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Mortgage Supply and the US Housing Boom: The Role of the Community Reinvestment Act

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Abstract

This paper studies the role of the Community Reinvestment Act (CRA) in the US housing boom-bust cycle. I find that the enhancement in CRA enforcement in 1998 increased the growth rate of mortgage lending by CRA-regulated banks to CRA-eligible census tracts. I show that during the boom period house price growth was higher in the eligible census tracts because of the shift in mortgage supply of regulated banks. Consequently, these census tracts experienced a worse housing bust. I find that CRA-induced mortgages went to borrowers with lower FICO scores and encountered more frequent delinquencies.

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Between 1998 and 2006 house prices in the US rose by about 90% in real terms, and subsequently experienced a sharp decline by about a third until 2010. These house price developments helped fuel enormous financial instability, large scale output losses in many countries around the world, and the collapse or near collapse of numerous financial institutions. Most academic research has focused on the role of credit market conditions in this boom-bust cycle: Short-term interest rates that were too low for too long (Maddaloni and Peydró, 2011; Ioannidou, Ongena, and Peydró, 2015) together with or caused by a global saving glut (Bernanke, 2005; Himmelberg, Mayer, and Sinai, 2005; Caballero, Farhi, and Gourinchas, 2008), branching deregulation of the banking industry (Favara and Imbs, 2015; Hoffmann and Stewen, 2019) or the securitization wave (Mian and Sufi, 2009) resulted in lax credit conditions that may have boosted credit supply and housing demand and consequently the sharp rise in house prices in the US.

In this paper, I examine the role of the US government policy in encouraging home ownership as an additional driver of the increase in mortgage supply and house prices from 1998 to 2006. In particular, I focus on the amendments introduced to the Community Reinvestment Act (hereafter, CRA) in 1995. The CRA was originally enacted in 1977 to address potential discriminatory credit practices against households in low- and moderate-income neighbourhoods (a practice called *redlining*). However, this act was not fully enforceable in the first two decades after its passing. The lack of objective and measurable criteria for assessing banks' compliance, and credible sanctions against noncompliant banks rendered the act ineffective in its original form. It was only in the 1990s that the CRA started to be credibly enforced. A major amendment was introduced to the act in 1995 with the purpose of boosting compliance rates of financial institutions by designing objective and formal criteria to assess banks' CRA performance. Moreover, for the first time noncompliance became punishable in that the regulator could decline violating banks' applications for any type of expansion or merger. The main purpose of this paper is to document the contribution of this enhancement in the CRA enforcement to the recent boom-bust cycle in the US housing market.

The identification strategy of this paper rests on three important institutional features

of the CRA. First, the amendment that was introduced in 1995 and came fully into effect in 1998 provides an exogenous variation over time. Second, the CRA designates those census tracts with a median family income less than 80% of the median family income in their respective metropolitan statistical area (MSA) as *CRA-eligible*. Hence, whether in a given census tract the CRA requirements apply depends not only on the income level of the census tract itself but additionally on the income level of the corresponding MSA. Hence, census tracts with similar median family income may be classified as CRA-eligible or ineligible, depending on the median family income of the MSA they are located in. This allows me to compare census tracts with similar median family income in different MSAs in the same state and further restricting the analysis to observations around the 80% threshold. Note also that CRA-eligibility is explicitly defined based on an observable characteristic, i.e., relative income. Hence, it eliminates concerns about biases arising from selection on unobservable characteristics. Third, not all financial institutions are subject to the CRA. Hence, there exist three exogenous variations for identification that allow for comparison of mortgage origination of CRA-regulated institutions with non-regulated institutions in otherwise-similar CRA-eligible and ineligible census tracts, before and after 1998. Furthermore, CRA-regulated institutions are examined for compliance with the CRA only inside their assessment areas, allowing for further tests to ensure the robustness of the results.

The main findings of the paper are as follows. First, I show that CRA-regulated banks, unlike other financial institutions, increased their mortgage origination to CRA-eligible census tracts across the income distribution. Second, I estimate the causal effect of mortgage supply on house prices. Consistent with this finding, I show that CRA-eligible census tracts experienced a higher house price growth during the boom because of the shift in mortgage supply by CRA-regulated banks. I also find that the collapse of house prices from 2007 to 2009 was more severe in CRA-eligible census tracts. Finally, I document that CRA-induced mortgages were slightly riskier ex-ante but experienced considerably more frequent delinquencies ex-post.

Figure 1 presents the first result of the paper. It shows that after 1998, when CRA-

enforcement was strengthened, regulated banks accelerated their lending to CRA-eligible census tracts while their mortgage origination in non-CRA census tracts continued its pre-1998 trend. Figure 2, on the other hand, presents the results of the same exercise but for mortgage originations of institutions that are not subject to the CRA and shows no difference between the growth rate of mortgages for eligible and ineligible census tracts neither before nor after 1998. Formally, in a difference-in-differences estimation, I find that the annual mortgage lending by CRA-regulated institutions in CRA-eligible census tracts from the 1993-1997 period to the 1998-2002 period increased approximately by 6% , relative to mortgage originations by the same institutions in CRA-ineligible census tracts. Furthermore, I show that the estimated effect mostly comes from adjustments at the extensive rather than the intensive margin: the growth in the number, rather than the size, of mortgages drives the largest part of difference. For mortgage originations by non-regulated institutions I find no difference in the growth rates between CRA-eligible and CRA-ineligible census tracts.

Based on this evidence, I examine whether CRA-eligible neighbourhoods experienced a higher house price appreciation and whether and by how much the increase in house prices can be linked to the positive shift in the supply of mortgages due to the CRA. Theory suggests a positive effect of mortgage supply on prices. In particular, Adelino, Schoar, and Severino (2012) argue that easier access to mortgage credit may generate higher demand for housing by increasing the number of households that are able to bid on houses. If the housing supply is not perfectly elastic, for instance due to limited developable land as in Saiz (2010), house prices will rise due to the higher demand. In addition, cheaper funds enable unconstrained buyers to bargain less hard for reductions in prices, which subsequently allows house prices to rise further.

Estimating the elasticity of house prices to mortgage supply, however, is non-trivial due to biases arising from omitted variables and reverse causality. In particular, demand effects has been shown to be important factors in building up bubbles where traders extrapolate future returns based on past returns and form expectations about the future price that further induces higher prices and higher trading volume (Barberis, Greenwood,

Jin, and Shleifer, 2018). Additionally, a higher collateral value of the real estate in regions with growing prices enables otherwise borrowing constrained households to apply for new mortgages (Kiyotaki and Moore, 1997). I use the exogenous shift in mortgage supply originated by the CRA enforcement in 1998 as an instrument to overcome such endogeneity issues and estimate the elasticity of house price growth to credit supply. I find that a one percentage point increase in annual mortgage supply growth rate generates a 0.7 to 1.0 percentage points rise in the annual house price growth rate. This finding supports Favara and Imbs (2015), Di Maggio and Kermani (2017) and Adelino et al. (2012) who also argue in favour of a causal link from credit to house prices.

Consistent with the established causal link from credit supply to house prices, I find that house prices grew faster between 1998 and 2006 for CRA-eligible census tracts relative to comparable tracts. Figure 3 plots house prices for CRA-eligible and ineligible census tracts separately. During the boom period, house prices increased faster for eligible census tracts. Also, when the housing market collapsed, the drop in house prices was more severe for eligible census tracts. These results can partially explain the findings in Gropp, Krainer, and Laderman (forthcoming) as presented in Figure 4. House price appreciation prior to the crisis and its subsequent depreciation during the crisis were substantially heterogeneous. Neighbourhoods with the highest rise in prices during the boom period were the ones that subsequently experienced sharper declines during the bust period. Both of these observations are consistent with the credit-induced boom-bust cycle to which the CRA contributed as I document in this paper.

Finally, I find that mortgages originated by CRA-regulated banks in CRA-eligible census tracts went to borrowers with approximately 1.9 points lower FICO scores. Banks seem to have compensated for this risk by charging higher interest rates.[1] Ex-post, the likelihood that CRA-induced mortgages encountered delinquency was approximately 10% higher than the average mortgage.

The CRA, as it was implemented in the late 1990s and early 2000s, was a welfare-

[1]These two results together are consistent with the findings in Canner, Laderman, Lehnert, and Passmore (2002) that CRA-regulated institutions did not carry lower spreads on their CRA mortgages, controlling for mortgage risk.

decreasing policy considering that it led to significant shifts in the volume and riskiness of the mortgage market and a more severe crash in the housing market. However, a more understated aspect of any credit-induced boom in the housing market is its distortionary effects on the real economy. For instance, Chakraborty, Goldstein, and MacKinlay (2018) argue that house price appreciations crowd out commercial and industrial loans as they make mortgage markets relatively more attractive for banks. In the case of the CRA this crowding-out effect might have also happened for the sake of compliance. Furthermore, Laeven and Popov (2016) show that the US real estate boom had asymmetric effects on skill formation whereby returns on unskilled labour went up due to increased demand for construction and retail services, hence reducing investments in schooling.

1. Literature

My paper contributes to the broader literature on the underlying reasons behind the rise in real estate prices in the early 2000s. Shiller (2005) argues that the boom in the housing market was more related to behavioural biases than to fundamentals and attributes the boom to *mass psychology*. On the other hand, however, there is a significant literature that emphasizes the role of the credit markets. Most importantly, Himmelberg et al. (2005) suggest that the rise in prices was due to the very low long-term interest rates coupled with increased income growth at a time when house prices were historically low. However, in a recent paper, Favilukis, Ludvigson, and Nieuwerburgh (2017) show that the relaxation of credit constraints, as opposed to the low interest rates, drives the boom in house prices. Mayer and Sinai (2009) argue that lending market efficiency directly affected house prices through lower origination costs for higher property prices and also created a greater use of subprime mortgage. Laxer credit standards might have been facilitated by the agency problems associated with the rise in securitization markets, as shown in Keys, Mukherjee, Seru, and Vig (2009) and Keys, Mukherjee, Seru, and Vig (2010), among others. My paper adds to this strand of literature by studying CRA as an additional factor contributing to the rise in size and riskiness of the mortgage market.

CRA may have been another reason why banks started to employ laxer screening practices in the late 1990s, and eliminated some of the credit constraints in the mortgage market (Favilukis et al., 2017). This would in turn, through competition channels, urge other financial institutions that were not directly regulated under the CRA to engage in riskier lending to preserve their market shares.[2]

My paper is also related to the debate on the exposure of different income groups to the boom in mortgage and housing markets in the early 2000s. Specifically, Adelino, Schoar, and Severino (2016) find that mortgage growth increased significantly for all income groups and thus emphasize the role of higher demand for mortgages, rather than supply shocks, to be responsible for the rise in pre-crisis housing markets. On the other hand, Mian and Sufi (2009) attribute the mortgage boom to subprime lending and to low income neighbourhoods and argue that it was driven mainly by the securitization wave. My results contribute to this debate in two ways: first, I document a distinct supply shock that affected both the mortgage and the housing markets in this period. Second, I show that although mortgage origination and house prices expanded for each income quartile, within each quartile CRA-eligible neighbourhoods experienced higher mortgage and house price booms. This observation relates to the findings in Mian and Sufi (2009) in that within-county analyses may be confounded by CRA effects and hence bias the results towards concluding that it was the lower income groups who were responsible for the excessive growth in the mortgage market. As I will show, CRA-eligibility is not based on absolute but rather relative income, and therefore many middle-income households also qualified for CRA mortgages. An analysis in which one fixes the county and compares low- versus high-income ZIP codes within one county is permeated with the effects of the CRA on the mortgage market. Therefore, my results propose CRA as an additional channel and highlight the importance of CRA loans that were originated not because of securitization but for the sake of compliance with government regulations.

[2]In fact the then governor of the Federal Reserve System explains the competition effects of the CRA as follows: *"[...] CRA also has stimulated competition for loans and banking services in low- and moderate-income communities, leading many institutions on a continuing search for techniques to help better understand and mitigate consumer lending risks."*. For the complete speech see http://www.federalreserve.gov/Boarddocs/Speeches/1998/19980512.htm.

Finally, this paper is related to a number of papers that study whether or not the CRA incentivized banks to generate more and/or riskier loans. My results are consistent with Demyanyk and Van Hemert (2011) and Agarwal, Benmelech, Bergman, and Seru (2012) who find more and riskier lending caused by the CRA. There exists, however, a number of studies with contrasting findings. While Gabriel and Rosenthal (2009) find no impact of the CRA on the overall volume of mortgage lending by the regulated banks, Bhutta (2011) shows that at least in larger MSAs CRA induced higher mortgage activity. Ringo (2015) finds that CRA increases refinancing activity, even though lenders do not receive CRA credit for refinancing mortgages. Ringo also shows that CRA-induced mortgages have lower probability of default while Avery and Brevoort (2014) does not find evidence in favour of riskier lending due to the CRA.

2. Institutional Setting

The Community Reinvestment Act of 1977 (12 U.S.C. 2901), implemented by Regulation BB (12 CFR 228), was enacted by the Congress with the purpose of enforcing depository institutions to satisfy the credit needs of their local community in which they were chartered and were acquiring deposits. CRA was a reaction to concerns regarding the geographical mismatch between banks' deposit-taking and lending activity. This concern applied particularly to disadvantaged areas, where consumers would deposit their savings in the local banks, but due to *redlining* practices would not benefit from their local bank's credits. Redlining can be defined as the refusal of a bank to extend credit to a customer solely due to the customer's place of residence, no matter whether she is creditworthy or not. Therefore, CRA explicitly encourages banks to provide loans to low- and moderate-income neighbourhoods, while ensuring their safety and soundness.

Banking institutions whose deposits are insured by the Federal Deposit Insurance Corporation (FDIC) need to comply with the CRA. These are national banks, savings associations, and state-chartered commercial and savings banks. Federal financial institution regulators, i.e. The Office of the Comptroller of the Currency (OCC); the Board

of Governors of the Federal Reserve System (FRB) and the Federal Deposit Insurance Corporation (FDIC), are responsible for the assessment of each bank's CRA performance. On the other hand, CRA does not apply to credit unions and independent mortgage companies. Credit unions are supervised by the National Credit Union Association (NCUA) and independent mortgage companies and non-bank entities exempt from the CRA are supervised by the Consumer Financial Protection Bureau.

In the early years of the CRA, compliance was measured through each bank's self-reported *CRA Statement*. The CRA statements had to be publicly available and included a delineation of the area that comprised the institutions community, and a list of principal types of credit that the institution is prepared to extend to its community. It was only in 1989 and 1990 when the supervisory agencies started examining the CRA statements, and conducted a four-tier grading system (i.e., outstanding, satisfactory, needs to improve, or substantial noncompliance). The grading was based on five areas of activity: (i) determining community credit needs; (ii) marketing of the credit offered; (iii) geographic distribution and record of office locations; (iv) discrimination; (v) community development (Overby (1995)).

At the time, there were two crucial issues with regards to compliance to and enforcement of the CRA. First, the grading system originated too many *satisfactory* cases. In fact, congress provided little specific guidance in the act as to what was satisfactory or unsatisfactory performance with regards to community reinvestment. Second, although CRA performance had to be *taken into account* when a bank applied for expansion[3], banks were able to acquire the supervisors' consent in almost all cases.

The problems mentioned above resulted in a comprehensive revision of the CRA, which was eventually approved in late April of 1995. The new regime became effective in July 1997 for small banks (less than $250 million) and in July 1998 for large banks (Agarwal et al. (2012)). Under the new guidelines the prior subjective and *efforts-based* criteria

[3]These applications may be (1) applications for a national bank or federal savings and loan charter; (2) applications for deposit insurance for a newly chartered state bank, savings and loan, or similar institution; (3) applications to establish a domestic branch; (4) applications to relocate a home office or a branch office; (5) applications for mergers, consolidations, asset acquisitions, or liability assumptions that otherwise require regulatory approval; and (6) applications to acquire shares in, or assets of, a regulated institution that otherwise require regulatory approval.Overby (1995)

for assessing whether an institution is meeting community credit needs was abandoned and replaced by a more quantitative evaluation procedure designed to measure actual *results* in meeting the credit needs of the institution's assessment area (Overby (1995)). The new guideline defines three tests; for each a bank receives a numerical rating and ultimately its overall CRA rating: lending, investment, and service tests.

The *lending test* measures an institution's home mortgage lending, small business and small farm loans, community development lending and in some cases, consumer loans (only if the main business of the bank is consumer loans). The *investment test* similarly measures each bank's realized community development investments. Finally, the *service test* is focused on banks' provision of retail-banking services and the extent and innovativeness of its community development services. Each test is then given a score based on a grading scale as in Table 1 and the final rating is calculated based on bank's performance in each test. The lending test is the most important part of the overall CRA rating, for at least three reasons. First, as we see in Table 1, the lending test has the highest weight among the three tests.[4] Second, banks in fact are not eligible to receive an *outstanding* grade on any of the other two tests unless they score outstanding on their lending test. Third, institutions must also earn at least a *low satisfactory* on lending to receive a *satisfactory* score overall.

Figure 5 shows the annual frequency of each CRA rating as a share of total number of CRA examinations from 1990 onward. Consistent with the new enforcement mechanism introduced in mid-1990s, we observe a significant drop in the share of banks receiving an outstanding rating. In fact, *outstanding* rating is the only rating that experiences a sharp decline in this period. On the other hand, there is an equal surge in the share of banks with a *satisfactory* rating. These two observations jointly suggest that in the mid 1990s a large share of examined banks were *downgraded* from outstanding to satisfactory. This is a strong evidence of enhanced enforcement with significant signalling effect about the regulators' stance on the CRA. We also observe bumps in the share of *needs to improve* and especially *substantial non-compliance*, which again suggest tougher enforcement.

[4]This grading scale only applies to large banks, i.e., banks bigger than $250 million in assets. For small banks the rules are more lenient.

Another significant modification in 1995 amendments to the CRA is the replacement of the previously used concept of *communities* with *assessment areas*. CRA assessment areas are the areas in which an institution operates its branches and deposit-taking ATMs and any surrounding areas in which it originates or purchases a substantial portion of its loans. In Section 6, I will discuss that the move from a branch-based definition of *communities* to the broader *assessment area* definition that puts more emphasis on banks' lending activity in addition to their branch locations has some important implications for banks' incentive regarding geographical expansion. The CRA tests emphasize specifically bank's CRA activities within the low- and moderate-income neighbourhoods within a bank's assessment area. Low- and moderate-income neighbourhoods are census tracts with median income less than 80% of their respective MSAs' median income.

Finally, a set of sanctions can come into effect against the non-compliant banks. If a bank scores poorly in its CRA assessments, the regulators may order that a bank's interstate branch(es) be closed, will not permit the bank to open a new branch, will issue a notice to the bank or will conduct a hearing. Moreover, applications for mergers and acquisitions could be stalled if communities believed that the banks involved had not lived up to their responsibilities under the CRA.[5]

3. Identification Strategy

The identification strategy of this paper relies on three exogenous variations stemming from the timing and the design of the CRA: First, I make use of the changes in enforcement that came into effect in 1998 and compare the desired outcome variables before and after 1998. Second, the act designates CRA-eligible and ineligible census tracts, which provide for a treatment and control group of census tracts. Finally, only some of the financial institutions are subject to the CRA regulations, which creates a third variation to be exploited in this paper. My identification strategy relies on these three pillars to isolate the effect of increased enforcement of the CRA on banks' supply of mortgages. The

[5] A famous example is the Citicorp's commitment to extending CRA loans at the time it planned to acquire Travelers in 1998: http://www.nytimes.com/1998/05/05/business/communities-to-receive-115-billion-citigroup-says.html?mcubz=0.

hypothetical experiment that one would ideally like to run is to find two census tracts with the same median family income, where one is located in an MSA with a slightly higher median family income and hence is a CRA-eligible census tract while the other one is not. To clarify this experiment, let us look at the diagram presented in Figure 6. The two big black boxes represent two different MSAs, in the same state, and each smaller box represents a census tract. The height of the boxes proxy median income at that region. Therefore, MSA 1 has a higher median family income relative to MSA 2. Therefore, the green census tract will be coded as CRA-eligible while the census tract with the exact similar median income located in MSA 2 will not.

Therefore, identification strategy in this paper relies on the local relativity of the 80% rule in determining whether a census tract is or is not eligible for CRA mortgages. I take advantage of this arbitrary rule and compare similar-income census tracts within the same state and with relative incomes around the 80% threshold. I compare mortgage originations, in terms of total volume, number of originations, and the size of the average mortgage, as well as house price growth before and after 1998 between CRA-eligible and ineligible census tracts, conditional on census tract median family income, and a host of census tract-, county-, and MSA-level control variables within states. In sum, I run the following difference-in-differences and triple-differences regressions:

$$Y_{ijt} = \beta_1\, CRA_i + \beta_2\, CRA_i \times Post_t + \beta_3\, Tract\ MFI_i + \beta_4\, Tract\ MFI_i \times Post_t \qquad (1)$$
$$+ \Gamma\, X_{it} + \alpha_s + \gamma_t + \varepsilon_{ijt}$$

$$Y_{ijt} = \beta_1\, CRA_i + \beta_2\, CRA_i \times Post_t + \beta_3\, Tract\ MFI_i + \beta_4\, Tract\ MFI_i \times Post_t \qquad (2)$$
$$+ \beta_5\, Regulated_j + \beta_6\, Tract\ MFI_i \times Regulated_j + \beta_7\, Tract\ MFI_i \times Regulated_j \times Post_t$$
$$+ \beta_8\, Regulated_j \times Post_t + \beta_9\, CRA_i \times Regulated_j \times Post_t$$
$$+ \Gamma\, X_{it} + \alpha_s + \gamma_t + e_{ijt}$$

$$X_{it} = \{ln(Population_i),\ ln(Population_i) \times Post_t,$$
$$Latent\ Demand_i,\ Latent\ Demand_i \times Post_t,\ Vacancy\ Rate_i,\ Vacancy\ Rate \times Post_t,$$
$$Ln(Houing\ Units_i),\ Ln(Housing\ Units_i)\ \times Post_t, Income\ Growth_c,$$
$$Income\ Growth_c \times Post_t,\ Employment\ Growth_{ct},\ Employment\ Growth_{ct} \times Post_t,$$
$$Pop.\ Growth_c,\ Pop.\ Growth_c \times Post_t,\ Elasticity_m,\ Elasticity_m \times Post_t\}$$

The outcome variables in regression (1), Y_{ijt}, are natural logarithm of total $ value of mortgage origination, the average mortgage size, and the total number of mortgage originations, separately by CRA-regulated and non-regulated institution, as well as house price growth in each census tract i in year t. Dummy variable CRA_i equals one if a census tract has a median family income less than 80% of the median family income of its respective MSA. Dummy variable $Post_t$ equals zero for years 1993 to 1997, and one for years 1998 to 2002. In regression (2), I test whether the mortgage originations are statistically different between CRA-regulated, $Regulated_j$, and non-regulated institutions. Because census tract median family income, $Tract\ MFI_i$, determines whether a census tract is CRA-eligible or not, and thus whether CRA-regulated institutions need to treat it differently relative to non-regulated institutions, it is important to add interactions of this variable with the dummy variables $Regulated_j$ and $Post_t$ to the regression model (2). This makes regression model (2) a more flexible and thus general model than a model without these interactions. Not including these interactions *forces* a similar response to census tract median family income by regulated and non-regulated institutions before and after 1998, which is too restrictive and against the identification strategy of the paper. Allowing for heterogeneous responses, however, is not only innocuous, but is also necessary as we know that census tract median family income has a definite role for regulated institutions (in determining whether a census tract is CRA-eligible or not) above and beyond its mere control for income differences. All other control variables are listed in the vector X_{it}. It includes control variables at the census tract, county, and MSA level and their interactions with the dummy variable $Post_t$. Census tract-level controls are population, latent demand, vacancy rate, and number of housing units. County-level

controls are income growth, employment growth, and population growth, while housing supply elasticity is a MSA-level control variable. Finally, the regressions include state and year fixed effects.

3.1. House Prices

Better access to a mortgage can generate higher demand for housing. If housing supply is not perfectly elastic, for example due to local geography as in Saiz (2010), house prices are expected to rise. In addition, cheaper funding allows unconstrained buyers to bargain less hard for reductions in prices, again resulting in house price increases (Adelino et al. (2012)). However, it is difficult to estimate an unbiased estimate of the elasticity of house prices to mortgage supply for multiple reasons. First, equilibrium mortgage and house prices are determined simultaneously. Second, higher expected house prices increase borrower's collateral value and hence, their borrowing capacity. Therefore, it is difficult to disentangle the supply effects of mortgage on house prices from the demand effects due to higher expected growth opportunities. In this paper, I use CRA regulation as an instrumental variable for mortgage supply. CRA-eligible census tracts, starting from 1998, were plausibly exposed to a shift in mortgage supply that was unrelated to the actual or expected house prices. I use this exogenous variation in exposure to the CRA regulation as an instrument to estimate the elasticity of house price growth to growth in mortgage supply, as in equations (3) and (4) below:

$$Motrgage\ Growth_i = \beta_1\ CRA_i + \beta_2\ Tract\ MFI_i + \Gamma\ X_i' + \alpha_s + \varepsilon_i \tag{3}$$

$$\Delta HPG_i = \beta_1\ \widehat{Motrgage\ Growth_i} + \beta_2\ Tract\ MFI_i + \Gamma\ X_i' + \alpha_s + \varepsilon_i \tag{4}$$

$$X_i' = \{ln(Population_i),\ Latent\ Demand_i,\ Vacancy\ Rate_i,\ Ln(Houing\ Units_i),$$
$$Income\ Growth_c,\ Employment\ Growth_c,\ Pop.\ Growth_c,\ Elasticity_m\}$$

Regression model (3) is the first-stage of the instrumental variable analysis in which $Mortgage\ Growth_i$ is the annual percentage growth of average dollar value of mortgage origination in each census tract, by each of the regulated and non-regulated institutions, from the 1993-1997 period to 1998-2002 period. Regression (4) represents the second-stage of the instrumental variable analysis where I regress ΔHPG_i, the change in average growth rate of house prices in each census tract from the 1993-1997 period to 1998-2002 period, and regress that on the predicted values of mortgage growth from the first stage.

To be a valid instrument, CRA needs to satisfy two conditions. First, it has to be correlated with mortgage supply and second, be unrelated to house prices through any other channel except mortgage supply after controlling for the observables, i.e. exclusion restriction assumption. The first condition is testable. In fact, the first part of the paper is intended to test whether or not the CRA affected mortgage supply to CRA-eligible census tracts. Second, the exclusion restriction, despite being untestable, warrants some discussion. Note that I can control for the observable differences among census tracts. These observables are the same as regressions (1) and (2), but without the interaction with the post-1998 dummy as this model is a cross-sectional regression. Therefore, the exclusion restriction assumption is that, after controlling for the observable characteristics, CRA status of a census tract affects house prices only through increased mortgage supply by CRA-regulated institutions to the CRA-eligible tracts. Hence, unobservable characteristics, like expected house prices, which drive demand for housing in each tracts are assumed to be unrelated to the CRA regulations. To verify this assumption, I run a placebo test, using non-regulated institutions mortgage origination, that confirms that omitted variables, such as demand, in the first-stage IV regression do not correlate with the dummy variable *CRA*.

4. Data

I use the home mortgage disclosure act (HMDA) data of mortgage originations from 1993 until 2002. HMDA is at the loan application level and includes information on

the applicant, the issuing institution and the loan itself. For example, it records the applicants' income, sex and race, the institutions' type, and the loans' purpose, amount, status, and more. I restrict my sample to the loans originated for the purpose of home purchase. Next, I distinguish between the issuing institutions by their relation to the Federal Financial Institutions Examination Council (FFIEC). As discussed earlier, only those institutions that are supervised by the OCC, FRS, FDIC and OTS are subject to the CRA regulations. Therefore, I aggregate the loans for the two types of regulated and non-regulated mortgage providers up to the census tract level in each year.[6] I generate annual measures of the total amount, total number, and the average size of mortgages originated by the two types of institutions in each census tract. Furthermore, I define *LatentDemand* as mortgage application rejection rate at the census tract level, which is the number of denied applications (coded as 3 in the entry *type of action*) normalized by the total number of applications averaged over the 1993-1997 period.

House price data at the census tract level are collected from Federal Housing Finance Agency (FHFA). FHFA reports single-family house price index that is a weighted repeat-sales index and measures average price changes in repeat sales or refinancings on the same properties. I use the annual change in the price index as the measure of house price growth.

According to the CRA, census tracts with a median family income of less than 80% of the median family income of their respective MSA are considered to be low- and moderate-income tracts and are classified as CRA-eligible. I use median family income at the census tract and MSA level from the decennial data of census 2000 to find the CRA eligible tracts based on this criteria. The other census tract level information are vacancy rates and the number of housing units. In addition, I add annual county-level employment growth from County Business Patterns (CBP) dataset of the Census Bureau. Furthermore, I include Income growth at the county level, which is the growth

[6]Census tract definitions change with every decennial census. Moreover, HMDA updates its definition of census tracts after each new decennial census is out. For example, HMDA uses census 1990 definitions until 2002. Therefore, in the mortgage analysis section I restrict the sample to 1993 until 2002 to abstract from changes in the definition of census tracts. This then leads to two five-years periods of [1993,1997] and [1998,2002] in my difference-in-differences analysis.

in median household income at each county between the 1990 and the 2000 census waves, and similarly, county-level population growth from the 1990 census to the 2000 census. Finally, I use the elasticity of housing supply from Saiz (2010), which is available for 95 MSAs.

I restrict the sample to the common support of the income distribution. That is, I drop CRA-eligible census tracts that could not be CRA-ineligible in any of the MSAs (the poorest census tracts), and CRA-ineligible census tracts that could not be CRA-eligible in any of the MSAs (the richest census tracts). Therefore, my final census tract-level sample contains 288,804 tract-year observations of 8,483 unique CRA-eligible and 6,496 ineligible census tracts. The data provides 42,332 tract-year observations with non-missing observations for house price growth, for 2,061 CRA-eligible and 3,041 ineligible census tracts. The summary statistics of these variables are presented in Table 2.

5. The CRA and Mortgage Supply

The first piece of evidence on the effect of the CRA on mortgage supply is provided in Figure 1. Prior to 1998, mortgage growth did not systematically differ between CRA-eligible census tracts and other tracts. However, starting from 1998 there is a clear upward shift in mortgage origination in CRA-eligible census tracts by CRA-regulated institutions. In Figure 2, I redo the same exercise but using mortgages originated by non-regulated institutions. The graph shows no difference in the growth of non-regulated mortgages between CRA-eligible and ineligible census tracts, neither before nor after 1998. These two graphs provide a first indication that the CRA regulations affect the supply of mortgages by regulated institutions to CRA-eligible census tracts, starting from 1998.[7]

Table 3 presents the results of regression models (1) and (2). The coefficient estimate of the interaction term $CRA \times Post$ indicate that CRA-regulated institutions' lending increased in CRA-eligible census tracts starting from 1998 in terms of total \$-value of

[7]In Figure C1 in Appendix C, I report the same graphs for an extended sample period that covers 1993 to 2009 and reflect the longer term dynamic effects of the credit expansion.

loans, average mortgage size, and most importantly the number of mortgage originations, as presented in columns (1) to (3) respectively. The effects come from both the intensive and the extensive margin: both the size of the average mortgage and the total number of mortgages rise. However, growth in the number of mortgage originations is twice as larger as the growth in the size of average mortgage, which is consistent with the goals and requirements of the CRA regulation that emphasizes mortgage origination rather than mortgage size. Nevertheless, as I will show in Section 7, mortgage supply can lead to rise in house prices, which in turn increases the size of a mortgage needed to buy an average house in an area. Columns (4) to (6) show the same analysis for non-regulated institutions. The increase in $-value of lending by non-regulated institutions in CRA-eligible census tracts is driven by an increase in the size of the average mortgage while there is no significant rise in the number of mortgage originations. The triple-difference results compare CRA-regulated and non-regulated institutions' lending before and after 1998 in and out of CRA-eligible census tracts and show that on average CRA-eligible institutions increased lending to CRA-eligible census tracts by 11.2% in terms of $-value of mortgages (Column (7)), and 9.3% in terms of the number of mortgage originations (column (8)).[8]

Although the regressions control for census tract median family income, and thus compare similar-income census tracts to each other, the identification comes from similar-income census tracts that are placed in different MSAs (in the same state) with different income levels, hence affecting their relative attractiveness and growth potential versus their surrounding. The county and MSA-level control variables, such as income growth, employment growth, population growth, and the elasticity of housing supply, partly control for such differences. Furthermore, note that if there were different demand effects between eligible and matched ineligible census tracts we would find significant results for the mortgages originated by non-regulated institutions too. Nevertheless, and to address this issue more directly, I confine the sample to census tracts that have an income ratio

[8]Table C1 presents the results of similar regressions where house price growth at the county level is added to the list of control variables. The results are similar to those in the main text, but the number of observations is approximately 40% lower.

in the vicinity of the 80% threshold. In these two samples, the differences in MSA-level median family income will be much lower, making their census tracts more comparable. Table 4 presents the results on mortgage origination using the sample of census tracts with an income ratio in the vicinity of the 80% threshold. Columns (1) to (3) show the findings in the sample of census tracts with a median family income between 60% and 100% of their MSA median family income. The results confirm the earlier findings.[9] CRA-regulated institutions increase mortgage origination in CRA-eligible census tracts starting from 1998. Same exercise yields no significant estimate for the mortgage originations of non-regulated institutions. The triple-difference analysis confirms that findings are indeed different across the two type of financial institutions. Columns (4) to (6) show a similar exercise using the sample of census tracts with an income ratio in the 70% to 90% range. The findings again confirm that the results are economically and statistically significant, and only so for CRA-regulated institutions. In Appendix A, I present an alternative analysis based on exact matching on census tract median family income, confirming the results of the difference-in-differences analysis.[10]

The aggregate growth in mortgage lending as a result of the CRA, from 1998 to 2002, measured as a share of total number of mortgage originations in this period, is between 2.1% and 3.3%, depending on different estimates in this paper. To arrive at this number, I take the end-of-1997 total lending of CRA-regulated banks in CRA-eligible tracts and calculate the additional, CRA-induced, growth in mortgages using the annual growth rate of 6.1% (from column (6) of Table 4) or 9.3% (from column (8) in Table 3) over the five years including and after 1998 relative to a growth rate equal to the pre-1998 average annual growth rate. I then divide this number by the total mortgage originations by both types of institutions recorded in HMDA in the five years from 1998 to 2002.

In interpreting this aggregate estimates some reservations need to be taken into ac-

[9] I also compare the growth in mortgage origination in census tracts with income ratio in three intervals: less than 80%, between 80% and 120%, and larger than 120%, and find that the results are only significantly different between CRA-regulated and non-regulated institutions for census tract with an income ratio below 80%. These findings are presented in Table C2.

[10] To further ensure the robustness of these findings to differential local demand, especially through gentrification, I run robustness checks using the increase in the share of *educated* residents within each census tract as a proxy for the extent of gentrification and show that the findings remain unchanged. These results are presented in Section 8.8.1.

count. The focus of this paper is on mortgage originations for the purpose of purchasing a residential property, and all the estimates refer to this definition of mortgage lending, while leaving out refinancing, home equity, and other types of lending.[11] Furthermore, the analysis is only restricted to the five-year period from 1998 to 2002 and therefore has limited implications for the longer term aggregate effects of the CRA.

5.1. The CRA across the Income Distribution

The role of different income groups in generating the growth in the mortgage market prior to the financial crisis is the subject of many studies. This paper contributes in particular to Adelino et al. (2016) who argue that mortgage growth was not concentrated within the low-income group of households. More importantly, they emphasize the demand view of the pre-crisis housing market and explain that positive expectations about growth in the housing market led to higher demand for housing across all income groups. This view is different to Mian and Sufi (2009) who argue that mortgage growth in the early 2000s were primarily driven by a growth in supply to the subprime borrowers, which itself was due to lower underwriting standards facilitated by a securitization boom. My paper contributes to this debate by showing that the CRA played an important role in generating an upward shift in mortgage supply, which is not necessarily concentrated in a particular income group. To verify this claim, let us consider Table 5. This table presents the results of regression model (1) run on sample splits based on quartiles of census tract median family income. The results in columns (1) to (3) show that CRA-regulated institutions' mortgage origination in CRA-eligible census tracts increased by 25.6%, 8.5%, and 10.8% in census tracts in the first, second, and third income quartile respectively. The top quartile is missing because there are no CRA-eligible census tracts in that income bracket. These estimates are statistically and economically significant. However, columns (4) to (6) show no statistical significance for mortgage growth of non-regulated

[11] HMDA does not cover the population of mortgage lending. The smallest institutions and those without a branch in an MSA need not report their data to HMDA. Moreover, lenders do not report mortgages taken out for reasons other than purchasing a residential property, refinancing, or home improvement. In comparison to Equifax, one of the nationwide consumer credit agencies, HMDA includes about 90% of mortgages for the purpose of purchasing a residential property or refinancing an outstanding mortgage. (Federal Reserve Bulletin, November 2017, Vol. 103, No 6)

institutions in CRA-eligible census tracts.

These findings confirm that, within each income group, those census tracts that fall below 80% of their own MSA's median family income experienced a stronger positive shift in mortgage origination. This corroborates that CRA mortgages are not all necessarily lent to low-income neighbourhoods. In fact, CRA-eligibility is defined based on local relative income. This may comprise part of the effect that Mian and Sufi (2009) capture by running within-county regressions. Within each county, especially in those with higher income variation, it is most likely that the low-income census tracts were CRA-eligible too.

6. CRA Assessment Area Analysis

To further ensure that the effects documented so far are due to the CRA, I make use of the fact that the CRA-regulated banks need to only comply with the CRA regulations within geographical areas that are delineated based on a set of guidelines specified as part of the CRA regulations. These areas were called *communities* in the original version of the law, but with the new amendments introduced in 1995 this term was replaced by *assessment areas*. Although the two terms differ in important ways, to which I will come back later, generally speaking both stipulate that community or assessment area are geographical areas, such as counties, where banks operate their deposit-taking branches (Avery, Courchane, and Zorn, 2009; Bhutta, 2011).

Therefore, I first start by merging HMDA data with the FDIC's Summary of Deposits (SOD) data (that starts in 1994) to identify counties in which each bank has its deposit-taking offices (I will refer to these as *assessment area counties* and identify them with the variable AAC).[12,13] I use this information to formally test banks' CRA lending in and outside their assessment areas using regression model (1) but separately for mortgage originations that are inside or outside each specific institution's assessment area,

[12] I thank Robert Avery for generously sharing the link file that allows matching institution IDs between HMDA and SOD datasets.

[13] Because the overwhelming majority of non-regulated institutions are non-banks and these are not deposit-taking entities, they do not appear in the SOD data and I cannot include them in this part of the analysis.

aggregated at the census tract level.

The results are presented in columns (1) and (2) of Table 6. Column 1 indicates that the post-1998 increase in mortgage origination of CRA-regulated institutions in CRA tracts inside their assessment areas was 6.7% and is statistically significant at the 5% level. Outside assessment area counties, I find an estimate of 5.4% for the increase in CRA lending, which is statistically insignificant at the conventional levels. These findings provide further evidence that the increased lending in CRA-eligible census tracts are in fact driven by the CRA-regulated institutions in response to the heightened enforcement of the regulation around 1998. Nevertheless, a more careful reading of the text of the CRA regulation provides important insights into the differences between the old *community* definition and the newly introduced *assessment area*, which can be further exploited. I provide a summary of these definitions below and examine their implications.

6.1. Community versus Assessment Area

At the inception, the CRA regulation required banks to comply with the requirements of the act inside their *communities*. The full text of the act regarding the definition of the community is presented in Appendix B. In sum, while the law primarily uses the location of branches and offices to stipulate what the regulator expects a bank's *community* to look like, it still leaves considerable discretion to the banks in designing their communities. A bank is allowed to add portions of adjacent neighbourhoods *where appropriate*, or adjacent neighbourhoods where they make a *substantial portion* of their loans, or *any other reasonably delineated area* as part of their *community*, as long as it does not violate the CRA goals. It is therefore evident that *community* can be larger than just the counties in which banks operate branches and offices, even though branches and offices appear prominently in the law.

The literature offers some interesting historical perspective on the reasons behind this sharp focus on branches. Macey and Miller (1993) and Overby (1995) argue that the consensus among the advocates of the act at the time (i.e., 1970s) was to tackle the geographical mismatch between banks' deposit-taking and lending activities, driven

by an *ideology of localism* towards banking activity. Banks were supposed to reinvest deposits as credit where they collected them (the term "reinvestment" in the Community Reinvestment Act refers to this idea). Thus, in defining a bank's community, branches take a central role.

Throughout 1980s and early 1990s and as the regulators realized that banks did not necessarily operate locally, this *local* view of banking was gradually replaced by a view that aimed at addressing banks' geographical expansion in lending and its implications for the CRA. In this updated view, banks not only had to adequately *reinvest* deposits where they collected them, but they also needed to have a balanced geographical presence in terms of their lending activity. *Credits*, therefore, are deemed as important as *deposits* in designing a bank's "assessment area". The 1995 amendment to the CRA clearly reflects this view in defining banks' *assessment area* that replaces the term *community* that was used previously. I report the text of the law regarding the designation of assessment area in Appendix B.

While before 1995 banks had the *choice* to include adjacent counties in which they originate loans in their *community* delineation, after 1995 (starting from 1997 for small banks and 1998 for large banks) counties in which banks originate substantial portion of their loans *must* be part of their assessment area. In fact, in 1998 approximately 46% of all mortgage originations were in counties where the originator did not operate a branch.[14] This observation suggests why the regulators are moving beyond branch counties and widening the definition of assessment area such that they can address possible discriminatory credit practices while banks are geographically expanding.

Nevertheless, there are three main issues to address in order to more accurately identify assessment areas at the bank level and over time (before and after 1998). First, there is significant discretion in the way a bank can delineate its *community* or *assessment area*. Second, assessment area definition changed at the same time as the CRA enforcement improved. This could generate obligations for banks because of their past lending in areas that were previously not considered inside their assessment area but started to be part

[14]Figure C3 in Appendix C presents the annual share of mortgage originations inside branch counties for the average bank.

of it under the new rules. Third, the new definition could potentially encourage banks to revisit their geographical expansion, especially regarding entering, or exiting, counties with CRA-eligible census tracts. In the following I will present some results that help clarify these issues.

6.2. Modified Definition of Assessment Area

Based on the discussion above, I conjecture that if an institution is actively lending to *non-CRA* census tracts of a county, the new CRA regulations are likely to require that institution to include that county as part of its assessment area even if it *does not* operate a branch in that county, if there exist CRA census tracts in that county. The idea is that the regulator is aiming to address the discriminatory geographical expansion of banks, irrespective of their branch locations. I assume that non-branch counties in which banks originated significant amounts of loans in non-CRA tracts before 1998 are likely to become part of that bank's assessment area after 1998 if there exists a CRA tract in that county. I also assume that non-branch counties in which banks originate significant amount of loans in non-CRA tracts after 1998 are likely to become part of that banks' assessment area after 1998 if there exists a CRA tract in that county.[15]

In sum, I include non-branch counties with a share of non-CRA lending in the top 5% of the distribution in either of the two periods as part of a bank's assessment area post-1998 if those counties include a CRA census tract. Using this new definition for assessment area counties, I repeat the same regressions as before. The results are presented in columns (3) and (4) in Table 6. Column (3) presents the growth in mortgage origination post-1998 in CRA census tracts inside banks' assessment areas, and implies a growth rate of 12.4%. Column (4) presents the same analysis for counties that are outside banks' assessment area and shows an insignificant and much smaller estimate for the interaction term. In columns (5) and (6) I check the robustness of this approach and rely on the top 10% of the distribution instead of the top 5% and repeat the analysis. Again, the results are only significant inside assessment areas.

[15]Table C3 in Appendix C reports the distribution of the share of banks' mortgage origination, relative to each bank's total mortgage origination, in the non-CRA census tracts of each county.

6.3. Bank's Geographical Expansion

The new definition of assessment areas plus the overall enhancement in CRA enforcement could potentially change CRA-regulated institutions' incentives regarding their geographical expansion. Prior to 1998, if these institutions saw profitable lending opportunities in counties where they did not have a branch, they could extend mortgages in that county without worrying about its implications for their CRA community definition, as they were given the choice to consider such counties as part of their community or not. In the new regime that prevails after 1998, however, they *must* include counties with significant lending as part of their assessment area even if they do not run a branch in that county. Before 1995 those institutions that were lending to non-CRA areas in a county did not need to worry about its discriminatory implications under the CRA because that county could be left out of their self-reported community delineation. Under the new regulations, such counties must be part of their assessment area, and hence will bring CRA responsibilities with them. Therefore, this new setting further raises the costs of geographical expansion for the CRA-regulated institutions. These concerns had been predicted at the time of the introduction of the new rules, most notably, by Overby (1995).

I find some evidence consistent with these predictions on geographical expansion and contraction of the CRA-regulated institutions being affected by the CRA regulations. I compare CRA-regulated and non-regulated institutions, and find that post-1998 CRA-regulated institutions are relatively less likely to enter counties that are new to them if that county includes a CRA census tract. Furthermore, I find that they are also relatively more likely to withdraw from counties with CRA census tracts in the longer term. Below, I explain the methodology and results in more detail.

Using HMDA data from 1991 to 2009, I construct an institution-county-year panel, and identify observations that mark the year an institution lends for the first time in a county, and similarly those that mark the year an institution lends for the last time in a county. The variable $Entry_{bct}$ equals one if institution b originates mortgages for the first time in county c in year t, and zero otherwise. Similarly, the variable $Exit_{bct}$ equals

one if institution b stops originating mortgages in county c in year t, and zero otherwise. Furthermore, I define a dummy variable, $CRAC$, which equals one for counties that encompass a CRA-eligible census tract, and zero otherwise. I then estimate the following regressions using OLS as I control for a large number of fixed effects, namely bank-by-year and county-by-year fixed effects.

$$\mathbb{1}\{\text{Entry}\}_{bct} = \beta_1 \, Regulated_b \times CRAC_c + \beta_2 \, Post_t \times Regulated_b \times CRAC_c + \alpha_{bt} + \gamma_{ct} + \varepsilon_{bct} \tag{5}$$

$$\mathbb{1}\{\text{Exit}\}_{bct} = \beta_1 \, Regulated_b \times CRAC_c + \beta_2 \, Post_t \times Regulated_b \times CRAC_c + \alpha_{bt} + \gamma_{ct} + \varepsilon_{bct} \tag{6}$$

The coefficient of interest is β_2 in regressions (5) and (6) that respectively compares CRA-Regulated institutions' entry to and exit from counties with CRA-eligible census tracts with counties without CRA-eligible census tracts, relative to non-regulated institutions, before and after 1998. The results are presented in Table 7. Column (1) refers to entry decision and indicates that CRA-regulated institutions are 2.0% less likely to enter counties with a CRA-eligible census tract than other counties after 1998 relative to non-regulated institutions. Column (2) reports the results of the exit decision and indicates no statistical difference between regulated and non-regulated institutions and from counties with and without CRA-eligible census tracts. This findings is consistent with the idea that banks' old mortgage originations under the previous regime (before 1997) brings them some obligations regarding their post-1998 CRA compliance. This makes more sense if we remember that CRA examination cycles are every 5 years for smaller banks (those with less than $250 million in assets) and every 2 years for larger banks. Therefore, and as predicted by Overby (1995), exit in the short-run is not a significant concern. However, in the longer run it becomes an option and as presented in column (4) of Table 7, when extending the sample until 2006 we find that CRA-regulated institutions leave counties with CRA-eligible census tract relatively more frequently. These findings verify the fact that the CRA regulations may have affected banks' geographical

expansion in important ways and need to be acknowledged when studying banks' lending in response to the regulation.

7. Mortgage Supply and House Prices

Does a shift in mortgage supply generate extra growth in prices in the housing market? The real estate literature offers at least two reasons why this may be the case. Adelino et al. (2012) argue that a shift in supply of mortgages may enable more households, who would otherwise be out of the market for housing, to enter the market and bid on the existing properties and push real estate prices upward. Furthermore, for those borrowers who are already in the market but now have access to cheaper funds higher property prices may still be attractive hence they bargain less hard on the price.

Consistent with the documented shift in mortgage supply by CRA-regulated institution in CRA-eligible census tracts, I show that house price growth rates also increase in these areas after 1998 relative to before. Figure 3 provides the time series of house prices in CRA-eligible and ineligible census tracts from 1993 to 2009, showing a more pronounced boom-bust cycle for CRA-eligible census tracts. Regression results confirm this preliminary observation. Column (1) in Table 8 shows the results of the regression model (1) using house price growth as the outcome variable. The coefficient estimate of the interaction term $CRA \times Post$ implies that, compared to similar but ineligible census tracts, annual house price growth rate was on average 2.3 percentage points higher in CRA-eligible census tracts in the 1998-2002 period relative to the 1993-1997 period. This results is robust if we focus on a narrow range on income ratio (census tract median family income relative to MSA median family income) around the 80% threshold. Column (2) of Table 8 presents the results for a sample of census tracts with an income ratio in the [60%,100%] range, while column (3) relies on census tracts with an income ratio in the [70%,90%] range. Both samples show that annual house price growth rate increases in the CRA-eligible census tracts post-1998 by at least 1.5 percentage points. Finally, if we look at census tracts across income distribution, we see positive effects in the first,

second, and third quartile of income, although the estimate in the second quartile is not statistically significant. As before, there are no CRA-eligible census tracts in the fourth quartile of census tract median family income.[16]

Despite intuitive reasons why mortgage growth may generate higher house prices, empirical estimation of the elasticity of house prices to mortgage supply has been proven to be challenging. Particularly, demand effects have been shown to be an important factor in building up bubbles where traders extrapolate future returns based on past returns and form expectations about the future price, which furthermore encourages higher prices and higher trading volume (Barberis et al. (2018)). In addition, higher collateral value of the real estate in regions with growing prices enables borrowing-constrained households to apply for new mortgages (Kiyotaki and Moore (1997)). Therefore, it is crucial for any econometric estimate of supply effects of mortgage on house prices to make sure that the estimation approach is able to isolate a pure supply factor. Thus, I make use of the CRA setting as an exogenous shift in the supply of mortgages in 1998 to estimate this causal effect using the two-stage least square model presented in equations (3) and (4). The CRA originated an outward shift in mortgage supply that is unrelated to the actual or expected house prices, hence is a valid instrument in a regression of house price growth on mortgage growth.

The first column in Table 9 provides the estimates of the first-stage regression as in equation (3) of mortgage growth on CRA dummy, controlling for census tract median family income and other control variables. Conditional on having the same median family income, CRA-eligible tracts experienced higher mortgage growth. The test of weak instrument is rejected, based on the first-stage Sanderson-Windmeijer F-statistic and P-values reported in Table 9 (Sanderson and Windmeijer, 2016). Standard errors are clustered at the state level, to account for any possible within-state correlation of house prices (Petersen, 2009; Angrist and Pischke, 2009). Column 2 presents the results of the second-stage regressions as in equation (4). The coefficient estimate of 0.7 means that for every one percentage point higher annual growth of mortgage supply, house price growth

[16]Figure C2 in Appendix C shows the time series of house prices across census tract income quartiles.

rate will rise by 0.7 percentage points. In columns 3 and 4, I control for elasticity of housing supply following Saiz (2010). The sample size is smaller because of the missing housing supply elasticity data for several MSAs. Nevertheless, the results remain significant and imply a slightly larger effect of mortgage supply on house price growth. To further study the validity of the exclusion restriction assumption, I use mortgage origination by non-regulated institutions and rerun the IV estimates. This can be viewed as a placebo test for the exclusion restriction assumption that we need in the instrumental variable analysis: if, after controlling for income and other observables, (unobserved) demand for housing correlates with the variable *CRA*, we should also observe correlation between mortgage originated by non-regulated institutions and the dummy variable *CRA*. Results in Table 10 do not support this idea. The evidence also corroborates the hypothesis that the higher house price growth in CRA-eligible tracts was in fact partly caused by the shift in the supply of mortgages by the CRA-regulated banks.[17]

In sum, the positive causal effect of mortgage supply on house prices generated a more pronounced boom-bust cycle in CRA-eligible census tracts. Table 11 shows some further evidence in this respect. Annual house prices were growing faster in CRA-eligible census tracts between 1998 and 2006 and declined sharper during 2007 to 2009. Columns (1) to (4) show the results for the boom period, while columns (5) to (8) are those of the bust period. Columns (3) and (7) use a sample of observations with non-missing values for housing supply elasticity, while columns (4) and (8) use the counterpart sample, i.e., observations with missing values for housing supply elasticity. The findings regarding the increase in prices are robust and clear. However, the results for the bust period indicate that house prices declined more in CRA-eligible census tracts only in MSAs in which the measure of housing supply elasticity is available, which presumably are the largest MSAs. In sum, this pronounced boom-bust cycle is partly responsible for the higher delinquency rates of mortgages, a result that I will discuss in Section 8.

[17]Table C4 and Table C5 in Appendix C present the IV results when controlling for state-ids interacted with tract median family income, as well as house price growth at the county level.

8. Ex-ante versus Ex-post Riskiness of CRA-induced Mortgages

Whether or not the CRA set the stage for riskier lending by the affected banks is still an unresolved debate both in the academic and in the policy sphere. While Avery and Brevoort (2014) finds little evidence for higher price or delinquencies of CRA mortgages, Demyanyk and Van Hemert (2011) and Agarwal et al. (2012) document significantly lower quality for CRA mortgages. In this section, I revisit this question with an eye on the differences between the ex-ante and the ex-post riskiness of CRA-induced mortgages. As before, I compare mortgages extended to two census tracts with similar income levels while one is CRA-eligible and the other is not. I conduct this exercise both for mortgages originated by CRA-regulated institutions and non-regulated institutions.

The analysis in this section is at the mortgage level. I use Fannie Mae and Freddie Mac's Single Family Loan Level Datasets that both are publicly available data of fully amortizing, 30-year fixed-rate mortgages provided by the two institutions. Both include higher-quality loans, conforming to agency guidelines (Adelino et al. (2016)). I match this data to the mortgage origination data from HMDA based on the size of the mortgage, (3-digit) ZIP code, occupancy, and purpose of the loan. Of course, these few variables are not enough for a one-to-one match between HMDA and Fannie Mae and Freddie Mac's Single Family Loan Level Dataset. Therefore, I keep only those observations that are uniquely identified by the set of matching variables. This rather strict criteria thus reduces the size of the sample to about 177,020 mortgage originated by CRA-regulated institutions and 56,623 by non-regulated institutions out of a total of 5.5 million observations in the population of Fannie Mae and Freddie Mac's data, after also dropping observations with missing covariates. The advantage, however, is that we can make sure the origination and performance information pertain to the same mortgage. This matching then allows us to have the census tract information from HMDA.

The Fannie Mae's data starts in 2000 and Freddie Mac's in 1999. Therefore, I match this data with HMDA for the years from 1999 until 2006 and track performance infor-

mation up until the end of 2016. Summary statistics presented in Table 12 confirm that the matched sample is similar in characteristics to the population of mortgages in Fannie Mae and Freddie Mac's datasets. Mortgages have economically similar average size, FICO score and interest rate, and thus resemble a random sample from the population.

The estimation in this section is in essence similar to the previous sections. Conditional on census tract income level, I compare mortgage characteristics between those that are extended to households living in a CRA-eligible census tract to those from an ineligible census tract, within the same state. Moreover, I do this exercise separately for CRA-regulated and non-regulated institutions. The outcome variables of interest are the borrower's FICO score (the ex-ante measure of risk), the original interest rate of the mortgage contract, and finally a dummy variable that indicates whether the mortgage became delinquent or not (the ex-post measure of risk). Delinquent mortgages are the ones that are at least 90 days past due on their monthly payments, are in foreclosure, or are real estate-owned. I construct this variable by using Fannie Mae and Freddie Mac's mortgage performance data.

The results are presented in Table 13 for the mortgages originated by the CRA-regulated institutions. The coefficient estimate of the dummy variable *CRA* on the first column indicates that the mortgages extended to CRA-eligible census tracts by CRA-regulated institutions went to borrowers with about 1.9 points lower FICO score. This effect is about 3% of the standard deviation of FICO score in my sample. The second column indicates that these loans also had higher interest rates of about 0.03 percentage points. More importantly, using a probit model, I find that the probability of CRA-induced mortgages becoming delinquent were higher than similar loans that were extended to borrowers in ineligible census tracts. This finding is in line with the findings in Demyanyk and Van Hemert (2011) and Agarwal et al. (2012) who also find higher delinquency rates for CRA-induced mortgages. The estimates in columns 3 imply an 0.7 percentage points higher probability of delinquency for CRA mortgages. Considering that the average delinquency rate in my sample is 3.9%, CRA mortgages are 18% more likely to become delinquent than an average mortgage. The higher delinquency likelihood

of CRA mortgages is economically considerably large. In contrast to the small ex-ante differences in riskiness of CRA mortgages, ex-post they default disproportionately more frequently. This effect remains even after controlling for FICO score and interest rates as shown in column (4). In column 5, I control for the extent of the boom and the bust in house prices, and in column (6) for both ex-ante mortgage risk measures and the extent of housing boom-bust cycle. The estimate in column (6) implies a 10% higher likelihood of default for CRA mortgages relative to the average mortgage. This evidence is consistent with the view that the larger number of defaults in CRA-eligible census tracts was partly due to the more severe house price collapse in these neighbourhoods. Furthermore, this finding, combined with the results in Section 5 regarding the larger size of mortgages in CRA-eligible census tracts, suggests that the higher house prices (that were partly driven by the CRA-induced shift in mortgage supply as shown in Section 7) forced borrowers in these regions to take on larger mortgages, which subsequently made the households more sensitive to declines in house prices during the collapse of the housing markets.

I repeat the same analysis for mortgages originated by non-regulated institutions and find that they differ neither in FICO scores nor in delinquency rates between CRA-eligible and ineligible census tracts, but they show significant differences in terms of interest rates (Table 14). Finally, the findings in Table 15 show the difference-in-differences estimate of the risk measures. While FICO scores and interest rates of mortgages of CRA-regulated and non-regulated institutions in CRA-eligible census tracts do not statistically differ, delinquency rates of mortgages originated by CRA-regulated institutions in CRA-eligible census tracts remain significantly larger. Overall, there is more evidence for the riskiness of the CRA-regulated institutions' mortgages in CRA-eligible census tracts than for mortgages of non-regulated institutions.

8.1. Gentrification and the CRA

Even though in the earlier sections we saw that house prices, number of housing units and vacancy rates were comparable in the matched sample, there might still exist unob-

served demand effects that might confound the estimates of the effect of the CRA. If we believe that borrower demand for mortgage is symmetric across CRA-regulated and non-regulated institutions, then the concern that the results are driven by demand, rather than supply through the CRA, are less worrying as there is no evidence of increased lending by non-regulated institutions in CRA-eligible census tracts. Nevertheless, in this section, I discuss a crucial element of higher demand for housing, namely gentrification, that could have potentially important interactions with the CRA.

Gentrification creates demand for housing by replacing the relatively poorer residents of a neighbourhood with more affluent newcomers. In that sense, one would expect to see an improvement in the credit risk profile of neighbourhoods that are more influenced by gentrification. In particular, one expects an ex-ante improvement in credit scores and an ex-post improvement of loan performances. My findings, as presented in Table 13 do not confirm these hypotheses. First, I find that the borrowers in CRA-eligible areas have a lower FICO score. Second, mortgages generated from 1999 until 2006 became delinquent more often in CRA-eligible tracts. These findings are more consistent with a supply-side relaxation of credit constraints through the CRA, rather than a demand-side improvement in credit quality through gentrification. Nonetheless, I specifically test for the confoundedness of my results with gentrification. Following Ellen, Mertens Horn, and Reed (2017) and McKinnish, Walsh, and White (2010), I use the increase in the share of educated individuals (those with at least a bachelors degree or professional education) from 1990 to 2000 as a proxy for the intensity of gentrification at the census tract level and run a triple interaction model the results of which are presented in Table 16. *Gentrified* is a dummy that equals one for census tracts that experienced an increase in the share of educated population that places them in the top 10% of the distribution.[18] The triple interaction term is positive, but it is small and statistically insignificant. If gentrification was an important confounding factor for the CRA, we should have found a large and positive estimate for the triple interaction term, which is not the case.

[18]The results are robust to alternatively classifying the top 25% of census tracts as *Gentrified*.

9. Conclusion

In this paper, I studied the role of the CRA in the US housing boom-bust cycle in the 2000s. I showed that the CRA significantly contributed to the rise in the supply of mortgages and consequently to the surging prices in the real estate sector. I also showed that CRA-induced mortgages were riskier and defaulted more often. I used the strengthened enforcement of the CRA in 1998 as a quasi-experiment to instrument for the supply of credit, and estimated the elasticity of house price growth to mortgage supply.

My results document a clear mortgage supply channel as an additional contributing factor to the risks building up prior to the crisis, as proposed by Mian and Sufi (2009). However, I also show that the rise in mortgage and housing market was not concentrated only at the low-income segments of the market. CRA originated a shift in mortgage supply throughout the income distribution while within each income quartile more exposure to the CRA was associated with higher growth in mortgage supply and house prices. These findings are important in our thinking of the role of different income groups in generating the financial crisis.

Put together, this study documents a clear example of the unintended consequences of well-intentioned policies towards increasing homeownership among the less-advantaged households. A natural follow-up to this study will be to analyse the possible crowding-out effect on the commercial and industrial loans due to the CRA enforcement and its real effects. Furthermore, studying the competitive effects of the CRA on the quantity and the quality of mortgage originations by independent mortgage companies can inform the design and the supervision of the CRA in the future.

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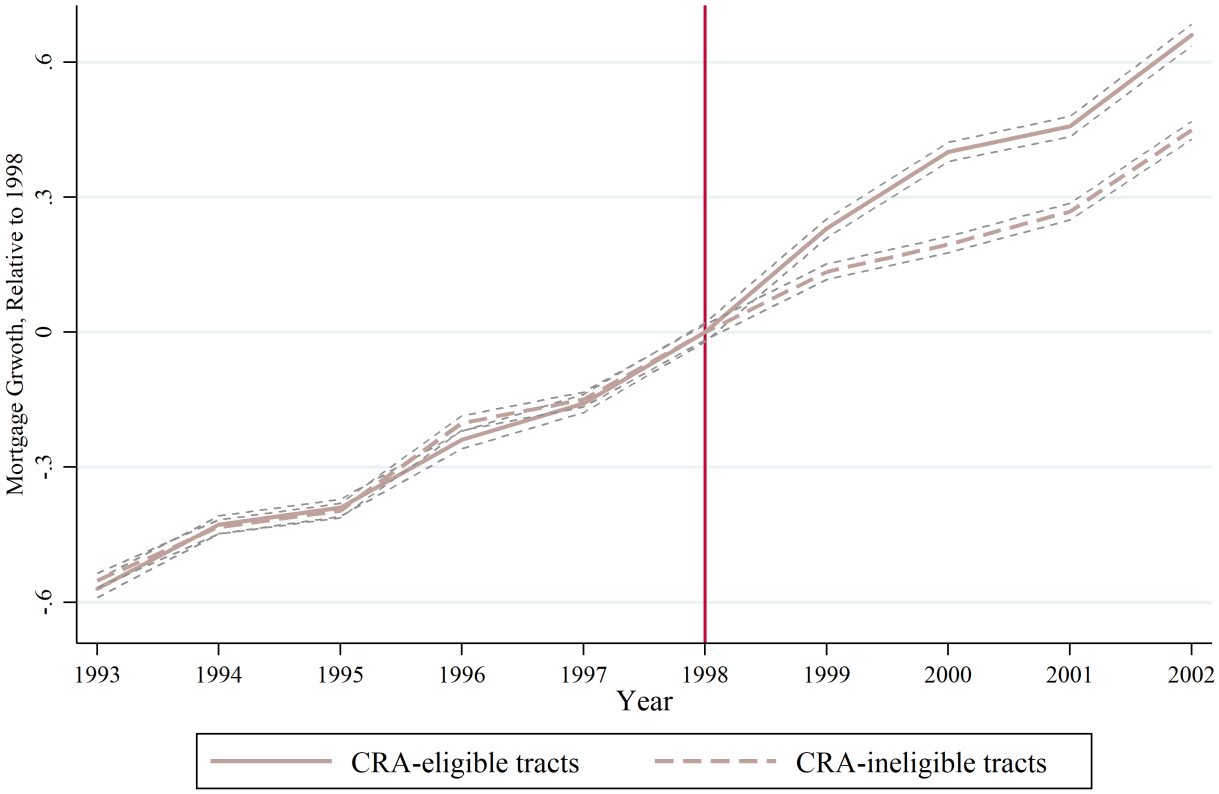
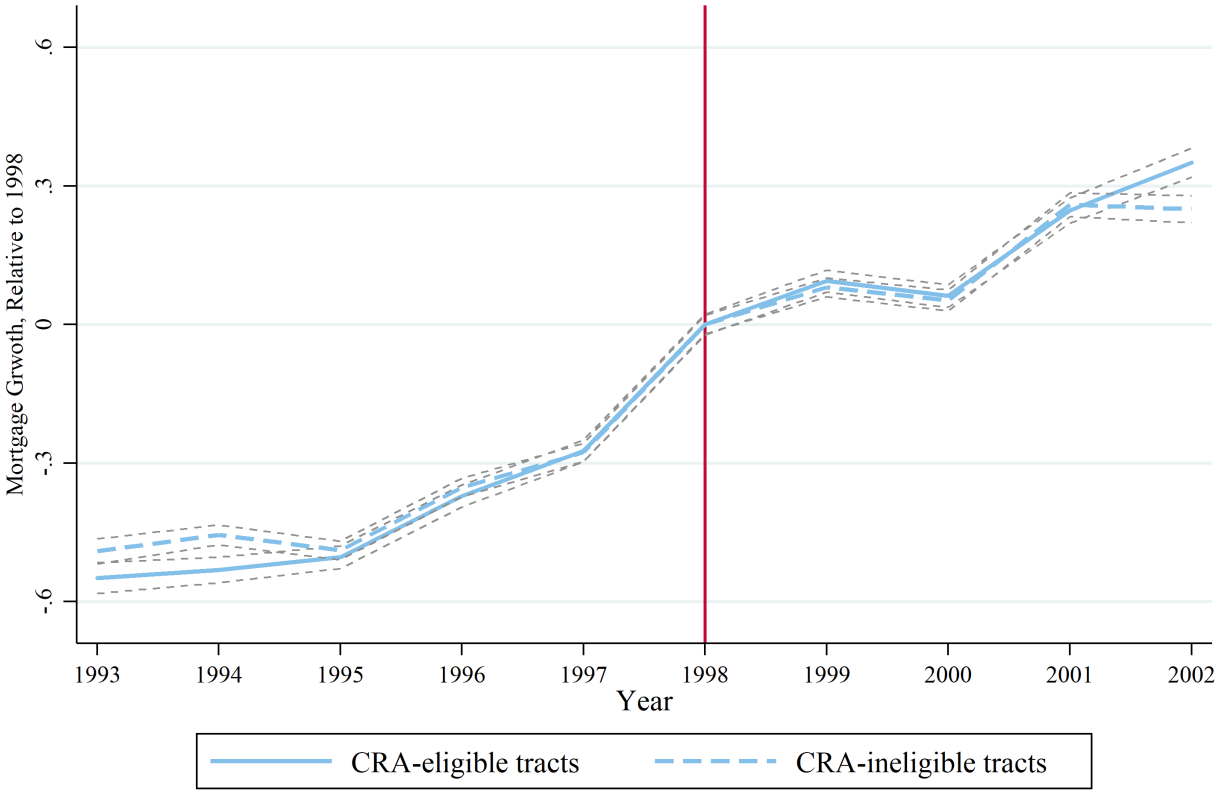
Figure 1. Growth in total amount of mortgage lending by CRA-regulated institutions



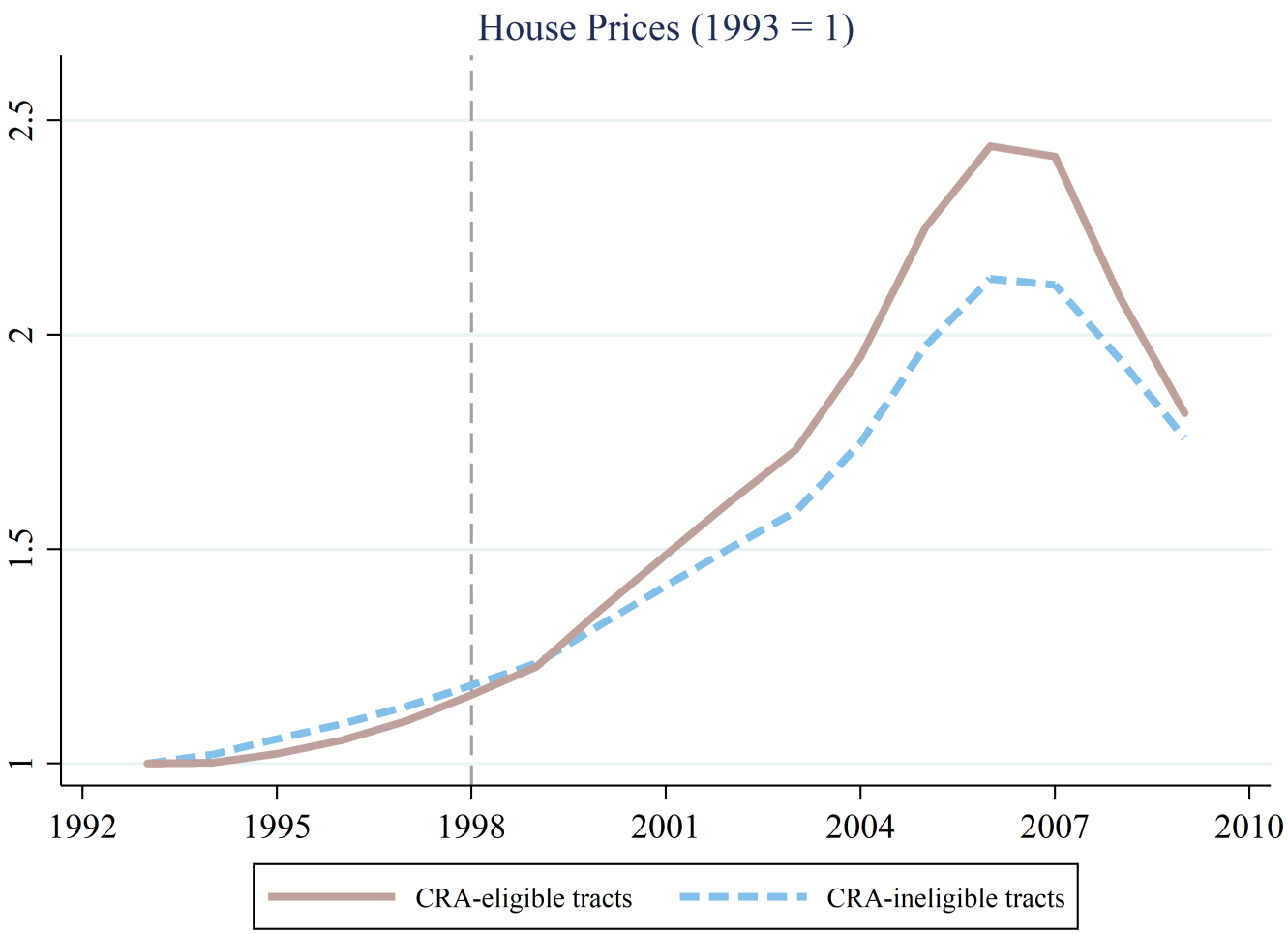
This figure illustrates total amount of mortgage origination by CRA-regulated institutions in CRA-eligible and ineligible census tracts. CRA-regulated institutions are those supervised by the FDIC, FRB, OCC and OTS. CRA-eligible census tracts are census tracts with a median family income of less than 80% of their respective MSA's median family income. Following Khwaja and Mian (2008), I normalize the y-axis so that the logarithm of total mortgage for both CRA-eligible and ineligible census tracts is forced to be 0 in 1998. Therefore, the time series illustrates the log-ratio of total mortgages in any given year relative to 1998, i.e., when the new enforcement mechanisms of the CRA became fully effective. The y-axis values can then be interpreted as growth rates in lending relative to 1998. The dashed lines represent the 5% confidence interval. The sample is originated as explained in Section 4.

Figure 2. Growth in total amount of mortgage lending by non-regulated institutions



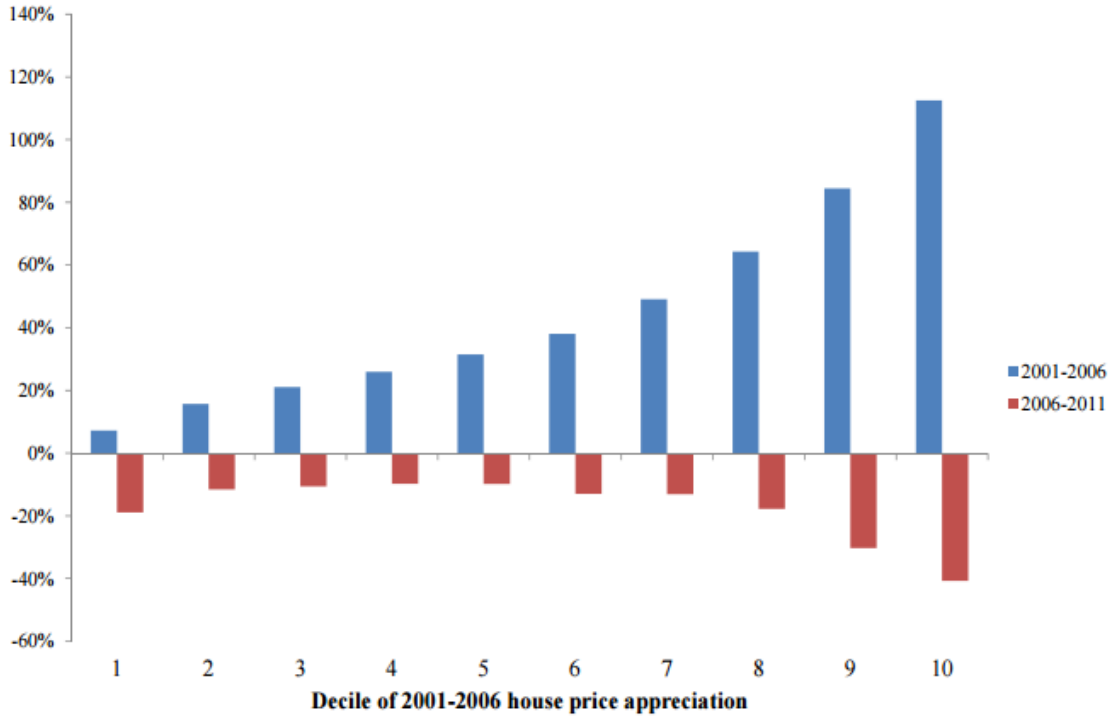
This figure illustrates total amount of mortgage origination by CRA-regulated institutions in CRA-eligible and ineligible census tracts. Non-regulated institutions are those that are supervised by NCUA or HUD and are not subject to the CRA regulations. CRA-eligible census tracts are census tracts with a median family income of less than 80% of their respective MSA's median family income. Following Khwaja and Mian (2008), I normalize the y-axis so that the logarithm of total mortgage for both CRA-eligible and ineligible census tracts is forced to be 0 in 1998. Therefore, the time series illustrates the log-ratio of total mortgages in any given year relative to 1998, i.e., when the new enforcement mechanisms of the CRA became fully effective. The y-axis values can then be interpreted as growth rates in lending relative to 1998. The dashed lines represent the 5% confidence interval. The sample is created as explained in Section 4.

Figure 3. House price dynamics in CRA-eligible and ineligible tracts



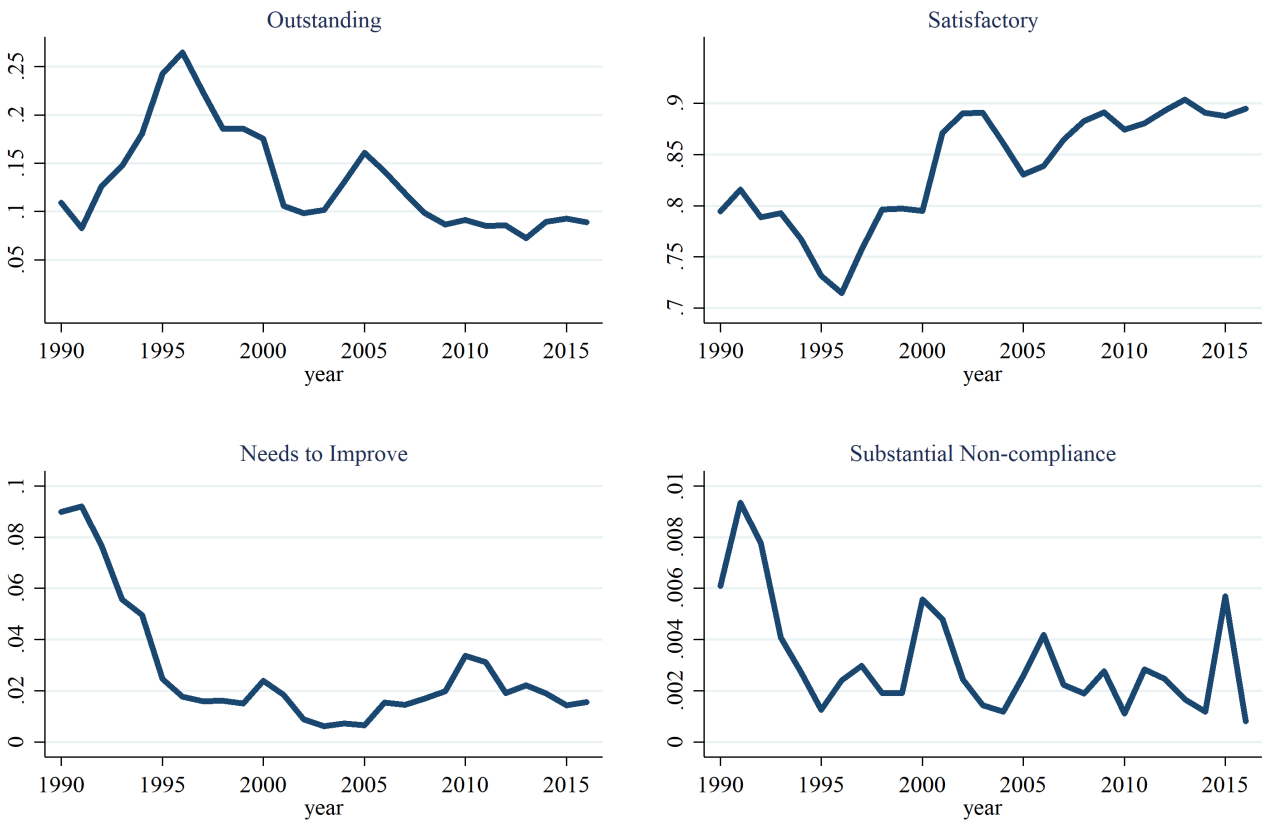
This figure illustrates the dynamics of house prices, normalized to 1993 levels, for CRA-eligible and ineligible census tracts. CRA-eligible census tracts are those with a median family income lower than 80% of their respective MSA's median family income. House price data is collected from the Federal Housing Finance Agency (FHFA).

Figure 4. Distribution of house price boom and bust at the county-level



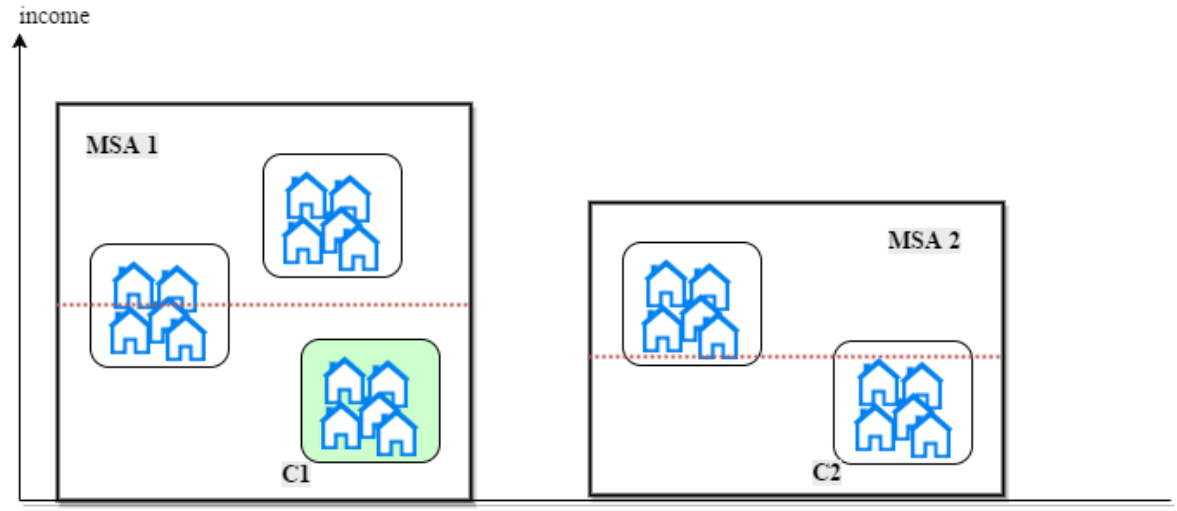
This figure is from Gropp et al. (forthcoming) and shows the heterogeneity in house price appreciation, at the county level, during the boom and depreciation during the bust period.

Figure 5. CRA ratings



This figure illustrates the frequency of each CRA rating as a share of all CRA examinations. *Outstanding* is the best rating followed by *Satisfactory*, *Needs to Improve*, and *Substantial Non-compliance*. The data is collected from the Federal Financial Institutions Examination Council's (FFIEC) web site.

Figure 6. Census tracts, metropolitan statistical areas and CRA-eligibility



This sketch shows the overlap of census tracts (small blocks) and MSAs (large blocks). Where the geographical areas lie on the y-axis indicates their median family income. For instance, the dotted line indicates the median family income in each MSA. Census tract C1 is therefore CRA-eligible because its median family income is less than 80% of the median family income of MSA 1. Census tract C2 in the neighbouring MSA has the same median family income as census tract C1 but is not CRA-eligible because its median family income is above 80% of median family income of MSA 2.

Table 1. CRA test components and rating scales

	CRA Test Components			Overall Rating
	Lending	Investment	Service	
Outstanding	12	6	6	20-24
High Satisfactory	9	4	4	11-19
Low Satisfactory	6	3	3	
Needs to Improve	3	1	1	5-10
Substantial Noncompliance	0	0	0	0-4

This table presents the grading scale for the three tests that the CRA regulators perform to assess banks' compliance with the CRA requirements. The three test are: lending, investment and service tests.

Table 2. Summary statistics of the census tract level sample

	N	Mean	Std. Dev.	Min	Max
	(1)	(2)	(3)	(4)	(5)
Total mortgages (Mil. $)	288804	2.326	3.254	0.001	182.6
Average mortgage (Mil. $)	288804	0.091	0.052	0.001	2.101
Number of mortgages	288804	25.30	28.51	1.000	1483
House price growth (%)	42332	4.772	6.650	-21.04	29.12
Tract MFI (Tsd. $)	288804	40.61	9.747	20.83	57.06
Population	288804	4262.3	2119.2	4.000	36146
Latent Demand	288804	15.56	8.174	0.000	50.00
Vacancy Rate	288804	8.378	6.537	0.000	84.23
Housing Units	288804	7.282	0.556	0.000	9.306
Employment Growth	288804	1.660	3.461	-24.69	31.77
Income Growth	288804	38.62	10.03	20.29	81.33
Population Growth	288804	11.37	13.27	-12.23	66.74
Elasticity	288804	1.670	0.934	0.630	5.450

This table reports the summary statistics of the census tract-by-year sample that covers the period 1993 to 2002. The sample is originated as explained in Section 4. Mortgage origination data is collected from HMDA. House price data at the census tract-by-year level is collected from Federal Housing Finance Agency (FHFA). Census tract level median family income (*Tract MFI*), *Population*, number of *Housing Units*, and the *Vacancy Rate* are collected from census data. *Latent Demand* is the average of annual mortgage application rejection rate, which is the number of denied applications (coded as 3 in the entry *type of action* in HMDA) as a share of total number of applications, at the census tract level annually in the 1993-1997 period. *Employment Growth* is annual county-level growth in employment from County Business Patterns (CBP) dataset of the Census Bureau. *Income Growth* at the county level is the growth in median household income at each county between the 1990 and the 2000 census waves. *Population Growth* at the county level is the growth in population between the 1990 and 2000 census waves. Supply *Elasticity* is borrowed from Saiz (2010) and measures the elasticity of housing supply at the MSA level. The sample is created as explained in Section 4.

Table 3. Mortgage growth

	CRA-Regulated Institutions			Non-Regulated Institutions			Both Institutions	
	Ln(Total Mortg.)	Ln(Avg. Size)	Ln(# Mortg.)	Ln(Total Mortg.)	Ln(Avg. Size)	Ln(# Mortg.)	Ln(Total Mortg.)	Ln(# Mortg.)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CRA	−0.010	0.033*	−0.056**	0.018	0.053***	−0.042	0.038	−0.032
	(0.030)	(0.018)	(0.026)	(0.038)	(0.018)	(0.038)	(0.049)	(0.044)
CRA × Post	0.170***	0.058***	0.103***	0.088**	0.048***	0.034	0.074*	0.023
	(0.033)	(0.014)	(0.025)	(0.035)	(0.012)	(0.027)	(0.039)	(0.030)
Tract MFI	0.051***	0.016***	0.030***	0.042***	0.012***	0.025***	0.042***	0.024***
	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.002)
Tract MFI × Post	0.005**	0.001	0.005***	0.002	0.003***	−0.000	0.001	−0.001
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Ln(Population)	0.577***	0.044**	0.485***	0.696***	0.009	0.600***	0.633***	0.540***
	(0.055)	(0.018)	(0.044)	(0.071)	(0.017)	(0.058)	(0.060)	(0.048)
Ln(Population) × Post	0.151***	0.029*	0.118***	0.071	0.042**	0.043	0.114***	0.082***
	(0.044)	(0.015)	(0.032)	(0.051)	(0.017)	(0.039)	(0.044)	(0.031)
Latent Demand	−0.025***	−0.009***	−0.014***	−0.025***	−0.012***	−0.011***	−0.025***	−0.012***
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Latent Demand × Post	0.003*	0.001**	0.000	0.005***	0.001**	0.003**	0.004***	0.001
	(0.001)	(0.000)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Vacancy Rate	−0.007***	0.001	−0.006***	−0.011***	0.001	−0.009***	−0.009***	−0.007***
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Vacancy Rate × Post	0.013***	0.003***	0.009***	0.008***	0.001*	0.006***	0.011***	0.007***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(Housing Units)	0.358***	−0.046**	0.349***	0.102	−0.025	0.097	0.232***	0.225***
	(0.062)	(0.018)	(0.052)	(0.086)	(0.016)	(0.073)	(0.070)	(0.060)
Ln(Housing Units) × Post	−0.145***	−0.060***	−0.059*	−0.001	−0.046***	0.044	−0.074*	−0.008
	(0.039)	(0.015)	(0.031)	(0.048)	(0.017)	(0.037)	(0.040)	(0.030)
Employment Growth	0.006**	−0.003**	0.008***	−0.004	−0.003**	−0.001	0.001	0.004**
	(0.003)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.002)
Employment Growth × Post	−0.001	0.003	−0.003	0.007*	0.002	0.004	0.003	0.001
	(0.004)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)
Income Growth	0.003	−0.003	0.006**	−0.012***	−0.005**	−0.006*	−0.004	0.000
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
Income Growth × Post	−0.001	0.004***	−0.005**	0.002	0.004***	−0.002	0.001	−0.003***
	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
Population Growth	0.007***	0.007***	0.000	0.016***	0.008***	0.007***	0.012***	0.004**
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Population Growth × Post	0.007***	−0.001	0.007***	−0.002	−0.001	−0.000	0.002**	0.003***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Elasticity	0.073*	−0.144***	0.194***	−0.098***	−0.157***	0.047	−0.012	0.121***
	(0.038)	(0.034)	(0.030)	(0.027)	(0.033)	(0.038)	(0.025)	(0.028)
Elasticity × Post	−0.099***	−0.035***	−0.057***	−0.032**	−0.031***	−0.001	−0.066***	−0.029***
	(0.021)	(0.007)	(0.016)	(0.015)	(0.006)	(0.013)	(0.013)	(0.009)
Regulated							0.219	0.253
							(0.184)	(0.157)
Tract MFI × Regulated							0.009***	0.007**
							(0.003)	(0.003)
Tract MFI × Regulated × Post							0.004**	0.007***
							(0.002)	(0.002)
Regulated × Post							−0.179	−0.291***
							(0.116)	(0.098)
CRA × Regulated × Post							0.112**	0.093**
							(0.047)	(0.040)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	146023	146023	146023	142781	142781	142781	288804	288804
Adj. R^2	0.653	0.559	0.647	0.593	0.554	0.543	0.620	0.595

This table reports the results of regression models in equations (1) and (2) using the census tract-by-year level sample. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. *Post* is a dummy variable that equals zero for the period 1993 to 1997, and one for the period from 1998 to 2002. *Regulated* is a dummy variable that equals one for mortgage originations by financial institutions that are supervised by the FDIC, FRB, OCC or OTS, and zero for those that are supervised by NCUA or HUD. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 4. Mortgage growth around the 80% cutoff

	Income Ratio ∈ [60%, 100%]			Income Ratio ∈ [70%, 90%]		
	CRA-Regulated Institutions	Non-Regulated Institutions	Both Institutions	CRA-Regulated Institutions	Non-Regulated Institutions	Both Institutions
	(1)	(2)	(3)	(4)	(5)	(6)
CRA	−0.100***	−0.053	−0.053	−0.072***	−0.038	−0.042
	(0.025)	(0.041)	(0.039)	(0.021)	(0.036)	(0.031)
CRA × Post	0.102***	0.035	0.025	0.074***	0.026	0.021
	(0.023)	(0.026)	(0.029)	(0.016)	(0.018)	(0.019)
Tract MFI × Regulated			0.004			0.004
			(0.005)			(0.006)
Tract MFI × Regulated × Post			0.009***			0.010**
			(0.003)			(0.004)
Regulated			0.391			0.359
			(0.274)			(0.305)
Post × Regulated			−0.398**			−0.407**
			(0.173)			(0.182)
CRA × Post × Regulated			0.090**			0.061**
			(0.040)			(0.025)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	93960	92344	186304	50835	50056	100891
Adj. R^2	0.626	0.515	0.573	0.622	0.511	0.570

This table reports the results of regression models in equations (1) and (2) using the census tract-by-year level sample. Columns (1) to (3) present the results for the sample limited to census tracts with an *Income Ratio* between 60% and 100%. *Income Ratio* is the ratio of census tract median family income to MSA median family income. Columns (4) to (6) present the results for the sample limited to census tracts with an *Income Ratio* between 70% and 90%. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. *Post* is a dummy variable that equals zero for the period 1993 to 1997, and one for the period from 1998 to 2002. *Regulated* is a dummy variable that equals one for mortgage originations by financial institutions that are supervised by the FDIC, FRB, OCC or OTS, and zero for those that are supervised by NCUA or HUD. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 5. Mortgage growth across income distribution

	CRA-Regulated Institutions			Non-Regulated Institutions		
	1st Quartile	2nd Quartile	3rd Quartile	1st Quartile	2nd Quartile	3rd Quartile
	(1)	(2)	(3)	(4)	(5)	(6)
CRA	−0.378	−0.010	−0.167***	−0.162	0.002	−0.132**
	(0.229)	(0.040)	(0.034)	(0.148)	(0.043)	(0.067)
CRA × Post	0.256***	0.085***	0.108***	0.168	0.028	0.009
	(0.066)	(0.031)	(0.033)	(0.106)	(0.032)	(0.039)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	37951	35835	36099	36482	35015	35524
Adj. R^2	0.466	0.575	0.618	0.431	0.502	0.519

This table reports the results of regression model in equation (1) using the census tract-by-year level sample, and across the quartiles of census tract median family income. There are no CRA-eligible census tracts in the top quartile of the distribution. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. *Post* is a dummy variable that equals zero for the period 1993 to 1997, and one for the period from 1998 to 2002. *Regulated* is a dummy variable that equals one for mortgage originations by financial institutions that are supervised by the FDIC, FRB, OCC or OTS, and zero for those that are supervised by NCUA or HUD. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 6. Mortgage originations by CRA-regulated institutions inside and outside assessment areas

	AAC ≡ Branch counties		AAC ≡ Branch counties plus top 5% non-branch counties		AAC ≡ Branch counties plus top 10% non-branch counties	
	AAC = 1	AAC = 0	AAC = 1	AAC = 0	AAC = 1	AAC = 0
	(1)	(2)	(3)	(4)	(5)	(6)
CRA	−0.064	−0.018	−0.069	−0.022	−0.071	−0.030
	(0.043)	(0.042)	(0.044)	(0.039)	(0.047)	(0.040)
CRA × Post	0.068**	0.059	0.124***	0.032	0.138***	0.041
	(0.033)	(0.045)	(0.037)	(0.040)	(0.044)	(0.052)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	127697	126539	128318	125881	128482	125468
Adj. R^2	0.477	0.614	0.491	0.604	0.501	0.585

This table reports the results of regression model in equation (1) using the census tract-by-year level sample, and separately for mortgages originated inside and outside assessment area counties ((AAC)). In columns (1) and (2) AAC for each bank is defined as counties in which that bank has a branch. In columns (3) and (4) the AAC not only includes branch counties, but also the non-branch counties in the post-1998 period for each bank in which the share of that bank's mortgage origination to non-CRA census tracts relative to the bank's total lending, in either of the two pre- and post-1998 period, is in the top 5% of the distribution and the county includes at least one CRA-eligible census tract. In columns (5) and (6) the AAC not only includes branch counties, but also the non-branch counties in the post-1998 period for each bank in which the share of that bank's mortgage origination to non-CRA census tracts relative to the bank's total lending, in either of the two pre- and post-1998 period, is in the top 10% of the distribution and the county includes at least one CRA-eligible census tract. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. *Post* is a dummy variable that equals zero for the period 1993 to 1997, and one for the period from 1998 to 2002. *Regulated* is a dummy variable that equals one for mortgage originations by financial institutions that are supervised by the FDIC, FRB, OCC or OTS, and zero for those that are supervised by NCUA or HUD. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 7. Banks' entry to and exit from counties with CRA-eligible census tracts

	Period 1993-2002		Period 1993-2006	
	Entry	Exit	Entry	Exit
	(1)	(2)	(3)	(4)
Regulated × CRAC	0.052***	0.002	0.052***	0.002
	(0.008)	(0.002)	(0.008)	(0.002)
Post × Regulated × CRAC	−0.020**	0.001	−0.026***	0.011***
	(0.008)	(0.003)	(0.007)	(0.003)
Bank-Year FE	Yes	Yes	Yes	Yes
County-Year FE	Yes	Yes	Yes	Yes
Observations	804103	804103	1377190	1377190
Adj. R^2	0.499	0.742	0.498	0.686

This table reports the results of regression models in equations (5) and (6). *Entry* is a dummy variable that equals one for observations that mark the first time a bank originates a mortgage in a county during the period of 1991 to 2009. *Exit* is a dummy variable that equals one for observations that mark the last time a bank originates a mortgage in a county during the period of 1991 to 2009. *CRAC* is a dummy variable that equals one for counties that include at least one CRA-eligible census tract. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. *Post* is a dummy variable that equals zero for the period 1993 to 1997, and one for the period from 1998 to 2002 in columns (1) and (2) and the period from 1998 to 2006 in columns (3) and (4). *Regulated* is a dummy variable that equals one for mortgage originations by financial institutions that are supervised by the FDIC, FRB, OCC or OTS, and zero for those that are supervised by NCUA or HUD. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 8. House price growth

	All	Income Ratio		Income distribution		
		[60%,100%]	[70%,90%]	1st Quartile	2nd Quartile	3rd Quartile
	(1)	(2)	(3)	(4)	(5)	(6)
CRA	−0.558	−0.220	−0.021	−1.083**	0.820*	−0.584
	(0.439)	(0.439)	(0.388)	(0.526)	(0.469)	(0.660)
CRA × Post	2.201***	2.004**	1.486**	2.518***	1.010	3.409***
	(0.821)	(0.805)	(0.628)	(0.812)	(0.732)	(1.238)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	42332	31866	18592	10208	10201	10943
Adj. R^2	0.283	0.273	0.282	0.274	0.270	0.290

This table reports the results of regression model in equation (1) using the census tract-by-year level sample. Columns (2) and (3) present the results for the sample limited to census tracts with an *Income Ratio* between 60% and 100%, or between 70% and 90%, respectively. *Income Ratio* is the ratio of census tract median family income to MSA median family income. Columns (4) to (6) present the results across the quartiles of census tract median family income. There are no CRA-eligible census tracts in the top quartile of the distribution. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. *Post* is a dummy variable that equals zero for the period 1993 to 1997, and one for the period from 1998 to 2002. *Regulated* is a dummy variable that equals one for mortgage originations by financial institutions that are supervised by the FDIC, FRB, OCC or OTS, and zero for those that are supervised by NCUA or HUD. House price data is collected from the Federal Housing Finance Agency (FHFA) and is at the census tract level. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 9. IV analysis

	(1st Stage) Mortgage Growth (1)	(2nd Stage) Δ HPG (2)	(1st Stage) Mortgage Growth (3)	(2nd Stage) Δ HPG (4)
CRA	2.911***		1.243**	
	(0.588)		(0.616)	
Mortgage growth		0.701***		1.048**
		(0.130)		(0.501)
Tract MFI	0.104***	0.013	−0.027	0.082
	(0.038)	(0.018)	(0.052)	(0.064)
Ln(Population)	2.303***	−1.605**	1.353	−2.171*
	(0.849)	(0.665)	(1.117)	(1.169)
Latent Demand	0.018	−0.046**	−0.050	0.034
	(0.032)	(0.023)	(0.042)	(0.058)
Vacancy Rate	0.163***	−0.097***	0.148***	−0.154*
	(0.028)	(0.027)	(0.040)	(0.081)
Ln(Housing Units)	−2.587***	2.069***	−2.261*	2.982*
	(0.864)	(0.643)	(1.245)	(1.517)
Employment Growth	−0.143	0.014	−0.196	0.210
	(0.225)	(0.136)	(0.362)	(0.366)
Income Growth	0.083	−0.118***	0.165**	−0.204*
	(0.063)	(0.033)	(0.078)	(0.115)
Population Growth	0.090**	−0.057*	0.070	−0.102
	(0.040)	(0.030)	(0.063)	(0.069)
Elasticity			−0.940	0.367
			(0.669)	(0.627)
State FE	Yes	Yes	Yes	Yes
Observations	6416	6416	4006	4006
F-statistic	25.82		4.34	
P-value	0.000		0.047	

This table reports the results of regression models in equations (3) and (4) using the census tract level sample, for the mortgage origination by CRA-regulated institutions, i.e., financial institutions that are supervised by the FDIC, FRB, OCC or OTS. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. The F-test statistics and p-values for tests of weak excluded instruments in the first-stage regressions are reported based on Sanderson and Windmeijer (2016). House price data is collected from the Federal Housing Finance Agency (FHFA) and is at the census tract level. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 10. IV analysis - Placebo tests

	(1st Stage) Mortgage Growth (1)	(2nd Stage) Δ HPG (2)	(1st Stage) Mortgage Growth (3)	(2nd Stage) Δ HPG (4)
CRA	0.647		1.010	
	(0.571)		(0.764)	
Mortgage growth		3.156		1.289
		(2.666)		(0.979)
Tract MFI	−0.015	0.134	0.018	0.031
	(0.038)	(0.147)	(0.030)	(0.032)
Ln(Population)	1.861	−5.864	0.450	−1.333
	(1.239)	(5.775)	(1.583)	(1.877)
Latent Demand	0.124***	−0.425	0.147***	−0.209
	(0.034)	(0.355)	(0.039)	(0.175)
Vacancy Rate	0.166***	−0.506	0.166**	−0.212
	(0.036)	(0.456)	(0.064)	(0.172)
Ln(Housing Units)	−1.366	4.564	−0.490	1.244
	(1.126)	(4.759)	(1.532)	(1.630)
Employment Growth	0.147	−0.552	0.552	−0.707
	(0.220)	(0.817)	(0.378)	(0.831)
Income Growth	0.225***	−0.769	0.153***	−0.228
	(0.044)	(0.619)	(0.034)	(0.152)
Population Growth	−0.036	0.119	−0.062	0.052
	(0.043)	(0.164)	(0.065)	(0.111)
Elasticity			−0.843	0.469
			(0.608)	(1.208)
State FE	Yes	Yes	Yes	Yes
Observations	6415	6415	4006	4006
F-statistic	0.65		1.75	
P-value	0.425		0.197	

This table reports the results of regression models in equations (3) and (4) using the census tract level sample, for the mortgage origination by non-regulated institutions, i.e., financial institutions that are supervised by the NCUA or HUD. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. The F-test statistics and p-values for tests of weak excluded instruments in the first-stage regressions are reported based on Sanderson and Windmeijer (2016). House price data is collected from the Federal Housing Finance Agency (FHFA) and is at the census tract level. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 11. CRA-induced growth in house prices: The boom-bust cycle

	The Boom Period of [1998,2006]				The Bust Period of [2007,2009]			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CRA	0.984***	0.593***	0.843***	0.682***	−1.299***	−0.183	−0.353	−1.374**
	(0.146)	(0.175)	(0.236)	(0.183)	(0.300)	(0.222)	(0.280)	(0.602)
Tract MFI	0.010	−0.017*	−0.003	0.003	0.029	0.069***	0.060**	0.051
	(0.009)	(0.010)	(0.013)	(0.010)	(0.023)	(0.025)	(0.029)	(0.036)
Ln(Population)	0.962***	0.590*	0.675**	0.860**	−3.298***	−3.245***	−3.314***	−2.967***
	(0.282)	(0.302)	(0.332)	(0.347)	(0.564)	(0.701)	(0.700)	(0.838)
Latent Demand	−0.036***	−0.032***	−0.038***	−0.026***	0.133***	0.120***	0.125***	0.113***
	(0.009)	(0.010)	(0.011)	(0.007)	(0.019)	(0.028)	(0.025)	(0.022)
Vacancy rate	0.063***	0.037***	0.038***	0.064***	0.006	0.023	0.023	−0.015
	(0.010)	(0.013)	(0.013)	(0.008)	(0.014)	(0.021)	(0.021)	(0.015)
Ln(Housing Units)	−1.332***	−1.254***	−1.394***	−0.988***	3.274***	3.277***	3.387***	3.232***
	(0.297)	(0.378)	(0.425)	(0.296)	(0.521)	(0.700)	(0.685)	(0.742)
Employment Growth	0.141***	0.179**	0.179**	0.112***	0.177***	0.274**	0.275**	0.042
	(0.039)	(0.070)	(0.070)	(0.034)	(0.063)	(0.118)	(0.119)	(0.048)
Income Growth	−0.060***	−0.056**	−0.062**	−0.045***	−0.008	−0.006	−0.003	0.006
	(0.016)	(0.023)	(0.026)	(0.016)	(0.044)	(0.052)	(0.053)	(0.054)
Population Growth	0.017	0.019	0.013	0.054***	−0.080***	−0.071***	−0.067**	−0.094***
	(0.012)	(0.019)	(0.019)	(0.010)	(0.018)	(0.025)	(0.026)	(0.026)
Elasticity		−0.878***				0.580		
		(0.218)				(0.541)		
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	147186	90982	90982	56204	54418	33590	33590	20828
Adj. R^2	0.349	0.350	0.347	0.373	0.433	0.412	0.411	0.508

This table reports the results of house price growth regressions using the census tract-by-year level sample during two periods: the boom period of 1998 to 2006 in columns (1) to (4), and the bust period of 2007 to 2009 in columns (5) to (8). *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. Columns (3) and (7) report the regressions using the sample with non-missing observations for the variable *Elasticity*. Columns (4) and (8) report the regressions using the sample with missing observations for the variable *Elasticity*. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 12. Mortgage risk characteristics: Population versus the matched sample

	Obs.	Mean	Std.	Min	Max
Population of mortgages from Freddie Mac					
Mortgage size (Tsd. $)	5504439	157.5	77.65	1.00	802.0
FICO score	5504439	726.7	54.91	300.0	850.0
Interest rate (%)	5504439	6.56	0.93	2.99	13.50
Matched sample of mortgages from Freddie Mac and HMDA					
Mortgage size (Tsd. $)	233653	169.1	85.10	4.00	802.0
FICO score	233653	722.4	55.14	300.0	850.0
Interest rate (%)	233653	6.84	0.92	3.00	11.50

This table compares the characteristics of the population of mortgages in Fannie Mae and Freddie Mac's Single Family Loan-Level Datasets and the matched sample to the universe of mortgages in Home Mortgage Disclosure Act (HMDA). I match mortgages in Freddie Mac's data to HMDA by using the size of the mortgage, ZIP code, occupancy, and purpose of the loan and only keep the unique matches.

Table 13. Mortgage risk: CRA-regulated mortgages

	FICO	Int. Rate	Delinquent	Delinquent	Delinquent	Delinquent
	(1)	(2)	(3)	(4)	(5)	(6)
CRA	−1.875***	0.031***	0.007***	0.005***	0.006***	0.004**
	(0.635)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)
Tract MFI	0.110***	−0.001***	−0.000***	−0.000***	−0.000***	−0.000***
	(0.010)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mortgage Size	0.001	−0.001***	−0.000	0.000	−0.000	0.000
	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Population)	−2.191***	−0.012**	0.001	0.000	0.000	−0.000
	(0.679)	(0.005)	(0.002)	(0.001)	(0.002)	(0.002)
Latent Demand	−0.143***	0.001***	0.000***	0.000*	0.000***	0.000*
	(0.044)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Vacancy Rate	−0.021	0.000	0.000	0.000	0.000	0.000
	(0.034)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Housing Units)	3.487***	0.004	−0.004***	−0.002	−0.003*	−0.001
	(0.593)	(0.005)	(0.002)	(0.001)	(0.002)	(0.002)
Employment Growth	−0.171***	0.000	−0.000	−0.000	−0.000	−0.000
	(0.050)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Income Growth	0.219***	−0.001***	−0.000	−0.000	−0.000	−0.000
	(0.051)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Population Growth	−0.020	0.000	−0.000	−0.000	−0.000	−0.000
	(0.027)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Elasticity	0.432	−0.024***	−0.001	0.000	−0.001	−0.000
	(0.626)	(0.005)	(0.002)	(0.001)	(0.002)	(0.001)
FICO Score				−0.001***		−0.001***
				(0.000)		(0.000)
Int. Rate				0.018***		0.018***
				(0.001)		(0.001)
HPG (Boom)					−0.005***	−0.004***
					(0.001)	(0.001)
HPG (Bust)					−0.007***	−0.004*
					(0.002)	(0.002)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	177026	177026	177020	177020	177020	177020
Adj. (Pseudo) R^2	0.021	0.771	0.036	0.132	0.036	0.133

This table reports mortgage risk regressions for mortgages originated by CRA-regulated institutions, i.e., financial institutions that are supervised by the FDIC, FRB, OCC or OTS. The sample includes mortgages from Fannie Mae and Freddie Mac's Single Family Loan-level datasets and spans the years from 1999 to 2006. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. The dependent variables are *FICO* score in column (1), original interest rate (*Int. Rate*) in column (2), and a dummy variables that equals one for delinquent mortgages, in columns (3) to (6). *Delinquent* mortgages are those that are at least 90 days past due on their monthly payments, are in foreclosure, or are real estate-owned. The results reported in columns (3) to (6) are marginal effects of the corresponding *probit* regressions. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 14. Mortgage risk: Non-regulated mortgages

	FICO	Int. Rate	Delinquent	Delinquent	Delinquent	Delinquent
	(1)	(2)	(3)	(4)	(5)	(6)
CRA	−0.676	0.038***	0.000	−0.001	0.001	−0.000
	(1.070)	(0.007)	(0.003)	(0.002)	(0.003)	(0.003)
Tract MFI	0.085***	−0.000	−0.000***	−0.000***	−0.000***	−0.000***
	(0.022)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mortgage Size	0.001	−0.001***	−0.000***	−0.000***	−0.000***	−0.000***
	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Population)	−1.725*	−0.009	−0.000	−0.002	0.000	−0.001
	(1.008)	(0.009)	(0.002)	(0.002)	(0.002)	(0.002)
Latent Demand	−0.150***	0.001*	0.000*	0.000	0.000*	0.000
	(0.051)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Vacancy Rate	−0.024	0.001	0.000	0.000	0.000	0.000
	(0.041)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Housing Units)	2.831***	−0.002	−0.004	−0.001	−0.004*	−0.002
	(0.890)	(0.008)	(0.002)	(0.002)	(0.002)	(0.002)
Employment Growth	−0.011	0.001**	0.000	0.000	0.000	0.000
	(0.085)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Income Growth	0.139**	−0.001	0.000	0.000	0.000	0.000
	(0.059)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Population Growth	−0.076*	0.000	−0.000	−0.000	−0.000	−0.000
	(0.039)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Elasticity	0.499	−0.032***	−0.004**	−0.002	−0.004**	−0.002
	(0.735)	(0.008)	(0.002)	(0.001)	(0.002)	(0.001)
FICO Score				−0.001***		−0.001***
				(0.000)		(0.000)
Int. Rate				0.016***		0.016***
				(0.001)		(0.001)
HPG (Boom)					0.000	0.001
					(0.001)	(0.002)
HPG (Bust)					−0.005*	−0.002
					(0.003)	(0.003)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	56627	56627	56623	56623	56623	56623
Adj. (Pseudo) R^2	0.018	0.742	0.042	0.164	0.043	0.164

This table reports mortgage risk regressions for mortgages originated by non-regulated institutions, i.e., financial institutions that are supervised by the NCUA or HUD. The sample includes mortgages from Fannie Mae and Freddie Mac's Single Family Loan-level datasets and spans the years from 1999 to 2006. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. The dependent variables are *FICO* score in column (1), original interest rate (*Int. Rate*) in column (2), and a dummy variables that equals one for delinquent mortgages, in columns (3) to (6). *Delinquent* mortgages are those that are at least 90 days past due on their monthly payments, are in foreclosure, or are real estate-owned. The results reported in columns (3) to (6) are marginal effects of the corresponding *probit* regressions. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 15. Mortgage risk: Difference-in-differences analysis

	FICO	Int. Rate	Delinquent	Delinquent
	(1)	(2)	(3)	(4)
CRA	−0.643	0.039***	0.000	−0.001
	(1.089)	(0.007)	(0.003)	(0.003)
Regulated	−2.647**	0.020	−0.006	−0.006
	(1.270)	(0.012)	(0.005)	(0.005)
CRA × Regulated	−1.203	−0.007	0.006**	0.006*
	(1.037)	(0.007)	(0.003)	(0.003)
Tract MFI	0.093***	−0.000	−0.000***	−0.000***
	(0.021)	(0.000)	(0.000)	(0.000)
Tract MFI × Regulated	0.015	−0.000**	0.000	0.000
	(0.018)	(0.000)	(0.000)	(0.000)
Mortgage Size	0.002	−0.001***	−0.000**	0.000
	(0.003)	(0.000)	(0.000)	(0.000)
Ln(Population)	−2.127***	−0.012**	0.001	−0.001
	(0.674)	(0.005)	(0.001)	(0.001)
Latent Demand	−0.142***	0.001***	0.000***	0.000*
	(0.040)	(0.000)	(0.000)	(0.000)
Vacancy Rate	−0.027	0.000*	0.000	0.000
	(0.032)	(0.000)	(0.000)	(0.000)
Ln(Housing Units)	3.395***	0.003	−0.004***	−0.001
	(0.575)	(0.005)	(0.001)	(0.001)
Employment Growth	−0.138***	0.000	0.000	0.000
	(0.045)	(0.000)	(0.000)	(0.000)
Income Growth	0.206***	−0.001**	−0.000	−0.000
	(0.050)	(0.000)	(0.000)	(0.000)
Population Growth	−0.038	0.000	−0.000	−0.000
	(0.027)	(0.000)	(0.000)	(0.000)
Elasticity	0.421	−0.026***	−0.001	−0.001
	(0.590)	(0.006)	(0.001)	(0.001)
Year FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Observations	233653	233653	233653	233653
Adj. R^2	0.020	0.770	0.036	0.138

This table reports mortgage risk difference-in-difference regressions between mortgages originated by CRA-regulated and non-regulated institutions. The sample includes mortgages from Fannie Mae and Freddie Mac's Single Family Loan-level datasets and spans the years from 1999 to 2006. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. *Regulated* is a dummy variable that equals one for mortgage originations by financial institutions that are supervised by the FDIC, FRB, OCC or OTS, and zero for those that are supervised by NCUA or HUD. The dependent variables are *FICO* score in column (1), original interest rate (*Int. Rate*) in column (2), and a dummy variables that equals one for delinquent mortgages, in columns (3) and (4). *Delinquent* mortgages are those that are at least 90 days past due on their monthly payments, are in foreclosure, or are real estate-owned. The results reported in columns (3) and (4) are marginal effects of the corresponding *probit* regressions. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table 16. Gentrification and CRA lending

	CRA-Regulated (1)	Non-Regulated (2)	Both (3)
CRA	−0.054**	−0.030	−0.026
	(0.024)	(0.036)	(0.042)
CRA × Post	0.092***	0.037	0.019
	(0.025)	(0.029)	(0.032)
CRA × Gentrified × Post	0.068**	−0.019	0.023
	(0.031)	(0.038)	(0.030)
CRA × Gentrified	0.015	−0.032	−0.005
	(0.063)	(0.045)	(0.051)
Gentrified × Post	0.052***	−0.011	0.022
	(0.015)	(0.021)	(0.014)
Gentrified	−0.109***	−0.228***	−0.168***
	(0.024)	(0.036)	(0.025)
Tract MFI × Regulated			0.007**
			(0.003)
Tract MFI × Regulated × Post			0.007***
			(0.002)
Regulated			0.253
			(0.158)
Post × Regulated			−0.291***
			(0.098)
CRA × Post × Regulated			0.093**
			(0.040)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Observations	146023	142781	288804
Adj. R^2	0.648	0.550	0.598

This table reports the results of a triple-difference analysis of the interaction between the CRA and gentrification. *Gentrified* is a dummy variable that equals one for census tracts in which the change in the share of educated residents (those with at least a bachelors degree or professional education), from the 1990 census to the 2000 census, are at the top 10% of the distribution, and zero otherwise. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. *Post* is a dummy variable that equals zero for the period 1993 to 1997, and one for the period from 1998 to 2002. *Regulated* is a dummy variable that equals one for mortgage originations by financial institutions that are supervised by the FDIC, FRB, OCC or OTS, and zero for those that are supervised by NCUA or HUD. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Appendix A. Matching Difference-in-Differences Analysis

An alternative approach to estimation based on the same identification assumptions as in the main text is to rely on exact matching of census tracts based on median family income. One can compare the change of the outcome variables, from the pre-1998 period to the post-1998 period, in each CRA-eligible census tracts with a CRA-ineligible census tract that has the same median family income but is not CRA-eligible only due to the fact that it is placed in a MSA, in the same state, with slightly lower median family income. This exact matching on income will result in a much smaller sample but has the advantage of removing several of observable differences between eligible and ineligible census tracts. CRA-eligible census tracts are different from CRA-ineligible census tracts especially in terms of income distribution. Table A1 compares observable characteristics of the two types of census tracts before and after matching them on median family income. Panel A of the table shows that before matching CRA-eligible census tracts have significantly lower median family income and receive much lower mortgage both from the CRA-regulated and non-regulated institutions. They also have a much higher rejection rates from regulated and non-regulated institutions as shown by the differences in the variable *Latent demand*. Interestingly, house prices and house price growth rates are similar across the two types of eligible and ineligible census tracts before 1998, though housing units and vacancy rates are different. County-level employment growth, income growth, and population growth are also significantly different across the two types of census tracts in the pre-1998 period. Matching on tract median family income reduces several of these differences significantly, and in many cases removes the differences altogether. As presented in Panel B of Table A1, the matching strategy generates comparable groups in terms of median family income, pre-1998 mortgage originations, house price growth, housing units, vacancy rates, county-level income growth and finally, the elasticity of housing supply. While there are still some other variables that are significantly different across the two groups, most importantly latent demand and county-level population growth, the differences are less significant

than the case without matching on median family income. Nevertheless, thee results indicate the importance of controlling for such observable characteristics in the difference-in-differences regressions in the main text.

The results of the difference-in-differences matching estimations are presented in Table A2. Each cell in this table presents the matching estimate of the average treatment effect on the treated, where the treated group is the set of CRA-eligible census tracts. The number of matches are chosen to be one and the caliper to be \$10. The results are robust to the choice of these parameters. I allow for replacement of the matched observations in all specifications. Panel A of Table A2 presents the results of the matching exercise using all the observations in the sample. The first, second and third rows present the effect on the total amount of mortgages, size of the average mortgage, and the number of mortgages, respectively. The results show that annual volume of mortgages originated by CRA-regulated institutions in CRA-eligible census tracts increased by 5.7 percentage points more after 1998, compared to the matched ineligible census tracts. The right-most column in Table A2 presents the results for the non-regulated institutions and indicates no significant difference in growth of total mortgages between CRA-eligible and the matched set of CRA-ineligible census tracts.

Although I compare similar-income census tracts to each other, they are placed in MSAs with different income levels, hence affecting their relative attractiveness and growth potential versus their surrounding. First, note that if there were different demand effects between eligible and matched ineligible census tracts we would find significant results for the mortgages originated by non-regulated institutions too. Second, and to address this issue more directly, I confine the sample to census tracts that have an income ratio in the vicinity of the 80% threshold. Panel B (Panel C) of Table A2 presents the results in the sample restricted to census tracts with a median family income in the range of $[0.6, 1.0]$ ($[0.7, 0.9]$) relative to their MSA. The estimates are again strongly significant for mortgage originations by the regulated institutions and insignificant for the mortgages originated by the non-regulated institutions.

The estimated effect comes from both the intensive and the extensive margin: Both

the size of the average mortgage and the total number of mortgages differ. However, the effect on the number of originated mortgages is twice as large as the effect on the average size of the mortgage. This is consistent with the fact that the purpose of the CRA was to incentivize banks to provide mortgages to otherwise-constrained borrowers and not to provide larger mortgages to unconstrained homeowners. The annual number of mortgages originated by the CRA-regulated institutions grew by about 3.4 percentage points more in an average eligible census tract compared to ineligible census tracts, while the growth in the size of the average mortgage was about 1.8 percentage points larger.

The effects on the number of mortgages are insignificant for non-regulated institutions. However, although non-regulated institutions did not have to comply with the CRA regulations, I find that the average size of the non-regulated mortgages also increase significantly. One reason for this observation may be the fact that house prices react positively to increased mortgage supply in CRA-eligible census tracts, hence increasing the size of mortgage needed to buy a house. Moreover, the negative estimate for the number of non-regulated mortgages suggests a weak crowding-out effect of non-regulated institutions by CRA-regulated institutions. Finally, the last row in each panel of Table A2 presents the effect on house price growth rate. House prices grow annually by 3.2 percentage points more in CRA-eligible census tracts. The estimate of house prices become inaccurate when looking at the narrow window of $[0.7, 0.9]$ because the sample size is too small (there are only 57 CRA-eligible census tracts in that sample with non-missing data for house prices.). Finally, Table A3 presents the findings across income quartiles. As also seen in the main text, the growth in mortgage lending by CRA-regulated institutions, as well as house price growth are not confined to the lowest-income census tracts but rather are present across the income distribution.

Table A1. Matching quality

	CRA-eligible	CRA-ineligible	%bias	t-statistic
Panel A: Before matching				
Num. of Census Tracts	13,289	24,852		
Census tract median family income	31,665	64,258	-180.8	-36.79
Population	3,792	4,596	-38.1	-12.53
Pre-1998 total CRA-regulated mortgages	1.171	5.283	-99.0	-28.22
Pre-1998 total non-regulated mortgages	0.747	2.439	-76.4	-19.37
Pre-1998 house price index	103.3	105.0	-19.1	-2.81
Pre-1998 house price growth rate	2.001	2.332	-8.5	-1.16
Latent demand	17.92	11.35	78.6	16.77
Housing units	1,503	1,688	-23.3	-10.01
Vacancy rate	10.15	6.618	47.6	10.87
Employment growth	2.044	2.542	-24.5	-5.67
Income growth	38.37	39.49	-11.9	-1.92
Population growth	10.12	12.33	-18.1	-4.51
Supply elasticity	1.589	1.598	-1.0	-0.44
Panel B: After matching				
Num. of Census Tracts	1,037	806		
Census tract median family income	41,254	41,254	0.0	0.00
Population	4,290	4,391	-4.3	-0.63
Pre-1998 total CRA-regulated mortgages	1.802	1.843	-1.0	-0.31
Pre-1998 total non-regulated mortgages	1.236	1.073	7.4	1.40
Pre-1998 house price index	101.6	100.8	10.4	0.68
Pre-1998 house price growth rate	1.173	0.485	17.7	1.18
Latent demand	15.47	18.35	-34.5	-3.17
Housing units	1,635	1,703	-8.5	-1.01
Vacancy rate	8.039	8.882	-11.4	-1.24
Employment growth	2.199	1.781	20.5	1.68
Income growth	38.57	38.12	4.7	0.24
Population growth	12.88	9.305	29.2	2.04
Supply elasticity	1.449	1.689	-26.3	-1.31

This table presents matching quality diagnostics. It shows the differences in census tract characteristics before and after matching on census tract median family income. *Pre-1998* prefix denotes the average of the corresponding variable during the period 1993 to 1997 for each census tract. % *bias*, is the % difference of the sample means in the CRA-eligible and ineligible samples as a percentage of the square root of the average of the sample variances in the respective groups. *t-statistic* is the test statistic of the difference in means across the two groups, using robust standard errors clustered at the county level. All variables are defined in Table 2.

Table A2. Mortgage growth: Difference-in-differences matching estimation

	Observations (CRA, non-CRA) census tracts	CRA-regulated institutions	Non-regulated institutions
Panel A: Full sample			
Total mortgages	(1037, 806)	5.71***	0.76
		(0.68)	(0.77)
Size of mortgages	(1037, 806)	1.79***	0.68***
		(0.24)	(0.26)
Number of mortgages	(1037, 806)	3.41***	-0.08
		(0.51)	(0.60)
House price growth	(209, 187)	3.06***	
		(0.87)	
Panel B: Income Ratio ∈ [0.6, 1.0]			
Total mortgages	(814, 633)	5.20***	0.50
		(0.73)	(0.86)
Size of mortgages	(814, 633)	1.76***	0.71***
		(0.26)	(0.29)
Number of mortgages	(814, 633)	3.02***	-0.36
		(0.55)	(0.65)
House price growth	(145, 131)	2.67***	
		0.99	
Panel C: Income Ratio ∈ [0.7, 0.9]			
Total mortgages	(340, 274)	4.79***	-0.73
		(1.08)	(1.26)
Size of mortgages	(340, 274)	1.62***	0.96***
		(0.40)	(0.44)
Number of mortgages	(340, 274)	2.76***	-1.89*
		(0.80)	(1.00)
House price growth	(57, 54)	1.04	
		(1.40)	

This table reports the results of difference-in-differences matching estimations, using the nearest neighbour, separately for mortgages originated by CRA-regulated and non-regulated financial institutions. For each census tract the annual total amount, size, number of mortgages, and house price growth are averaged over each of the two periods of 1993-1997 and 1998-2002. The annual percentage growth rate of each of the mortgage variables, and first differences of house price growth, are calculated for each census tract between these two periods. Finally, every CRA-eligible census tract is matched to a CRA-ineligible census tract from the same state with similar median family income. The reported estimates are the average treatment effect on the treated, taking CRA-eligible census tracts as the treated group and the matched CRA-ineligible census tracts as the control group. *Income Ratio* is the ratio of each census tract's median family income to its respective MSA's median family income. Standard errors are heteroskedasticity-consistent analytical standard errors proposed by Abadie and Imbens (2006). *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table A3. Mortgage growth and house prices across income distribution and CRA eligibility

Income quartiles	CRA-eligible tracts	Matched ineligible tracts	ATET	t-statistic
Panel A: Total mortgages by CRA-regulated institutions				
1 (low income)	14.64	9.54	5.10	3.09
2	15.87	9.92	5.95	7.74
3	23.16	18.42	4.73	1.71
4 (high income)	-	-	-	-
Panel B: Total mortgages by non-regulated institutions				
1 (low income)	13.82	10.76	3.05	1.50
2	12.35	12.16	0.19	0.21
3	15.38	14.23	1.14	0.48
4 (high income)	-	-	-	-
Panel C: House price index				
1 (low income)	33.87	11.28	22.58	2.70
2	37.89	23.89	15.00	4.34
3	51.52	29.76	21.76	3.07
4 (high income)	-	-	-	-
Panel D: House price growth rate				
1 (low income)	13.80	4.75	9.04	2.93
2	8.76	5.65	3.11	3.16
3	13.37	12.43	2.09	0.45
4 (high income)	-	-	-	-

This table reports the results of the difference-in-differences matching estimation of growth in total CRA-regulated mortgages (Panel A), non-regulated mortgages (Panel B), house price index (Panel C), and house price growth (Panel D), between the 1993-1997 period and the 1998-2002 period across the income distribution. The sample is split based on quartiles of census tract median family income. There are no CRA-eligible census tracts in the top quartile of census tract median family income distribution. Panel A and Panel B show the results for growth in mortgages originated by CRA-regulated and non-regulated institutions, respectively. For each census tract, the annual percentage growth rate is calculated between the pre- and post-1998 periods. Each CRA-eligible census tract is matched to a CRA-ineligible census tracts from the same state with similar median family income. The reported estimates are then the average treatment effect on the treated, taking CRA-eligible census tracts as the treated group and the matched CRA-ineligible census tracts as the control group. Standard errors are heteroskedasticity-consistent analytical standard errors proposed by Abadie and Imbens (2006). *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Appendix B. The Legal Definitions of Community and Assessment Area

The original (from 1977) text of the CRA as legislated in Public Law 95128, title VIII, §802, Oct. 12, 1977, reads as the following:

> (a) The Congress finds that-
>
> (1) regulated financial institutions are required by law to demonstrate that their deposit facilities serve the convenience and needs of the communities in which they are chartered to do business;
>
> (2) the convenience and needs of communities include the need for credit services as well as deposit services; and
>
> (3) regulated financial institutions have continuing and affirmative obligation to help meet the credit needs of the local communities in which they are chartered.
>
> (b) It is the purpose of this chapter to require each appropriate Federal financial supervisory agency to use its authority when examining financial institutions, to encourage such institutions to help meet the credit needs of the local communities in which they are chartered consistent with the safe and sound operation of such institutions.[19]

Appendix B.1. Community

In its original form, the CRA required banks to meet the credit needs of their *communities*. In fact, the term *assessment area* was not part of the language of the CRA until mid-1990s. What community for an specific bank meant was later defined in §228.3 43 FR 47148, Oct. 12, 1978 as the following:

> (a) Each State member bank shall prepare, and at least annually review, a delineation of the local community or communities that comprise its entire commu-

[19] https://www.law.cornell.edu/uscode/text/12/2901

nity, without excluding low- and moderate-income neighbourhoods. Maps shall be used to portray community delineations. The reasonableness of the delineations will be reviewed by Federal Reserve System examiners.

(b) Except as provided in paragraph (c) of this section, a local community consists of the contiguous areas surrounding each office or group of offices, including any low- and moderate-income neighbourhoods in those areas. More than one office of a State member bank may be included in the same local community. Unless the Board determines otherwise, a community delineation need not take account of an off-premises electronic facility that receives deposits for more than one depository institution. In preparing its delineation, a bank may use any one of the three bases set forth below.

(1) Existing boundaries such as those of standard metropolitan statistical areas (SMSA's) or counties in which the bank's office or offices are located may be used to delineate a local community. Where appropriate, portions of adjacent areas should be included. The bank may make adjustments in the case of areas divided by State borders or significant geographic barriers, or areas that are extremely large or of unusual configuration. In addition, a small bank may delineate those portions of SMSA's or counties it reasonably may be expected to serve.

(2) A bank may use its effective lending territory, which is defined as that local area or areas around each office or group of offices where it makes a substantial portion of its loans and all other areas equidistant from its offices as those areas. Adjustments such as those indicated in paragraph (b)(1) of this section may be made.

(3) A bank may use any other reasonably delineated local area that meets the purposes of the Community Reinvestment Act (CRA) and does not exclude low- and moderate-income neighbourhoods.

(c) A State member bank whose business predominantly consists of serving persons who are active duty or retired military personnel or their dependents and

who are located outside of its local community or communities, may delineate a military community for those customers, in addition to its local community or communities. Provisions of this part concerning local communities shall also apply to military communities, except that military communities shall be delineated by a written description rather than a map.[20]

Appendix B.2. Assessment Area

§228.41 Assessment area delineation.

(a) In general. A bank shall delineate one or more assessment areas within which the Board evaluates the bank's record of helping to meet the credit needs of its community. The Board does not evaluate the bank's delineation of its assessment area(s) as a separate performance criterion, but the Board reviews the delineation for compliance with the requirements of this section.

(b) Geographic area(s) for wholesale or limited purpose banks. The assessment area(s) for a wholesale or limited purpose bank must consist generally of one or more MSAs or metropolitan divisions (using the MSA or metropolitan division boundaries that were in effect as of January 1 of the calendar year in which the delineation is made) or one or more contiguous political subdivisions, such as counties, cities, or towns, in which the bank has its main office, branches, and deposit-taking ATMs.

(c) Geographic area(s) for other banks. The assessment area(s) for a bank other than a wholesale or limited purpose bank must:

(1) Consist generally of one or more MSAs or metropolitan divisions (using the MSA or metropolitan division boundaries that were in effect as of January 1 of the calendar year in which the delineation is made) or one or more contiguous political subdivisions, such as counties, cities, or towns; and

(2) Include the geographies in which the bank has its main office, its branches,

[20] https://www.govinfo.gov/content/pkg/CFR-1997-title12-vol3/xml/CFR-1997-title12-vol3-sec228-3.xml

and its deposit-taking ATMs, as well as the surrounding geographies in which the bank has originated or purchased a substantial portion of its loans (including home mortgage loans, small business and small farm loans, and any other loans the bank chooses, such as those consumer loans on which the bank elects to have its performance assessed).

(d) Adjustments to geographic area(s). A bank may adjust the boundaries of its assessment area(s) to include only the portion of a political subdivision that it reasonably can be expected to serve. An adjustment is particularly appropriate in the case of an assessment area that otherwise would be extremely large, of unusual configuration, or divided by significant geographic barriers.

(e) Limitations on the delineation of an assessment area. Each bank's assessment area(s):

(1) Must consist only of whole geographies;

(2) May not reflect illegal discrimination;

(3) May not arbitrarily exclude low- or moderate-income geographies, taking into account the bank's size and financial condition; and

(4) May not extend substantially beyond an MSA boundary or beyond a state boundary unless the assessment area is located in a multistate MSA. If a bank serves a geographic area that extends substantially beyond a state boundary, the bank shall delineate separate assessment areas for the areas in each state. If a bank serves a geographic area that extends substantially beyond an MSA boundary, the bank shall delineate separate assessment areas for the areas inside and outside the MSA.

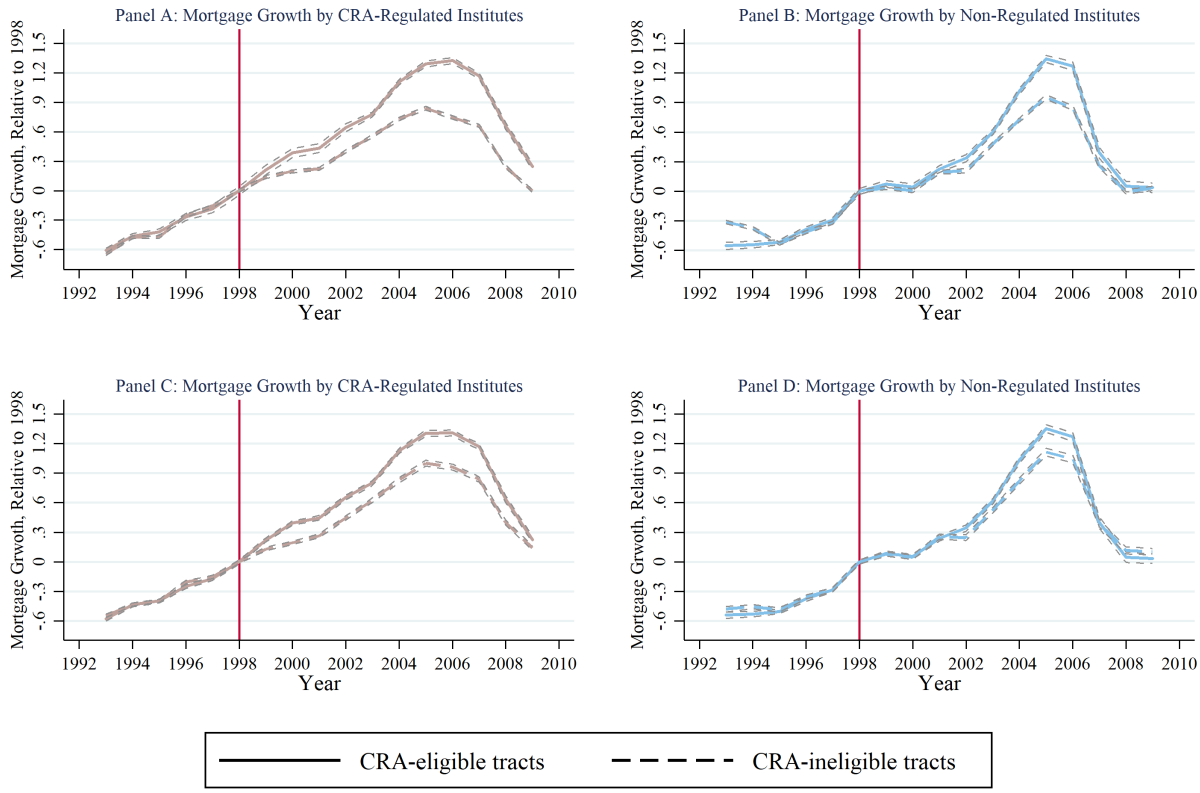
(f) Banks serving military personnel. Notwithstanding the requirements of this section, a bank whose business predominantly consists of serving the needs of military personnel or their dependents who are not located within a defined geographic area may delineate its entire deposit customer base as its assessment area.

(g) Use of assessment area(s). The Board uses the assessment area(s) delineated

by a bank in its evaluation of the bank's CRA performance unless the Board determines that the assessment area(s) do not comply with the requirements of this section.

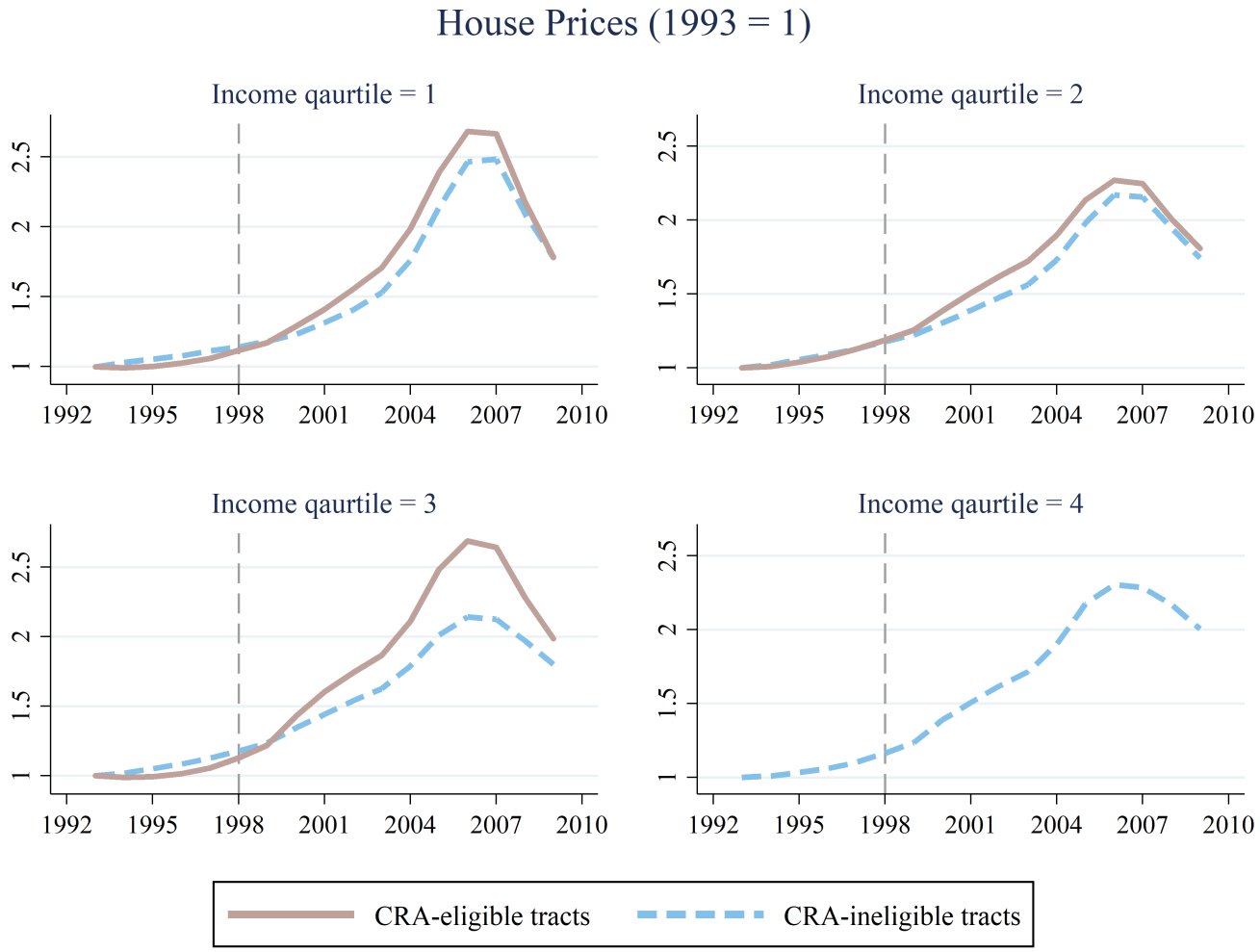
Appendix C. On-line Appendix - Further Results

Figure C1. Mortgage growth - Extended sample period



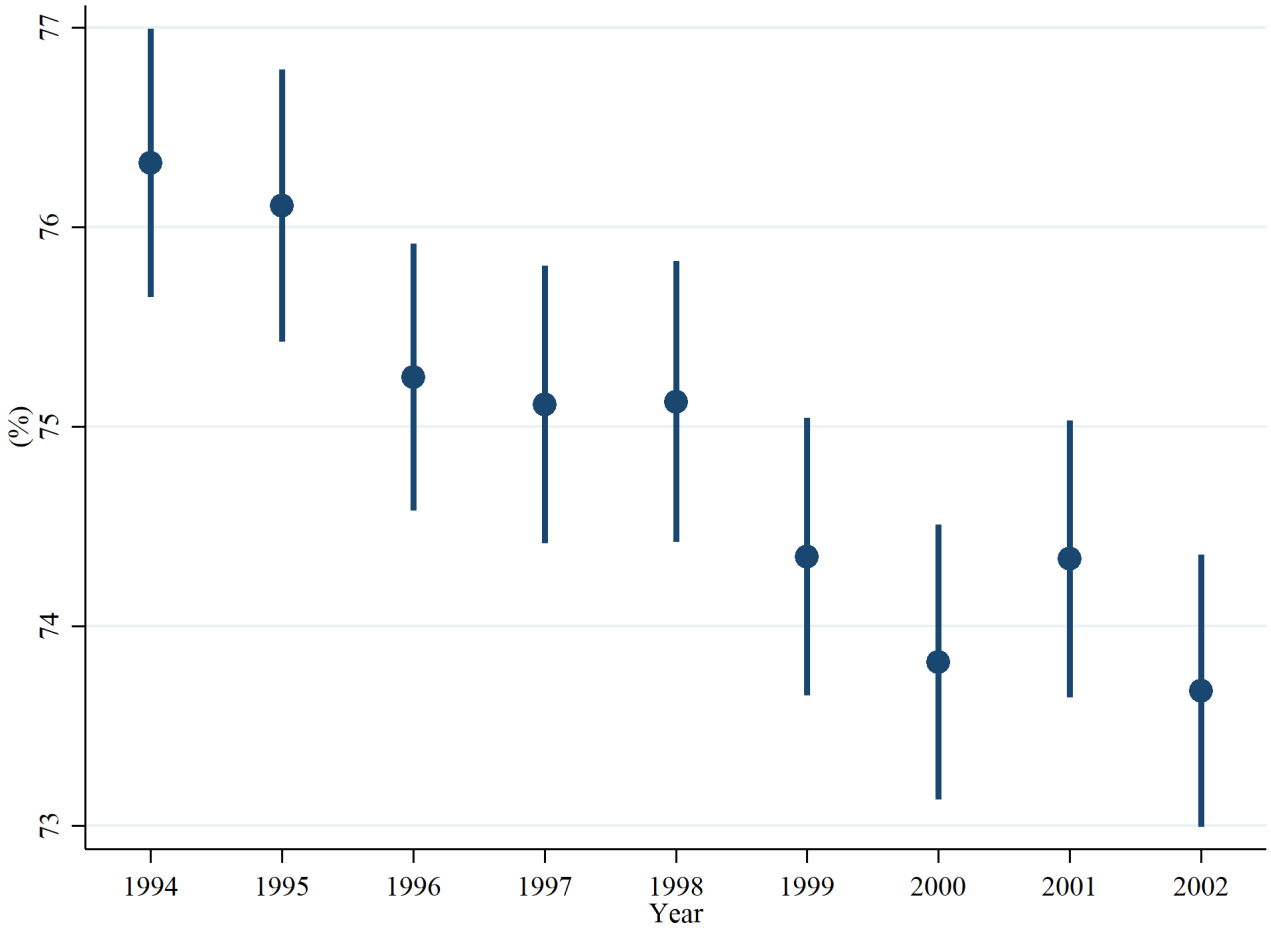
This figure illustrates total mortgage origination by CRA-regulated (Panels A and C) and non-regulated (Panels B and D) institutions in CRA-eligible and ineligible census tracts. Panels A and B are based on the *full sample*, while in Panels C and D I use the *common support sample*, which differs from the *full sample* in that it excludes CRA-eligible census tracts that do not have a similar-income counterpart in the sample of ineligible census tracts, and vice versa. CRA-regulated institutions are those supervised by the FDIC, FRB, OCC and OTS. Non-regulated institutions are those that are supervised by NCUA or HUD and are not subject to the CRA regulations. CRA-eligible census tracts are census tracts with a median family income of less than 80% of their respective MSA's median family income. Following Khwaja and Mian (2008), I normalize the y-axis so that the logarithm of total mortgage for both CRA-eligible and ineligible census tracts is forced to be 0 in 1998. Therefore, the time series illustrates the log-ratio of total mortgages in any given year relative to 1998, i.e., when the new enforcement mechanisms of the CRA became fully effective. The y-axis values can then be interpreted as growth rates in lending relative to 1998. The dashed lines represent the 5% confidence interval. The sample is originated as explained in Section 4.

Figure C2. House price dynamics in CRA-eligible and ineligible tracts across income distribution



This figure illustrates the dynamics of house prices, normalized to 1993 levels, for CRA-eligible and ineligible census tracts. CRA-eligible census tracts are those with a median family income lower than 80% of their respective MSA's median family income. House price data is collected from the Federal Housing Finance Agency (FHFA).

Figure C3. Lending inside branch counties



This figure presents the share of the average bank's mortgage origination inside the entirety of its branch counties, i.e., those counties in which it has at least one branch, as well as the 95% confidence intervals.

Table C1. Mortgage growth - Controlling for house price growth at the county level

	CRA-Regulated Institutions			Non-Regulated Institutions			Both Institutions	
	Ln(Total Mortg.)	Ln(Avg. Size)	Ln(# Mortg.)	Ln(Total Mortg.)	Ln(Avg. Size)	Ln(# Mortg.)	Ln(Total Mortg.)	Ln(# Mortg.)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CRA	0.004	0.030	−0.037	0.049	0.058***	−0.016	0.060	−0.019
	(0.038)	(0.018)	(0.029)	(0.046)	(0.019)	(0.044)	(0.052)	(0.045)
CRA × Post	0.108***	0.040***	0.062***	0.032	0.023**	0.008	0.018	0.003
	(0.024)	(0.011)	(0.019)	(0.024)	(0.011)	(0.019)	(0.026)	(0.019)
Tract MFI	0.054***	0.015***	0.034***	0.041***	0.012***	0.025***	0.040***	0.023***
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Tract MFI × Post	0.000	0.001	0.000	0.002	0.003***	−0.000	0.002	0.000
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(Population)	0.701***	0.070***	0.574***	0.820***	0.037*	0.691***	0.760***	0.632***
	(0.051)	(0.022)	(0.036)	(0.063)	(0.020)	(0.049)	(0.052)	(0.039)
Ln(Population) × Post	0.004	−0.005	0.013	−0.032	0.011	−0.028	−0.014	−0.008
	(0.032)	(0.013)	(0.022)	(0.035)	(0.018)	(0.024)	(0.029)	(0.019)
Latent Demand	−0.023***	−0.009***	−0.012***	−0.016***	−0.013***	−0.003	−0.020***	−0.007***
	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Latent Demand × Post	0.000	0.001**	−0.001	−0.003*	0.003***	−0.006***	−0.001	−0.003***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Vacancy Rate	−0.000	0.001	−0.001	−0.008***	−0.000	−0.006**	−0.004*	−0.003
	(0.002)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.002)
Vacancy Rate × Post	0.005***	0.002***	0.003**	0.005***	0.002***	0.003**	0.005***	0.003***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(Housing Units)	0.238***	−0.083***	0.279***	0.021	−0.054***	0.054	0.130*	0.167***
	(0.065)	(0.021)	(0.051)	(0.085)	(0.019)	(0.071)	(0.071)	(0.058)
Ln(Housing Units) × Post	−0.002	−0.017	0.026	0.073**	−0.012	0.076***	0.035	0.052**
	(0.034)	(0.013)	(0.024)	(0.034)	(0.017)	(0.023)	(0.030)	(0.021)
Employment Growth	−0.002	0.003	−0.005	−0.008	0.003	−0.010**	−0.006	−0.007**
	(0.004)	(0.002)	(0.004)	(0.006)	(0.002)	(0.005)	(0.004)	(0.003)
Employment Growth × Post	0.004	−0.005	0.008**	0.008	−0.006**	0.013**	0.006	0.010***
	(0.005)	(0.003)	(0.004)	(0.006)	(0.003)	(0.005)	(0.004)	(0.004)
Income Growth	0.007**	−0.003	0.009***	−0.006**	−0.005*	−0.001	0.001	0.004*
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Income Growth × Post	−0.003**	0.002**	−0.005***	−0.002	0.001*	−0.003**	−0.003**	−0.004***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Population Growth	0.010***	0.007***	0.003*	0.015***	0.007***	0.008***	0.013***	0.005***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Population Growth × Post	0.004**	0.001	0.003***	0.000	0.001*	−0.000	0.002**	0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
County MHPG	0.007***	0.004**	0.002	−0.002	0.004*	−0.005**	0.002	−0.001
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
County MHPG × Post	0.009***	0.008***	0.000	0.010***	0.008***	0.002	0.009***	0.001
	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)
Elasticity	0.023	−0.168***	0.174***	−0.134***	−0.189***	0.045	−0.055*	0.110***
	(0.044)	(0.038)	(0.029)	(0.031)	(0.037)	(0.041)	(0.028)	(0.028)
Elasticity × Post	−0.039**	−0.004	−0.031**	0.000	0.009	−0.007	−0.020*	−0.019**
	(0.016)	(0.006)	(0.013)	(0.016)	(0.006)	(0.014)	(0.010)	(0.009)
Tract MFI × Regulated							0.014***	0.013***
							(0.003)	(0.003)
Tract MFI × Regulated × Post							−0.001	−0.000
							(0.002)	(0.001)
Regulated							−0.017	−0.069
							(0.180)	(0.148)
Post × Regulated							0.055	0.035
							(0.095)	(0.076)
CRA × Post × Regulated							0.105***	0.066**
							(0.036)	(0.029)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	84908	84908	84908	83858	83858	83858	168766	168766
Adj. R^2	0.659	0.542	0.663	0.596	0.562	0.551	0.631	0.613

This table reports the results of regression models in equations (1) and (2) using the census tract-by-year level sample. It is similar to the analysis in Table 3, except that house price growth at the county level is added to the list of control variables. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table C2. Mortgage originations across income ratio

	Regulated Institutions (1)	Non-regulated Institutions (2)	Both Institutions (3)
$\mathbb{1}_{\{Income\ Ratio<80\%\}}$	−0.055*	−0.041	−0.030
	(0.030)	(0.062)	(0.081)
$\mathbb{1}_{\{Income\ Ratio\geq120\%\}}$	−0.104	−0.020	0.039
	(0.080)	(0.070)	(0.094)
$\mathbb{1}_{\{Income\ Ratio<80\%\}} \times$ Post	0.102***	0.034	0.022
	(0.025)	(0.033)	(0.038)
$\mathbb{1}_{\{Income\ Ratio\geq120\%\}} \times$ Post	−0.066	−0.083	−0.093
	(0.041)	(0.061)	(0.062)
Tract MFI × Regulated			0.007
			(0.005)
Tract MFI × Regulated × Post			0.007**
			(0.003)
Regulated			0.248
			(0.318)
$\mathbb{1}_{\{Income\ Ratio<80\%\}} \times$ Regulated			−0.040
			(0.114)
$\mathbb{1}_{\{Income\ Ratio\geq120\%\}} \times$ Regulated			−0.199*
			(0.116)
Post × Regulated			−0.290*
			(0.169)
$\mathbb{1}_{\{Income\ Ratio<80\%\}} \times$ Post × Regulated			0.093*
			(0.051)
$\mathbb{1}_{\{Income\ Ratio\geq120\%\}} \times$ Post × Regulated			0.034
			(0.058)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Observations	146023	142781	288804
Adj. R^2	0.647	0.543	0.596

This table reports the results of regression models that compare mortgage origination in census tracts with an *Income Ratio* in the [80%, 120%] with those below and above this range, using the census tract-by-year level sample. *Income Ratio* is the ratio of census tract median family income to the median family income of the respective MSA. $\mathbb{1}_{\{Income\ Ratio<80\%\}}$ is equivalent to the *CRA* dummy in the main text. *Post* is a dummy variable that equals zero for the period 1993 to 1997, and one for the period from 1998 to 2002. *Regulated* is a dummy variable that equals one for mortgage originations by financial institutions that are supervised by the FDIC, FRB, OCC or OTS, and zero for those that are supervised by NCUA or HUD. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table C3. Share of bank mortgage origination in non-CRA census tracts per county

	N	Mean	1%	5%	10%	25%	50%	75%	90%	95%	99%
	Share of lending in 1994-1997 to non-CRA census tracts (%)										
Branch county = 0	79654	1.3	0.00	0.00	0.01	0.02	0.09	0.5	2.7	6.1	22.2
Branch county = 1	16837	20.6	0.01	0.08	0.22	1.16	7.10	34.0	63.6	77.8	98.9
	Share of lending in 1998-2002 to non-CRA census tracts (%)										
Branch county = 0	117814	0.8	0.00	0.00	0.00	0.01	0.05	0.3	1.4	3.4	14.3
Branch county = 1	19615	13.6	0.00	0.02	0.05	0.23	2.31	17.7	48.9	64.5	88.0

This table presents the distribution of banks mortgage origination in non-CRA census tracts, as a whole, in each county, relative to each bank's total mortgage origination, conditional on non-zero lending activity of the bank in that county. The distribution is reported separately for branch counties and non-branch counties over the two periods of 1994 to 1997, and 1998 to 2002. The sample is at the bank-by-county-by-year level.

Table C4. IV analysis - CRA-regulated institutions - Robustness

	ΔHPG			
	(1)	(2)	(3)	(4)
Mortgage growth	0.950**	0.687***	2.343	0.668***
	(0.437)	(0.188)	(4.927)	(0.177)
Tract MFI	−0.024	−0.051	−0.139	−0.055
	(0.053)	(0.034)	(0.291)	(0.036)
Ln(Population)	−1.722*	−0.910	−1.501	−0.898
	(0.952)	(0.595)	(2.185)	(0.592)
Latent Demand	0.024	−0.054**	0.105	−0.045*
	(0.053)	(0.024)	(0.323)	(0.024)
Vacancy Rate	−0.128*	−0.079***	−0.263	−0.074***
	(0.066)	(0.027)	(0.543)	(0.025)
Ln(Housing Units)	2.393**	1.363**	2.734	1.388**
	(1.193)	(0.558)	(3.957)	(0.560)
Employment Growth	0.149	0.071	0.853	0.099
	(0.320)	(0.156)	(2.150)	(0.153)
Income Growth	−0.189*	−0.109***	−0.307	−0.111***
	(0.102)	(0.033)	(0.552)	(0.032)
Population Growth	−0.092	−0.069*	−0.362	−0.071*
	(0.061)	(0.038)	(0.826)	(0.036)
County MHPG		−0.085	−1.817	−0.069
		(0.168)	(5.070)	(0.160)
Elasticity	0.164		0.780	
	(0.541)		(2.392)	
Elasticity (Filled)				−0.178
				(0.397)
State FE	Yes	Yes	Yes	Yes
State FE × Tract MFI	Yes	Yes	Yes	Yes
Observations	4006	6127	3898	6034
F-statistic	4.31	10.18	0.23	10.78
P-value	0.039	0.001	0.630	0.001

This table reports the results of regression model (4) using the census tract level sample, for the mortgage origination by CRA-regulated institutions, i.e., financial institutions that are supervised by the FDIC, FRB, OCC or OTS. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. *Elasticity (Filled)* is equal to *Elasticity* for MSAs with non-missing values for this variable, and equals the state-wide average *Elasticity* for MSAs for which this variable is missing. The F-test statistics and p-values for tests of weak excluded instruments in the first-stage regressions are reported based on Sanderson and Windmeijer (2016). House price data is collected from the Federal Housing Finance Agency (FHFA) and is at the census tract level. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table C5. IV analysis - Non-regulated institutions - Robustness

	ΔHPG			
	(1)	(2)	(3)	(4)
Mortgage growth	3.270	5.710	0.992	−124.710
	(2.923)	(14.112)	(0.945)	(6873.949)
Tract MFI	−0.072	−0.119	−0.028	−3.252
	(0.228)	(0.475)	(0.075)	(178.231)
Ln(Population)	−5.767	−6.869	−0.715	114.287
	(6.201)	(16.865)	(1.325)	(6337.147)
Latent Demand	−0.438	−0.780	−0.168	15.935
	(0.386)	(1.896)	(0.140)	(879.417)
Vacancy Rate	−0.510	−0.798	−0.134	16.271
	(0.488)	(1.981)	(0.137)	(896.916)
Ln(Housing Units)	4.322	4.310	0.638	−51.004
	(5.048)	(10.915)	(1.251)	(2853.600)
Employment Growth	−0.558	−0.441	−0.488	−0.342
	(0.860)	(1.695)	(0.569)	(34.508)
Income Growth	−0.796	−1.222	−0.167	26.240
	(0.676)	(2.839)	(0.106)	(1450.446)
Population Growth	0.116	0.037	0.019	2.002
	(0.169)	(0.255)	(0.052)	(109.503)
County MHPG		−0.926	0.094	30.286
		(3.632)	(0.518)	(1641.272)
Elasticity			0.160	
			(0.876)	
Elasticity (Filled)				−164.726
				(9072.381)
State FE	Yes	Yes	Yes	Yes
State FE × Tract MFI	Yes	Yes	Yes	Yes
Observations	6415	6126	3898	6033
F-statistic	1.16	0.16	1.35	0.00
P-value	0.282	0.688	0.246	0.986

This table reports the results of regression model (4) using the census tract level sample, for the mortgage origination by CRA-regulated institutions, i.e., financial institutions that are supervised by the FDIC, FRB, OCC or OTS. *CRA* is a dummy variable that equals one for census tracts with a median family income less than 80% of the median family income of their respective MSA. *Elasticity (Filled)* is equal to *Elasticity* for MSAs with non-missing values for this variable, and equals the state-wide average *Elasticity* for MSAs for which this variable is missing. The F-test statistics and p-values for tests of weak excluded instruments in the first-stage regressions are reported based on Sanderson and Windmeijer (2016). House price data is collected from the Federal Housing Finance Agency (FHFA) and is at the census tract level. Control variables are defined in Table 2. Robust standard errors, clustered at the county level, are in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

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