

Home Price Growth and Minority Access to Mortgage Credit

Abstract

This paper examines the relationship between home price growth and mortgage lending standards for minority applicants during the 2001-2006 (pre-crisis) and 2012-2017 (post-crisis) periods. Using the housing supply elasticity measure by Saiz (2010) to instrument for home price growth, I find that minorities in metropolitan areas with home price appreciation experienced looser mortgage lending standards during the pre-crisis period but tighter lending standards during the post-crisis years. Moreover, there was a greater increase in minority loan acceptance rate relative to non-minority loan acceptance rate in these areas during the pre-crisis period. The results suggest that home price appreciation improved minority access to mortgage credit through lower lending standards during the pre-crisis years.

Keywords: home price growth, residential lending standards, minority borrowers, subprime loans, mortgage supply

JEL Classifications: G20, G21

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I. Introduction

Studies have documented how minority borrowers face additional challenges in getting access to mortgage credit compared to non-minority borrowers. Munnell, Browne, McEneaney, and Tootell (1996) show that the loan rejection rate of minority applicants is higher than White applicants of similar creditworthiness. Ross and Tootell (2004) find that applications in minority neighborhoods have lower probability of being accepted, irrespective of the race of the applicant. Similarly, Bartlett, Morse, Stanton, and Wallace (2019) argue that discrimination can explain 0.74 to 1.3 million rejected minority applications between 2009 and 2015. They also find evidence that minorities face higher interest rates for home purchase loans than non-minorities.¹

Higher interest rates and underwriting standards for minority groups can adversely affect their homeownership rate (Quercia, McCarthy, and Wachter, 2003), which is significantly lower among African-Americans and Hispanics than Whites (Haurin, Herbert, and Rosenthal, 2007).² This paper studies whether home price growth (HPG) benefits minority borrowers by increasing their access to mortgage credit. I categorize African-American and Hispanic borrowers as minority and Non-Hispanic White borrowers as non-minority.

The housing boom before the financial crisis led to massive increase in mortgage originations. Several papers have documented lax bank lending standards during this period. For example,

¹ Bartlett, Morse, Stanton, and Wallace (2019) suggest that lenders may charge higher rates to minority borrowers because they are less likely to shop for better rates or that interest rates in areas with a higher percentage of minority applicants are less-competitive. According to Bayer, Ferreira, and Ross (2018), between 2004 and 2007, the probability of African-American and Hispanic borrowers of being in a high-cost home purchase loan were 103% and 78% higher, respectively, than other borrowers of similar creditworthiness. Furthermore, Bocian, Ernst, and Li (2008) find that African-American and Latino borrowers have a higher probability of being in a high-rate subprime mortgage loan compared to White borrowers of similar credit risk.

² Bhutta and Hizmo (2019) do not find evidence of discrimination in mortgage lending. They argue that the higher interest rates paid by African-American and Hispanic borrowers are offset by lower upfront mortgage costs. Their results suggest that minority borrowers pay higher interest rates not due to discrimination but due to a higher preference for loans with lower upfront costs. Courchane (2007) show that up to 90% of the APR gap of African-Americans and 85% of the APR gap of Hispanics can be explained by observable differences in various mortgage pricing factors. The results indicate that a relatively small percentage of the difference in APR between minority and non-minority borrowers can be explained by discrimination.

Demyanyk and Van Hemert (2011) find evidence that mortgages during this period had lower subprime-prime spread, higher loan-to-value ratios and a greater probability of being originated with low documentation. Expectation of higher home prices encouraged banks to ease lending standards, since it reduces their risk of borrower default. I examine whether home price growth during the 2001-2006 (pre-crisis) and 2012-2017 (post-crisis) periods increased minority access to mortgage credit through lower lending standards.³ Focusing on both the pre-crisis and post-crisis years allow me to study if the relationship between home price growth and minority lending standards is similar during these two periods. I use the Saiz (2010) housing supply elasticity measure to instrument for home price appreciation.⁴

My results show that minority lending standards during the pre-crisis period were looser in MSAs (Metropolitan Statistical Areas) that experienced home price appreciation, suggesting that home price growth improved access to mortgage credit for minority borrowers. However, during the post-crisis period, home price appreciation is associated with tighter lending standards for minority borrowers, indicating that banks became more conservative after the financial crisis. I measure lending standards using loan acceptance rate, which is the ratio of accepted loans to the total number of loan applications in an MSA. Lending standards post-crisis may have been tighter due to the expectation of another decline in the housing market since fall in home prices can increase the risk of borrower default (Ding, Quercia, and Ratcliffe, 2010; Agarwal, Ambrose, Chomsisengphet, and Sanders, 2012).⁵

³ Previous studies show that bank lending decisions are negatively affected by local factors such as natural disasters and environmental contamination (Jackson, 2001; Duanmu et al., in press; Xu and Xu, 2020); these events can adversely affect the local economy and home prices, increasing the risk of borrower default.

⁴ Mian and Sufi (2009, 2011, and 2014), Adelino, Schoar, and Severino (2015), Brown, Stein, and Zafar (2015), Bhutta and Keys (2016), Stroebel and Vavra (2019), and Li and Tahsin (2021) also use the MSA housing supply elasticity measure to instrument for home price appreciation.

⁵ The decline in home prices played a major role in the high mortgage default rates during the financial crisis (Capozza and Van Order, 2011; Kau, Keenan, Lyubimov, and Slawson, 2011). Borrowers are more likely to default when their home equity values become negative (Jackson and Kasserian, 1980; Foster and Van Order, 1984; Kau, Keenan and Kim, 1994).

Moreover, experience of banks during the recession and new underwriting regulations of the Consumer Financial Protection Bureau (CFPB) have contributed to tighter lending standards.

The Housing Finance Policy Center's credit availability index (HCAI) also shows that loans originated during the post-crisis years had lower default risk compared to the ones originated during the pre-crisis years; the average expected default risk for owner-occupied home purchase loans were 14.2% during 2001-2006 and 5.7% during 2012-2017. The results are consistent with Li and Tahsin (2021), who show that home price growth is associated with higher loan acceptance rate during the pre-crisis period but lower acceptance rate during the post-crisis years. Unlike Li and Tahsin (2021), this paper specifically studies the relationship between home price growth and lending standards of minority borrowers; it also examines the relationship between home price appreciation and the lending standards of minority applicants relative to non-minority applicants.

To study whether home price growth affects the lending standards of subprime loans differently than prime loans, I regress minority loan acceptance rate on home price appreciation from 2001-2006, separately, for subprime and prime loans.⁶ I classify subprime and prime loans using the HUD Subprime and Manufactured Home Lender List.⁷ This specification is run only for the pre-crisis period since the HUD Lender List is not available in later years. I expect a stronger impact of HPG on the lending standards of subprime mortgages since subprime lenders are more likely to originate riskier loans and higher home prices reduce their risk of borrower default. The results show that home price appreciation is associated with higher minority loan acceptance rates for both prime and subprime loans; however, the effect is stronger among subprime mortgages.

⁶ Subprime borrowers usually have lower credit scores than prime borrowers. Furthermore, certain features of subprime mortgages such as prepayment penalties and adjustable rates are associated with higher probability of loan default (Ambrose, LaCour-Little, and Huszar, 2005; Ding et al., 2011; Pennington-Cross and Ho, 2010; Quercia, Stegman, and Davis, 2007).

⁷ For more details about the HUD Lender List, please visit <https://www.huduser.gov/portal/datasets/manu.html>.

Next, I study the relationship between home price growth and minority mortgage supply by regressing minority loan origination growth on home price appreciation. I find that MSAs with home price appreciation experienced an increase in minority loan origination growth during the pre-crisis years, but I do not find any statistically significant relationship during the post-crisis period. A one standard deviation increase in the estimated home price appreciation is associated with a 7.1% increase in loan origination growth, which explains about 22.9% of its standard deviation between 2001 and 2006.

Finally, I examine the relationship between home price appreciation and the lending standards of minority applicants compared to non-minority applicants, using the ratio of minority loan acceptance rate to non-minority loan acceptance rate (minority acceptance ratio) as the dependent variable. After controlling for borrower characteristics and local economic factors, I find that MSAs with home price appreciation experienced an increase in minority acceptance ratio from 2001-2006, indicating that there was a greater increase in minority loan acceptance rate compared to non-minority acceptance rate in these locations. Home price appreciation, which increased the incentive of lenders to originate riskier loans, may have contributed to a bigger increase in the loan acceptance rate of minorities, since they had a higher percentage of subprime applications. My results show that a one standard deviation increase in the estimated home price growth is associated with a 1.4% increase in the minority acceptance ratio, which explains about 22.4% of its standard deviation from 2001-2006. On the other hand, I do not find any statistically significant relationship between home price appreciation and minority acceptance ratio from 2012-2017.

This paper contributes to the literature by showing that home price growth is associated with looser minority lending standards from 2001-2006, but tighter minority lending standards from 2012-2017. Minority access to mortgage credit improved in MSAs with home price growth during the housing boom years, but had the opposite relationship during the post-crisis years. My results show a

positive relationship between home price growth and minority loan acceptance rates for both prime and subprime mortgages. Moreover, they show that minority acceptance ratio increased in MSAs with home price appreciation from 2001-2006, indicating that there was a bigger increase in minority loan acceptance rate compared to non-minority loan acceptance rate in these locations. Overall, the results add to our understanding of the relationship between home price growth and minority access to mortgage credit during the pre-crisis and post-crisis years.

The remaining paper proceeds as follows. Section 2 presents the definitions and sources of variables. Section 3 discusses the methodology and results. Section 4 concludes.

II. Summary Statistics and Data Sources

This section describes the data and summary statistics. Data for mortgage applications are reported by most financial institutions in the U.S. under the Home Mortgage Disclosure Act (HMDA) and are publicly available at the Federal Financial Institutions Examination Council (FFIEC) website.⁸ In my sample, I include all conventional home purchase loan applications to depository institutions and their affiliates. The data include information such as loan acceptance decision, loan amount requested, and applicant's income, race, ethnicity and geographic location. I only keep applications by African-American, Hispanic and White borrowers, since I define African-Americans and Hispanics as minority and Non-Hispanic Whites as non-minority. I collect MSA-level data for poverty and population from the U.S. Census Bureau and Gross domestic product (GDP) data from the Bureau of Economic Analysis. Unemployment data comes from the Bureau of Labor Statistics and home price data from zillow.com. The loan application data are aggregated at the MSA-level and matched with the relevant economic variables.

⁸ For more information on the HMDA data, please visit <http://www.ffiec.gov/hmda/hmdaproducts.htm>.

Figure 1 presents the trend in average MSA-level loan acceptance rates for minority and non-minority applicants from 2001-2017. Loan acceptance rates for minorities were lower than non-minorities throughout the sample period; both loan acceptance rates increased from 2001-2003, gradually decreased from 2004-2011, and increased again from 2012-2017. Figure 2 presents the median MSA home prices from 2001-2017. There was a significant increase in home prices during the 2001-2006 period, followed by a decline in prices from 2007-2011. Home prices increased again during the 2012-2017 years. This paper focuses on the relationship between minority lending standards and home price appreciation during the 2001-2006 and 2012-2017 periods.

Figure 3 presents the average minority application share at the MSA-level from 2001-2017. The minority share of applications increased slightly from 11.1% in 2001 to 11.9% in 2006. However, during the 2007-2013 period, it went down significantly from 10.9% to 4.2%. Then, it recovered from 4.6% in 2014 to 5.7% in 2017. The minority share of applications was significantly lower during the post-crisis period than the pre-crisis period. Figure 4 shows the average MSA-level ratio of minority to non-minority loan acceptance rates from 2001-2017. The ratio increased from 0.82 in 2001 to 0.88 in 2004. However, during 2005-2008, it went down from 0.86 to 0.81. Then, the ratio increased gradually from 0.82 in 2009 to 0.87 in 2017.

In Panel A of Table 1, I present the summary statistics of loan applications each year from 2001-2006. In my sample, there are a total of 1.3 million minority loan applications compared to 7.95 million non-minority applications. Minority applications increased from 160,796 in 2001 to 290,940 in 2006, reflecting the significant increase in loan demand during the pre-crisis years. Similarly, non-minority applications increased from 1 million in 2001 to 1.5 million in 2006. From 2001-2006, the average minority share of loan applications went up slightly from 11.1% to 11.9%. Furthermore, the average loan-to-income ratio increased from 1.85 to 1.99 for minorities and 1.78 to 1.94 for non-minorities during this period.

In Panel B of Table 1, I show the summary statistics of loan applications each year from 2012-2017. There are a total of 217,105 minority loan applications and 3.2 million non-minority applications in my sample. Both minority and non-minority loan applications were lower during the post-crisis years compared to the pre-crisis years. Minority applications gradually increased from 25,781 in 2012 to 46,631 in 2017. Similarly, non-minority applications increased from 452,291 in 2012 to 558,250 in 2017. The share of minority loan applications was significantly lower during the post-crisis period compared to the pre-crisis period; on average, it was 11.4% during the pre-crisis years, whereas, it went down to 5% during the post-crisis years. Additionally, the average loan-to-income ratio increased from 2.0 to 2.37 for minorities and 2.06 to 2.33 for non-minorities during the 2012-2017 period.

Table 2 presents a detailed list of variables used in this paper including their sources and definitions. Table 3 presents the summary statistics of loan applications aggregated at the MSA-level from 2001-2006 and 2012-2017. After excluding MSAs with missing socioeconomic variables and those with less than 17 minority applications per year, my sample is left with 136 MSAs.⁹ Table 3, Panel A shows the MSA-level variables from 2001 to 2006. During this period, the average minority loan acceptance rate was 76.6% and non-minority loan acceptance rate was 89%. The minority acceptance rates for subprime and prime loans were 61.5% and 78.2%, respectively. The average growth in minority applicant income was 7.4% and non-minority applicant income was 5.3%. Moreover, the average home price growth and unemployment rate were 5.8% and 5.3%, respectively.

Table 3, Panel B shows the MSA-level variables from 2012 to 2017. During this period, the mean loan acceptance rate was 74.3% for minority applicants and 88.4% for non-minority applicants. The average applicant income growth for minority and non-minority applicants were 2.4% and 1.8%, respectively. The average home price growth was lower during the post-crisis period compared to the pre-crisis period; the average growth in home prices was 4.3% during 2012-2017, whereas, it was 5.8%

⁹ Tahsin and Yeager (2019) require counties in their sample to have a minimum of 17 jumbo loan applications each year.

during 2001-2006. Finally, the average unemployment rate was 5.7% during the post-crisis period, compared to 5.3% during the pre-crisis period.

III. Methodology and Results

First, I study the relationship between home price appreciation and minority loan acceptance rate using the following OLS regression model:

$$\begin{aligned} \text{Loan Acceptance}_{m,t} = & \beta_0 + \beta_1(\text{Home Price Appreciation})_{m,t} + \beta_2 \text{Loan Demand}_{m,t} + \\ & \beta_3 \text{Borrower}_{m,t} + \beta_4 \text{Economy}_{m,t} + \varepsilon_{m,t} \end{aligned} \quad (1)$$

I match the loan applications data aggregated at the MSA-level with the relevant economic variables. *Loan Acceptance_{m,t}* refers to loan acceptance rate in MSA *m* and year *t*. *Home Price Appreciation_{m,t}* is the home price growth in MSA *m* between year *t-1* and *t*. I control for mortgage demand using the variable *Loan Demand*, which is the log of total loan applications in an MSA. *Borrower* represents MSA-level applicant characteristics such as log of applicant income, loan-to-income ratio, and applicant income growth between year *t-1* and *t*. *Economy* controls for economic conditions in an MSA; it includes unemployment rate, GDP growth rate between year *t-1* and *t*, the log of household income, poverty rate, and the log of population. The regressions are weighted by MSA population and include year fixed effects. Standard errors are clustered at the year level.

In Table 4, using equation 1, I regress minority loan acceptance rate on home price growth during the pre-crisis and post-crisis periods. My results show that home price appreciation has a positive relationship with minority loan acceptance rate from 2001-2006, indicating that minority access to mortgage credit increased in MSAs with home price growth. On the other hand, I do not find any statistically significant relationship between home price appreciation and minority loan acceptance rate during the 2012-2017 period. A potential limitation of the OLS specification is reverse

causality, since increase in loan acceptance rate can lead to higher credit supply and thus higher home prices.

I address this problem with an instrumental variable specification, where I use the Saiz (2010) housing supply elasticity measure to instrument for home price growth. The elasticity index is based on the land-topology of an MSA; for example, water bodies and elevation of an area can affect its housing supply elasticity. If new housing constructions are difficult due to the land-topology of an MSA, it is given a low elasticity score. An increase in housing demand will have a bigger impact on home prices in these locations, since housing supply is less elastic. The advantage of using the elasticity index as an instrumental variable is that it is correlated with home price growth but does not directly affect loan acceptance rate. In Table 5, I regress home price appreciation on the Saiz (2010) housing supply elasticity measure (inverse) and find that it has a strong positive correlation with home price growth during both the pre-crisis and post-crisis years.¹⁰

There are two potential concerns with the instrumental variable specification. First, MSAs with elastic versus inelastic housing supply may have varying loan demand, which may affect lending standards independent of their home price growth. Since I use loan acceptance rate to measure lending standards, it captures bank lending decisions after taking into account mortgage demand. I also specifically control for loan demand using the log of total applications in an MSA. Second, housing elasticity may affect the type of mortgage applications in a location. If lenders prefer a specific mortgage type, loan acceptance rates may vary across MSAs with elastic versus inelastic housing supply independent of their home price growth. I address this concern by only including conventional home purchase loan applications in my sample.

¹⁰ For ease of interpretation, I use the additive inverse of the Saiz (2010) housing supply elasticity index.

Using the following two-stage specification, I study the relationship between home price appreciation and minority loan acceptance rate:

$$\begin{aligned} \text{Home Price Appreciation}_{m,t} = & \alpha_0 + \alpha_1(\text{Housing Inelasticity})_m + \\ & \alpha_2\text{Loan Demand}_{m,t} + \alpha_3\text{Borrower}_{m,t} + \alpha_4\text{Economy}_{m,t} + \varepsilon_{m,t} \end{aligned} \quad (2)$$

$$\begin{aligned} \text{Loan Acceptance}_{m,t} = & \beta_0 + \beta_1(\text{Home Price Appreciation})_{m,t} + \\ & \beta_2\text{Loan Demand}_{m,t} + \beta_3\text{Borrower}_{m,t} + \beta_4\text{Economy}_{m,t} + \varepsilon_{m,t} \end{aligned} \quad (3)$$

In the first-stage, using Equation (2), I regress *Home Price Appreciation* on *Housing Inelasticity*. *Home Price Appreciation* is the growth in home prices in MSA m between year $t-1$ and t and *Housing Inelasticity* is the additive inverse of the Saiz (2010) housing supply elasticity measure in MSA m . A higher score of *Housing Inelasticity* indicates that an MSA has less flexible housing supply. In the second-stage, using Equation (3), I regress *Loan Acceptance* on the estimated *Home Price Appreciation* from the first-stage. *Loan Acceptance* is the acceptance rate of minority loan applications in MSA m and year t . All the control variables are identical to the ones in Equation (1). The regressions are weighted by MSA population and include year fixed effects.¹¹ Standard errors are clustered at the year level.

Table 5 presents results using the IV specification for the pre-crisis and post-crisis periods. In the first stage, as presented in columns 1 and 3, I regress home price appreciation on the Saiz (2010) housing supply elasticity measure from 2001-2006 and 2012-2017, respectively. As expected, I find that home price appreciation is positively correlated with housing supply elasticity (inverse) during both the sample periods, suggesting that inelastic MSAs experienced higher home price growth. In the second-stage, as presented in columns 2 and 4, I regress minority loan acceptance rate on the estimated home price growth from 2001-2006 and 2012-2017, respectively. The results show that

¹¹ I do not use MSA fixed effects since the housing supply elasticity index is constant across time for MSAs.

minority borrowers in MSAs with home price appreciation experienced looser lending standards during 2001-2006 but tighter lending standards during 2012-2017.

The results are consistent with previous papers that find looser bank lending standards during the pre-crisis years. For example, Duca et al. (2011) show that down payment ratios for first-time homeowners were lower during this period. Similarly, Nadauld and Sherlund (2013) find that mortgage originations during this period had lower rejection rates, higher share of subprime loans, and higher rates of default. Based on my results, an increase of one standard deviation in the estimated home price growth is associated with a 2.1% increase in minority loan acceptance rate, which represents about 29.8% of its standard deviation during 2001-2006. On the other hand, a one standard deviation increase in the estimated home price growth can explain a 6.9% decline in minority loan acceptance rate during 2012-2017.

In Table 6, I examine whether the relationship between home price appreciation and minority loan acceptance rate is different for subprime and prime loans. Since subprime loans have relatively higher risk, I expect home price appreciation to have a bigger impact on their lending standards. During 2001-2006, there is a positive relationship between home price growth and minority loan acceptance rates for both subprime and prime loans; however, the relationship is stronger for subprime mortgages. I run this specification only from 2001 to 2006 since the HUD Lender List, which I use to identify whether a loan is subprime or prime, is not available in later years. The results suggest that home price appreciation increases access to mortgage credit for both subprime and prime borrowers. A one standard deviation increase in the estimated home price growth is associated with a 3.2% and 1.7% increase in subprime and prime loan acceptance rates, respectively.

Table 7 studies the relationship between home price appreciation and loan origination growth of minority applicants. I define loan origination growth as the growth in dollar amount of loans originated at the MSA-level between year $t-1$ and t . Since home price appreciation is associated with

looser lending standards during the pre-crisis years, I expect it to have a positive impact on loan origination growth as well. The results show that MSAs with home price appreciation experienced higher minority loan origination growth during the pre-crisis period, but there was no statistically significant relationship between HPG and minority origination growth during the post-crisis years. My results show that an increase of one standard deviation in the estimated home price appreciation can explain a 7.1% increase in minority loan origination growth, which accounts for 22.9% of its standard deviation during 2001-2006.

In Table 8, I investigate the relationship between home price appreciation and the ratio of minority loan acceptance rate to non-minority loan acceptance rate (minority acceptance ratio). Since minority and non-minority borrower characteristics may be different in certain locations, I separately control for minority and non-minority applicant characteristics in my specification. The results show that minority acceptance ratio was higher in MSAs with home price appreciation during 2001-2006, indicating that minority applicants experienced a higher increase in loan acceptance rate compared to non-minority applicants. Home price growth reduced the risk perception of lenders and encouraged them to originate riskier loans during this period; this may have led to a bigger increase in the loan acceptance rate of minorities, since they had a higher percentage of subprime applications compared to non-minorities.¹² A one standard deviation increase in the estimated home price growth is associated with a 1.4% increase in minority acceptance ratio, which represents about 22.4% of its standard deviation between 2001 and 2006. However, there was no statistically significant relationship between home price appreciation and minority acceptance ratio during the post-crisis years.

In Table 9, I examine whether mortgage securitization affects the relationship between home price appreciation and minority lending standards. Securitization increased the incentive of lenders to

¹² In my sample, the percentage of subprime applications among minorities and non-minorities were 9.2% and 3.6%, respectively.

originate riskier loans and played a major role in the subprime boom (Mian and Sufi, 2009; Keys, Mukherjee, Seru, and Vig, 2010; Dell-Ariccia, Igan, and Laeven, 2012; Nadauld and Sherlund, 2013; Rajan, Seru, and Vig, 2015). I measure the easiness of mortgage securitization in an MSA using the share of loans in an MSA that are sold within a year of origination. In columns 1 and 2, I regress minority loan acceptance rate on the estimated home price appreciation during the pre-crisis and post-crisis periods, respectively. After controlling for loan securitization share in an MSA, the results are still consistent with my main findings. The results show that home price appreciation is associated with easier lending standards during the pre-crisis years but tighter lending standards during the post-crisis years.

Finally, Table 10 examines whether bank competition in an MSA affects the relationship between home price appreciation and minority lending standards. In columns 1 and 2, as a measure of bank competition, I use the log of total number of banks in an MSA. In columns 3 and 4, as a second measure of bank competition, I use the Herfindahl index of market share, using banks' share of accepted mortgages in an MSA. My results show that the inclusion of lender competition measures does not affect the relationship between home price appreciation and minority loan acceptance rates, supporting my main findings in Table 5.

IV. Conclusion

Previous studies show that minority borrowers, compared to non-minority borrowers, face additional hurdles in accessing mortgage credit (Munnell, Browne, McEneaney, and Tootell, 1996; Ross and Tootell, 2004). Minorities also have lower homeownership rate than Whites (Haurin, Herbert, and Rosenthal, 2007). Since lending standards eased significantly during the housing boom years, I examine whether minority access to mortgage credit also increased in MSAs with home price appreciation. My results show that home price growth led to looser lending standards for minority borrowers during the pre-crisis period but tighter lending standards during the post-crisis years.

Experience of banks during the recession, new underwriting rules of the Consumer Financial Protection Bureau (CFPB), and prospects of another fall in the housing market may have contributed to tighter lending standards during the post-crisis period.

I also find that the ratio of minority to non-minority loan acceptance rates increased in MSAs with home price appreciation during the 2001-2006 period, suggesting that there was a larger increase in minority loan acceptance rate compared to non-minority acceptance rate in these locations. Overall, the results add to our understanding of the relationship between home price growth and mortgage lending standards for minority borrowers.

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Figure 1: Loan Acceptance Rates from 2001-2017

This figure plots the average loan acceptance rates for minority and non-minority applicants at the MSA-level from 2001-2017 using the HMDA Data. African-Americans and Hispanics are classified as minority and Non-Hispanic Whites are classified as non-minority.

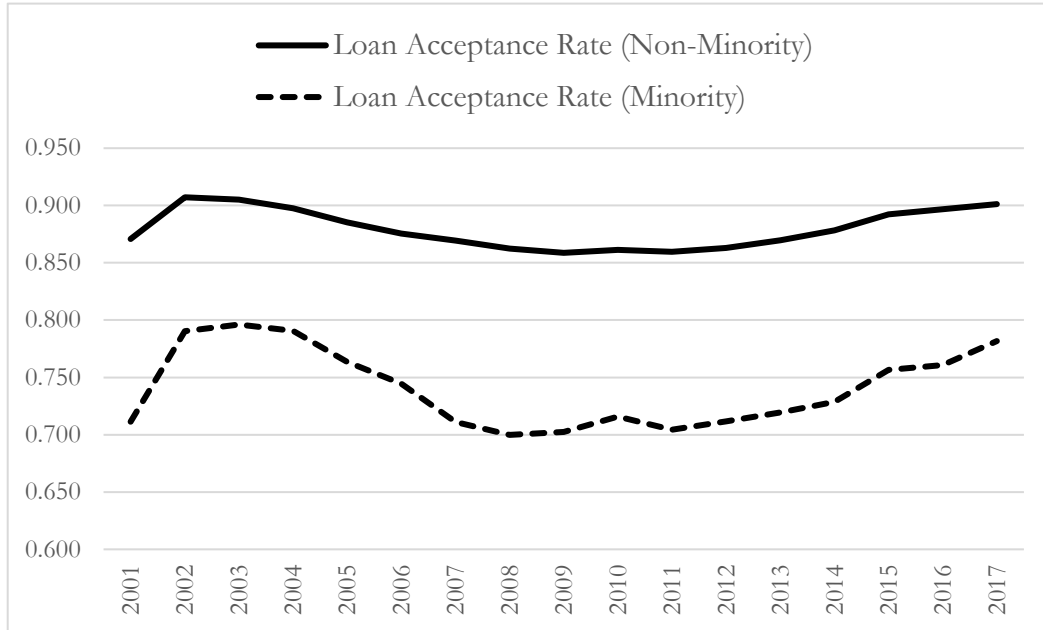


Figure 2: Home Price from 2001-2017

This figure shows the median home price at the MSA-level from 2001-2017. Data are collected from zillow.com.

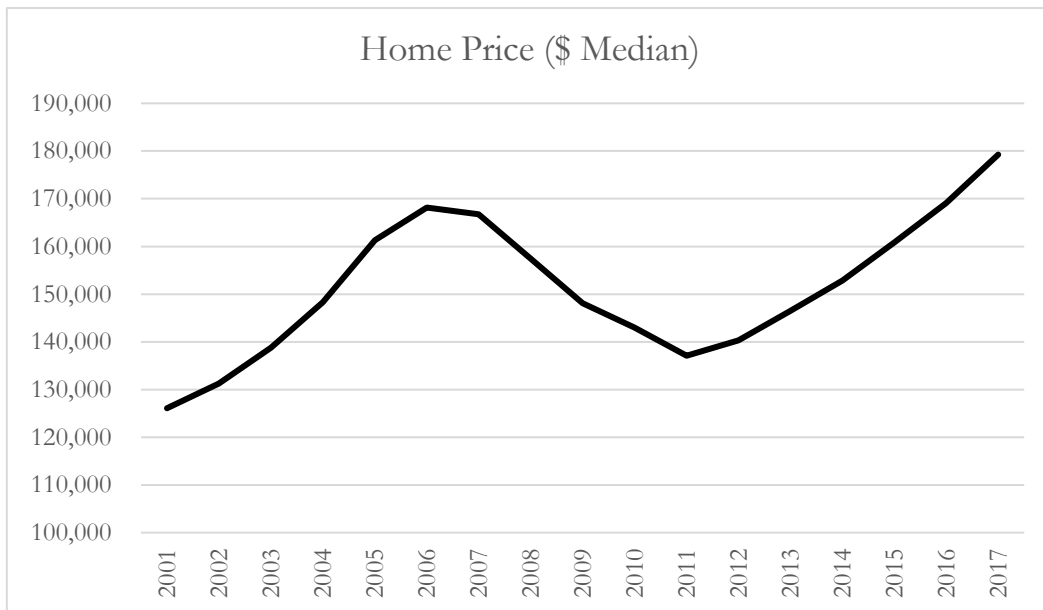


Figure 3: Minority Application Share from 2001-2017

This figure plots the average minority application share at the MSA-level from 2001-2017 using the HMDA data. Minority application share is the ratio of minority to total applications in an MSA.

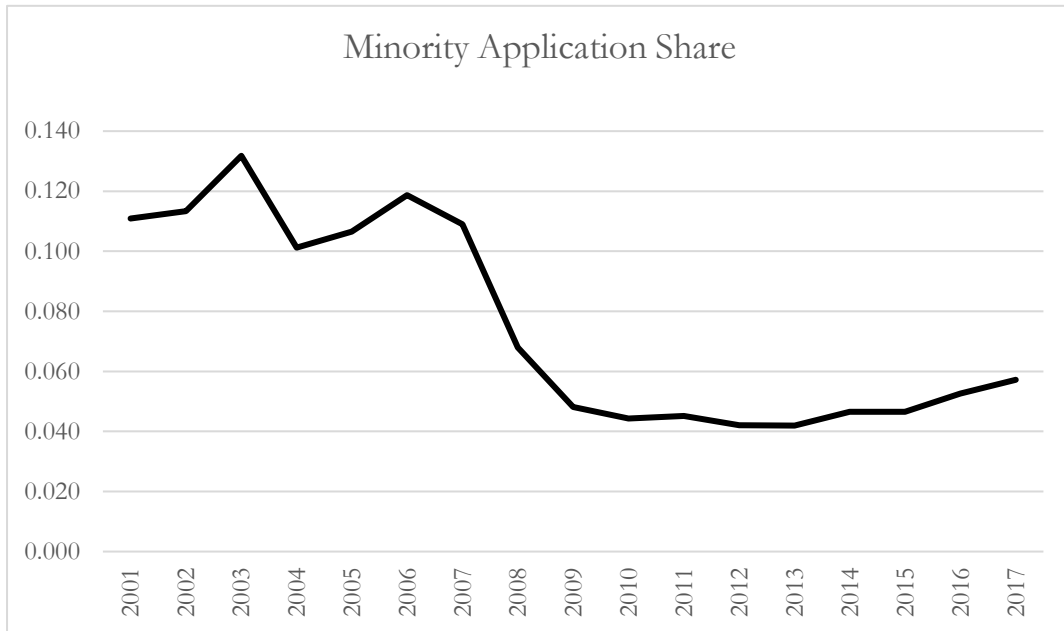


Figure 4: Ratio of Minority to Non-Minority Loan Acceptance Rates from 2001-2017

This figure plots the average MSA-level ratio of minority to non-minority loan acceptance rates from 2001-2017 using the HMDA data. African-Americans and Hispanics are classified as minority and Non-Hispanic Whites are classified as non-minority.

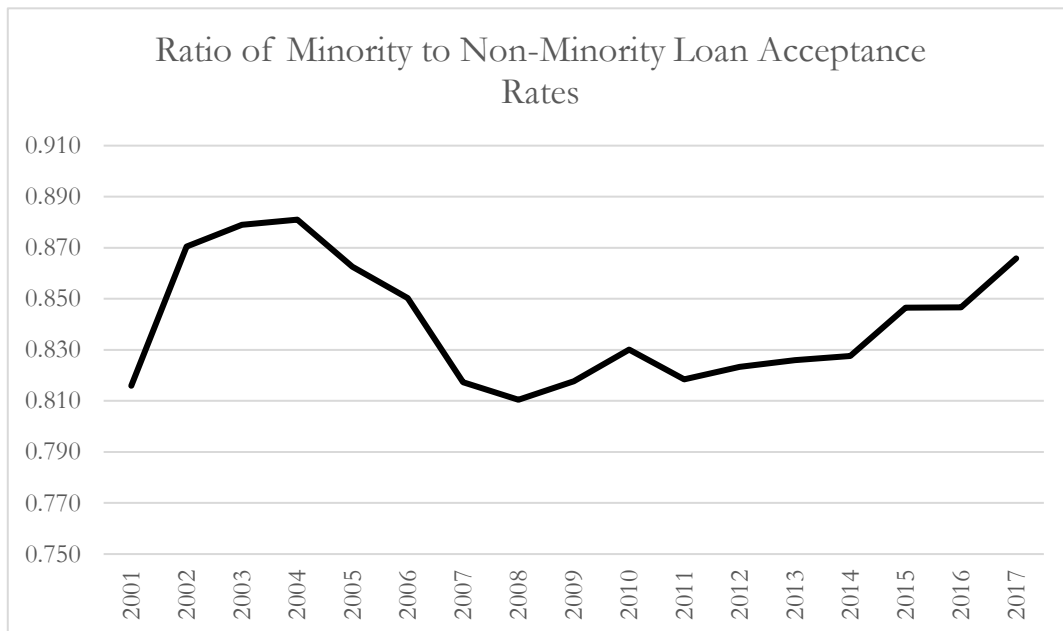


Table 1. Summary Statistics of Loan Applications

This table presents loan applications in my sample from 2001-2006 and 2012-2017. I focus on conventional home purchase loan applications to depository institutions and their affiliates. Home purchase loans are those that are used to purchase a dwelling. Applications with missing economic variables are excluded. I classify African-Americans and Hispanics as minority and Non-Hispanic Whites as non-minority.

Panel A. HMDA Loan Applications between 2001 and 2006

Application Variables	2001	2002	2003	2004	2005	2006
<u>Minority Applicants</u>						
Total minority applications	160,796	176,803	228,472	215,970	270,404	290,940
Loan acceptance rate (mean)	0.71	0.79	0.80	0.79	0.76	0.74
Loan-to-income ratio (mean)	1.85	1.93	2.08	2.10	2.05	1.99
Income of applicants (mean in \$000s)	57	62	63	68	73	81
<u>Non-Minority Applicants</u>						
Total non-minority applications	1,004,621	1,084,355	1,250,038	1,461,930	1,643,688	1,508,690
Loan acceptance rate (mean)	0.87	0.91	0.91	0.90	0.89	0.88
Loan-to-income ratio (mean)	1.78	1.88	1.99	2.03	2.00	1.94
Income of applicants (mean in \$000s)	80	84	86	90	98	107
Minority share of total applications	0.111	0.113	0.132	0.101	0.107	0.119

Panel B. HMDA Loan Applications between 2012 and 2017

	2012	2013	2014	2015	2016	2017
<u>Minority Applicants</u>						
Total minority applications	25,781	31,081	34,260	36,135	43,217	46,631
Loan acceptance rate (mean)	0.71	0.72	0.73	0.76	0.76	0.78
Loan-to-income ratio (mean)	2.00	2.08	2.16	2.19	2.33	2.37
Income of applicants (mean in \$000s)	91	94	90	95	97	103
<u>Non-Minority Applicants</u>						
Total non-minority applications	452,291	542,357	530,982	555,424	571,445	558,250
Loan acceptance rate (mean)	0.86	0.87	0.88	0.89	0.90	0.90
Loan-to-income ratio (mean)	2.06	2.12	2.14	2.20	2.26	2.33
Income of applicants (mean in \$000s)	118	120	121	123	126	132
Minority share of total applications	0.04	0.04	0.05	0.05	0.05	0.06

Table 2. Definitions and Sources of Variables

This table presents definitions and sources of variables used in my sample.

Variable	Definition
Loan Acceptance Rate	Acceptance rate of loan applications aggregated at the MSA-level. HMDA loan data are available at the Federal Financial Institutions Examination Council (FFIEC).
Loan Acceptance Rate - Prime	Acceptance rate of loan applications to prime lenders aggregated at the MSA-level. Prime lenders are those institutions that are not identified as subprime lenders in the HUD Subprime and Manufactured Home Lender List. The HUD list is available at www.huduser.gov .
Loan Acceptance Rate - Subprime	Acceptance rate of loan applications to subprime lenders aggregated at the MSA-level. Subprime lenders are those institutions that are identified as subprime lenders in the HUD Subprime and Manufactured Home Lender List. The HUD list is available at www.huduser.gov .
Loan Origination Growth	Growth in the dollar amount of loans originated at the MSA-level between year $t-1$ and t .
Minority To Non-Minority Loan Acceptance Ratio	The ratio of minority loan acceptance rate to non-minority loan acceptance rate in an MSA.
LTI	Loan-to-income ratio of applicants at the MSA-level using the HMDA loan data.
Log(Applicant Income)	Log of the mean income of loan applicants at the MSA-level using the HMDA loan data.
Applicant Income Growth	Growth in the MSA-level average applicant income between year $t-1$ and t using the HMDA loan data.
Minority Application Share	The ratio of minority to total loan applications in an MSA.
Log(Total Applications)	Log of the total number of loan applications at the MSA-level.
Unemployment Rate	Rate of unemployment at the MSA-level. Unemployment data are collected from the Bureau of Labor Statistics.
GDP Growth Rate	Growth in MSA real gross domestic product (GDP) between year $t-1$ and t . Data are collected from the Bureau of Economic Analysis.
Log(Household Income)	Log of MSA-level median household income. Household Income data are available at the Federal Financial Institutions Examination Council (FFIEC).
Poverty Rate	Proportion of MSA population living below the poverty line. Data are collected from the U.S. Census Bureau.
Home Price Growth	Growth in MSA median home price between year $t-1$ and t . Data are collected from zillow.com .
Saiz Elasticity Index (Inverse)	Saiz (2010)'s housing supply elasticity measure of metropolitan areas based on land-topology. For ease of interpretation, I use the additive inverse of the elasticity index. MSAs with inelastic housing supply are assigned a higher score.
Log(Population)	Log of MSA-level population. Data are collected from the U.S. Census Bureau.

Table 3. Summary Statistics of MSA-Level Variables

This table presents summary statistics of loan applications in my sample aggregated at the MSA-level from 2001-2006 and 2012-2017. I classify African-Americans and Hispanics as minority and Non-Hispanic Whites as non-minority.

Panel A. MSA-Level Variables between 2001 and 2006

Variable	N	Mean	Std. Dev.	Min	Max	Median
Minority Loan Acceptance Rate	816	0.766	0.069	0.459	0.910	0.775
Minority Loan Acceptance Rate - Prime	816	0.783	0.066	0.455	0.948	0.791
Minority Loan Acceptance Rate - Subprime	811	0.622	0.169	0.000	1.000	0.643
Minority Loan Origination Growth	816	0.158	0.308	-0.657	1.033	0.149
Non-Minority Loan Acceptance Rate	816	0.890	0.035	0.723	0.964	0.895
Minority to Non-Minority Loan Acceptance Ratio	816	0.860	0.062	0.555	1.020	0.869
Minority LTI	816	2.000	0.338	1.086	3.356	1.973
Log(Minority Applicant Income)	816	4.177	0.255	3.491	5.187	4.148
Minority Applicant Income Growth	816	0.074	0.112	-0.225	0.356	0.061
Non-Minority LTI	816	1.936	0.310	1.291	3.262	1.923
Log(Non-Minority Applicant Income)	816	4.471	0.261	3.946	5.677	4.419
Non-Minority Applicant Income Growth	816	0.053	0.049	-0.059	0.129	0.052
Minority Application Share	816	0.101	0.081	0.011	0.681	0.077
Log(Total Applications)	816	9.055	1.006	6.223	11.867	8.968
Unemployment Rate	816	0.053	0.014	0.024	0.123	0.051
GDP Growth Rate	816	0.032	0.042	-0.127	0.171	0.028
Log(Household Income)	816	10.914	0.160	10.497	11.566	10.910
Poverty Rate	816	0.125	0.035	0.060	0.281	0.118
Log(Population)	816	13.213	0.885	11.317	15.511	13.079
Home Price Growth	816	0.058	0.037	-0.055	0.117	0.048
Saiz Elasticity Index (Inverse)	816	-2.421	1.416	-12.148	-0.673	-2.113

Panel B. MSA-Level Variables between 2012 and 2017

Variable	N	Mean	Std. Dev.	Min	Max	Median
Minority Loan Acceptance Rate	816	0.743	0.097	0.278	1.000	0.753
Minority Loan Origination Growth	816	0.218	0.320	-0.653	1.033	0.196
Non-Minority Loan Acceptance Rate	816	0.884	0.042	0.725	0.970	0.890
Minority to Non-Minority Loan Acceptance Ratio	816	0.839	0.090	0.355	1.099	0.851
Minority LTI	816	2.189	0.515	1.080	3.854	2.094
Log(Minority Applicant Income)	816	4.505	0.291	3.821	6.742	4.467
Minority Applicant Income Growth	816	0.024	0.168	-0.225	0.356	0.008
Non-Minority LTI	816	2.184	0.391	1.300	3.344	2.109
Log(Non-Minority Applicant Income)	816	4.777	0.263	4.156	5.913	4.735
Non-Minority Applicant Income Growth	816	0.018	0.050	-0.059	0.129	0.014
Minority Application Share	816	0.052	0.048	0.007	0.324	0.035
Log(Total Applications)	816	8.149	0.964	5.595	10.548	8.051
Unemployment Rate	816	0.057	0.019	0.022	0.153	0.054
GDP Growth Rate	816	0.018	0.033	-0.127	0.171	0.016
Log(Household Income)	816	11.057	0.156	10.633	11.619	11.054
Poverty Rate	816	0.151	0.036	0.074	0.295	0.146
Log(Population)	816	13.333	0.892	11.418	15.746	13.217
Home Price Growth	816	0.043	0.036	-0.059	0.117	0.039
Saiz Elasticity Index (Inverse)	816	-2.421	1.416	-12.148	-0.673	-2.113

Table 4. Relationship between minority loan acceptance rate and home price appreciation

In this table, I regress minority loan acceptance rate on home price growth at the MSA-level from 2001-2006 and 2012-2017. All regressions are weighted by MSA population and include year fixed effects. Standard errors are clustered by year and presented in parentheses. ***, **, * represent 1%, 5%, and 10% level of significance, respectively.

Variables	Minority Loan Acceptance Rate (OLS) 2001-2006	Minority Loan Acceptance Rate (OLS) 2012-2017
Home Price Growth	0.404*** (0.05)	-0.077 (0.10)
Log(Total Applications)	0.003 (0.01)	0.043*** (0.00)
Minority LTI	-0.000 (0.01)	0.004 (0.01)
Log(Minority Applicant Income)	0.018 (0.01)	0.004 (0.01)
Minority Applicant Income Growth	-0.040 (0.03)	0.010 (0.01)
Minority Application Share	0.007 (0.04)	-0.328*** (0.05)
Unemployment Rate	-0.051 (0.25)	0.900** (0.24)
GDP Growth Rate	0.078** (0.03)	0.049 (0.08)
Log(Household Income)	0.009 (0.02)	0.104** (0.04)
Poverty Level	-0.324 (0.18)	-0.518** (0.15)
Log(Population)	-0.012 (0.01)	-0.045*** (0.01)
Constant	0.707*** (0.16)	-0.191 (0.38)
Year FE	Y	Y
Observations	816	816
R-squared	0.446	0.377
Adjusted R-squared	0.434	0.364

Table 5. Two-stage regressions of minority loan acceptance rate on home price appreciation

This table shows results from two-stage least squares regressions from 2001-2006 and 2012-2017. The first stage, as presented in columns 1 and 3, regresses home price appreciation on the instrumental variable. I use the Saiz housing supply elasticity index (inverse) to instrument for home price growth. The second-stage, as presented in columns 2 and 4, regresses minority loan acceptance rate on the estimated home price growth. All regressions are weighted by MSA population and include year fixed effects. Standard errors are clustered by year and presented in parentheses. ***, **, * represent 1%, 5%, and 10% level of significance, respectively.

Variables	Home Price	Minority Loan	Home Price	Minority Loan
	Growth	Acceptance Rate	Growth	Acceptance Rate
	2001-06	2001-06	2012-17	2012-17
	(1st Stage)	(2nd Stage)	(1st Stage)	(2nd Stage)
Saiz Elasticity Index (Inverse)	0.010*** (0.00)		0.003** (0.00)	
Home Price Growth		0.562*** (0.12)		-1.910** (0.84)
Log(Total Applications)	0.015*** (0.00)	0.001 (0.01)	0.027*** (0.00)	0.086*** (0.02)
Minority LTI	0.010 (0.01)	-0.004 (0.01)	0.019*** (0.00)	0.043*** (0.01)
Log(Minority Applicant Income)	0.028 (0.02)	0.012 (0.01)	0.018 (0.01)	0.035 (0.02)
Minority Applicant Income Growth	0.014 (0.01)	-0.041 (0.03)	-0.002 (0.01)	0.008 (0.02)
Minority Application Share	0.041 (0.02)	0.002 (0.03)	-0.126*** (0.03)	-0.596*** (0.06)
Unemployment Rate	-0.212 (0.13)	-0.026 (0.23)	0.375** (0.12)	1.620*** (0.33)
GDP Growth Rate	0.076 (0.05)	0.067** (0.03)	0.186* (0.09)	0.378* (0.22)
Log(Household Income)	-0.081*** (0.02)	0.026*** (0.01)	-0.028 (0.02)	0.055 (0.07)
Poverty Level	-0.191 (0.11)	-0.281** (0.13)	0.174 (0.11)	-0.235 (0.24)
Log(Population)	-0.018*** (0.00)	-0.009 (0.01)	-0.018*** (0.00)	-0.069*** (0.01)
Constant	0.950*** (0.19)	0.540*** (0.07)	0.184 (0.32)	0.211 (0.79)
Year FE	Y	Y	Y	Y
Observations	816	816	816	816
R-squared	0.361	0.438	0.454	0.380
Adjusted R-squared	0.348	0.427	0.443	0.368

Table 6. Two-stage regressions of prime and subprime loan acceptance rates on home price appreciation from 2001-2006

This table presents results from the second stages of two-stage least squares regressions from 2001-2006. In columns 1 and 2, I regress minority acceptance rate on the instrumented home price growth for subprime and prime loans, respectively; I use the Saiz housing supply elasticity measure (inverse) as the instrumental variable. All regressions are weighted by MSA population and include year fixed effects. Standard errors are clustered by year and presented in parentheses. ***, **, * represent 1%, 5%, and 10% level of significance, respectively.

Variables	Minority Loan Acceptance Rate Subprime	Minority Loan Acceptance Rate Prime
Home Price Growth	0.885*** (0.18)	0.454** (0.21)
Log(Total Applications)	0.011 (0.02)	0.004 (0.01)
Minority LTI	-0.001 (0.01)	-0.004 (0.01)
Log(Minority Applicant Income)	0.022 (0.05)	-0.001 (0.01)
Minority Applicant Income Growth	0.035 (0.04)	-0.036 (0.04)
Minority Application Share	0.174*** (0.06)	0.029 (0.02)
Unemployment Rate	1.026* (0.60)	-0.138 (0.23)
GDP Growth Rate	0.156* (0.08)	0.031 (0.03)
Log(Household Income)	0.056 (0.06)	-0.001 (0.01)
Poverty Level	-0.624* (0.33)	-0.437*** (0.09)
Log(Population)	-0.008 (0.02)	-0.009 (0.01)
Constant	-0.135 (0.54)	0.890*** (0.18)
Year FE	Y	Y
Observations	632	632
R-squared	0.478	0.466
Adjusted R-squared	0.465	0.452

Table 7. Two-stage regressions of minority loan origination growth on home price appreciation

This table presents results from the second stages of two-stage least squares regressions. In columns 1 and 2, I regress minority loan origination growth on the instrumented home price appreciation from 2001-2006 and 2012-2017, respectively; I use the Saiz housing supply elasticity measure (inverse) as the instrumental variable. Loan origination growth is defined as the growth in dollar amount of loans originated at the MSA-level between year $t-1$ and t . All regressions are weighted by MSA population and include year fixed effects. Standard errors are clustered by year and presented in parentheses. ***, **, * represent 1%, 5%, and 10% level of significance, respectively.

Variables	Minority Loan Origination Growth	Minority Loan Origination Growth
	2001-06	2012-17
Home Price Growth	1.926*** (0.42)	2.451 (1.99)
Log(Applications)	0.008 (0.03)	-0.025 (0.07)
Minority LTI	-0.161* (0.10)	-0.003 (0.06)
Log(Minority Applicant Income)	-0.147* (0.08)	-0.140*** (0.05)
Minority Applicant Income Growth	-0.133 (0.16)	0.399*** (0.07)
Minority Application Share	1.103*** (0.20)	0.376 (0.36)
Unemployment Rate	0.077 (1.56)	-1.168 (2.21)
GDP Growth Rate	1.251*** (0.24)	0.783** (0.32)
Log(Household Income)	-0.085 (0.16)	-0.158 (0.11)
Poverty Level	-2.076** (0.95)	-0.932 (0.62)
Log(Population)	0.001 (0.02)	0.008 (0.06)
Constant	1.898 (1.70)	2.664** (1.21)
Year FE	Y	Y
Observations	816	816
R-squared	0.407	0.111
Adjusted R-squared	0.396	0.0937

Table 8. Two-stage regressions of the ratio of minority to non-minority loan acceptance rates on home price appreciation

This table presents results from the second stages of two-stage least squares regressions from 2001-2006 and 2012-2017. In columns 1 and 2, I regress the ratio of minority to non-minority loan acceptance rates in an MSA on the estimated home price appreciation from 2001-2006 and 2012-2017, respectively; I use the Saiz housing supply elasticity measure (inverse) as the instrumental variable. All regressions are weighted by MSA population and include year fixed effects. Standard errors are clustered by year and presented in parentheses. ***, **, * represent 1%, 5%, and 10% level of significance, respectively.

Variables	Minority To Non-Minority Loan Acceptance Rates 2001-2006	Minority To Non-Minority Loan Acceptance Rates 2012-2017
Home Price Growth	0.381** (0.17)	-0.850 (0.93)
Log(Total Applications)	0.001 (0.01)	0.042 (0.03)
Minority LTI	0.032** (0.01)	0.018* (0.01)
Log(Minority Applicant Income)	0.122*** (0.01)	0.062*** (0.02)
Minority Applicant Income Growth	-0.038* (0.02)	-0.025* (0.02)
Non-Minority LTI	-0.013 (0.02)	0.046* (0.03)
Log(Non-Minority Applicant Income)	-0.057*** (0.01)	-0.066*** (0.03)
Non-Minority Applicant Income Growth	-0.101 (0.06)	0.079 (0.07)
Minority Application Share	-0.024 (0.04)	-0.452*** (0.13)
Unemployment Rate	0.252 (0.25)	1.313*** (0.39)
GDP Growth Rate	0.154*** (0.04)	0.159 (0.24)
Log(Household Income)	-0.093*** (0.02)	-0.027 (0.08)
Poverty Level	-0.324** (0.15)	-0.458*** (0.10)
Log(Population)	-0.008 (0.01)	-0.031** (0.02)
Constant	1.671*** (0.22)	1.192 (0.74)
Year FE	Y	Y
Observations	816	816
R-squared	0.433	0.169
Adjusted R-squared	0.420	0.149

Table 9. Two-stage regressions of minority loan acceptance rate on home price appreciation after controlling for loan securitization share

This table examines how mortgage securitization impacts the relationship between home price appreciation and minority lending standards. I control for the easiness of loan securitization in an MSA using a variable for the share of loans in an MSA that are sold within a year of origination. In columns 1 and 2, I regress minority loan acceptance rate on the estimated home price appreciation using Saiz housing supply elasticity measure (inverse) as the instrumental variable. After controlling for loan securitization share in an MSA, the results are still consistent with my main findings. All regressions are weighted by MSA population and include year fixed effects. Standard errors are clustered by year and presented in parentheses. ***, **, * represent 1%, 5%, and 10% level of significance, respectively.

Variables	Minority Loan Acceptance Rate	
	2001-2006	2012-2017
Home Price Growth	0.578*** (0.13)	-1.458** (0.74)
Securitization Share	0.050*** (0.01)	0.161*** (0.04)
Log(Total Applications)	0.000 (0.01)	0.060*** (0.02)
Minority LTI	-0.004 (0.01)	0.038*** (0.01)
Log(Minority Applicant Income)	0.012 (0.01)	0.045* (0.03)
Minority Applicant Income Growth	-0.043 (0.03)	-0.001 (0.02)
Minority Application Share	-0.007 (0.03)	-0.595*** (0.06)
Unemployment Rate	-0.004 (0.23)	1.334*** (0.34)
GDP Growth Rate	0.062** (0.03)	0.267 (0.21)
Log(Household Income)	0.025*** (0.01)	0.084 (0.05)
Poverty Level	-0.290** (0.13)	-0.307 (0.20)
Log(Population)	-0.010 (0.01)	-0.050*** (0.01)
Constant	0.519*** (0.07)	-0.253 (0.60)
Year FE	Y	Y
Observations	816	816
R-squared	0.440	0.180
Adjusted R-squared	0.428	0.162

Table 10. Two-stage regressions of minority loan acceptance rate on home price appreciation after controlling for bank competition

This table examines whether bank competition in an MSA impacts the relationship between minority loan acceptance rate and home price appreciation. I regress minority loan acceptance rate on the estimated home price appreciation using Saiz housing supply elasticity measure (inverse) as the instrumental variable. In columns 1 and 2, as a measure of bank competition, I include the log of number of banks in an MSA. In columns 3 and 4, as a second measure of bank competition, I include the Herfindahl index of market share of banks, which is based on their share of accepted mortgages in an MSA. The results show that the inclusion of lender competition measures does not affect the relationship between home price appreciation and minority loan acceptance rate. All regressions are weighted by MSA population and include year fixed effects. Standard errors are clustered by year and presented in parentheses. ***, **, * represent 1%, 5%, and 10% level of significance, respectively.

VARIABLES	Minority Loan	Minority Loan	Minority Loan	Minority Loan
	Acceptance Rate	Acceptance Rate	Acceptance Rate	Acceptance Rate
	2001-06	2012-17	2001-06	2012-17
Home Price Growth	0.548*** (0.12)	-1.734* (0.92)	0.564*** (0.12)	-2.359** (1.03)
Log (Number of Lenders)	-0.008 (0.01)	-0.034 (0.03)		
Herfindahl Index (Market Share)			0.060 (0.05)	0.648*** (0.18)
Log(Total Applications)	0.004 (0.01)	0.098*** (0.01)	0.001 (0.01)	0.111*** (0.03)
Minority LTI	-0.005 (0.01)	0.040*** (0.01)	-0.004 (0.01)	0.052*** (0.02)
Log(Minority Applicant Income)	0.011 (0.01)	0.035 (0.02)	0.011 (0.01)	0.034 (0.03)
Minority Applicant Income Growth	-0.041 (0.03)	0.004 (0.02)	-0.042 (0.03)	0.014 (0.02)
Minority Application Share	0.004 (0.03)	-0.557*** (0.09)	0.001 (0.03)	-0.551*** (0.07)
Unemployment Rate	-0.052 (0.21)	1.485*** (0.40)	-0.041 (0.23)	1.525*** (0.41)
GDP Growth Rate	0.066** (0.03)	0.345 (0.23)	0.063** (0.03)	0.372 (0.24)
Log(Household Income)	0.022** (0.01)	0.035 (0.06)	0.025*** (0.01)	-0.013 (0.07)
Poverty Level	-0.302** (0.14)	-0.314 (0.27)	-0.283** (0.13)	-0.383 (0.24)
Log(Population)	-0.009 (0.01)	-0.065*** (0.01)	-0.009 (0.01)	-0.079*** (0.02)
Constant	0.596*** (0.11)	0.464 (0.74)	0.544*** (0.07)	0.861 (0.77)
Year FE	Y	Y	Y	Y
Observations	816	816	816	816
R-squared	0.440	0.053	0.438	0.392
Adjusted R-squared	0.428	0.0324	0.426	0.379