions and summary statistics of all variables in Table 1.

5 Empirical Tests

5.1 Baseline Results

Figure 1 depicts the credit share by loan type over the sample period. While purchase and refinancing exhibit a strong time-varying pattern, home improvement loans share seems to remain, more or less, flat over the entire period. The purchase share and refinancing share move in opposite directions, partly a mechanical effect (given that we look at shares) but not inconsistent with our conjecture that refinancing has an offsetting effect on the demand for purchase. Sharpe and Sherlund (2016) also document that increased refinancing activity, in the wake of lower rates, crowds out purchase. Further, and similarly, home improvement and refinancing move in opposite directions, which is not inconsistent with our conjecture that homeowners might opt for a home improvement loan only when the gains from refinancing are limited.

We next turn to a regression analysis. Our empirical tests investigate how the effect of change in rate on mortgage lending varies by income. We estimate the following specification:

$$ln(Credit)_{i,t} = \beta_1 \triangle Rate_t \cdot ln(MFI)_{i,t} + \beta_2 ln(MFI)_{i,t} + \beta_3 Fee_{i,t} + \beta_4 \triangle HxPx_{c,t} + Tract\_Income_i + Commuting\_Zone_c + Year_t + u_{i,t}$$

where i indexes census tract, c county, and t year. In the above specification, credit origination (by type) in a given tract is regressed on interaction of change in rate and tract MFI, relevant controls and a set of fixed effects. Two alternative measures are employed at the tract-year level to measure credit origination ($ln(Credit)_{i,t}$): total dollar value of mortgage credit and number of loans originated. We take natural logs of absolute quantities. $\triangle Rate_t$ measures the change in mortgage rate relative to the previous year's rate. $ln(MFI)_{i,t}$ is natural logs of census tract MFI. $Fee_{i,t}$ measures financial intermediation costs at tract level. A key determinant of credit expansion is house prices. We employ annual growth in county-level house price indices, $\triangle HxPx_{c,t}$, to control for change in house price.[3] Apart from controlling tract MFI directly, we also employ tract income classification dummies, since lower-income tracts might attract regulatory attention in relation to the CRA. Year effects are included to capture macroeconomic effects. We cluster errors at the tract level to capture potential serial correlation (Petersen (2009)).

To capture local economic conditions, we employ commuting zone fixed effects. A commuting zone is a group of neighboring counties that share the same commuting pattern. Commuting zones were first developed by a federal agency, Economic Research Service, and updated by Fowler, Rhubart, and Jensen (2016) for later periods. County

[3]The results remain largely unchanged when we employ Zillow house price indices, instead; however, the coverage of FHFA is much better than that of Zillow.

boundaries might inadequately identify a local economy since commuting distance better captures the interrelationships among local economic agents.[4]

Although the direct effect of the change in rate are subsumed by year fixed effects, in the above specification, the omission does not affect our analysis, since the variable of interest is $\triangle Rate_t \cdot ln(MFI)_{i,t})$, interaction of change in rate and tract MFI, which captures the differential effect of change in rate on lending by income after directly controlling for census tract income, financial intermediation costs, house price growth, tract income effects, macroeconomic effects, and local economic effects. As a benchmark, if β_1 is insignificant, then it implies that the effect of change in rate on lending does not vary with tract income, supporting the "neutrality" view. On the other hand, if β_1 is positive and significant, then it implies that sensitivity of credit to monetary conditions decreases with income. In other words, the effect of change in rate on lending is low-income friendly. In contrast, if β_1 is negative and significant, then it implies that sensitivity of credit to monetary conditions increases with income, suggesting that the effect of change in rate on lending is larger for higher-income tracts.

Refinancing: We begin with refinancing. The refinancing channel of monetary policy transmission supports the view that monetary conditions affect refinancing activity. Interest rates play a key role in refinancing activity. Since interest rates are set federally, a change in the rate has a broad-based effect on housing markets nation-wide. For example, Agarwal, Driscoll, and Laibson (2013) derive a closed-form solution where optimal refinancing decision depends on innovation in mortgage rates. A lower rate stimulates the demand for refinancing since a lower rate can reduce future mortgage repayments. One way of enjoying housing wealth gains is by refinancing mortgage at a lower rate. Figure 2 shows movements in interest rate and refinancing activity for the period, where refinancing share is on left axis and interest rate movement on right axis. As suggested

[4]Results (unreported) remain largely unchanged when MSA or county fixed effects are employed, instead.

by the refinancing channel, interest rate and refinancing seem to be inversely related. For example, the refinancing share was rising when the rate was falling between 1996 and 1998 and the share was falling when the rate was rising between 1999 and 2000. In the 2000s, refinancing went up when interest fell, and refinancing went down when the interest rate rose, except for the period, 2009-2011, when refinancing experienced a fall despite declining rates.

Columns 1—3 of Table 2 present the results for refinancing. Columns 1 and 2 report results for refinancing volume, and column 3 for the number of loans. Column 1 excludes tract income fixed effects, while column 2 includes tract income effects. In column 1, a negative and significant β_1, at -0.460, implies that the sensitivity of credit to changes in the rate increases with tract income. $\triangle Rate_t \cdot ln(MFI)_{i,t})$ is the interaction of the change in the rate and tract MFI, where the direct effect of change in the rate on credit is expected to be negative but that effect cannot be estimated since the the change in rate is subsumed in year effects. Nevertheless, the direct effect of tract income on credit is positive and significant, at 1.483, implying that refinancing volume increases with tract income, which is not too surprising since homeowners in tracts with higher income might live in more expensive houses financed with bigger mortgages. The effect of financial intermediation costs on credit volume is negative and significant, at -0.424, which implies that financial intermediation costs, that decreases as loan size increases, adversely affect refinancing, especially in the tracts with smaller loan size. The effect of a change in house prices on refinancing volume is positive and significant, at 0.011, which is consistent with extant evidence that equity extraction is positively associated with house price growth. In column 2, the pattern of results does not change much when we include tract income fixed effects.

In terms of economic relevance, a 50 bps (a standard deviation) decrease in interest rate results in a 1.4 pp higher refinancing volume by high income household relative to

low income household, where high (low) income is measured as MFI mean plus (minus) one standard deviation. In column 3, the results continue to remain robust when we employ our second measure of credit, number of loans in a given year. A 50 bps decrease in interest rate results in a 2.2 pp higher refinancing number for high-income homeowners versus low-income homeowners. Thus, gains in house equity, in response to change in monetary conditions, accrue more to high-income homeowners than to low-income homeowners. This is our main finding.

Purchase: We next examine house purchases. HMDA does not indicate whether a purchase is made by a first-time buyer or by a returning buyer. Nevertheless, the US Census provides some information on homeownership rates. Figure 3 shows homeownership rates in the US during the sample period. A few observations are in order: First, the overall homeownership rate, at nearly 65%, has been largely stable over the sample period; it decreased by one percentage point from 65.4% in 1996 to 64.4% in 2018. Second, the rate exhibits a time-varying pattern, it reached its peak at 69% in 2004 and its bottom at 63.4% in 2016. Finally, a significant disparity, of nearly 30 pp, exists between the homeownership rates of high-income homeowners and low-income homeowners.[5] These trends, across income groups, are very similar over the sample period, which suggests the disparity between the two income groups has been persistent.

Columns 4—6 of Table 2 present the results for purchase. As previously, columns 4 and 5 report results for purchase volume, and column 6 for number of loans. Column 4 excludes tract income fixed effects, while column 5 includes them. β_1 remains negative and significant across the columns, which implies that the sensitivity of purchase to change in monetary conditions increases with tract income. However, since HMDA does not indicate whether a purchase is made by a first-time buyer or a returning buyer, the result cannot distinguish whether the transfer from lower-income households to higher-

[5]A homeowner is classified high-income homeowner if the ratio of tract MFI to the relevant (MSA) MFI is 50% or above, else low-income homeowner.

income households crowds out first-time buyers or returning buyers. Since the pattern of the other control variables hardly change, we suppress their discussion. A 50 bps decrease in interest rate results in a 0.6 pp higher likelihood of purchase volume and a 0.8 pp higher likelihood of purchase applications by high income household relative to low income household. Hence, the results in section support the conjecture that purchase sensitivity to monetary conditions increases with household income.

Home Improvement Loans: We next turn to home improvement loans. As mentioned earlier, home improvement loans are a costlier alternative to refinancing. Thus, homeowners with tighter liquidity constraints are more likely to take out a home equity loan. Thus, our conjecture is that home improvement loan sensitivity to monetary conditions decreases with income.

Columns 7—9 of Table 2 present the results for home improvement loans. In column 7, β_1 is negative and significant; however, in column 8, β_1 turns insignificant, when tract income effects are introduced, suggesting that home improvement loans sensitivity to monetary conditions is income neutral. In column 9, where credit is measured in terms of number of loans, β_1 becomes positive and significant, which implies home improvement loans sensitivity to monetary conditions is low-income friendly. Due to lack of clean evidence, we are unable to draw any meaningful inference about the redistributive effects regarding home improvement loans.

5.2 Subperiod Analysis: Before, During, After the Great Financial Crisis

Our results in the previous section pertain to the full sample, highlighting the long-term redistributive effects of monetary conditions in mortgage markets. While a long-horizon study is needed to properly examine a long-term phenomenon, such as redistributive effects, a valid concern is that such a long time window could potentially mask the

role of significant periodic breakpoints in mortgage markets. One such breakpoint was the Great Financial Crisis, that affected credit markets, including mortgage markets, unprecedentedly (Mayer, Pence, and Sherlund (2009) and Keys, Piskorski, Seru, and Vig (2012)).

Numerous studies examine various aspects of the Great Financial Crisis and enrich our understanding. The focus of this paper is on monetary conditions, and thus, a natural question is whether monetary conditions had any differential impact on the redistributive effects during the boom-bust cycle due to the Crisis. While some studies (reviewed above) document the effects of QE policy on refinancing, the role of income heterogeneity stills remains to be examined. Further, an implicit assumption in above-mentioned studies seems to be that monetary conditions would have had no serious redistributive effects prior to Fed's adoption of unconventional QE measures. Then, it also immediately follows that redistributive concerns would subside when Fed discontinued those unconventional measures. We next examine the redistributive effects of monetary conditions in three sub-periods, earmarked by the Great Financial Crisis: 1998-2006 (pre-crisis), 2007-2011 (crisis), and 2012-2018 (post-crisis). We examine 1998-2006, instead of 1996-2006, as the pre-crisis period, since subprime credit was more increasingly available during this period, which might have played a role in the credit conditions.

Refinancing: Columns 1—3 of Table 3 present results for refinancing volume during 1998-2006 (pre-crisis), 2007-2011 (Crisis), and 2012-2018 (post-crisis) subperiods. In column 1, β_1 is negative and significant, which implies that refinancing sensitivity of higher-income homeowners was higher than that of lower-income homeowners in response to monetary conditions during the pre-crisis period. In contrast, Adelino, Schoar, and Severino (2016) document that credit flowed symmetrically across income groups during the pre-crisis period, where institutions lent given rising house prices. Despite directly

controlling for house price growth, the evidence above, that refinancing sensitivity to monetary conditions increases with income during the pre-crisis period, does not support their finding. On the other hand, our finding is consistent with Coibion, Gorodnichenko, Kueng, and Silvia (2017), that shows that lower-income households, relative to higher-income households, have lower access to credit.

In column 2, the result remains unchanged; however, the coefficient on house price growth turns insignificant, suggesting that, interaction effect of monetary conditions and tract income on refinancing still persisted during the crisis period independent of house prices. Further, while lacklustre growth in house prices might not have supported refinancing much during the crisis period, positive coefficient on tract income suggests that refinancing increased with tract income. Our finding is consistent with Fuster and Willen (2010), that show that refinancing of borrowers with higher credit scores increased in response to an increase in credit availability, during the crisis period. Lastly, in column 3, while β_1 continues to remain negative, the coefficient on house price growth turns positive and significant during the post-crisis period, suggesting that the interaction of monetary conditions and income is persistent.

Specifically, in response to a 50 bps decrease in interest rate, differential refinancing likelihood between high income household and low income household increased from 0.8 pp during the pre-crisis period to 1.2 pp during the crisis period; it further widened to 1.4 pp during the post-crisis period, indicating that the differential has been increasing over time. The trend, that refinancing sensitivity to monetary conditions increases with income, existed before the Great Financial Crisis and continued to persist after the Great Financial Crisis indicates that QE policy alone did not trigger the worsening of the redistributive effects. Thus, the gist of the above analysis is that refinancing sensitivity to monetary conditions *persistently* increases with income, lending further support to the main finding.

Purchase: Columns 4—6 of Table 3 present results for purchase volume for the respective subperiods. In column 4, β_1 is insignificant, which implies that purchase sensitivity to monetary conditions was income invariant during the pre-crisis period. In contrast, Mian and Sufi (2009) document that financial institutions lent a larger amount of credit to lower-income households, due to misaligned financial intermediation. We directly control for financial intermediation costs; however, our finding does not support their result. On the other hand, Adelino, Schoar, and Severino (2016) also document that credit did not flow asymmetrically across income groups; however, their causal explanation, rising house prices, is different than ours.

In column 5 and 6, β_1 turns negative and significant, implying that purchase sensitivity to monetary conditions was higher for higher-income homeowners during the crisis and the post-crisis subperiods. In response to a 50 bps decrease in interest rate, differential purchase likelihood between high income household over low income household has been at 0.8 pp since 2007. Thus, while purchase sensitivity to monetary conditions is income invariant for the pre-crisis period, the sensitivity turns high-income friendly in subsequent subperiods.

Home Improvement Loans: Columns 7—9 of Table 3 present the results for home improvement loans for the subperiods. In column 7 of Table 3, β_1 is positive and significant, which suggests that home improvement loan sensitivity to monetary conditions was low-income friendly during the pre-crisis period. It is a bit puzzling since credit availability was quite unrestricted during that period. In column 1, we find that refinancing sensitivity to monetary conditions was high-income friendly during the same period. As mentioned earlier, home equity loans, such as home improvement loans, are likely to be more expensive than refinancing. In addition, home improvement loan size is typically smaller than refinancing or purchase loan. Thus, despite greater availability of credit, the results seem to suggest that lower-income households might have been dealt

an unfair hand, in the form of more-expensive home equity loans, instead of refinancing. Furthermore, in columns 8 and 9, β_1 turns negative and significant, implying that home equity loan sensitivity to monetary conditions turned high-income friendly during the crisis and post-crisis subperiods indicating even more-restricted granting of credit to lower income households.

Home improvement loan differential likelihood (high income household over low income household) increased by 1.2 points from -0.5 pp (low-income friendly) during the pre-crisis period to 0.7 pp (por-rich) during the crisis period, in response to a 50 bps decrease in interest rate; however, the differential slightly went down to 0.5 pp during the post-crisis period, the trend remains unchanged. In the preceding section (Table 2 for the full sample), we could not draw any meaningful conclusion regarding this category of loans, due to a mixed evidence. A subperiod analysis in this section presents a clearer picture by better capturing the time-varying pattern.

Evidence in this section suggests that even during the pre-crisis period, when credit was relatively unrestricted, lower-income households seemed to get only home equity loans, that were costlier than refinancing; however, in subsequent subperiods, even that costlier option seemed to have become increasingly more inaccessible.

5.3 House Price Growth

Interest rates and house prices tend to be correlated since a lower rate leads to an increase in asset prices, including house prices. Moreover, house prices and economic conditions tend to go hand-in-hand. Despite directly controlling for house price changes, a concern is that correlation between change in interest rate and house price growth might affect our results. Table 1 shows a significant variation in house prices, that could be temporal or cross-sectional. After examining temporal (sub-period) behavior in the preceding section, we next examine the potential cross-sectional (regional) variation in

house prices, that might potentially affect the results.

In our specifications, house price change is measured at county level, which implies that census tracts with varying incomes within a county, experience the same house price growth.[6] If the credit origination in counties varies with house price growth, then the potential correlation between change in house price and change in interest rate might affect our results. For instance, Beraja, Fuster, Hurst, and Vavra (2019) show that, in response to rate cuts, regions with higher growth in house prices experience greater refinancing activity than regions with lower growth in house prices. Thus, potential regional correlation between change in interest rate and change in house price might affect the results. In particular, Adelino, Schoar, and Severino (2018) document that mortgage credit expansion during the pre-crisis period was income neutral. To examine the concern, we next split our samples by positive/negative change in house prices and repeat the regressions.

Refinancing: Table 4 presents the results. Columns 1—4 of Table 4 present the results for refinancing, where columns 1 and 3 show results for full sample and columns 2 and 4 for the pre-crisis period. Columns 1 and 2 present results for positive (negative) growth in house price, while columns 3 and 4 for negative growth. β_1 remains negative and significant across the columns 1-4, implying that refinancing sensitivity to monetary conditions was higher for higher-income homeowners irrespective of house price growth during the full sample period as well as the pre-crisis period. During the full sample period, a 50 bps decrease in interest rate results in a 1.3 (1.6) pp higher likelihood of refinancing volume of high income household versus low income household, when house price growth is positive (negative). Likewise, during the pre-crisis period, the differential refinancing likelihood between high income household and low income household increases from 0.7 to 1.1 pp, when gains in house equity turn from positive

[6]Census tract is nested in county.

to negative. Thus, the main finding, that refinancing sensitivity to monetary conditions is high-income friendly, is not driven by regional heterogeneity in house prices.

Purchase: Columns 5—8 of Table 4 present the results for purchase, where the arrangement of results remains unchanged. In columns 5 and 7, β_1 remains negative and significant, indicating that purchase sensitivity to monetary conditions was high-income friendly for the full sample, irrespective of house price growth. During the full sample period, the differential purchase likelihood between high income household and low income household increases by 10 times, from 0.5 to 5.1 pp, when house price growth turns from positive to negative. In contrast, during the pre-crisis period in columns 6 and 8, β_1 is insignificant, which implies that purchase sensitivity to monetary conditions was income-invariant irrespective of house price growth, suggesting limited role of regional heterogeneity in house prices.

Home Improvement Loans: Lastly, columns 9—12 of Table 4 present the results for home improvement loans. On one hand, in columns 9 and 11 for full sample, while home improvement loan sensitivity to monetary conditions is income neutral when house price growth is positive, the sensitivity turns high-income friendly when house price growth is negative. On the other hand, in columns 10 and 12 for the pre-crisis period, the sensitivity to monetary conditions switches from low-income friendly to income neutral as house price growth turns from positive to negative.

In conclusion, the pattern of most results remains the same, irrespective of house price growth, which indicates that our results, for the full sample period as well as the pre-crisis period, are not driven by the correlation between monetary conditions and house prices or rising house prices.

5.4 House Price Expectations

We next explore the potential role of heterogeneous house price expectations on mortgage decisions. House prices were rising starting the late 1990s until the onset of the Financial Crisis, that might affect house price expectations across heterogeneous households. Various studies document the role of heterogenous house price expectations in mortgage market. Piazzesi and Schneider (2009) model heterogeneous households in incomplete market with risky assets only. Households have heterogeneous beliefs while facing inflation risk as well as idiosyncratic shocks to both labor income and house equity. They argue that household borrowing increases when house prices are expected to go up. Burnside, Eichenbaum, and Rebelo (2016) model the role of beliefs. In the absence of new information, households are not able to update their beliefs over time and their priors are likely to persist over time, which implies that only a subset of household have correct beliefs about fundamentals. They allow a subset of households to update their beliefs socially, and show that a boom-bust cycle is more likely when correct beliefs are pessimistic. DeFusco, Nathanson, and Zwick (2017) argue that house price expectations can attract increased speculative trading, that destabilizes prices.

Relatedly, income and education tend to be correlated, suggesting that lower-income homeowners might be less-equipped to fully understand the economic impact of monetary conditions than higher-income homeowners, implying there might be a transfer from lower-income homeowners to higher-income homeowners. For instance, Gabaix and Laibson (2006) argue that products with hidden/confusing information can generate a transfer from less-informed to more-informed households. Agarwal, Rosen, and Yao (2016) document that more-informed borrowers make smaller mistakes by timing their refinancing decisions at optimal rates. In a life-cycle setting, Agarwal, Driscoll, Gabaix, and Laibson (2009) show that middle-aged adults (with plausibly higher incomes) make fewer financial mistakes than younger or older adults (with plausibly lower

incomes), that suggests that higher-income households might make more optimal financial decisions. Since higher-income (more-informed) households are also likely to have greater financial flexibility than lower-income (less-informed) households, higher-income homeowners might be able to adjust their behavior more efficiently than lower-income homeowners.

Thus, a concern is that the house price expectations might affect our results, especially during the pre-crisis period. If so, our specification is likely to be misspecified. To examine the role of house price expectations, we modify our specification by replacing realized house price growth with expected growth in house prices, and as previously, we split our samples by positive/negative change in expected house prices and repeat the regressions.

Refinancing: We conjecture that if house prices are expected to rise in next period, then higher-income homeowners are likely to postpone their refinancing decisions to the next period in order to take fuller advantage of potential gains in house equity, such that a higher proportion of lower-income homeowners refinance in the current period, and thus a positive coefficient on the interaction term is expected. Likewise, when house prices are expected to fall in next period, then higher-income homeowners are likely to prepone their refinancing decisions to the current period, such that a lower proportion of lower-income homeowners refinance in the current period, and thus, we expect a negative coefficient on the interaction term.

Table 5 reports the results. As previously, columns 1—4 show the results for refinancing, where columns 1 and 2 present results for positive expected house price growth and columns 3 and 4 for negative expected house price growth. Columns 1 and 3 show results for full sample and columns 2 and 4 for the pre-crisis period. In columns 1 and 3 for the full sample, β_1 is negative and significant, suggesting no evidence that higher-income homeowners postponed their refinancing decisions. A 50 bps decrease in interest

rate results in a 1.3 (1) pp higher likelihood of refinancing volume of the high income households relative to that of low income households, during the full sample (pre-crisis) period, when house price expectations are positive.

In column 3, for the full sample, β_1 continues to remain negative and significant. A 50 bps decrease in interest rate results in a 0.7 pp higher likelihood of refinancing volume by high income household versus low income household, when house price expectations are negative. In contrast, in column 4 for the pre-crisis period, β_1 turns insignificant, indicating that higher-income homeowners did not prepone their refinancing decisions when house prices were expected to fall in next period; however, the number of observations are relatively fewer. In sum, house price expectations do not seem to affect our main finding that refinancing sensitivity to monetary conditions increases with income.

Purchase: Columns 5—8 of Table 5 present the results for purchase. Purchase activity is expected to rise when households expect house price to go up in the next period. In columns 5 and 6, β_1 is negative and significant, indicating that higher-income households are better able to take advantage of positive house price expectations. A 50 bps decrease in interest rate results in a 0.5 (0.3) pp higher likelihood of purchase volume of the high income households relative to that of low income households, during the full sample (pre-crisis) period, when house price expectations are positive. On the other hand, in columns 7 and 8, β_1 turns insignificant. While higher-income households' sensitivity to monetary conditions continue to remain greater than that of lower-income households when house price expectations are positive, there is no evidence that lower-income households are at disadvantage when house price expectations turn negative.

Home Improvement Loans: Columns 9—12 present the results for home improvement loans. A homeowner is more likely to take out a home improvement loan when the gains from refinancing are lower. If house prices are expected to go up next period, then lower-income homeowners are more likely to take out home improvement

loans in the current period, when refinancing gains are lower. In contrast, in column 9 for full sample, β_1 is negative and significant, indicating that credit sensitivity to monetary condition is high-income friendly even when house price are expected to go up in next period. Further, in columns 10 and 12 for the pre-crisis period, the sensitivity to monetary conditions remains income neutral, irrespective of house price expectations. Thus, house price expectations play no significant effect on home improvement loans during the pre-crisis period.

Although house price expectations seem to affect purchase activity, the credit sensitivity to monetary conditions, in general, continues to remain high-income friendly. Thus, house price expectations do not seem to be driving the results.

5.5 Securitization

Originate-to-hold and originate-to-distribute are two popular models in loan origination. Under originate-to-distribute model, lender originates a loan to sell it in the secondary mortgage market, whereby earning origination fees without bearing the loan risk, whereas, under originate-to-hold model, lender originates a loan to hold it on her books. In a typical securitization process, secondary market buyers pool those (sold) loans, repackage them into securities with varying (risk and) cash flow, and sell the securities to investors.

During the pre-crisis period, originate-to-distribute model became a popular choice among mortgage lenders. Securitization is not foreign to mortgage markets as GSEs have been issuing mortgage-backed-securities (MBS) for a long time; however, the share of non-GSE securitization significantly increased during the pre-crisis period (Ashcraft and Schuermann (2008) and Keys, Piskorski, Seru, and Vig (2012)).

A number of studies document moral hazard associated with securitization, in particular, private-label securitization during the pre-crisis period. Keys, Mukherjee, Seru,

and Vig (2010) document that originate-to-distribute model caused laxity in mortgage screening process, resulting in an increased origination of riskier loans, around a FICO credit score threshold. Loutskina and Strahan (2011) document that geographically less-diversified lenders were less lax than geographically more-diversified lenders. Purnanandam (2010) shows that lenders with higher involvement in originate-to-distribute model, originated poorer quality (underpriced) loans. Chemla and Hennessy (2014) argue that in the absence of prudent regulation, lenders are more likely to originate underpriced loans.

While securitization creates the liquidity in mortgage markets, the effects can vary across lenders and policy-regimes. On the one hand, Loutskina and Strahan (2009) document that liquidity-constrained banks originate more GSE-eligible (conforming) loans. On the other hand, Drechsler, Savov, and Schnabl (2019) document that non-banks made low quality (non-conforming) loans due to greater availability of (non-GSE) securitization. They argue that securitization greatly offset monetary policy effects, especially contraction, during the pre-crisis period.

A concern is that the distribution of securitized (sold) loans might be different than that of retained (unsold) loans by originators, due to potential moral hazard associated with originate-to-distribute model. Thus, our results pertaining to the pre-crisis period might be potentially biased. To examine the potential bias, we split the pre-crisis period sample by sold/unsold loans and rerun the regressions.

Since default risk decreases with income, a possibility is that originators were likely to retain higher-income households' (less-risky) loans on the books and sell lower-income households' (riskier) loans in the secondary market. Besides, higher-income households are more likely to live in a bigger house with a bigger mortgage (jumbo), that might be ineligible as per GSE underwriting standards. Consequently, originators held a high proportion of jumbo (non-conforming) loans on their books and sold a larger proportion

of non-jumbo (conforming) loans in secondary market. Thus, we expect a negative coefficient (high-income friendly) on β_1 for unsold (retained) loans and a positive coefficient (low-income friendly) for sold (securitized) loans.

Refinancing: Table 6 shows the results. Odd-numbered columns show the results for retained (unsold) loans and even-numbered columns for sold loans. Columns 1 and 2 present estimates for refinancing, where β_1 remains negative and significant, indicating the refinancing sensitivity to monetary conditions was high-income friendly, regardless of securitization. A 50 bps decrease in interest rate results in a 0.7 pp higher likelihood of refinancing volume of high income households (versus low income households), irrespective of loans being sold or unsold, which is consistent with the finding of Acharya, Schnabl, and Suarez (2013), who document that securitization provided little risk transfer. Thus, our main finding remains robust to securitization.

Purchase: Columns 3 and 4 present results for purchase, where β_1 remains insignificant for unsold loans, while it turns negative and significant for sold loans, suggesting originators were selling higher-income households' (plausibly less-risky) loans in the secondary market. Nevertheless, the finding does not affect the result found earlier for purchase activity that purchase sensitivity to monetary conditions was income neutral in the pre-crisis period (column 4 of Table 3). A 50 bps decrease in interest rate marginally increases the differential purchase likelihood between high income household and low income household by 0.2 pp for securitized loans.

Home Improvement Loans: In columns 5 and 6 for home improvement loans, β_1 switches from positive, for unsold loans, to negative, for sold loans, suggesting that originators were holding riskier loans on books and selling plausibly less-risky loans in the secondary market. Once again, securitization does not seem to affect the result for home improvement loans in the pre-crisis period (column 7 of Table 3).

Thus, securitization, during the pre-crisis period, hardly affects the results.

6 Conclusion

US credit markets have been experiencing a number of significant changes, starting with banking branch deregulation in the mid-1990s, that led to increased credit supply. On the one hand, increased liquidity and financial integration increased local credit supply by lowering geographical barriers. On the other hand, policy regulations, such as the CRA, have long aimed at reducing disparity in local credit availability across income groups. A natural question is how much gains in expanded credit supply have accrued to lower-income households.

Although housing, in general, is characterized by illiquid markets, excessive house price volatility, and a high degree of idiosyncratic risk, US mortgage markets are considered highly competitive. Since two-thirds of the population live in owned houses, refinancing, allowing (liquidity-constrained) households to access gains in their house equity to support consumption, remains a broad-based economic activity.

In this paper, we examine the impact of monetary conditions across income groups in mortgage markets, via the refinancing channel. We find that since the mid-1990s refinancing sensitivity to monetary conditions has been persistently higher among the rich households than among the poor households. Despite various regulatory reforms and financial/technological innovations in the mortgage market, the persistence of a difference in sensitivity to mortgage credit cost across income groups may point to a first-order policy "distortion".

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Figure 1: Credit Share

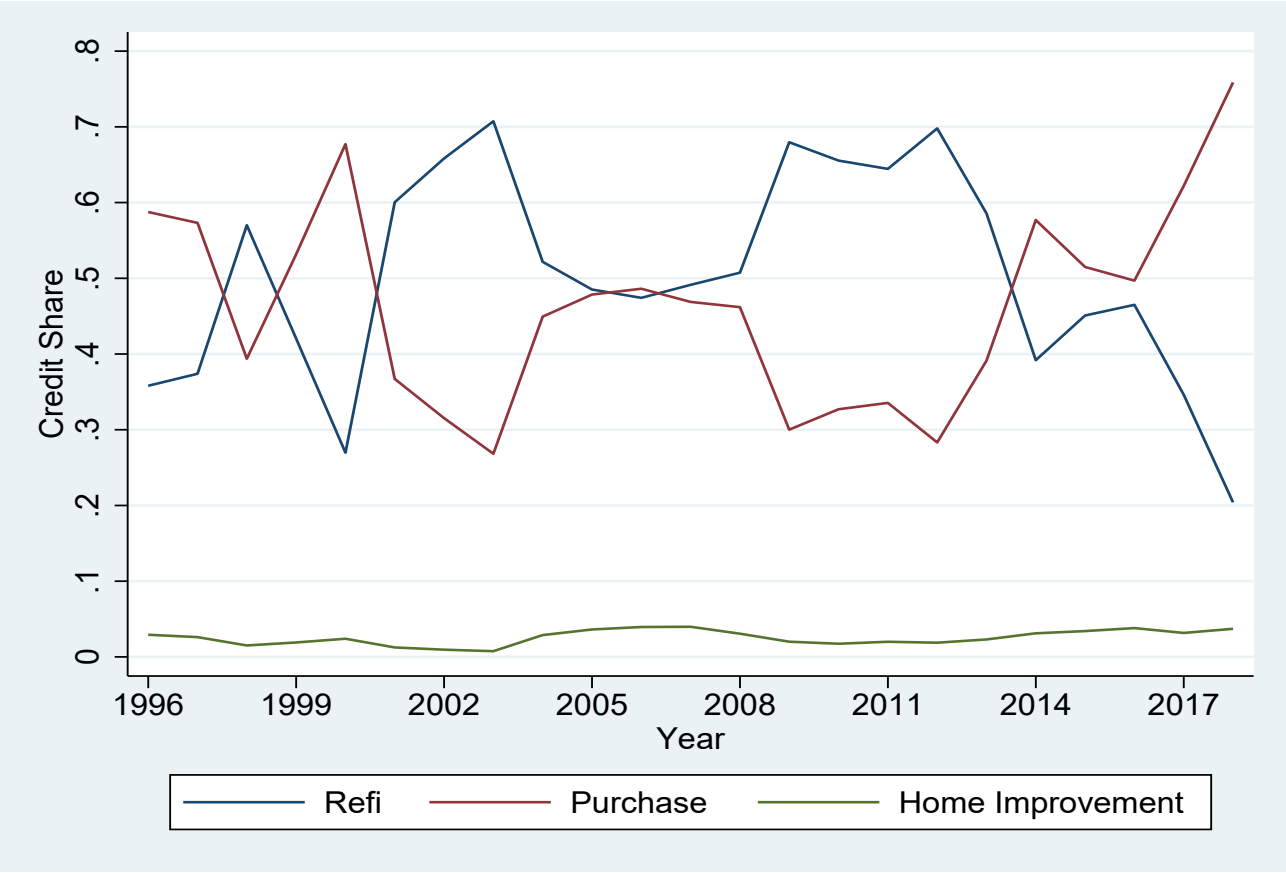

Figure 2: Refinancing and Interest Rate

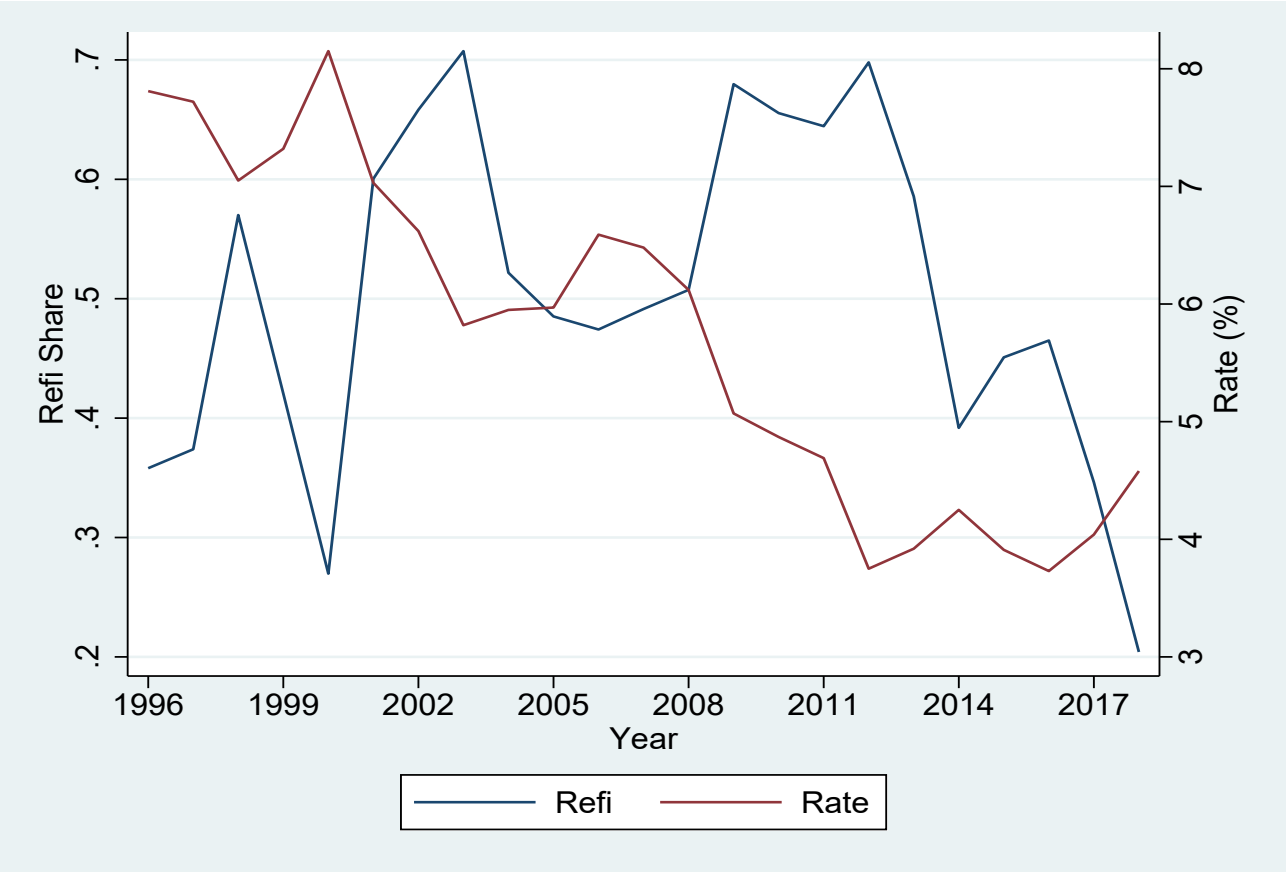

Figure 3: Homeownership Rate

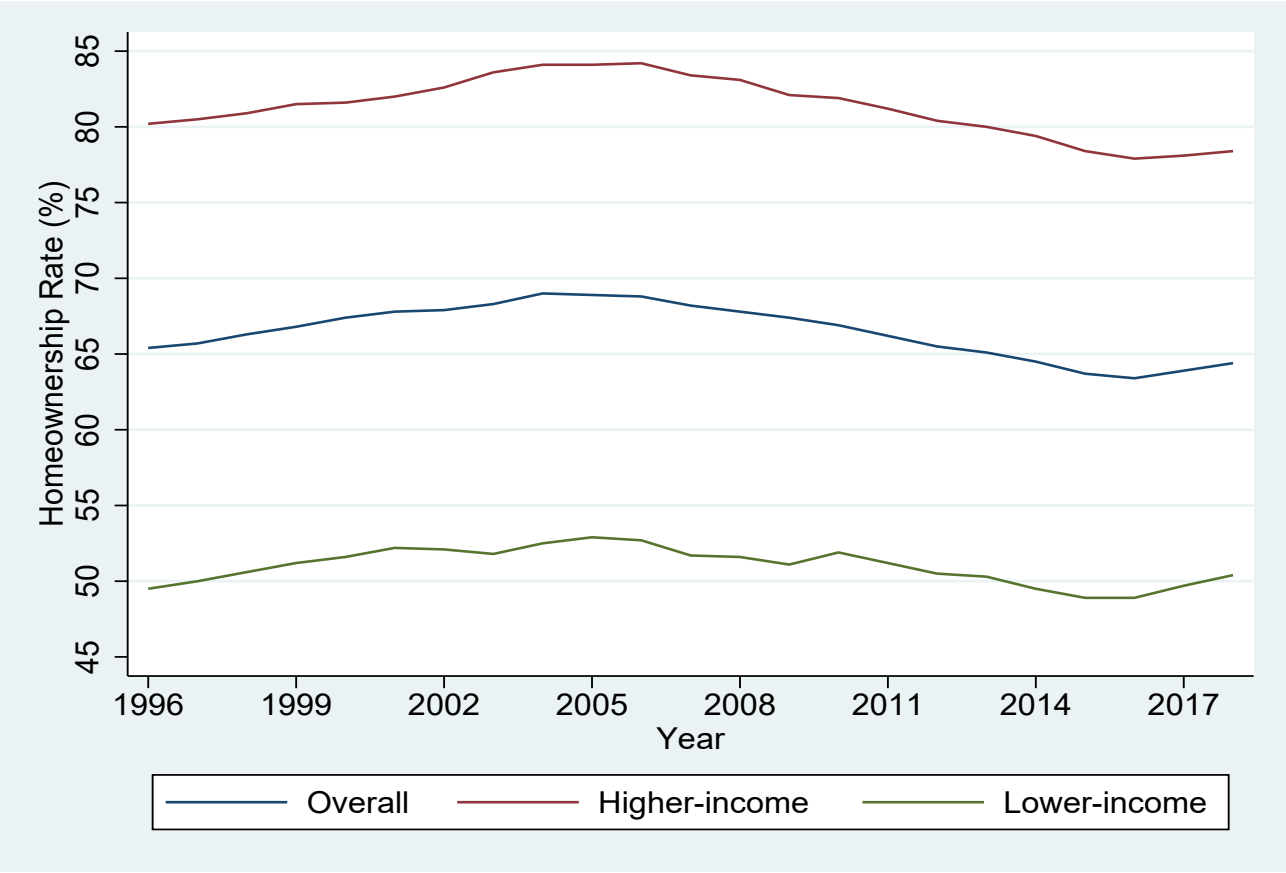

Table 1. Variable names, definitions, statistics and data sources

Name		Definition	Mean	St. Dev.	Minimum	Median	Maximum	Source
Refinancing	Log(Amount)	The (logarithm of the) total dollar value of newly originated mortgage credit.	10.67	1.92	0.69	10.47	17.72	HMDA
	Number	The number of loans newly originated.	5.95	1.71	0	5.81	12.20	HMDA
Purchase	Log(Amount)	The (logarithm of the) total dollar value of newly originated mortgage credit.	10.27	1.96	2.48	10.03	17.03	HMDA
	Number	The number of loans newly originated.	5.54	1.70	0	5.37	11.65	HMDA
Home Improvement	Log(Amount)	The (logarithm of the) total dollar value of newly originated mortgage credit.	7.87	1.80	0	7.75	14.63	HMDA
	Number	The number of loans newly originated.	4.24	1.57	0	4.16	9.54	HMDA
Δ Interest Rate		Interest rate data come from the FHFA'S monthly interest rate survey (MIRS). MIRS provides information on a monthly basis on mortgage rates, which are reported by various lenders such as savings associations, mortgage companies, commercial banks and savings banks. We take annual average of monthly fixed-rate mortgage rates in order to construct our annual measure of mortgage rate. We employ the change in annual rate, Rate(t) - Rate(t-1), in our regressions.	-0.19	0.50	-1.12	-0.18	0.83	MIRS
Log(Median Family Income) in Tract		We make use of the HUD's estimated MFI(Tract)/MFI(MSA) ratio and MFI(MSA) to extrapolate annual estimates of tract MFI. We employ logs of estimated Tract MFI in our regressions.	3.94	0.34	1.93	3.93	5.60	HUD, CRA, HMDA
Average (Refinancing Fee / Loan Amount) in Tract		MIRS also provides information on a monthly basis on lending fees and charges. We take annual average of the lending fees and charges to construct our annual measure of lending fees and charges. We employ the ratio of (Fees and Charges) in bps to logs of (Avg. Tract Loan Size) in our regressions.	16.08	6.73	5.02	16.84	54.82	MIRS, HMDA
Δ House Price Index in County		100*(HPI(t) – HPI(t-1))/ HPI(t-1), where HPI is county-level house price index.	2.68	5.58	-44.72	2.66	56.12	FHFA
Δ Expected House Price Index in County		100*(HPI(t+1) – HPI(t))/ HPI(t), where HPI is county-level house price index.	2.73	5.67	-44.72	2.70	56.12	FHFA
Year Fixed Effects		Year Effects.						
Commuting Zone Fixed Effects		A commuting zone is a group of neighboring counties that share the same commuting pattern, capturing local economic conditions.						ERS
Median Family Income in Tract Fixed Effects		Fixed effects for low-income, moderate-income, middle-income, and higher-income census tracts.						CRA, HMDA

CRS = Community Reinvestment Act; ERS = Economic Research Service; FHFA = Federal Housing Finance Agency; HMDA = Home Mortgage Disclosure Act; HUD = Department of Housing and Urban Development; MIRS = Monthly Interest Rate Survey provided by the FHFA.

Table 2. Impact of changes in monetary conditions on mortgage credit origination across tracts between 1996 and 2018.

Sample Period	**1996-2018**								
Type of Mortgage	**Refinancing**			**Purchase**			**Home Improvement**		
Quantity in Tract	Log(Amount)		Number	Log(Amount)		Number	Log(Amount)		Number
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ Interest Rate * Log(Median Family Income) in Tract	-0.460***	-0.423***	-0.384***	-0.215***	-0.168***	-0.121***	-0.070***	-0.028	0.075***
	(0.024)	(0.023)	(0.023)	(0.025)	(0.023)	(0.022)	(0.024)	(0.023)	(0.021)
Log(Median Family Income) in Tract	1.483***	2.277***	2.123***	1.709***	2.630***	2.271***	1.373***	2.232***	1.945***
	(0.059)	(0.089)	(0.088)	(0.060)	(0.087)	(0.082)	(0.053)	(0.081)	(0.077)
Average (Refinancing Fee / Loan Amount) in Tract	-0.424***	-0.400***	-0.211***	-0.395***	-0.365***	-0.238***	-0.256***	-0.229***	-0.111***
	(0.016)	(0.015)	(0.013)	(0.021)	(0.019)	(0.015)	(0.016)	(0.015)	(0.012)
Δ House Price Index in County	0.011***	0.012***	0.009***	0.018***	0.018***	0.014***	0.018***	0.019***	0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commuting Zone Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Median Family Income in Tract Fixed Effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
R2	0.693	0.703	0.648	0.66	0.674	0.625	0.609	0.622	0.595
Number of Observations	61,238	61,238	61,238	61,125	61,125	61,125	60,850	60,850	60,850
The impact of a Δ Interest Rate = -50 basis points ≅ - 1 St. Dev.									
on Low-Income Median Family Income (Mean - 1 St. Dev.), in % of Mean Dependent Variable	*7.8%*	*7.1%*	*11.6%*	*3.8%*	*2.9%*	*3.9%*	*-1.6%*	*0.6%*	*-3.2%*
on High-Income Median Family Income (Mean + 1 St. Dev.), in % of Mean Dependent Variable	*9.2%*	*8.5%*	*13.8%*	*4.5%*	*3.5%*	*4.7%*	*-1.9%*	*0.8%*	*-3.8%*

The table reports cross-tract regression estimates of the amount and number of newly originated refinancing, purchase and home improvement mortgages on the indicated variables and fixed effects. All variables are defined in Table 1. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1

Table 3. Impact of changes in monetary conditions on mortgage credit origination across tracts in the pre-crisis, crisis, and post-crisis periods.

Sample Period	**1998-2006**	**2007-2011**	**2012-2018**	**1998-2006**	**2007-2011**	**2012-2018**	**1998-2006**	**2007-2011**	**2012-2018**
Crisis Period Label	**Pre-**	**During**	**Post-**	**Pre-**	**During**	**Post-**	**Pre-**	**During**	**Post-**
Type of Mortgage	**Refinancing**			**Purchase**			**Home Improvement**		
Quantity in Tract	Log(Amount)			Log(Amount)			Log(Amount)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ Interest Rate * Log(Median Family Income) in Tract	-0.270***	-0.406***	-0.512***	-0.035	-0.241***	-0.247***	0.124***	-0.178***	-0.134***
	(0.029)	(0.063)	(0.047)	(0.030)	(0.065)	(0.046)	(0.030)	(0.069)	(0.048)
Log(Median Family Income) in Tract	2.684***	2.140***	1.607***	2.992***	2.374***	1.999***	2.606***	1.951***	1.652***
	(0.119)	(0.119)	(0.136)	(0.135)	(0.123)	(0.109)	(0.104)	(0.113)	(0.111)
Average (Refinancing Fee / Loan Amount) in Tract	-0.447***	-0.817***	-0.475***	-0.457***	-0.796***	-0.422***	-0.222***	-0.508***	-0.310***
	(0.064)	(0.027)	(0.014)	(0.088)	(0.031)	(0.017)	(0.042)	(0.028)	(0.016)
Δ House Price Index in County	0.018***	0.002	0.005***	0.024***	-0.002	0.012***	0.029***	0.006***	0.013***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commuting Zone Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Median Family Income in Tract Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.717	0.742	0.714	0.705	0.728	0.667	0.674	0.665	0.611
Number of Observations	23,780	14,300	18,681	23,754	14,277	18,648	23,699	14,236	18,509
The impact of a Δ Interest Rate = -50 basis points									
on Low-Income Median Family Income (Mean - 1 St. Dev.), in % of Mean Dependent Variable	*4.4%*	*6.9%*	*9.3%*	*0.6%*	*4.4%*	*4.5%*	*-2.8%*	*4.1%*	*3.2%*
on High-Income Median Family Income (Mean + 1 St. Dev.), in % of Mean Dependent Variable	*5.2%*	*8.1%*	*10.9%*	*0.7%*	*5.2%*	*5.3%*	*-3.3%*	*4.8%*	*3.7%*

The table reports cross-tract regression estimates of the amount of newly originated refinancing, purchase and home improvement mortgages on the indicated variables and fixed effects. All variables are defined in Table 1. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1

Table 4. Impact of changes in monetary conditions on mortgage credit origination across tracts in the whole and pre-crisis period for counties with positive or negative house price index growth.

Sample Period	**1996-2018**	**1998-2006**	**1996-2018**	**1998-2006**	**1996-2018**	**1998-2006**	**1996-2018**	**1998-2006**	**1996-2018**	**1998-2006**	**1996-2018**	**1998-2006**
Crisis Period Label	**Whole**	**Pre-**	**Whole**	**Pre-**	**Whole**	**Pre-**	**Whole**	**Pre-**	**Whole**	**Pre-**	**Whole**	**Pre-**
Type of Mortgage	**Refinancing**				**Purchase**				**Home Improvement**			
Quantity in Tract	Log(Amount)				Log(Amount)				Log(Amount)			
Δ House Price Index in County	*>= 0*		*< 0*		*>= 0*		*< 0*		*>= 0*		*< 0*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Δ Interest Rate * Log(Median Family Income) in Tract	-0.382***	-0.243***	-0.502***	-0.378*	-0.151***	-0.013	-0.307***	-0.034	0.005	0.140***	-0.252***	0.009
	(0.029)	(0.030)	(0.062)	(0.222)	(0.028)	(0.031)	(0.058)	(0.236)	(0.028)	(0.031)	(0.059)	(0.265)
Log(Median Family Income) in Tract	2.315***	2.659***	2.037***	1.581***	2.680***	2.966***	2.279***	1.874***	2.279***	2.595***	1.873***	1.495***
	(0.092)	(0.123)	(0.105)	(0.296)	(0.090)	(0.141)	(0.106)	(0.330)	(0.084)	(0.107)	(0.099)	(0.308)
Average (Refinancing Fee / Loan Amount) in Tract	-0.375***	-0.454***	-0.456***	-0.254***	-0.344***	-0.466***	-0.404***	-0.234***	-0.220***	-0.231***	-0.217***	0.007
	(0.017)	(0.070)	(0.018)	(0.071)	(0.022)	(0.096)	(0.019)	(0.073)	(0.017)	(0.047)	(0.017)	(0.072)
Δ House Price Index in County	-0.006***	0.007***	0.042***	0.085***	-0.004*	0.011***	0.043***	0.095***	-0.000	0.020***	0.044***	0.083***
	(0.002)	(0.002)	(0.003)	(0.012)	(0.002)	(0.002)	(0.003)	(0.012)	(0.002)	(0.002)	(0.003)	(0.014)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commuting Zone Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Median Family Income in Tract Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.691	0.708	0.761	0.81	0.666	0.696	0.707	0.789	0.619	0.666	0.666	0.755
Number of Observations	45,066	22,291	16,172	1,489	44,984	22,267	16,141	1,487	44,789	22,214	16,061	1,485
The impact of a Δ Interest Rate = -50 basis points												
on Low-Income Median Family Income (Mean - 1 St. Dev.), in % of Mean Dependent Variable	*6.4%*	*3.9%*	*8.5%*	*6.1%*	*2.6%*	*0.2%*	*5.4%*	*0.6%*	*-0.1%*	*-3.2%*	*5.8%*	*-0.2%*
on High-Income Median Family Income (Mean + 1 St. Dev.), in % of Mean Dependent Variable	*7.7%*	*4.6%*	*10.1%*	*7.2%*	*3.1%*	*0.3%*	*10.5%*	*0.7%*	*-0.1%*	*-3.8%*	*6.9%*	*-0.2%*

The table reports cross-tract regression estimates of the amount of newly originated refinancing, purchase and home improvement mortgages on the indicated variables and fixed effects. All variables are defined in Table 1. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1

Table 5. Impact of changes in monetary conditions on mortgage credit origination across tracts in the whole and pre-crisis period for counties with positive or negative expected house price index growth

Sample Period	**1996-2018**	**1998-2006**	**1996-2018**	**1998-2006**	**1996-2018**	**1998-2006**	**1996-2018**	**1998-2006**	**1996-2018**	**1998-2006**	**1996-2018**	**1998-2006**
Crisis Period Label	**Whole**	**Pre-**	**Whole**	**Pre-**	**Whole**	**Pre-**	**Whole**	**Pre-**	**Whole**	**Pre-**	**Whole**	**Pre-**
Type of Mortgage	**Refinancing**				**Purchase**				**Home Improvement**			
Quantity in Tract	Log(Amount)				Log(Amount)				Log(Amount)			
Δ Expected House Price Index in County	*>= 0*		*< 0*		*>= 0*		*< 0*		*>= 0*		*< 0*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Δ Interest Rate * Log(Median Family Income) in Tract	-0.411***	-0.360***	-0.224***	0.224	-0.139***	-0.079**	-0.093	0.288	-0.047*	0.037	-0.019	0.336
	(0.027)	(0.031)	(0.062)	(0.269)	(0.027)	(0.031)	(0.062)	(0.259)	(0.027)	(0.031)	(0.060)	(0.265)
Log(Median Family Income) in Tract	2.307***	2.663***	2.222***	2.201***	2.680***	3.001***	2.445***	2.246***	2.305***	2.613***	1.943***	1.764***
	(0.097)	(0.121)	(0.115)	(0.283)	(0.092)	(0.140)	(0.117)	(0.280)	(0.086)	(0.107)	(0.105)	(0.280)
Average (Refinancing Fee / Loan Amount) in Tract	-0.389***	-0.449***	-0.476***	-0.475***	-0.356***	-0.458***	-0.419***	-0.431***	-0.221***	-0.233***	-0.240***	-0.157**
	(0.018)	(0.068)	(0.017)	(0.066)	(0.024)	(0.093)	(0.020)	(0.067)	(0.017)	(0.046)	(0.018)	(0.072)
Δ Expected House Price Index in County	-0.013***	-0.011***	0.027***	0.062***	-0.006***	0.001	0.039***	0.070***	-0.013***	-0.006***	0.030***	0.046***
	(0.002)	(0.002)	(0.003)	(0.013)	(0.002)	(0.002)	(0.003)	(0.013)	(0.002)	(0.002)	(0.004)	(0.014)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commuting Zone Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Median Family Income in Tract Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.688	0.711	0.756	0.849	0.665	0.697	0.726	0.86	0.615	0.661	0.69	0.856
Number of Observations	43,839	22,412	15,993	1,939	43,745	22,387	15,971	1,938	43,566	22,340	15,894	1,926
The impact of a Δ Interest Rate = -50 basis points												
on Low-Income Median Family Income (Mean - 1 St. Dev.), in % of Mean Dependent Variable	*6.9%*	*5.9%*	*3.8%*	*-3.6%*	*2.4%*	*1.3%*	*1.6%*	*-4.9%*	*1.1%*	*-8.5%*	*0.4%*	*-7.7%*
on High-Income Median Family Income (Mean + 1 St. Dev.), in % of Mean Dependent Variable	*8.2%*	*6.9%*	*4.5%*	*-4.3%*	*2.9%*	*1.6%*	*1.9%*	*-5.7%*	*1.3%*	*-10.1%*	*0.5%*	*-9.2%*

The table reports cross-tract regression estimates of the amount of newly originated refinancing, purchase and home improvement mortgages on the indicated variables and fixed effects. All variables are defined in Table 1. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1

Table 6. Impact of changes in monetary conditions on mortgage credit origination across tracts in the pre-crisis period for mortgages that are left unsold or that are sold.

Sample Period	**1998-2006**					
Crisis Period Label	**Pre-Crisis**					
Type of Mortgage	**Refinancing**		**Purchase**		**Home Improvement**	
Quantity in Tract	Log(Amount)		Log(Amount)		Log(Amount)	
Characteristic of Mortgage	*Unsold*	*Sold*	*Unsold*	*Sold*	*Unsold*	*Sold*
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Interest Rate * Log(Median Family Income) in Tract	-0.251***	-0.250***	0.007	-0.071**	0.085***	-0.123***
	(0.029)	(0.030)	(0.030)	(0.032)	(0.029)	(0.030)
Log(Median Family Income) in Tract	2.600***	2.622***	2.847***	3.047***	2.554***	2.849***
	(0.111)	(0.100)	(0.131)	(0.137)	(0.106)	(0.130)
Average (Refinancing Fee / Loan Amount) in Tract	-0.386***	-0.581***	-0.444***	-0.484***	-0.240***	-0.444***
	(0.056)	(0.025)	(0.085)	(0.088)	(0.046)	(0.079)
Δ House Price Index in County	0.016***	0.019***	0.024***	0.023***	0.023***	0.021***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Commuting Zone Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Median Family Income in Tract Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.704	0.736	0.707	0.707	0.657	0.707
Number of Observations	23,750	23,746	23,716	23,726	23,687	23,780
The impact of a Δ Interest Rate = -50 basis points						
on Low-Income Median Family Income (Mean - 1 St. Dev.), in % of Mean Dependent Variable	*4.1%*	*4.1%*	*-0.1%*	*1.2%*	*-1.9%*	*2.8%*
on High-Income Median Family Income (Mean + 1 St. Dev.), in % of Mean Dependent Variable	*4.8%*	*4.8%*	*-0.1%*	*1.4%*	*-2.3%*	*3.3%*

The table reports cross-tract regression estimates of the amount of newly originated refinancing, purchase and home improvement mortgages on the indicated variables and fixed effects. All variables are defined in Table 1. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1