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 recent US housing boom-bust cycle. Using a difference-in-differences matching estimation, I find that the enhancement of CRA enforcement in 1998 caused a 7.7 percentage points increase in annual growth rate of mortgage lending by CRA-regulated banks to CRA-eligible census tracts relative to a group of similar-income CRA-ineligible census tracts within the same state. Financial institutions which are not subject to the CRA, however, do not show any change in their mortgage supply between these two types of census tracts after 1998. I take advantage of this exogenous shift in mortgage supply within an instrumental variable framework to identify the causal effect of mortgage supply on housing prices. I find that every 1 percentage point higher annual growth rate of mortgage supply leads to 0.3 percentage points higher annual growth rate of housing prices. Reduced form regressions show that CRA-eligible neighborhoods experienced higher house price growth during the boom and sharper decline during the bust period. I use placebo tests to confirm that this effect is in fact channeled through the shift in mortgage supply by CRA-regulated banks and not by unobserved demand factors. Furthermore, my results indicate that CRA-induced mortgages went to borrowers with lower FICO scores, carried higher interest rates, 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 then fell 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 et al., 2015) together with or caused by a global "saving glut" (Bernanke, 2005; Himmelberg et al., 2005; Caballero et al., 2008), "branching deregulation" of the banking industry (Favara and Imbs, 2015) or "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 housing 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 housing 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 neighborhoods (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 non-compliant 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 sort 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 two important institutional features of the CRA. First, the CRA classifies census tracts as "eligible" in which median family income is less than 80% of the median family income in the respective metropolitan statistical area (MSA). Hence, whether or not in a given census tract CRA rules apply depends on the income level of the MSA and not just on the income level in the census tract. Census tracts with similar median household income levels may be classified as CRA-eligible or CRA-ineligible, depending on the median household income of the MSA they are located in. This allows me to compare census tracts with similar median family incomes 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. Second, not all financial institutions are subject to the CRA regulation. Hence, there exist two exogenous variations for identification: I can compare the mortgage supply of financial institutions subject to the CRA to the mortgage supply of financial institutions not subject to the CRA in otherwise-similar CRA-eligible and CRA-ineligible census tracts, before and after 1998.

The main findings of the paper are as follows. First, I show that CRA-regulated banks, unlike other financial institutions, increased their mortgage supply to CRA-eligible census tracts across the income distribution. Second, I estimate the causal effect of mortgage supply on housing prices. Consistent with this finding, I show that ZIP codes with a higher share of CRA-eligible population experience higher house price growth from 1998 to 2006 because of the shift in mortgage supply by CRA-regulated banks. I also find that the collapse of housing prices from 2007 to 2010 is more severe in ZIP codes with a higher share of CRA-eligible population. Finally, I document that CRA-induced mortgages are relatively riskier and experience more frequent delinquencies.

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 supply of mortgages to non-CRA census tracts continued its trend as it was since 1993. Figure 2, however, presents the same exercise for the mortgages generated by institutions which are not regulated under the CRA and shows no difference between the growth rate of mortgages for eligible and ineligible census tracts before and after 1998. Formally, in a difference-in-differences matching estimation, I find that the growth in average annual mortgages generated by CRA-regulated institutions in CRA-eligible census tracts from the 1993-1997 period to the 1998-2002 period is about 45 percentage points higher than the growth in mortgages by the same institutions in a matched control group of CRA-ineligible census tracts. This translates to a 7.7 percentage points higher average annual growth rate in mortgage lending. This 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 difference. For mortgages supplied by institutions that are not regulated under the CRA 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 neighborhoods experienced a higher housing 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 et al. (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, perhaps due to limited developable land as in Saiz (2010), house prices will rise due to this higher demand. In addition, cheaper funds enable unconstrained buyers to bargain less hard for reductions in prices that subsequently allows housing prices to rise further.

Estimating the elasticity of house prices to mortgage supply, however, is nontrivial 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 which furthermore encourages higher prices and higher trading volume (Barberis et al., 2016). 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 generated 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 0.3 percentage points rise in the annual housing price growth rate. This finding supports Favara and Imbs (2015), Di Maggio and Kermani (2014) and Adelino et al. (2012) who also argue in favor of a causal link from credit to housing 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 ZIP codes with a higher share of CRA-eligible population[1]. Figure 3 plots house prices for ZIP codes with low and high shares of CRA-eligible population separately for each quartile of ZIP code average income per capita. During the boom period, house prices increased faster for high-CRA ZIP codes irrespective of their absolute level of income, especially in the bottom half of the income distribution: High-CRA ZIP codes in the first and the second quartile of income rose by about 40 percentage points more relative to low-CRA ZIP codes. Note that these differences cannot simply be explained by income differences (i.e., higher growth for lower income neighborhoods) as across the four quartiles of income we see a slightly higher unconditional growth in house prices for higher income ZIP codes. Finally, when the housing market collapsed, the drop in house prices was more severe for high-CRA ZIP codes. These results can partially explain the findings in Gropp et al. (2014) as presented in Figure 4. Housing price appreciation prior to the crisis and its subsequent depreciation after the crisis were substantially heterogeneous. Furthermore, neighborhoods with the highest rise in prices during the boom period are the ones which also experience sharper declines during the bust period. Both of these observations are consistent with the credit-induced boom-bust cycle through the CRA as I document in this paper.

Finally, the practice of redlining is perhaps best understood as a form of statistical discrimination (Phelps, 1972; Arrow, 1973), based on borrowers' neighborhoods, which is an optimal risk management policy from the perspective of the banks. The CRA in effect undermined this method of borrower screening, which consequently should have resulted

[1] House price data is not available at census tract level. Instead I use house prices at ZIP code level. To aggregate census tract level data on mortgage and demography up to ZIP code level, I follow the approach in Adelino et al. (2016). The details are explained in Section IV.

in CRA-regulated banks generating more risky mortgages. I find some evidence for this hypothesis. Mortgages generated by CRA-regulated banks in CRA-eligible census tracts went to borrowers with lower FICO scores. Banks compensated for this risk by charging higher interest rates. These two results together are consistent with the findings in Canner et al. (2002) who find that CRA-regulated institutions did not carry lower spreads on their CRA mortgages, controlling for mortgage risk. Finally, I find that CRA-induced mortgages encounter delinquency more frequently. None of these effects are observed for the mortgages generated by institutions which do not have to comply with the CRA.

The CRA, as it was implemented in the late 1990s and early 2000s, was a welfare-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 subtle aspect of any credit-induced boom in the housing market is its distortionary effects on the real economy. For instance, Chakraborty et al. (2016) argue that housing 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 labor went up due to increased demand for construction and retail services, hence reducing investments in schooling.

Taken together, the results suggest that the CRA affected mortgage and housing markets significantly as early as 1998. Hence, academic and policy studies on the determinants of the housing boom in the US must consider the interplay between the CRA and other factors to offer a better understanding of the problem. The remainder of this paper proceeds as follows: Section I reviews of the related studies to this paper and Section II describes the evolution of the CRA in detail since its commencement in 1977. Section III sketches the identification strategy of the paper. Section IV covers the data sources and sample selection procedures. The results on mortgage supply and house prices will be explained in sections V and VI, respectively. Section VII presents the last main result, i.e. the riskiness of the marginal CRA-induced mortgages and finally, section VIII concludes.

I. 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), proposing *mass psychology* as an explanation, argues that the boom in the housing market was more related to behavioral biases than to fundamentals. On the other hand, however, there is a significant literature which emphasizes the role of the credit markets. Most importantly, Himmelberg et al. (2005) suggest that it was due to the very low long-term interest rates coupled with increased income growth at a time when house prices were historically low. Mayer and Sinai (2009) claim that lending market efficiency directly affected housing prices through lower origination costs for higher property prices and also created a greater use of subprime mortgage. Favilukis et al. (2013) point out the relaxation of credit constraints and also low transaction costs as drivers of increasing house prices, although they refuse the role of inflow of foreign credit into the US bond market as an influential factor. Laxer credit standards itself might have been facilitated by the agency problems associated with the rise in securitization markets, as shown in Keys et al. (2009) and Keys et al. (2010) among others. My paper adds to this strand of literature by offering an additional factor contributing to the rise in size and riskiness of the mortgage market. CRA could be one additional reason why banks started to employ laxer screening practices in the late 1990s. This would in turn, through competition channels, urge other financial institutions which 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 et al. (2016) find that mortgage growth was significant for all income groups and argue against the supply side story of Mian and Sufi (2009) who attribute the mortgage boom to the subprime borrowers and to low income neighborhoods which they argue that itself

[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`.

was driven mainly because of the securitization wave. Based on their findings, Adelino et al. (2016) continue to emphasize the role of higher *demand* for mortgages, rather than supply shocks, to be responsible for the pre-crisis housing market. My results contribute to this debate in two ways: first, I document a distinct supply shock which affected both the mortgage and the housing market in this period. Second, I show that although mortgages and prices went up for each income quartile, within each quartile CRA-eligible neighborhoods experienced higher mortgage and house price booms. This observation in part explains the findings in Mian and Sufi (2009) in that within-county analyzes are 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 plagued with the effects of CRA on the mortgage market. Therefore, my results propose CRA as an additional explanation for the results in Mian and Sufi (2009) and highlight the importance of CRA loans which were made not because of securitization but for the sake of compliance with government regulations.

Finally, my paper is related to a number of papers that study whether or not the CRA incentivized banks to generate more and/or riskier loans. 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 induces higher mortgage activity. Contrary to what we would expect, Ringo (2015) finds that CRA increases refinancing activity, even though lenders do not receive CRA credit for refinancing mortgages. This paper also shows that CRA-induced mortgages have lower probability of default while Avery and Brevoort (2014) does not find evidence in favor of riskier lending due to the CRA. The studies mentioned above, except Ringo (2015), use a regression discontinuity (RD) design in which they compare mortgage activities of banks in census tracts just below and just above the 80% threshold. This approach generates a *local* estimation of the desired effect; finding no result at the immediate bound around the cutoff does not necessarily imply that the effect is insignificant further away from the threshold too. Moreover, if for any reason this cutoff rule is not exact and sharp, then it is not surprising that the RD estimations will show no difference in outcomes around the threshold. Finally, none of these studies take advantage of the time-variation in CRA enforcement starting from 1997 and 1998, for small and big banks, respectively. One last notable contribution in this area is Agarwal et al. (2012) which finds positive effects on approval and default rates of CRA loans in the months just before and after CRA examination dates. However, Reid et al. (2013) criticize the identification strategy of Agarwal, et al. by arguing that CRA examiners only take the long-term past performance of the banks into account, hence searching for CRA activity in a few months around, especially after, the CRA examination does not reflect the actual examination goals accurately.

II. 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*[3] practices would not benefit from their local bank's credits. Therefore, CRA explicitly encourages banks to provide loans to low- and moderate-income neighborhoods, 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[4] (OCC); the

[3]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.

[4]http://www.occ.gov/topics/compliance-bsa/cra/index-cra.html

Board of Governors of the Federal Reserve System[5] (FRB) and the Federal Deposit Insurance Corporation[6] (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 and independent mortgage companies and non-bank entities exempt from the CRA are supervised by the Consumer Financial Protection Bureau.[7]

In the early years of the CRA, compliance was measured through each bank's self-reported *CRA Statemant*. The CRA statements had to be publicly available and included a delineation of the area that comprises 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 generated too many *satisfactory* cases. In fact, congress provided little specific guidance in the act as to what is satisfactory or unsatisfactory performance in regard to community reinvestment. Second, although CRA performance had to be *taken into account* when a bank applied for expansion[8], 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

[5] http://www.federalreserve.gov/communitydev/cra_about.htm

[6] https://www.fdic.gov/regulations/cra/

[7] http://www.occ.gov/topics/community-affairs/publications/fact-sheets/fact-sheet-cra-reinvestment-act.pdf

[8] Such applications are (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)

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 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 I 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 I, the lending test has the highest weight among the three tests[9]. 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.

Another significant modification in 1995 amendments to the CRA is the replacement of *assessment area* with previously used concept of *community.* 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. The CRA tests emphasize specifically bank's CRA activities within the low- and moderate-income neighborhoods within a bank's assessment area. Low- and moderate-income neighborhoods are census tracts with median income less than 80% of their respective MSAs' median income.

[9]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.

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 or branches be closed, will not permit the bank to open a new branch, will issue a notice to the bank or will conduct a hearing.

III. Identification Strategy

I present my identification strategy in two separate parts. First, I explain the difference-in-differences matching method that I employ in a census-tract-level analysis, to estimate the effect of the CRA regulations on the supply of mortgages to CRA-eligible census tracts compared to ineligible census tracts. Second, I will discuss the need to aggregate the data to the ZIP code level and the instrumental variable approach to estimate the effect of mortgage growth on house price growth.

A. Mortgage Supply

The CRA regulations rely on census tracts' relative median family income to identify CRA-eligible census tracts. Moreover, only some of the financial institutions are required to comply with the CRA regulations. My identification strategy relies on these two pillars to isolate the effect of increased enforcement of the CRA on banks' supply of mortgages. The 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 simply because it is located in an MSA with a median family income lower than that of the other MSA. To clarify this experiment, let us look at the diagram presented in Figure 5. The two big black boxes represent two different MSAs 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 section 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 the log-difference in mortgages before and after 1998 between each CRA-eligible census tract and a group of matched ineligible census tracts from another MSA but within the same state. Finally, I run this exercise separately for both types of mortgages, i.e., those generated by CRA-regulated institutions and those by non-regulated institutions. I will explain the details of the sample construction in Section IV.A.

B. Price of Housing

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 has been a challenge to estimate an unbiased effect of mortgage growth on house price growth 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. As we have seen so far, CRA-eligible census tracts, starting from 1998, were exposed to a shift in mortgage supply which is unrelated to the actual or expected housing prices. I use this exogenous variation in exposure to the CRA regulation as an instrument to estimate the elasticity of house price growth to credit supply.

Ideally, we would like to estimate the following two-stage model:

$$Mortgage\ Growth_{ijt} = \alpha_0 + \alpha_1 CRA_i + \alpha' \mathbb{X}_{ijt} + \gamma_j + \lambda_t + u_{ijt} \tag{1}$$

$$House\ Price\ Growth_{ijt} = \beta_0 + \beta_1 \widehat{Mortgage\ Growth}_{ijt} + \beta' \mathbb{X}_{ijt} + \theta_j + \xi_t + \varepsilon_{ijt} \quad (2)$$

where we would use the census tract-by-year sample of observations and estimate house price reactions to mortgage growth by using the CRA dummy as an instrument. However, house price data are available only at the ZIP code level. Hence, I need to aggregate up the census tract level sample to a ZIP code level sample. ZIP codes are designed for the purpose of postal services and are generally bigger than census tracts. As is depicted in Figure 6 with red circles, two ZIP codes with the same income distribution but located in different MSAs could be differently exposed to the CRA regulations. In fact, the ZIP code in MSA 1 is partly populated by some households from a CRA-eligible census tract while an identical ZIP code in MSA 2 does not have any CRA-eligible population. Therefore, I aggregate up the data to the ZIP code level and estimate the following system of equations using a two-stage least square estimator (Schaffer (2005)):

$$Mortgage\ Growth_{ijt} = \alpha_0 + \alpha_1 CRA\ Ratio_i + \alpha' \mathbb{X}_{ijt} + \gamma_j + \lambda_t + u_{ijt} \quad (3)$$

$$House\ Price\ Growth_{ijt} = \beta_0 + \beta_1 \widehat{Mortgage\ Growth}_{ijt} + \beta' \mathbb{X}_{ijt} + \theta_j + \xi_t + \varepsilon_{ijt} \quad (4)$$

the only difference here is that, instead of the dummy variable *CRA*, I use the share of population in each ZIP code which belongs to the CRA-eligible census tracts of that particular ZIP code, called as the instrument. I call this variable *CRA Ratio*. For this variable to be a valid instrument we need to argue that it satisfies the two conditions of an acceptable instrument. 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. It is the second condition which needs more scrutiny. First, note that I can control for some of the observable differences between ZIP codes. These observables are income distribution within each ZIP code, initial house prices (as a measure of collateral value), population, population density and finally, elasticity of housing supply as suggested by Saiz (2010).

Therefore, the identification assumption (the exclusion restriction assumption) is that, after controlling for the observable characteristics, CRA status of a ZIP code (measured by *CRA Ratio*) affects house prices only through increased mortgage supply to the share of CRA-eligible population within each ZIP code. Hence, unobservable characteristics, like expected house prices, which drive demand for housing in each ZIP code are assumed to be unrelated to the CRA regulations.

IV. Data

The data that I use in this paper come from multiple sources. This section gives a detailed explanation of each one, and clarifies the sample selection procedures to generate the two separate samples I use in this paper.

A. Census-tract Level Sample

I use the home mortgage disclosure act (HMDA) data of the universe of mortgages generated from 1993 until 2006. 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 etc. I restrict my sample to the loans generated 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 institutions which are supervised by agencies such as OCC, FRS, FDIC and OTS have to comply with the CRA regulations. Therefore, I aggregate the loans for both types of regulated and non-regulated mortgage providers up to the census tract level in each year[10]. I generate measures of the total amount and number of mortgages generated by the both types of institutions in each of the census tracts. I also create a measure of

[10] Census tract definitions change for 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 changing definitions of census tracts. For the house price analysis section, however, since I aggregate census tract level data to the ZIP code level I can extend the data to 2006.

the size of the average mortgage for each type.

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 the above-mentioned criteria. My final census tract-level sample contains information on the amount, number and size of mortgages generated by CRA-regulated and non-regulated institutions and census-tracts' and MSAs' median family income. As discussed in Section III.A, I restrict the sample to the common support of the income distribution. I.e., I drop CRA census tracts which could not be CRA-ineligible in any of the MSAs (the poorest census tracts), and CRA-ineligible census tracts which could not be CRA-eligible in any of the MSAs (the richest census tracts.). Therefore, my final census tract-level sample contains 379913 census tract-year observations for 39449 unique census tracts from 1993 until 2002, of which 13804 are CRA-eligible census tracts. The summary statistics of this sample are presented in Table II.

B. ZIP code Level Sample

House price data at the ZIP code level are collected from Zillow.com[11]. Zillow provides estimated monthly house price indexes for different kinds of homes and various geography levels in the US. In this paper I use single family residence price index which is the median estimated home value for all detached single family homes within a given region. This measure is widely used in the real estate literature (Mian et al. (2015) and Adelino et al. (2016)). The data include information on 12445 ZIP codes from 50 states and 1035 counties in the US. This is about one-third of the total number of ZIP codes in the US. Using the monthly data I calculate the annual growth rate of the single family residence house price index for each ZIP code, from June of each year to May of the year after. I also define a new variable, *Log(initial price)* which is the natural logarithm of the index

[11] http://www.zillow.com/research/data/

at the beginning of my period of study, i.e., 1998[12].

I collect income distribution data within each ZIP code from IRS income data for years 1998, 2001, and 2004 to 2010 and calculate mean and standard deviation of income at the ZIP code level in each year. The IRS data is very comprehensive in covering almost all ZIP codes in the US. Each year I observe around 30000 ZIP codes in the IRS data. However, information for years 1999, 2000, 2002 and 2003 are missing from IRS's public data. In my main analysis I linearly interpolate the data for the missing years. However, the results remain qualitatively unchanged if I set each missing year's information equal to the closest year's available data. For example, income data for years 1999 will be set equal to the data in 1998 which is observed. It would also be possible to calculate income distributions within ZIP codes by using HMDA data. However, first there is a selection problem inherent in using this data due to the fact that I only observe income of mortgage applicants and not a random sample of the population, and second, based on Mian and Sufi (2015) there is evidence of income overstatement in low credit score and low income ZIP codes during the 2002-2005 period.

Finally, I aggregate total tract-level mortgages from HMDA using the population weights of census tracts comprising each ZIP code. The data that link ZIP codes and census tracts with population weights come from Missouri Census Data Center for both of the 1990 and 2000 census definitions[13].

The ZIP code-level sample in which I have both house prices and residential loans includes 68326 ZIP code-by-year observations from 1998 until 2006. I have house price data for 7989 ZIP codes[14] which corresponds to an annual average of 130 million in population which is more than 46% of the whole US population in 2002. The median ZIP code consists of 6 census tracts either partly or wholly. In total, 3620 ZIP codes have some CRA population, among which the median ZIP code has 38% of its population from CRA census tracts. The summary statistics of this sample is presented in Table VI.

[12] Zillow's ZIP code data start in 1996, however since I use growth rates I can only use the data starting from 1997, but then, as discussed earlier, CRA regulations changed in 1998. This is the reason my ZIP code level data starts in 1998

[13] http://mcdc2.missouri.edu/websas/geocorr2k.html

[14] Mian and Sufi (2009) have 3014 and Griffin and Maturana (2016) have 5176 ZIP codes in their final sample.

V. The CRA and Mortgage Supply

Table II presents the summary statistics of the census tract-level sample. Note that the unit of observation in this table is census tract per year, and the sample covers the period from 1993 until 2002 which is symmetric around the year 1998 in which the new CRA requirements became effective for big banks. Total regulated mortgages represent the sum of all mortgages generated in a census tract by all depository institutions which have to comply with the CRA regulations. Total non-regulated mortgages, however, is the sum of all mortgages generated by all other institutions in each census tract. On average, regulated institutions provide about $5.5 million worth of mortgages per year to the average census tract while this value for non-regulated institutions is about $2.5 million. The difference is due to the number of mortgages generated, not their size. The size of the average mortgage generated is $114.6 thousand and $111.8 thousand, respectively.

To analyze the differential growth rates of mortgages by different types of institutions to different census tracts, consider Figure 1. This figure shows the growth of mortgages, relative to 1998, generated by regulated institutions to the two types of census tracts. Prior to 1998, mortgage growth does not systematically differ between CRA-eligible census tracts and other tracts. However, starting from 1998 there is a clear upward shift in supply of mortgages to CRA-eligible census tracts by CRA-regulated institutions. In Figure 2, I redo the same exercise but using mortgages generated by non-regulated institutions. The graph shows no difference in growth of non-regulated mortgages between CRA-eligible and ineligible census tracts, neither for before nor for after 1998. These two graphs already provide a first indication that the CRA regulations affect the supply of mortgages by regulated institutions to CRA-eligible census tracts, starting from 1998.

Motivated by this preliminary finding, I now proceed with a matching estimation procedure to compare the growth of mortgages, from the pre-1998 period to the post-1998 period, in a representative CRA-eligible census tract with a set of comparable ineligible tracts which have the same median family income but are not CRA-eligible only due to the fact that they are placed in a MSA, in the same state, with slightly lower median family income. For each CRA-eligible census tract, I find four ineligible census tracts with similar value of median family income[15], which is per definition from a different MSA, and compare their growth of mortgages from before to after 1998. CRA-eligible census tracts are different from CRA-ineligible census tracts especially in terms of income distribution. Table III 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 CRA-regulated and non-regulated institutions (pre-1998) although they have statistically similar population. However, as presented in Panel B of Table III, my matching strategy generates statistically comparable samples in terms of median family income, population and pre-1998 mortgages.

The results of the difference-in-differences matching estimations are presented in Table IV. 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. Panel A of Table IV presents the results of the matching exercise for the whole 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, from pre-1998 to post-1998, the growth in total mortgage lending by CRA-regulated institutions to CRA-eligible census tracts was about 56 percentage points higher compared to this growth in a set of matched ineligible census tracts. The right column in Table IV 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 could be placed in MSAs with completely 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 non-eligible census tracts we would find

[15] The caliper in the main analysis is chosen to be $10. The results are robust to the choice of this caliper. Moreover, the number of matches are also chosen by following the findings in Abadie and Imbens (2011), however, the results are robust if, for example, I choose only the nearest neighbor as the match. Finally, I allow for replacement of matches in all specifications.

significant results for the mortgages generated by non-regulated institutions too. Second, to address this issue more precisely, I confine the sample to census tracts which have an income ratio in the vicinity of the 80% threshold. Panel B of Table IV presents the results for the case in which I restrict the sample to census tracts with a median family income in the range of $[0.6, 1.0]$ relative to their MSA[16]. The estimates are again strongly significant for the mortgages generated by the regulated institutions and insignificant for the mortgages generated by the non-regulated institutions. Note that the magnitudes of the estimates are also statistically not different from the baseline results in Panel A. Again, no significant difference is found for the growth of lending by non-regulated institutions between the two types of census tracts.

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 generated 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 total number of mortgages generated by the CRA-regulated institutions grew by about 20 percentage points more in an average eligible census tract compared to ineligible census tracts, while the growth in size of the average mortgage is about 10 percentage points larger. Note that 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 amendments to the CRA regulations, I find some weak evidence regarding them being crowded out by CRA-regulated institutions. That is why the size of the average mortgage increases also by non-regulated institutions in CRA-eligible census tracts while the number of mortgages weakly decreases.

There is a current debate about the role of different income groups in generating the growth in the mortgage market. Adelino et al. (2016) argue that unlike what Mian and

[16]In Panel C of Table IV I report the results of repeating the same exercise but confining the sample to census tracts with a median family income in the range of $[0.7, 0.9]$ of their respective MSA. All the implications remain as explained in the main text.

Sufi (2009) claim, mortgage growth is 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 is in contrast to Mian and Sufi (2009) who argue that mortgage growth in the early 2000s were primarily driven by a growth in supply to the sub-prime market which is due to lower underwriting standards which itself is a product of securitization boom. My paper contributes to this debate by showing that the CRA plays an important role in generating an upward shift in mortgage supply, which is not necessarily concentrated in a particular income group. To show this point let's consider Table V. This table presents the growth in total mortgages in CRA-eligible and matched CRA-ineligible census tracts from the period 1993-1997 to the period 1998-2002, separately for mortgages generated by CRA-regulated and non-regulated institutions in Panels A and B, respectively. Furthermore, I split the sample to four equal groups based on census tracts' median family income. The results show that CRA-regulated institutions' mortgages grew by about 120% to 206% in CRA-eligible census tracts across all income groups (except the top quartile in which there is no CRA-eligible census tract) and by about 70% to 147% for matched CRA-ineligible census tracts, again across all income groups. The difference, which is driven by CRA regulations is more than 50 percentage points, as I also showed before, across different income groups and is statistically highly significant. When I repeat the same exercise using mortgages generated by non-regulated institutions, as before, I do not find statistically different growth in mortgages between CRA-eligible and matched ineligible census tracts, in neither of the income groups.

These findings confirm that, within each income group, those census tracts which fall below 80% of their own MSA's median family income experienced a stronger positive shift in mortgage growth. This confirms that CRA mortgages are not all necessarily lent to low-income neighborhoods. In fact, CRA-eligibility is defined based on local relative income. This may well be 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 ZIP codes are CRA-eligible. Therefore, the reason why Mian and Sufi (2009) find stronger growth for low-income ZIP codes within each county could be partly because census tracts in these ZIP codes qualified for CRA mortgages.

VI. Mortgage Supply and the Price of Housing

So far we saw that the increased enforcement of the CRA generated a shift in mortgage supply to some but not all census tracts throughout the US. I take advantage of this exogenous shift in mortgage supply within an instrumental variable framework to estimate the causal effect of mortgage supply on housing prices. Next I discuss the reduced-form results, and finally present a set of placebo tests to rule out any concerns regarding the appropriateness of the proposed instrumental variable.

A. The Credit Channel: CRA as an Instrument

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.

Despite intuitive reasons why mortgage growth generates higher house prices, empirical estimation of the size of this effect has been proven to be challenging. Particularly, demand effects has 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. (2016)). Moreover, 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 employed approach can isolate a pure supply factor. For that reason, in this section I make use of the CRA setting as an exogenous shift to the supply of mortgage to estimate this causal effect. The CRA generated an outward shift in mortgage supply which is unrelated to the actual or expected house prices, hence is a good instrument in a regression of house price growth on mortgage growth.

As explained in Section IV.B this part of analysis relies on ZIP code level data due to the unavailability of house prices at the census tract level. For each ZIP code I define the share of ZIP code's population living in CRA-eligible census tracts as the measure of exposure to the CRA and I call it *CRA Ratio*. This measure varies between zero and one, with an average of 0.20 and a standard deviation of 0.31. Summary statistics of the other variables in the final sample are presented in Table VI. The average ZIP code experienced an annual growth of 8.1% per year in house prices. Nonetheless, there is a huge variation across ZIP codes and years. Prices declined by about 19.9% for some ZIP code in a year, while in other ZIP codes it increased by as much as 29.8% in one year. During the same period, total mortgages generated by CRA-regulated institutions grew by about 14.2% per year for the average ZIP code in an average year. ZIP codes in my sample have a mean income of $26.6 thousand and a within-ZIP code standard deviation of income of $16.9 thousand. Other control variables include initial house prices (i.e., as of 1998), population and population density. Finally, I use elasticity of housing supply, denoted in this paper by *elasticity*, which I borrow from Saiz (2010)[17]. This variable is at the MSA level and is time-invariant. It shows that 29.0% of the average MSA's land is not developable. The higher this number the lower the elasticity of housing supply and hence higher sensitivity of prices to increased demand for housing.

The two-stage least square estimation results of the system of equations in 3 and 4 are respectively presented in Table VII and Table VIII. Remember that the identification relies on a between-MSA estimation, hence I can control for state fixed effects and compare

[17]The number of observation for this variable is lower due to the partial coverage of it in the aforementioned paper.

ZIP codes within the same state but in different MSAs. Moreover, I control for year effects to capture the upward trends which characterized both mortgage and housing markets during the period under study. Standard errors are clustered at the state level, to account for any possible within-state correlation of house price growth rates. Moreover, this will also address the autocorrelation of growth rates through time for each ZIP code (Petersen (2009), Bertrand et al. (2004) and Angrist and Pischke (2009))[18].

Consider the first-stage results as presented in Table VII. The first column provides the estimates of regressing mortgage growth on CRA ratio while controlling for income distribution (i.e., mean and standard deviation) at the ZIP code level. Conditional on having the same income distribution, ZIP codes in which a bigger part of the population qualifies for CRA mortgages experience higher mortgage growths. In fact, the estimates of this model imply that a ZIP code whose census tracts are all CRA-eligible will have 4.2 percentage points higher annual mortgage growth rate than a similar (in terms of income) ZIP code in which none of its census tracts are CRA-eligible. This effect is economically significant considering that it is about 25 percent of the mean and 11 percent of the standard deviation of the annual mortgage growth rate. The test of weak instrument is rejected for all specifications, based on the first-stage Sanderson-Windmeijer F-statistic and P-values reported in Table VII (Sanderson and Windmeijer (2016)).

The results of the second-stage regressions are shown in Table VIII. Each column in this table corresponds to the respective first-stage result in Table VII. The coefficient estimate of the estimated mortgage growth, in the last column where I control for state-by-year fixed effects, is 0.3. This estimate means that for every one percentage point higher growth of mortgage supply, house prices will grow by 0.3 percentage point faster. A back-of-the-envelop calculation suggests that if we assume that all mortgage supply in this period is supply-driven then the average annual mortgage growth, i.e., 14% per year, would generate an additional 4.2 percentage points higher annual housing price growth rate. Of course not all mortgage growth was driven by supply shocks. For example, the CRA generated an average of 4.2 percentage points higher mortgage growth rates

[18]Nonetheless, I check for clustering the standard errors at the ZIP code level and as expected the resulting standard errors are smaller than the case when I cluster at the state level.

for a completely CRA-eligible ZIP code relative to a ZIP code with no CRA population. This supply shift generates an extra 1.2 percentage points higher growth rates in real estate prices in fully CRA ZIP codes. This effect is statistically significant even after controlling for a battery of ZIP code and metropolitan characteristics. Most importantly, I control for elasticity of housing supply following Saiz (2010). The coefficient estimate of the variable *elasticity* shows that annual housing price growth differs by 0.6 percentage points between two ZIP codes with one standard deviation difference in housing supply elasticity, after controlling for mortgage supply, income, demography and state-specific differences.

My results offer an explanation for the findings of Justiniano et al. (2015). In a general equilibrium framework, Justiniano et al. (2015) suggest that only a *"a progressive relaxation of lending constraints starting in the late 1990s, which led to a significant expansion in the supply of mortgage credit"* can explain the main characteristics of the boom in the housing and mortgage market prior to the financial crisis. These main characteristics are: the unprecedented rise in home prices and household debt, the stability of debt relative to house values, and the fall in mortgage rates. The results of my paper offer one channel through which mortgage supply rose during the early 2000s and contributed to the general trends in mortgage and housing market in this period.

B. Reduced Form

Did CRA-eligible areas experience higher house price growth relative to comparable, but CRA-ineligible ones? We already saw that CRA-eligible tracts received more mortgages. Theory suggests that higher supply of mortgages results in higher prices through generating more demand for housing by the formerly borrowing-constrained households.

To estimate the effect of the CRA enforcement on the affected ZIP codes, I use CRA ratio of population in each ZIP code as a proxy for each ZIP code's exposure to this regulation and estimate its effect on house price growth rates. Particularly, I regress annual house price growth rates at the ZIP code level on the share of each ZIP code's population who lives in CRA-eligible census tracts within that particular ZIP code, while controlling for average and standard deviation of income at the ZIP code level and other ZIP code level demographic characteristics. Moreover, I control for state and year fixed effects. In essence, this model compares two ZIP codes with the same income distribution but in two different MSAs (in the same state though) with different median family incomes which hence makes them different in their share of population who qualify for CRA mortgages.

The results are presented in Table XI for the boom period, i.e., 1998 to 2006 and Table XII for the bust period, i.e., 2007 to 2010. The higher a ZIP code was populated with CRA-eligible households, the faster house price growths from 1998 to 2006. Considering the estimate in the last column of Table XI, a fully CRA-populated ZIP code experienced 1 percentage point higher annual house price growth rate relative to a ZIP code which did not have any CRA-eligible population. Note that the average annual house price growth in this period is 8.1% and hence, the estimated effect is about 12.5% of the average annual house price growth rate during the same period. Furthermore, the same ZIP codes go through a more severe collapse during 2007 until 2010. Table XII shows that the higher a ZIP code is populated with CRA-eligible population, the faster is the decline in prices in this period. In sum, the CRA-eligible neighborhoods experienced an even stronger boom-bust cycle from 1998 until 2010.

Favara and Imbs (2015) argue that deregulation of interstate bank branching restrictions starting in 1994 generated an upward short-term shift in mortgage supply within deregulating states. To make sure that my findings are not confounded with the effect of bank branching deregulation, I add state-by-year fixed effects to the model presented at the last column of Table XI, which will non-parametrically capture all state-specific annual variations. The results barely change after controlling for state-by-year effects. Furthermore, it is not clear why banks would enter CRA-eligible neighborhoods more aggressively than CRA-ineligible neighborhoods.

C. Housing Prices across Income Distribution

Figure 3 depicts house price dynamics for low CRA-populated and high CRA-populated ZIP codes within each income quartile. Low-CRA ZIP codes are those in the first tercile of the distribution of the share of CRA-population (no CRA-population) and high-CRA ZIP codes are those in the top tercile (with an average of 60% CRA-population). This figure shows that during the boom period house prices increased almost equally in every income quartile. Second, within each income quartile house prices increased significantly more for high-CRA ZIP codes. The difference in house price appreciation for high-CRA ZIP codes relative to low-CRA ZIP codes in the first quartile of income distribution is more than 50 percentage points from 1998 until 2006. This equals to a twice higher total appreciation in house prices for CRA ZIP codes. The difference in the second and third quartiles of ZIP code income distribution is more than 30 percentage points, and more than 10 percentage points in the top quartile. One important take-away from this figure is that variation of housing prices over CRA is much stronger than its variation over income levels. In fact, the average unconditional house price growth only slightly increases from the first to the third quartile of ZIP code average income. Table IX presents the same findings using annual growth rates. Again, in general higher-income ZIP codes experienced a higher annual house price growth rate from 1998 until 2006. Nevertheless, within each income quartile, annual house price growth rates are economically and statistically higher for high-CRA ZIP codes.

This finding helps to partly resolve the critiques of Adelino et al. (2016) on Mian and Sufi (2009). My results so far show that in studying the early 2000's housing and mortgage markets one needs to factor in the role of the CRA. In fact, neither using ZIP code level data alone nor incorporating county fixed effects, as suggested in Mian and Sufi (2009), are able to capture the effects of the increased supply of mortgages to CRA census tracts, which are not necessarily low-income in absolute terms. Controlling for county fixed effects and running within-county regressions picks up on the differences between high-CRA and low-CRA ZIP codes which within the same county are likely to be the relatively poor versus the relatively rich ZIP codes. Moreover, it is also known that income levels and income growth were strongly positively correlated in this period (Adelino et al. (2016)). Not surprisingly, therefore, the same pattern as seen in Table IX appears to be still true if I use quartiles of income growth instead of income levels. Namely, within each quartile of income growth, house prices in high-CRA ZIP codes grow significantly faster than low-CRA ZIP codes. Nevertheless, my results in essence corroborate the supply side explanation in Mian and Sufi (2009), and offer an additional channel through which supply of mortgages surged in some neighborhoods more than the others which in turn generated higher house price growth rates for the ones which were more exposed to this positive shift.

D. Placebo Tests

When running the instrumental variable regressions in this section I used total mortgages generated only by the CRA-regulated institutions. If I instead use total mortgages generated by non-regulated institutions, the first-stage results disappear as presented in the first column of Table XIII. This indicates that mortgage supply by non-regulated institutions does not correlate with the share of CRA-eligible population at the ZIP code level. This can be viewed as a placebo test for the exclusion restriction assumption that I made in the previous section: if, after controlling for income and other observables, demand for housing correlates with CRA Ratio, we should also observe correlation between mortgage generated by non-regulated institutions and CRA Ratio. Results in Table XIII does not support this idea.

Another important test is the case when I use total mortgages generated by all types of institutions in my instrumental variable setting. The results are presented in the last two columns of Table XIII and show that the estimates are almost unchanged compared to the main results in Table VII and Table VIII. Only the standard errors become slightly wider for that the non-regulated mortgages do not correlate with CRA Ratio and hence introduce noise into the estimates.

The evidence in this section corroborates the hypothesis that relative higher house price growth in CRA-eligible neighborhoods (as shown in the previous section) is in fact caused by the shift in supply of mortgages by the CRA-regulated banks.

VII. Riskiness of the Marginal CRA-induced Mortgage

The literature seems to disagree as to whether the CRA set the stage for riskier lending by the affected banks. While Avery and Brevoort (2014) finds little evidence for higher price or delinquencies of CRA mortgages, Agarwal et al. (2012) document a significant difference in riskiness of mortgages which were produced around the CRA examination dates. Reid et al. (2013) have criticized the identification strategy of Agarwal et al. (2012) by arguing that CRA examiners take the long-term past performance of the banks into account, hence what they look for at the time of examination is their performance during the preceding years and not just a few months around the examination date.

I contribute to this literature by analyzing the riskiness of the CRA-induced mortgages within the proposed framework of the paper. In particular, I compare the riskiness of mortgages extended to two census tracts with similar income levels while one is CRA-eligible and the other is not. Moreover, I do this exercise both for mortgages generated by CRA-regulated institutions and non-regulated institutions.

The analysis in this section is at the mortgage level. I use a public data set of fully amortizing, 30-year fixed-rate mortgages provided by Freddie Mac[19] which includes higher-quality loans that were acquired by Freddie Mac and hence conformed to agency guidelines (Adelino et al. (2016)). In order to find the exact census tract of each mortgage in this data, I match this data to the origination data from HMDA based on the size of the mortgage, ZIP code, occupancy, and purpose of the loan. The Freddie Mac data starts in 1999. Therefore, I match this with HMDA for the years from 1999 until 2002 and find mortgage performance data for about 36000 mortgages generated in these four years. To make sure that the matching procedure does not introduce systematic biases into the sample, I present the summary statistics of the main variables of this section in

[19] http://www.freddiemac.com/news/finance/sf_loanlevel_dataset.html

Table XIV. Although there are about 2.3 million mortgages in the population of Freddie Mac data, I am only able to find census tract data for around 36 thousand of them. This is much smaller than the original sample. However, as long as the two samples are comparable, this should not be a big concern. Summary statistics presented at Table XIV confirm that the matched sample is similar in characteristics to the population. Mortgages have economically similar average size, FICO score and interest rate.

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 which are extended to households living in a CRA-eligible census tract to those from an ineligible census tract, from the same state. Moreover, I do this exercise separately for CRA-regulated and non-regulated banks. The outcome variables of interest are the borrower's FICO score, the original interest rate of the mortgage contract and finally a dummy variable which indicates whether the mortgage was delinquent or not. Delinquent mortgages are the ones which are at least 60 days past due on their monthly payments, are in foreclosure or are real estate-owned. I construct this variable by using the Freddie Mac mortgage performance data.

The results are presented in Table XV. The first three columns pertain to the outcome of mortgages generated by CRA-regulated institutions and the last three columns are those of non-regulated institutions. The coefficient estimate of the dummy variable *CRA* on the first column indicates that the mortgages which were extended to CRA-eligible census tracts by CRA-regulated institutions went to borrowers with about 7 points lower in FICO score. These loans also had higher interest rates of about 0.12 percentage points. These two results together are consistent with the findings in Canner et al. (2002) who find that CRA-regulated institutions did not carry lower spreads on their CRA mortgages, controlling for mortgage risk. Moreover, I find that CRA-induced mortgages were delinquent 3.7% more often than similar loans which were extended to borrowers in similar census tracts which were however ineligible for CRA loans. All the coefficients are statistically significant at the 1 percent level. This is in line with the findings in Demyanyk and Van Hemert (2011). However, when I redo the same exercise for the mortgages generated by non-regulated institutions I do not find any significant difference between mortgages in CRA-census tracts and non-CRA census tracts.

Note that the results in this section are unlikely to be driven by subprime mortgages in that the sample I use here comes from the Freddie Mac's single family loan-level dataset, which in fact requires the mortgages it holds to comply with the agency standards. These standards practically restricts subprime mortgages from entering any of the agencies' portfolios (Keys et al. (2010)). Therefore, subprime mortgages are in general underrepresented in the sample I use in this section of the paper. In particular, only 5.6% of the observations in my sample have a FICO score smaller than 620 (the *rule-of-thumb* for considering a mortgage subprime as suggested in Avery et al. (1996)).

VIII. Conclusion

In this paper I studied the role of the Community Reinvestment Act in the late 1990s and early 2000s and showed that it significantly contributed to the steep rise in supply of mortgages and consequently to the surging prices in the real estate sector. I also showed that the marginal 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 documented the elasticity of house price growth to mortgage supply.

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 analyze the possible crowding out of the commercial and industrial loans due to the CRA enforcement and its real effects. Moreover, competitive effects of the CRA on independent mortgage providers is another important topic which has to be studied.

My results document a clear mortgage supply channel as an additional contributing factor to the situation before 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 generated 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 mortgages and house prices. These findings reconcile part of the recent debate in the literature on the role of different income groups in generating the financial crisis.

REFERENCES

Abadie, Alberto, and Guido Imbens, 2011, Bias-Corrected Matching Estimators for Average Treatment Effects, *Journal of Business* & *Economic Statistics* 29, 1–11.

Abadie, Alberto, and Guido W. Imbens, 2006, Large Sample Properties of Matching Estimators for Average Treatment Effects, *Econometrica* 74, 235–267.

Adelino, Manuel, Antoinette Schoar, and Felipe Severino, 2012, Credit Supply and House Prices: Evidence from Mortgage Market Segmentation, NBER Working Papers 17832, National Bureau of Economic Research, Inc.

Adelino, Manuel, Antoinette Schoar, and Felipe Severino, 2016, Loan Originations and Defaults in the Mortgage Crisis: The Role of the Middle Class, *Review of Financial Studies* .

Agarwal, Sumit, Efraim Benmelech, Nittai Bergman, and Amit Seru, 2012, Did the Community Reinvestment Act (CRA) Lead to Risky Lending?, Working Paper 18609, National Bureau of Economic Research.

Angrist, J.D., and J.S. Pischke, 2009, *Mostly Harmless Econometrics: An Empiricist's Companion* (Princeton University Press).

Arrow, Kenneth .J., 1973, *The Theory of Discrimination. In: Ashenfelter, O., Rees, A. (Eds.), Discrimination in Labor Markets.* (Princeton University Press).

Avery, Robert, Raphael Bostic, Paul Calem, and Glenn Canner, 1996, Credit Risk, Credit Scoring and the Performance of Home Mortgages, *Federal Reserve Bulletin* 82, 621–648.

Avery, Robert B., and Kenneth P. Brevoort, 2014, The Subprime Crisis: Is Government Housing Policy to Blame?, *Review of Economics and Statistics* 97, 352–363.

Barberis, Nicholas, Robin Greenwood, Lawrence Jin, and Andrei Shleifer, 2016, Extrapolation and Bubbles, Working Paper 21944, National Bureau of Economic Research.

Bernanke, Ben, 2005, The Global Saving Glut and the U.S. Current Account Deficit, *Sandridge Lecture, Virginia Association of Economics, Richmond, VA* .

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan, 2004, How Much Should We Trust Differences-In-Differences Estimates?, *The Quarterly Journal of Economics* 119, 249–275.

Bhutta, Neil, 2011, The Community Reinvestment Act and Mortgage Lending to Lower Income Borrowers and Neighborhoods, *The Journal of Law & Economics* 54, 953–983.

Caballero, Ricardo J., Emmanuel Farhi, and Pierre-Olivier Gourinchas, 2008, An Equilibrium Model of "Global Imbalances" and Low Interest Rates, *American Economic Review* 98, 358–93.

Canner, Glenn B., Elizabeth Laderman, Andreas Lehnert, and Wayne Passmore, 2002, Does the Community Reinvestment Act (CRA) cause banks to provide a subsidy to some mortgage borrowers?, Finance and Economics Discussion Series 2002-19, Board of Governors of the Federal Reserve System (U.S.).

Chakraborty, Indraneel, Itay Goldstein, and Andrew MacKinlay, 2016, Do Asset Price Booms Have Negative Real Effects?, *Unpublished working paper* .

Demyanyk, Yuliya, and Otto Van Hemert, 2011, Understanding the Subprime Mortgage Crisis, *Review of Financial Studies* 24, 1848–1880.

Di Maggio, Marco, and Amir Kermani, 2014, Credit-induced Boom and Bust, Research Paper No. 14-23, Columbia Business School.

Favara, Giovanni, and Jean Imbs, 2015, Credit Supply and the Price of Housing, *American Economic Review* 105, 958–92.

Favilukis, Jack, Sydney Ludvigson, and Stijn Van Nieuwerburgh, 2013, The Macroeconomic Effects of Housing Wealth, Housing Finance, and Limited Risk-Sharing in General Equilibrium, Working paper, SSRN.

Gabriel, Stuart A., and Stuart S. Rosenthal, 2009, Government-Sponsored Enterprises, the Community Reinvestment Act, and Home Ownership in Targeted Underserved Neighborhoods, *Housing markets and the economy : risk, regulation, and policy* .

Griffin, John M., and Gonzalo Maturana, 2016, Did Dubious Mortgage Origination Practices Distort House Prices?, *Review of Financial Studies* .

Gropp, Reint, John Krainer, and Elizabeth Laderman, 2014, Did Consumers Want Less Debt? Consumer Credit Demand versus Supply in the Wake of the 2008-2009 Financial Crisis, SAFE Working Paper Series, No. 42.

Himmelberg, Charles, Christopher Mayer, and Todd Sinai, 2005, Assessing High House Prices: Bubbles, Fundamentals, and Misperceptions, Working Paper 11643, National Bureau of Economic Research.

Ioannidou, Vasso, Steven Ongena, and Jos-Luis Peydr, 2015, Monetary Policy, Risk-Taking, and Pricing: Evidence from a Quasi-Natural Experiment, *Review of Finance* 19, 95–144.

Justiniano, Alejandro, Giorgio E. Primiceri, and Andrea Tambalotti, 2015, Credit supply and the housing boom, Working Paper 20874, National Bureau of Economic Research.

Keys, Benjamin J., Tanmoy Mukherjee, Amit Seru, and Vikrant Vig, 2009, Financial regulation and securitization: Evidence from subprime loans, *Journal of Monetary Economics* 56, 700–720.

Keys, Benjamin J., Tanmoy Mukherjee, Amit Seru, and Vikrant Vig, 2010, Did Securitization Lead to Lax Screening? Evidence from Subprime Loans, *The Quarterly Journal of Economics* 125, 307–362.

Khwaja, Asim, and Atif Mian, 2008, Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market, *American Economic Review* 98, 1413–42.

Kiyotaki, Nobuhiro, and John Moore, 1997, Credit Cycles, *Journal of Political Economy* 105, 211–248.

Laeven, Luc, and Alexander Popov, 2016, A Lost Generation? Education Decisions and Employment Outcomes during the US Housing Boom-Bust Cycle of the 2000s, *American Economic Review* 106, 630–35.

Maddaloni, Angela, and Jos-Luis Peydró, 2011, Bank Risk-taking, Securitization, Supervision, and Low Interest Rates: Evidence from the Euro-area and the U.S. Lending Standards, *Review of Financial Studies* 24, 2121–2165.

Mayer, Christopher, and Todd Sinai, 2009, U.S. House Price Dynamics and Behavioral Finance, In *Policy Making Insights from Behavioral Economics*, edited by Christopher L. Foote, Lorenz Goette, and Stephan Meier, chapter 5, Federal Reserve Bank of Boston.

Mian, Atif, and Amir Sufi, 2009, The Consequences of Mortgage Credit Expansion: Evidence from the U.S. Mortgage Default Crisis, *The Quarterly Journal of Economics* 124, 1449–1496.

Mian, Atif, Amir Sufi, and Francesco Trebbi, 2015, Foreclosures, House Prices, and the Real Economy, *The Journal of Finance* 70, 2587–2634.

Mian, Atif R., and Amir Sufi, 2015, Fraudulent Income Overstatement on Mortgage Applications during the Credit Expansion of 2002 to 2005, Working Paper 20947, National Bureau of Economic Research.

Overby, Brooke A., 1995, Community Reinvestment Act Reconsidered, *University of Pennsylvania Law Review* 143, 1431.

Petersen, Mitchell A., 2009, Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches, *Review of Financial Studies* 22, 435–480.

Phelps, Edmund, 1972, The statistical theory of racism and sexism, *American Economic Review* 62, 659–61.

Reid, Caolina, Ellen Seidman, Mark Willis, Lei Ding, Josh Silver, and Janneke Ratcliffe, 2013, Debunking the CRA Myth- Again, Technical report, University of North Carolina at Chapel Hill.

Ringo, Daniel R., 2015, Refinancing, Default and the Community Reinvestment Act, *SSRN Electronic Journal* .

Saiz, Albert, 2010, The Geographic Determinants of Housing Supply, *The Quarterly Journal of Economics* 125, 1253–1296.

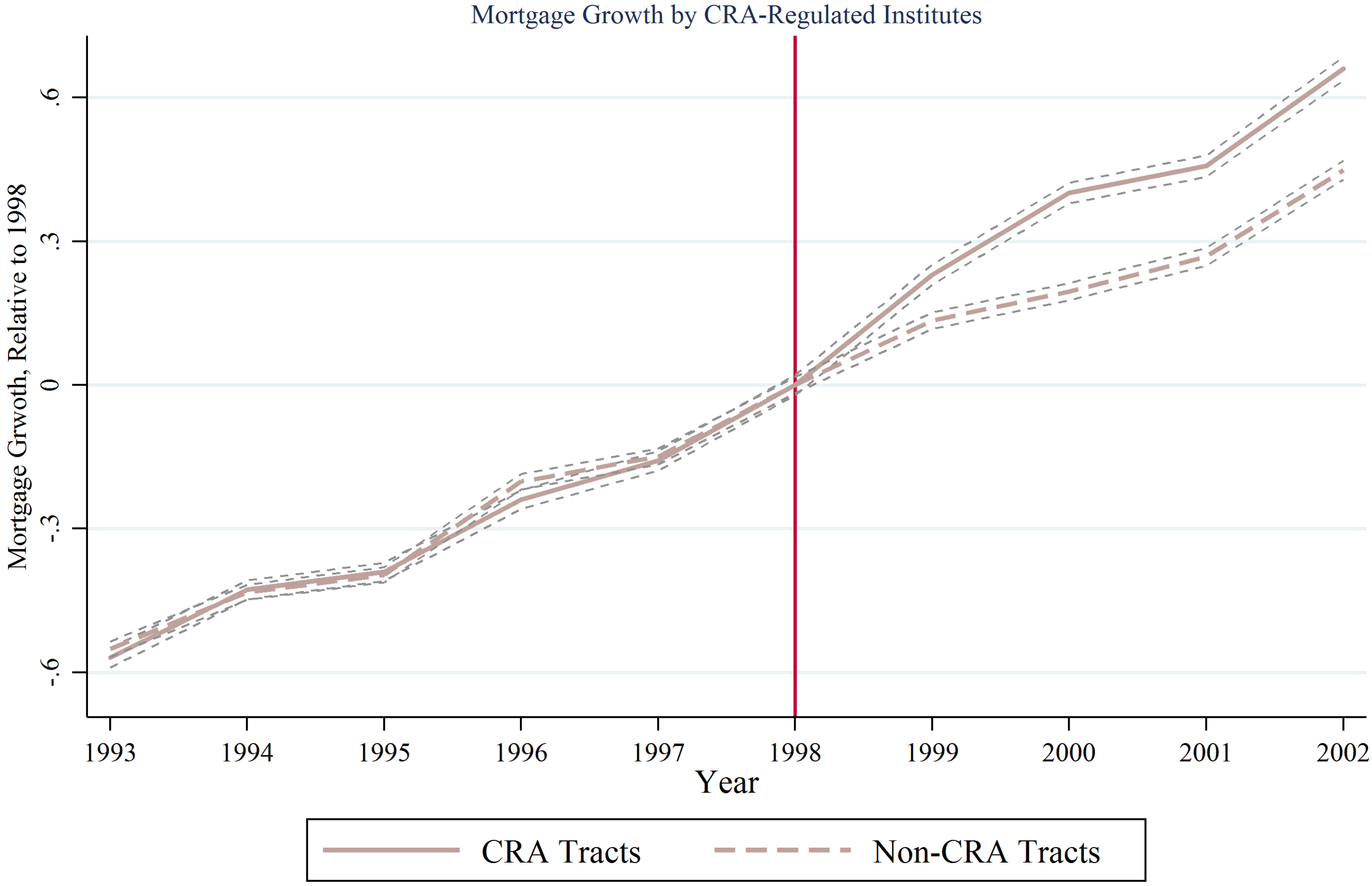
Sanderson, Eleanor, and Frank Windmeijer, 2016, A Weak Instrument F-test in Linear IV Models with Multiple Endogenous Variables, *Journal of Econometrics* 190, 212–221.

Schaffer, Mark E, 2005, XTIVREG2: Stata module to perform extended IV/2SLS, GMM and AC/HAC, LIML and k-class regression for panel data models, Statistical Software Components, Boston College Department of Economics.

Shiller, Robert, 2005, *Irrational Exuberance*, second edition (Princeton, NJ: Princeton University Press).

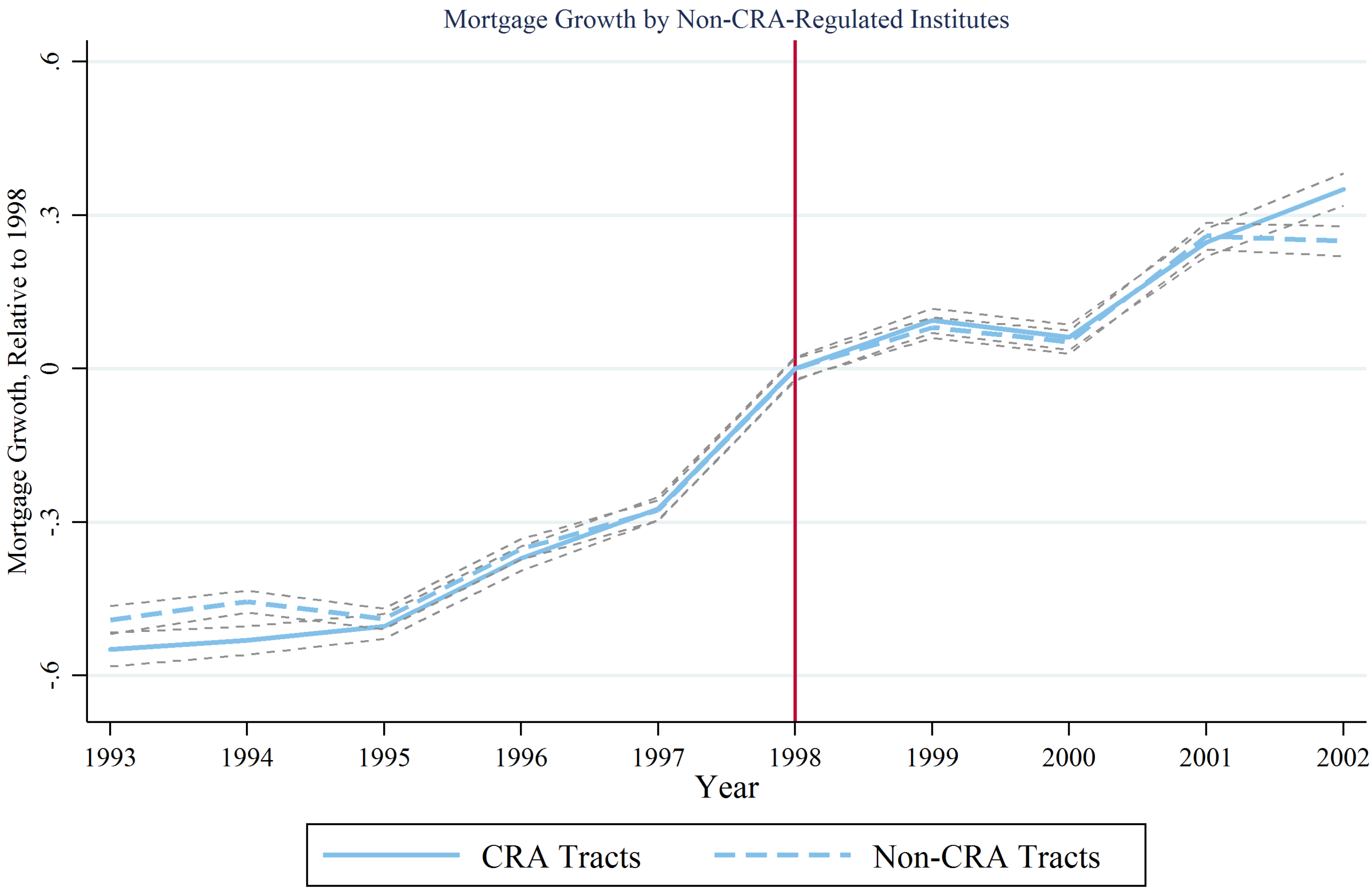
IX. Figures

Figure 1. Growth in total amount of mortgages by regulated institutions



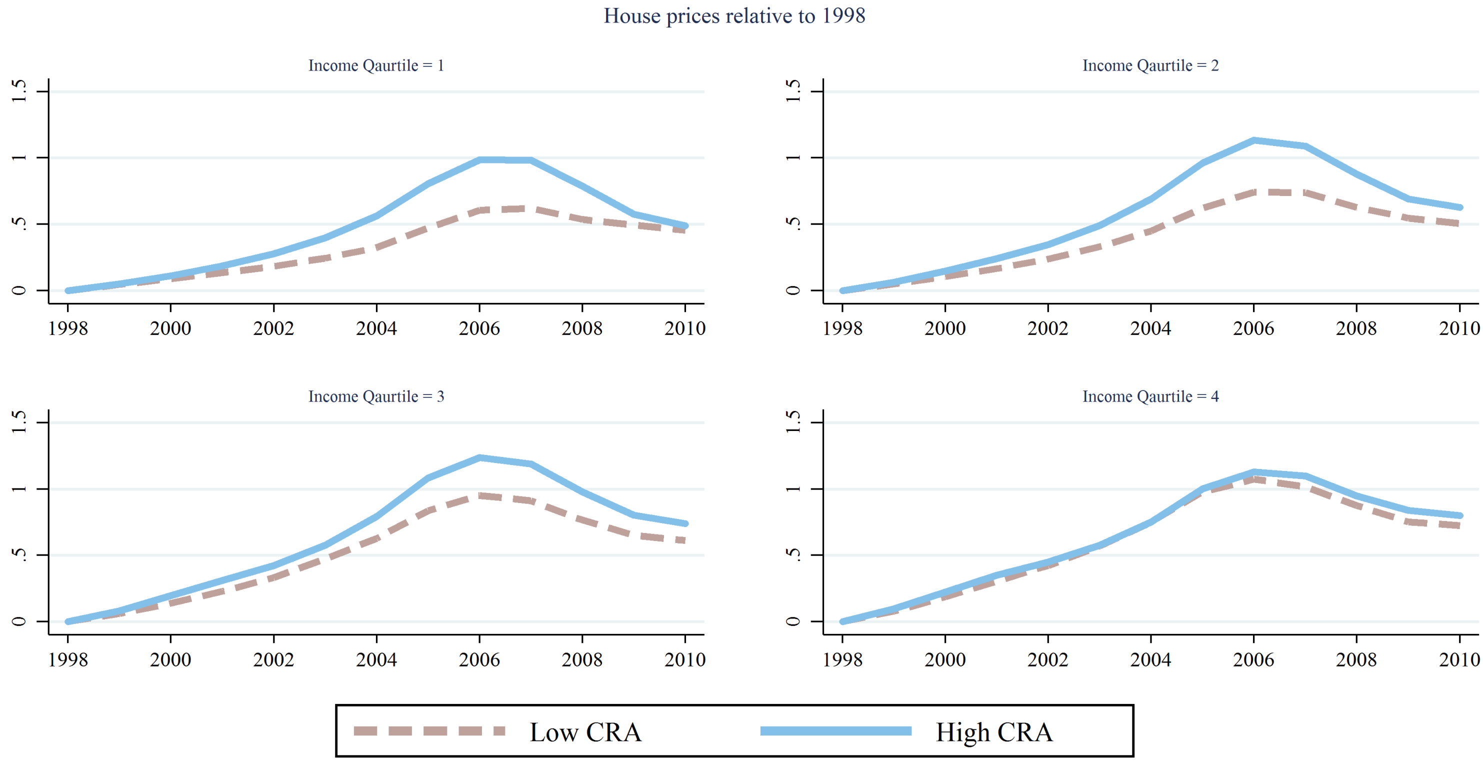
This figure illustrates the total mortgage supply by CRA-regulated institutions to the two types of CRA-eligible and ineligible census tracts. CRA-regulated institutions are those supervised by FDIC, FRB, OCC and OTS. CRA-eligible census tracts are census tracts with a median family income of less than 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, i.e. the time series illustrates the log-ratio of total mortgages in a given year relative to the year of the enhanced enforcement in CRA regulations. 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 generated as explained in Section IV.A.

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



This figure illustrates the total mortgage supply by non-regulated institutions to the two types of CRA-eligible and ineligible census tracts. Non-CRA-regulated institutions are those which are supervised by NUCA and HUD. 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, i.e. the time series illustrates the log-ratio of total mortgages in a given year relative to the year of the enhanced enforcement in CRA regulations. 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 generated as explained in Section IV.A.

Figure 3. House price dynamics for high versus low CRA-populated ZIP codes within each income quartile

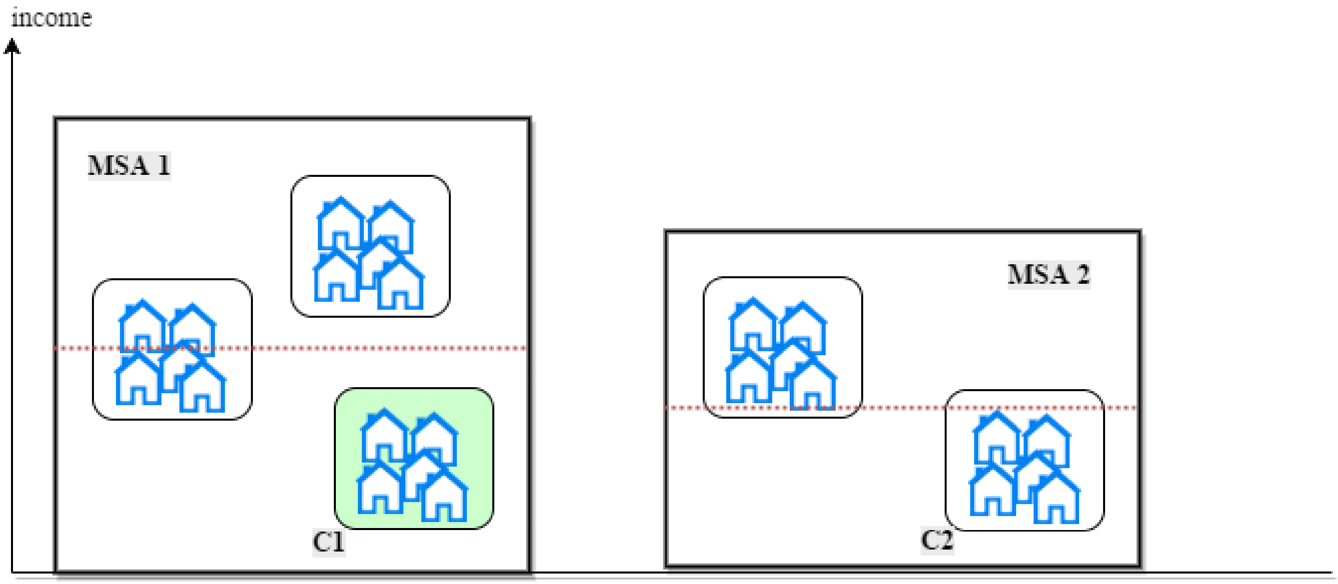


This figure illustrates the evolution of house prices, normalized in 1998, for low- versus high-CRA populated ZIP codes within each income quartile. Low-CRA ZIP codes are those in the lower tercile of the distribution of ZIP codes' share of CRA-eligible population and high-CRA ZIP codes are those on the top tercile. ZIP code average income from 1998 until 2006 is calculated from the data reported by the IRS and house price data are from Zillow.

Figure 4. County-level deciles of house price appreciation rates

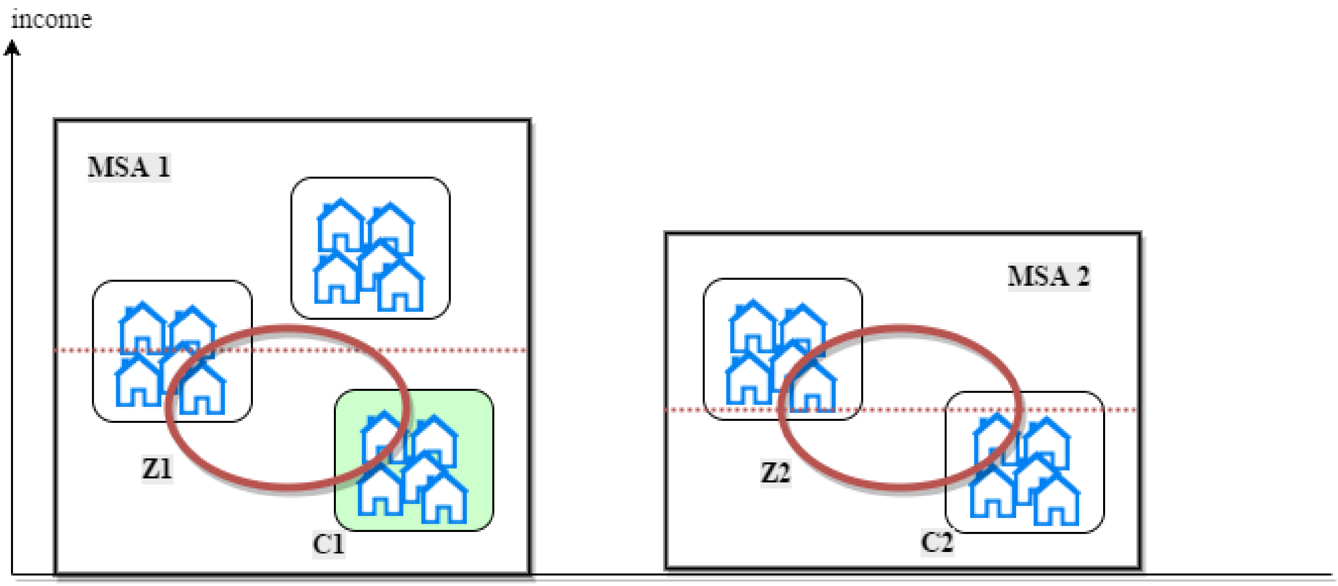
This figure is from Gropp et al. (2014) and shows the heterogeneity in housing price appreciation before and depreciation after the housing crisis.

Figure 5. Census tracts, metropolitan statistical areas and CRA-eligibility



This sketch shows the overlap of census tracts (small blocks) and MSAs (big blocks). Furthermore, where the geographical areas lie on the y-axis indicates their median family income. In particular, 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 neighboring 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.

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



This sketch shows the overlap of census tracts (small blocks), ZIP codes (red ovals), and MSAs (big blocks). Furthermore, where the geographical areas lie on the y-axis indicates their median family income. This sketch shows that ZIP codes with the same level of income can have different shares of CRA-eligible population.

X. Tables

Table I. 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 which the CRA regulators perform to assess each bank's level of compliance with CRA requirements. These three test are: lending, investment and service tests.

Table II. Summary statistics of the census tract level sample

	N	Mean	Std. Dev.	Min	Max
Total regulated mortgages (Mil. $)	379913	5.472	8.776	0.000	702.0
Average regulated mortgage (Mil. $)	374607	0.115	0.080	0.001	3.000
Number of regulated mortgages per tract	379913	42.35	47.11	0.000	3923
Total non-regulated mortgages (Mil. $)	379913	2.464	4.365	0.000	610.8
Average non-regulated mortgage (Mil. $)	367620	0.112	0.074	0.001	4.000
Number of non-regulated mortgages per tract	379913	20.92	30.22	0.000	4029
Tract median family income (Tsd. $)	379913	53.07	25.24	0.000	200.0
MSA median family income (Tsd. $)	379913	54.10	7.848	26.01	71.33
Income ratio	379913	0.979	0.427	0.000	4.508

This table reports the summary statistics of the census tract-by-year sample which covers the years 1993 until 2002. The sample is generated as explained in Section IV.A. Mortgage generation data is collected from HMDA. *Regulated mortgages* denotes to the mortgages generated by CRA-regulated institutions. *Non-regulated mortgages* denotes to the mortgages generated by institutions which do not have to comply with the CRA regulations. Census tract and MSA median family income are collected from census data. *Income Ratio* is the ratio of each census tract's median family income to its respective MSA's median family income.

Table III. Matching quality

	CRA-eligible	CRA-ineligible	%bias	t-stat
Panel A: Before matching				
Num. of Census Tracts	13351	24868		
Census tract median family income	31.6	64.3	-181.0	-20.27
Population	3785	4595	-38.4	-1.33
Pre-1998 total regulated mortgages	1.167	5.279	-97.0	-19.59
Pre-1998 total non-regulated mortgages	0.744	2.438	-76.5	-10.10
Panel B: After matching				
Num. of Census Tracts	1037	1026		
Census tract median family income	41.3	41.3	0.0	0.05
Population	4290	4402	-5.3	-1.00
Pre-1998 total regulated mortgages	1.802	1.842	-1.0	-0.36
Pre-1998 total non-regulated mortgages	1.236	1.082	7.0	1.07

This table presents matching quality diagnostics. It shows the number of CRA-eligible and CRA-ineligible census tracts and the average of census tracts' median family income for each group before and after matching. % bias, is the % difference of the sample means in the CRA-eligible and CRA-ineligible samples as a percentage of the square root of the average of the sample variances in the respective groups. t-stat is the test statistic of the difference in means. Standard errors are corrected for clustering at the state level.

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

	CRA-regulated institutions	Non-regulated institutions
Panel A: Full sample		
Total mortgages	0.558***	0.068
	(0.063)	(0.072)
Size of mortgages	0.115***	0.041**
	(0.014)	(0.016)
Number of mortgages	0.261***	0.010
	(0.039)	(0.047)
Panel B: Income Ratio $\in$ *(0.6, 1.0)*		
Total mortgages	0.474***	0.025
	(0.067)	(0.080)
Size of mortgages	0.109***	0.037**
	(0.016)	(0.018)
Number of mortgages	0.218***	-0.013
	(0.042)	(0.050)
Panel C: Income Ratio $\in$ *(0.7, 0.9)*		
Total mortgages	0.452***	-0.038
	(0.097)	(0.111)
Size of mortgages	0.098***	0.054**
	(0.024)	(0.027)
Number of mortgages	0.213***	-0.103
	(0.059)	(0.073)

This table reports the results of difference-in-differences matching estimations, using four nearest neighbors, separately for mortgages generated by the two types of financial institutions, i.e., the ones which are regulated under CRA and the ones that are not. For each census tract the total amount, number and size of the mortgages are averaged over each of the two periods of 1993-1997 and 1998-2002. Then the linear growth in each of the variables is calculated for each census tract. Finally, every CRA-eligible census tract is matched to four CRA-ineligible census tracts from the same state with similar median family incomes. The reported estimates are then the average treatment effect on the treated, taking CRA-eligible census tracts as the treated group and the matched group of 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. The sample is generated as explained in Section IV.A. Standard error 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 V. Mortgage growth across income distribution and CRA eligibility

Income quartiles	CRA Census Tracts	Matched Non-CRA Tracts	Difference	T-stat
Panel A: CRA-regulated institutions				
1 (low income)	1.2529	0.6950	0.5579	3.70
2	1.3063	0.7515	0.5549	7.79
3	2.0640	1.4727	0.5913	2.16
4 (high income)	-	-	-	-
Panel B: Non-regulated institutions				
1 (low income)	1.1726	0.9770	0.1957	1.01
2	1.0060	0.9768	0.0292	0.35
3	1.1834	1.0350	0.1484	0.73
4 (high income)	-	-	-	-

This table reports the results of the difference-in-differences matching estimation of growth in total mortgages 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. Panel A and Panel B show the results for growth in mortgages generated by CRA-regulated and non-regulated institutions, respectively. For each census tract the total amount, number and size of the mortgages are averaged over each of the two periods of 1993-1997 and 1998-2002. Then the linear growth in each of the variables is calculated for each census tract. Finally, every CRA-eligible census tract is matched to four CRA-ineligible census tracts from the same state with similar median family incomes. The reported estimates are then the average treatment effect on the treated, taking CRA-eligible census tracts as the treated group and the matched group of CRA-ineligible census tracts as the control group. The sample is generated as explained in Section IV.A. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table VI. Summary statistics of the ZIP code-level sample

	N	Mean	Std. Dev.	Min	Max
House Price Growth	68443	0.082	0.071	-0.199	0.298
Mortgage Growth	68443	0.148	0.302	-0.991	1.771
CRA Ratio	68443	0.204	0.312	0.000	1.000
Avg. Income	68443	53.55	32.07	0.000	245.6
Std. Income	68443	52.17	40.62	0.000	322.0
Log(Initial price)	68443	11.72	0.528	10.71	13.81
Log(Population)	68443	9.441	1.036	3.807	11.65
Log(Pop. Density)	68443	6.739	1.702	-0.977	10.82
Elasticity	50269	1.489	0.781	0.600	5.360

This table reports the summary statistics of the ZIP code-level sample for the period from 1998 until 2006. The sample is generated as explained in Section IV.B. *House Price Growth* is the annual growth of ZIP code level single family residence price index from Zillow. *Mortgage Grwoth* is the annual growth of total mortgages generated by the CRA-regulated institutions collected from HMDA. *CRA Ratio* measures the share of population in each ZIP code which belongs to the CRA-eligible census tracts encompassed within that ZIP code. *Avg. Income* is the ZIP code level average annual household income, stated in thousand dollars, while *Std. Income* is the standard deviation of this measure. *Initial price* is house price index at 1998. *Log(Population)* is the logarithm of total ZIP code population from census 2000 and *Log(Pop. Density)* is the logarithm of the ZIP code level number of residents per squared mile. Finally, *Elasticity* measures housing supply elasticity as provided in Saiz (2010).

Table VII. IV estimation- First-stage results

	Mortgage Growth				
CRA Ratio	0.046***	0.055***	0.036***	0.044***	0.042***
	(0.014)	(0.015)	(0.005)	(0.006)	(0.006)
Avg. Income	0.000*	−0.001***	−0.000*	−0.000**	−0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Std. Income	−0.001***	0.000	−0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(Initial price)		0.044***	0.018	0.009	0.007
		(0.013)	(0.018)	(0.019)	(0.019)
Log(Population)		0.016***	0.006**	0.008***	0.008***
		(0.004)	(0.002)	(0.003)	(0.003)
Log(Pop. Density)		−0.010***	−0.007**	−0.011***	−0.011***
		(0.003)	(0.003)	(0.004)	(0.004)
Elasticity				0.003	0.003
				(0.006)	(0.006)
Year FE	No	Yes	Yes	Yes	No
State FE	No	No	Yes	Yes	No
State-by-year FE	No	No	No	No	Yes
F-statistic	10.49	14.01	45.09	47.23	43.44
P-value	0.002	0.000	0.000	0.000	0.000
Observations	68326	68326	68326	50160	50160

This table reports the results of the first-stage instrumental variable regressions at the ZIP code level. 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). The sample is generated as explained in Section IV.B. Standard errors are corrected for clustering at the state level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table VIII. IV estimation- Second-stage results

	House Price Growth				
$\widehat{\text{Mortgage Growth}}$	0.473***	0.422***	0.294***	0.279***	0.299***
	(0.092)	(0.063)	(0.078)	(0.083)	(0.083)
Avg. Income	0.000	0.000	−0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Std. Income	0.000**	−0.000	0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(Initial price)		0.028***	0.014***	0.013**	0.017***
		(0.006)	(0.005)	(0.005)	(0.005)
Log(Population)		−0.008***	−0.004***	−0.004***	−0.004***
		(0.002)	(0.001)	(0.001)	(0.001)
Log(Pop. Density)		0.008***	0.005***	0.006***	0.006***
		(0.001)	(0.001)	(0.001)	(0.001)
Elasticity				−0.008***	−0.008***
				(0.003)	(0.003)
Year FE	No	Yes	Yes	Yes	No
State FE	No	No	Yes	Yes	No
State-by-year FE	No	No	No	No	Yes
Observations	68326	68326	68326	50160	50160

This table reports the results of the second-stage instrumental variable regressions at the ZIP code level. The sample is generated as explained in Section IV.B. Standard errors are corrected for clustering at the state level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table IX. Annual house price growth across income level and CRA Ratio distribution

	CRA Ratio terciles				
Income quartiles	1	2	3	3-1	t-stat
1	0.0499	0.0608	0.0744	0.0245	18.85
2	0.0631	0.0686	0.0884	0.0253	22.24
3	0.0836	0.0860	0.1025	0.0189	13.89
4	0.0956	0.0951	0.1019	0.0063	3.68

This table reports the average annual house price growth rate for ZIP codes. The sample is double sorted on income and share of CRA-eligible population. House prices are from Zillow and are estimated using the median house price for single family homes in each ZIP code as of June of each year. Income data are collected from the IRS.

Table X. Annual house price growth across income growth and CRA Ratio distribution

	CRA Ratio terciles				
Income growth quartiles	1	2	3	3-1	t-stat
1	0.0636	0.0574	0.0689	0.0053	4.89
2	0.0718	0.0760	0.0855	0.0137	11.37
3	0.0835	0.0874	0.0998	0.0163	12.01
4	0.0974	0.1020	0.1075	0.0101	7.23

This table reports the average annual house price growth rate for ZIP codes. The sample is double sorted on income growth and share of CRA-eligible population. House prices are from Zillow and are estimated using the median house price for single family homes in each ZIP code as of June of each year. Income data are collected from the IRS.

Table XI. CRA-induced growth in house prices: The boom period

	House Price Growth				
CRA Ratio	0.022***	0.023***	0.011***	0.012***	0.013***
	(0.008)	(0.008)	(0.002)	(0.003)	(0.003)
Avg. Income	0.000	−0.000*	−0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Std. Income	0.000	0.000	−0.000	−0.000	−0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(Initial price)		0.046***	0.019**	0.016*	0.019**
		(0.009)	(0.008)	(0.009)	(0.009)
Log(Population)		−0.001	−0.002***	−0.001	−0.002
		(0.003)	(0.001)	(0.001)	(0.001)
Log(Pop. Density)		0.004***	0.003***	0.002***	0.003***
		(0.001)	(0.000)	(0.001)	(0.001)
Elasticity				−0.008*	−0.007*
				(0.004)	(0.004)
Year FE	No	Yes	Yes	Yes	No
State FE	No	No	Yes	Yes	No
State-by-year FE	No	No	No	No	Yes
Observations	68326	68326	68326	50160	50160
Adj. R^2	0.023	0.163	0.116	0.126	0.035

This table reports the results of the effect of CRA-regulations on house price growth rates during the boom period of 1998 until 2006 at the ZIP code level. The sample is generated as explained in Section IV.B. Standard errors are corrected for clustering at the state level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table XII. CRA-induced growth in house prices: The bust period

	House Price Growth				
CRA Ratio	−0.021***	−0.018*	−0.008**	−0.006**	−0.006*
	(0.008)	(0.010)	(0.004)	(0.003)	(0.003)
Avg. Income	−0.000	0.001*	0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Std. Income	0.000	−0.000	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(Initial price)		−0.038***	−0.011	0.005	0.005
		(0.012)	(0.015)	(0.016)	(0.016)
Log(Population)		−0.007**	−0.003**	−0.003**	−0.003**
		(0.003)	(0.001)	(0.001)	(0.001)
Log(Pop. Density)		−0.001	−0.002	0.001	0.001
		(0.002)	(0.002)	(0.002)	(0.002)
Elasticity				0.011**	0.011**
				(0.005)	(0.005)
Year FE	No	Yes	Yes	Yes	No
State FE	No	No	Yes	Yes	No
State-by-year FE	No	No	No	No	Yes
Observations	32104	32104	32104	23737	23737
Adj. R^2	0.008	0.187	0.196	0.237	0.036

This table reports the results of the effect of CRA-regulations on house price growth rates during the bust period of 2007 until 2010 at the ZIP code level. The sample is generated as explained in Section IV.B. Standard errors are corrected for clustering at the state level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table XIII. Placebo tests of the IV estimation

	Non-regulated institutions		All institutions	
	1st stage	2nd stage	1st stage	2nd stage
CRA Ratio	0.016		0.034***	
	(0.010)		(0.007)	
$\widehat{\text{Mortgage Growth}}$		0.761		0.371***
		(0.532)		(0.116)
Avg. Income	−0.000	0.000	−0.000**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Std. Income	−0.000**	0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Log(Initial Price)	0.019	0.004	0.013	0.014***
	(0.023)	(0.013)	(0.018)	(0.005)
Log(Population)	0.012***	−0.010*	0.009***	−0.005***
	(0.004)	(0.006)	(0.003)	(0.001)
Log(Pop. Density)	−0.016***	0.015**	−0.011***	0.007***
	(0.005)	(0.007)	(0.004)	(0.001)
Elasticity	−0.002	−0.006	0.000	−0.007***
	(0.007)	(0.005)	(0.005)	(0.003)
State-by-year FE	Yes	Yes	Yes	Yes
F-statistic	2.57		23.36	
P-value	0.117		0.000	
No. of Observations	50243	50243	50269	50269

This table reports the results of the instrumental variable regressions using mortgages by non-CRA-regulated banks (the first two columns) and mortgages by all banks (the last two columns). 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). The sample is generated as explained in Section IV.B. Standard errors are corrected for clustering at the state level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.

Table XIV. Mortgage characteristics: Population versus the matched sample

	Obs.	Mean	Std.	Min	Max
Population of mortgages from Freddie Mac					
Mortgage size (Tsd. $)	2285237	142.29	62.38	5.00	650.00
FICO score	2265162	716.42	54.18	300.00	849.00
Interest rate (%)	2285237	7.28	.72	3.00	13.70
Matched sample of mortgages from Freddie Mac and HMDA					
Mortgage size (Tsd. $)	36030	147.00	80.88	5.00	578.00
FICO score	35680	714.90	55.31	300.00	837.00
Interest rate (%)	36030	7.28	0.75	4.48	11.50

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

Table XV. Mortgage risk

	CRA-regulated institutions			Non-regulated institutions		
	FICO Score	Int. Rate	Delinquet	FICO Score	Int. Rate	Delinquent
CRA	−6.977***	0.116***	0.037***	−3.638	0.040	0.020
	(1.351)	(0.020)	(0.008)	(3.025)	(0.024)	(0.016)
Tract MFI	0.161***	−0.000**	−0.001***	0.253***	−0.001*	−0.001***
	(0.026)	(0.000)	(0.000)	(0.067)	(0.000)	(0.000)
Mortgage Size	−0.006	−0.001***	−0.000***	−0.031*	−0.001***	−0.000***
	(0.004)	(0.000)	(0.000)	(0.018)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	31849	32180	32180	3831	3850	3850
Adj. R^2	0.015	0.625	0.023	0.021	0.568	0.019

This table reports the results of the effect of CRA-regulations on mortgage risk. The sample is generated as explained in Section VII. Standard errors are corrected for clustering at the state level. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.