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Residential Land Use Regulation and the US Housing Price Cycle Between 2000 and 2009

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Abstract

In a sample covering more than 300 cities in the US between January 2000 and July 2009, we find that more restrictive residential land use regulations and geographic land constraints are linked to larger booms and busts in housing prices. The natural and man-made constraints also amplify price responses to an initial positive mortgage-credit supply shock, leading to greater price increases in the boom and subsequently bigger losses.

JEL classification: R3
Keywords: residential land use regulation; credit expansion; housing prices

1 Introduction

Large swings in asset prices are a concern for macroeconomic stability. Historical experiences in the US and other industrialized countries show that asset price cycles often coincided with, or preceded, booms and busts of business cycles. Compared to that of equity prices, the volatility of housing prices appears to be more destabilizing, as housing busts typically involve a larger loss in GDP than equity busts.[1] A case in point is to compare the US recession in 2001 after the bursting of the IT bubble

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[1]Helbling and Terrones (2003) surveyed industrialized countries' asset price booms and busts between 1959 and 2002. They found that output losses associated with housing price busts were twice as large as those associated with equity price busts (8% versus 4%).

and the recession that started in late 2007 following a housing bust: the former was minor; the latter is commonly referred to as the "Great Recession," the biggest in seven decades.

A crucial factor in shaping boom-bust housing cycles is the supply conditions in the housing market (Malpezzi and Wachter (2005) and Glaeser, Gyourko, and Saiz (2008); also see Capozza, Hendershott, Mack, and Mayer (2002)). In this paper, we empirically examine whether supply constraints affect the magnitude of price fluctuations in local housing markets in the US. We focus on the price cycle in the last decade between January 2000 and July 2009. We divide the sample into the boom and bust phases, and explore the relation between regulatory and geographic constraints on housing supply and the extent of price swings. We focus on mortgage-credit supply expansion as the primary demand shifter.

We expect, for housing booms, a greater price increase in areas that are more supply-constrained conditional on the same increase in demand. For busts, however, the relation between supply conditions and the price movement is more ambiguous. On the one hand, supply restrictions limit the amount of construction in booms and thus reduce downward pressure on prices in busts. On the other hand, speculative demands, if they are indeed triggered by extrapolations of past trends in house prices, are likely to be more severe in areas with inelastic supply, thus leading to greater busts, as in the simulated model of Malpezzi and Wachter (2005). The theoretical and empirical findings in Glaeser et al. (2008) illustrate the ambiguity. The researchers' model of housing bubbles predicts an ambiguous overall impact of supply inelasticity on price declines after the bubble. Their empirical work, using the US metropolitan data between 1982 and 2006 (a period that includes two booms and one bust), finds that a tighter geographic land constraint is correlated with bigger price increases in the booms, but has little correlation with price declines during the bust. Because the fall in house prices is the key to the destabilizing impact of a housing price cycle, it is important to understand what contributes to the magnitude of price corrections. Our sample period covers the three years of housing bust after mid-2006, which is not in Glaeser et al. (2008); it will provide more evidences on the relation between housing supply and housing busts.

We consider and compare two types of supply constraints: residential land use regulations and geographic land scarcity. The measure for the regulatory constraint is the Wharton Residential Land Use Regulatory Index (WRLURI), developed by Gyourko, Saiz, and Summers (2008) based on a 2005 survey. The measure of geographic constraints is the percentage of undevelopable land around a metropolitan area, constructed by Saiz (forthcoming). We are interested in whether these constraints amplified the response of housing prices to the subprime mortgage credit expansion, the primary driver of the housing boom in the last decade. The expansion is a nationwide phenomenon; its impacts, however, are likely be heterogenous across cities. To proxy for the local impacts, we follow Mian and Sufi (2008a) and use the rejection rates of mortgage applications in 1996 as a measure of unmet demand for mortgage credit in a locality. We assume that cities that had a greater share of marginal borrowers before the expansion, inferred from a higher rejection rate, benefited more from the expansion initially. Taking the rejection rate as a valid indication of the initial shock, we ask whether the supply constraints amplified prices' response to the shock during the boom, and if so, whether the extra gain in prices subsequently became a greater loss.

We find that the regulatory and geographic constraints substantially add to the size of the price boom as well as the price bust. In addition, the constraints amplify housing prices' response to the initial credit shocks, adding extra price gain in the boom and subsequently led to a greater loss from the peak. These findings contribute to the literature that studies housing cycle through the perspective of supply. Relative to Glaeser et al. (2008), our first contribution is to use data from the latest episode of housing bust that reveals a different pattern on the relation between supply constraints and price corrections. Secondly, in addition to the geographic constraints studied in Glaeser et al. (2008), we simultaneously examine the regulatory environment on land uses. This not only expands the scope of research, but also allows us to study the regulation while controlling for fundamental differences in land availability.[2] Our findings also add to the body of evidence on the impacts of housing regulations. While it is often found in the literature that a stringent regulatory environment raises housing costs, our findings indicate that it raises price volatility as well. Malpezzi and Wachter (2005) has already found the regulation to be correlated with price volatility that is measured as unconditional second moments of price changes. Our contribution is to show that the regulation amplifies price responses to an initial shock, leading to bigger price gains and losses.

The structure of the paper is as follows: Section 2 reviews the literature. Section 3 describes the data and our empirical specification. Section 4 presents the main results. Robustness checks and further discussions are in section 5. Section 6 concludes.

2 Literature review

Our paper is related to the literature that studies housing markets through the perspective of supply. Most economists agree that housing supply is important in shaping the course of housing cycles. But the supply side has received far less attention compared to the demand side. A special issue on Journal of Real Estate Finance and Economics, for which the editor's note is aptly titled "Housing Supply:

[2]Saiz (forthcoming) explores the determinants of land use regulation and suggests that geographic constraint begets more restrictive regulations. See also Malpezzi, Chun, and Green (1998).

The Other Half of the Market" (Rosenthal (1999)), is dedicated to raising awareness of the sparseness of the literature. Here we review some of the more recent contributions, focusing on those that study regulatory and geographic constraints.

One important aspect of housing supply is residential land use regulation. Quigley and Rosenthal (2006) provides a review of empirical studies published before 2004, many of which present evidences that regulatory restrictions increase housing costs, reduce price elasticity of constructions, or are associated with greater increase of housing prices over time. Glaeser et al. (2005) uses "man-made scarcity" to describe the impact of government regulation on housing supply, and attributes the increase in US house prices since 1970 as a reflection of the "increasing difficulty of obtaining regulatory approval for building new homes." The evidences presented in the paper include the combination of increases in housing prices and decreases in new construction, the increase in the ratios of house prices to construction costs, and the extra value for land that is bundled together with the right to build. Quigley and Raphael (2005) focuses on California and uses a survey of land use officials to create a city-level index of regulatory stringency. The index is found to be correlated with higher housing prices and rents and lower growth in housing stock.[3] Green et al. (2005) finds that stringency of the regulation measured by the index in Malpezzi (1996) is linked to lower estimate of metro-specific supply elasticities.[4] Ihlanfeldt (2007) study Florida cities; Glaeser and Ward (2009) studies those in the greater Boston area. Both find positive relation between regulatory restriction and house prices.[5]

[3]Quigley and Raphael (2005) uses an instrumental variable to show that the more regulated cities have weaker responses in housing construction to exogenous changes in housing demand. The instrumental variable is the forecast of employment growth based on individual cities' industrial composition and the state-wide trend in employment growth by industries.

[4]The measure of supply elasticity in Green et al. (2005) is from 45 MSA-specific regressions that use a proxy of percentage changes in housing stock as the left-hand-side variable and lagged differences in housing prices as the right-hand-side variable.

[5]Glaeser and Ward (2009) finds that the price effect of regulation disappears in an expanded

In terms of measuring regulatory stringency, the most recent work, which also has the largest scale, is Gyourko et al. (2008). It provides multidimensional measures on local land use control environments for more than 2,600 US cities, towns and villages nationwide. The underlying data source is a 2005 survey and other supplemental information. Pendall and Martin (2006) reports a 2003 survey of land use regulations for communities within the 50 largest metropolitan areas. Xing, Hartzell, and Godschalk (2006) reports a 2002 survey with information for about 50 metropolitan areas. Malpezzi (1996) is an earlier effort to measure the regulatory environment; its regulation index is built upon the survey information in Linneman et al. (1990). A review of earlier efforts can be found in Malpezzi (1996). In this paper we use the information from Gyourko et al. (2008) for its larger scale, smaller governmental units and because it is more recent.

Another factor that is thought to be an important determinant of housing supply is geographic constraint. Saiz (forthcoming) estimates for 95 major US metropolitan areas the percentage of land that is lost to water bodies, wetlands or slopes. The paper shows that a restrictive geography is a "very strong predictor of housing price levels and growth for all metro areas during the 1970-2000 period." The geographic data is used in Glaeser et al. (2008), which we will discuss below; it is also what we use for this paper. Rose (1989) constructed a similar measure of land constraint for a smaller number of cities.

Our paper differs from a large part of literature in that we focus on short-run fluctuations in house prices; we ask whether geographic constraint and the stringency of regulation are associated with greater booms and busts. In terms of the research question asked, the paper is close to Malpezzi and Wachter (2005) and Glaeser et al.

regression with contemporary density and demographics as controls in their samples that consist largely small cities and towns. They interpret the weaker effect in the expanded regression as the indication that supply constraints have little impact on prices in one locale if there are close substitute towns.

(2008); the former paper uses regulatory index in its empirical work; the latter uses geographic constraint. We study both. Capozza et al. (2002) and Hwang and Quigley (2006) also relate housing supply to the dynamics of housing prices.

Capozza et al. (2002) estimates the serial correlation coefficient and the mean reversion coefficient for the dynamics of housing prices in a panel of 62 US metro areas using data between 1979 and 1995. Its empirical specification relates the two coefficients to city size, income growth, population growth and construction costs. Among other findings, the paper shows that higher construction costs, which the authors interpret as indicators of factors that reduce the short-run responsiveness of supply, are associated with higher serial correlation and lower mean reversion, thus presenting conditions for substantial overshooting of house prices.[6] Hwang and Quigley (2006), in an effort to explain intermetropolitan variation in housing costs, finds a positive relation between regulation and the response of house price to fundamental shocks. The paper uses a panel of 74 MSAs over the period 1987-1999 and the regulation index from Malpezzi (1996). It finds that for the same exogenous increase in income, the increase in house prices is more substantial and persistent in a city that has more stringent regulation (San Francisco as the example) than a less regulated city (Denver as the example). Saks (2008) finds that housing supply regulation increases house prices' response to labor demand shocks and reduces employment's long-run responses.

Malpezzi and Wachter (2005) presents a model that features supply lags and speculative demand. It uses simulations to show that supply constraints exacerbate price cycle in response demand shocks. In the model, markets with lower supply

[6] An earlier paper, Abraham and Hendershott (1996), conducted a similar exercise. The paper found stronger evidence of price bubble in coastal cities relative to inland cities, with the former attracting larger coefficient on lagged price appreciation. The researchers hypothesized that differences in supply constraints between coastal cities and inland cities might be a cause. They tried interacting indices of supply restrictions with various growth variables, but did not find meaningful effects and thus did not report the findings.

elasticity experience larger and more persistent price increases when hit by the same demand shock; such price movements then attract myopic speculative actions and eventually lead to a bigger bust. Empirically, Malpezzi and Wachter (2005) finds that there is a positive correlation between the stringency of regulation and the standard deviation of price changes between 1979 and 1996. Our paper will add to the body of evidence by examining conditional responses instead of unconditional second moments.

Glaeser et al. (2008) presents a model of housing bubbles that features irrational overoptimism and adaptive expectations. Because expectations are adaptive, housing bubbles arising from the exuberance are endogenous to supply conditions; they last for shorter durations in places that have elastic supply. The model predicts that places that have inelastic supply experience greater increase in prices during the bubbles. It has ambiguous prediction on the decline of prices after the bubbles burst: inelasticity does not necessarily lead to greater price corrections because it reduces new constructions during the bubbles. The researchers' empirical study uses data from two boom phases (1982-1989 and 1996-2006) and one bust phase (1989-1996) of the US housing cycles. They find that the geographic constraint developed in Saiz (forthcoming) is correlated with bigger price increases during the booms, but is uncorrelated with the size of the price declines between 1989 and 1996. We study the period between January 2000 and July 2009, which includes three years' housing bust after mid-2006. The new episode allows us to reexamine the link between supply constraints and price busts.

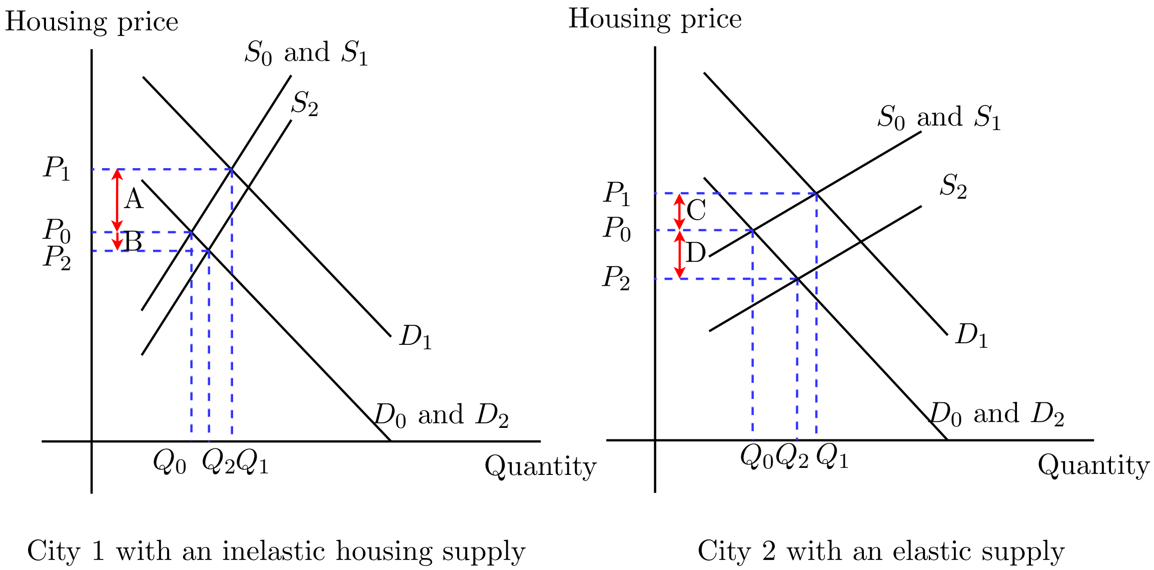

Figure 1: Demand shock and housing prices

3 Empirical specification and data

3.1 The analytical framework and empirical specification

In this section, we use simple supply-demand diagrams to explain the way in which we approach the empirical analysis. Figure 1 presents the demand and supply of housing in two cities.

The supply in city 1 is inelastic. At date 0, the supply and demand are S_0 and D_0, with the corresponding equilibrium housing price being P_0. We focus on a mortgage-credit supply expansion as the housing demand shock. At date 1, the expansion gives residents greater access to loans, thus lifting demand for housing to D_1, while supply remains the same. The equilibrium price is P_1 and the price gain is segment A. At date 2, the credit expansion ends and the demand for housing shifts back to its initial position, i.e. D_2 coincides with D_0. However, since new houses are built at date 1, the supply of houses increases, shifting the supply curve to S_2 in date 2. The price drop in date 2 has two components. The first is the price drop due to decrease in demand, represented by segment A. The second is the price drop due to increase in supply, represented by segment B.

City 2 is also subject to the same positive shock in credit supply at date 1 and hence the same shift in demand. However, the supply of houses is more elastic there. At date 1, the rise in price, represented by segment C, is smaller compared to A. At date 2, the decline in price due to the end of credit expansion, represented again by segment C, is also smaller. However, the drop in price due to increase in supply, represented by segment D, is larger compared to B in city 1, because more houses are built in city 2 in date 1. Therefore, although the price gain during the boom in city 1 (A) is bigger than in city 2 (C), it is not clear the price drop in city 1 ($A + B$) will be bigger than that in city 2 ($C + D$).

Cities vary in housing supply elasticities due to differences in regulatory and geographic constraints. The mortgage credit supply expansion could have different local impacts on housing demand. For our empirical analysis, we need measures for the supply constraints as well as for the demand shifts. For the constraints, we have the land use regulation index from Gyourko et al. (2008) and the geographic characteristics from Saiz (forthcoming). For the local impacts of credit supply expansion, we use a city's mortgage-application rejection rates in 1996 as a proxy. The assumption is that a higher rejection rate indicates a greater share of subprime borrowers who were more likely to benefit from a credit supply expansion, because the expansion extended loans to less credit-worthy borrowers. There are direct measures of mortgage expansion such as changes in the volume of mortgage loans. But the loan volume is an equilibrium outcome that cannot be used to explain house prices. In this paper we follow the innovative approach in Mian and Sufi (2008a) and use the mortgage rejection rate instead. If a city had a high level of rejection rate in 1996, we assume that it had a greater share of residents who were subprime in the sense that their applications for loans were more likely to be rejected under the lending standards before the subprime mortgage expansion. With the expansion, the standards were lowered and more subprime borrowers are able to obtain loans. The expansion therefore had greater impacts in places where more people were having difficulty meeting the old and higher standards. A formal model to justify the approach can be found in Mian and Sufi (2008a). We need to point out that the aggregation level in Mian and Sufi (2008a) is geographically finer than ours.[7] Relating our assumptions to Figure 1, we assume that cities that had a higher pre-expansion rejection rate, else identical, experienced a bigger outward shift in the demand curve initially and greater inward shift when credit supply declines subsequently. Cities with the same rejection rate, on the other hand, experienced the same outward shift at the beginning, and the same inward shift afterward.

In addition, other factors, such as changes in local economic conditions, can also shift housing demand. Such factors are controlled for in our empirical specification described by

$$\begin{aligned} \mathit{price\ gain}_{i,boom} &= \alpha_0 + \alpha_c \cdot \mathit{reject}_i + \alpha_r \cdot \mathit{regulation}_i + \alpha_g \cdot \mathit{geographic\ constraint}_i \\ &\quad + \alpha_{cr} \cdot \mathit{reject}_i \cdot \mathit{regulation}_i + \alpha_{cg} \cdot \mathit{reject}_i \cdot \mathit{geographic\ constraint}_i \\ &\quad + \alpha_X \cdot X_{i,boom} + u_{i,boom} \\ \mathit{price\ loss}_{i,bust} &= \beta_0 + \beta_c \cdot \mathit{reject}_i + \beta_r \cdot \mathit{regulation}_i + \beta_g \cdot \mathit{geographic\ constraint}_i \\ &\quad + \beta_{cr} \cdot \mathit{reject}_i \cdot \mathit{regulation}_i + \beta_{cg} \cdot \mathit{reject}_i \cdot \mathit{geographic\ constraint}_i \\ &\quad + \beta_X \cdot X_{i,bust} + u_{i,bust} \end{aligned}$$

where $u_{i,boom}$ and $u_{i,bust}$ are error terms. The X_i's are vectors of other control variables that include percentage changes in employment and percentage changes in

[7] Mian and Sufi (2008a) uses aggregate the rejection rates at the census-tract level and use them for zip-code level regressions. We use the rejection rates at the city level. Their measure is therefore finer than ours. Nevertheless, as we show with the summary statistics in Table 1, there are large variations in the rejection rates across cities.

average household income (the latter is only available for the boom equation because of data availability), as well as the city profile variables including population density, population size, the level of average household income, the fraction of urban population, the proportion of vacant housing units in 2000 and the level of unemployment rate at the census.

The important features of the specification are that we break the price movements between 2000 and 2009 into two phases: an initial boom and a bust afterward. The price changes in the two periods are the dependent variables. City profile and contemporaneous changes in economic conditions are control variables, while the focus is on the two supply constraints, the initial credit shocks and their interactions. The interactions allow us to test whether the supply constraints amplified the response of house prices to the same initial shock, turning it into a bigger boom and a bigger bust.

3.2 Data and descriptive statistics

This paper uses five sets of data for its main results. They are the house prices, the index of land use regulation, the share of undevelopable land, the mortgage-application rejection rates, as well as demographic and economic profile. Extra data for robustness check will be described in appropriate sections.

We have two different indices for housing prices. One is from Zillow.com; it is used to derive the main results because it is available below the metropolitan level, same as the land use regulation index. The second index, used for robustness checks, is the House Price Index from the Federal Housing Finance Agency (formerly known as the OFHEO House Price Index); the index is available only at the level of metropolitan areas, which generally consists of more than one city. Zillow provides estimates of prices for individual houses in US urban areas, using mostly public data such as county records, and information on local housing market conditions.

To examine the estimates' accuracy, the Wall Street Journal on line (February 14, 2007) sampled 1,000 homes in seven states, and found a median margin of error of 7.8%, and an equal split between overestimates and underestimates.[8] The equal split suggests that the price data must have better accuracy at aggregated levels; we use the aggregated index at city levels. We are primarily interested in changes instead of levels. On this front the Zillow data also has good accuracy. Mian and Sufi (2008a) uses Zillow data at the zip code level for robustness checks. They find from 2,248 zip codes that house price changes from the Zillow's index and the Fiserv Case Shiller Weiss index have a correlation coefficient of 0.91 (page 10 of the cited paper).

We also check the quality of the Zillow data with a comparison to the index from the Federal Housing Finance Agency that is at the metropolitan level. We aggregate the Zillow prices to metropolitans using populations as weights. The largest available sample consists of 210 metropolitan areas. We then calculate, for each index, the price gain in the boom period between 2000 and 2006 and the price loss in the bust period between 2006 and 2009. The correlation coefficient between the two sources is 0.93 for the price gain and 0.90 for the price loss.

The index for regulatory land restriction is the Wharton Residential Land Use Regulatory Index (WRLURI) developed by Gyourko et al. (2008). The index is based on a nationwide survey of local land use controls in 2005. The survey reports information about local jurisdictions' regulatory processes and rules on residential land use, such as binding limits on new construction, minimum lot size, affordable housing requirements, open space dedications, and developers' payment for infrastructure. It also provides information about the outcomes of the regulatory process such as change in cost of lot development and change in review time. The survey is supplemented by information on the legal, legislative and executive actions regarding

[8]Zillow itself reports a median margin of error at 11% for individual houses in October 2008.

land use policies, and measures of community participation such as environmental and open space-related ballot initiatives. The WRLURI itself is a summary measure of the stringency of the regulatory environment; specifically it is the first factor from a factor analysis of eleven subindexes.[9]

The data on geographic land constraint comes from Saiz (forthcoming), who uses GIS maps to estimate the proportion of undevelopable land that is lost to water bodies, wetlands and steep slopes within 50-kilometer radii from metropolitan central cities. The estimates are available for 95 major Metropolitan Statistical Areas (MSA). We assign to each city the value associated with the MSA where it locates.[10] We are primarily interested in land use regulations; the inclusion of geographic constraint is an acknowledgment to the possibility that land scarcity begets stringent regulations (see Saiz (forthcoming), also Malpezzi et al. (1998)).

As noted before, we use city-specific rejection rate of mortgage applications in 1996 to measure local impacts of the subprime mortgage-credit supply expansion that started the housing boom. Specifically, we assume that the expansion took the form of a relaxation in lending standards, which would have a greater impact in cities that had more subprime borrowers who could benefit from the relaxation in standards. The source of the mortgage-application data is the Loan Application Register (LAR) of the Home Mortgage Disclosure Act (HMDA). The HMDA, en-

[9]In our sample, examples of cities with a regulation index score at least one standard deviation below the mean are Cleveland (-1.28), Chicago (-1.17), Rochester (-1.12), and Oklahoma City (-0.74); the numbers in the parentheses are the index values. Examples of cities with a regulation index score around mean are New York city (0.03), Pittsburgh (0.12) and San Jose (0.16). Examples of cities with a regulation index score at least one standard deviation above the mean are Palm Beach Gardens (1.07), Phoenix (1.25), Los Angeles (2.12) and Ann Arbor (2.79).

[10]In our sample, examples of cities with a proportion of undevelopable land at least one standard deviation below the mean are Oklahoma City (2.5%), Atlanta (4.1%) and Ann Arbor (9.7%). The numbers in the parentheses are the percents of undevelopable land. Examples of cities with a proportion of undevelopable land around mean are Pittsburgh (30.0%), Rochester (30.5%), Chicago (40.01%), NYC (40.4%) and Cleveland (40.5%). Examples of cities with a proportion of undevelopable land at least one standard deviation above the mean are Los Angeles (52.5%), San Jose (63.8%) and Palm Beach Gardens (64.0%).

acted in 1975, requires lending institutions to report their lending activity in the mortgage market. The LAR data is believed to cover a large majority of mortgage loans in the U.S.[11] For each individual record, the LAR reports information about the loan and the applicant, the actions that were taken on the application, as well as the location of the property at the level of census tract. In our robustness check, we use the percentage of high-cost loans as an alternative measure of credit expansion. The percentage is also derived from the HMDA report. We use the data that has been compiled by the US Department of Housing and Urban Development (HUD).[12]

Our analysis controls for contemporaneous changes in economic situations. The main controls are percentage changes in employment and percentage changes in average household income. The former comes from the Local Area Unemployment Statistics program of the Bureau of Labor Statistics; the latter from the USA Countries data files. We use data at the county level for better coverage and because the average income is available only at the county level. Replacing the county-level employment information with city-level counterparts does not change our result, but it reduces sample size substantially. For the boom phase, we use both the employment changes and the income changes as controls. For the bust period, we have only the changes in employment, because the income information after the year 2007 is not yet available at its source. Other control variables are from the 2000 census. They

[11] Most banks, savings associations, credit unions, and other mortgage lending institutions that have home or branch offices in metropolitan areas, or who are deemed to have offices in such areas, need to file annual reports; exemptions are made for small lenders (if the assets are less than $35 million in the case of depository institutions for the year of 2006. Avery et al. (2007) suggest that HMDA-covered lenders together "account for approximately $80% of all home lending nationwide. (page 351)" An earlier study, Berkovec and Zorn (1996), found that the HMDA overlaps 70% of loans purchased by Freddie Mac in 1992, and the coverage increased to 75% with the increased reporting requirements in 1993.

[12] The HUD uses the data to forecast local foreclosure risks and thus allocation of federal funds for neighborhood stabilization. The HUD defines a high-cost loan as one for which "the rate spread is 3 percentage points above the Treasury security of comparable maturity." (HUD, Neighborhood Stabilization Program Data, Methodology and Data Dictionary for HUD Provided Data. URL: http://www.huduser.org/portal/datasets/Desc_%20NSP_data.doc.)

include population density, population size, the level of average household income, the share of urban population, the unemployment rate and the proportion of vacant housing units in 2000.

Our analysis is at the city level, which corresponds to "incorporated places" in the US census. The house price, the land use regulation and the census information are all available at the city level. The mortgage information is at the census tract level. We aggregate the tract-level data to the city level using population as the weights. As for the information at the county level (namely, changes in employment and average household income), we again use population-weighted averages if a city lies in more than one county. Finally, we only use cities that have a population of at least 10,000.

The use of multiple datasets means a multi-level filtering process, since few of the data sources offer 100% coverage. Zillow's house prices and the residential land use regulation data are responsible for the large shrinkage in coverage. Zillow's data does not include 15 states that are less densely populated. The regulation data is from a survey with incomplete responses.[13] The third layer of filtering is the limited availability of geographic variable from Saiz (forthcoming), which covers the top 95 metropolitan areas only. Our final sample consists of 326 cities from 28 states, covering areas where 47 million Americans resided as of the 2000 census; this is 28% of our targeted population universe (urban population living in incorporated places with at least 10,000 residents), or 52% of those within the targeted universe for which the Zillow city prices are available. The 28 states are Alaska, Arkansas, Arizona, California, Colorado, Delaware, Florida, Georgia, Illinois, Kentucky, Massachusetts, Maryland, Michigan, Minnesota, North Carolina, Nebraska, New Jersey, Nevada, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina,

[13] According to Gyourko et al. (2008), the jurisdictions that responded to the survey account for 60% of the population being surveyed.

Virginia, Washington, and Wisconsin.

To determine the division between the boom phase and the bust phase, we examine the average house prices in our sample for each month over the period. The peak is June of 2006. We thus define the boom of house price to be the price change in percents between January 2000 and June 2006. We then define the bust as the price change in percents between June 2006 and July 2009.

Table 1 provides summary statistics for the variables used in the regressions. We did not apply population weights to generate the summary statistics; neither will we use weights for later analysis. The use of the unweighted sample is to prevent the outcome from being dominated by megacities in New York and California.

The table shows that among the 326 cities, the average increase of real housing prices is 71% in the boom.[14] The average real price bust is 20%. The sample mean of the index of housing regulation is 0.16. Because the original scale of this index is standardized nationally to have a standard deviation of 1 and a mean of 0, the positive sample mean suggests that our sample is slightly more regulated than the average city in the nation. This is not surprising since our sample concentrates on more densely populated states. The standard deviation of this index in our sample is 0.87, meaning that our sample is more homogeneous than the nation as a whole. On average, 30.6% of the land is undevelopable. The cities in the sample on average rejected 26% of mortgage applications in 1996 with a standard deviation of 12%, indicating large variations in the initial credit constraints. Finally, about 26% of mortgages sold during the years 2004-2006 involve high interest rates.

In Table 2, we present tabulations of mean price changes to see if the regulation index, geographic constraint and the proxies of credit shocks are associated with the size of price swings.

The first panel of Table 2 is a tabulation of the boom and the bust in house

[14]The housing prices have been adjusted for Consumer Price Index excluding shelters.

prices by the level of the land use regulatory index. We use the sample median of the index to divide the sample into two subsamples: the more regulated half and the less regulated half. The more regulated subsample had a boom and a bust that are 82.00% and -23.91%, respectively. For the less regulated subsample, a 60.60% boom was followed by a -15.23% bust. Similarly, in the second, third and fourth panels, we divide the sample into halves by geographic constraint, mortgage rejection rate and the proportion of high-interest loans. Overall, we observe that cities that are more regulated or have less developable land experienced larger booms and larger busts in house prices. The same was true for cities that had higher rejection rates in mortgage applications in 1996, and cities that are sold proportionally more high-interest mortgages.

Table 3 presents a matrix of simple bivariate correlation coefficients between the price changes, regulation, geographic constraint and the two proxies for credit expansion. It confirms the pattern of correlation observed from the tabulations in Table 2.

4 Regression Results

In Table 4, we present the main regression results. Each column corresponds to one estimation. The variables shown on the top row are dependent variables. Our preferred specifications are columns (2) and (4) for the boom and the bust equations, respectively. Column (1) and (3) are their counterparts without the interactive terms between the mortgage rejection rate and the two variables of land constraints. When there are interaction terms of a variable in regressions, the marginal effect of the variable on the dependent variable would depend on the value of other variables with which it interacts. To facilitate the interpretation of coefficients, we removed the means from all explanatory variables and we do so before interacting any variables with one another. This way we can interpret the coefficients on non-interaction terms as measuring the marginal effects at the sample mean.

We first describe the estimates qualitatively, before using hypothetical examples to illustrate them quantitatively. The estimates in Columns (2) and (4) show that a more restrictive geographic or regulatory constraint on land supply is significantly correlated with bigger booms and bigger busts in house prices. The mortgage rejection rate in 1996 is positively correlated with the size of the boom and the bust, indicating that subprime cities (following a similar term in Mian and Sufi (2008b)) experienced greater swing in house prices. The statistical significance is weak in the boom equation but strong in the bust equation. As for the interactive terms between supply constraint and the mortgage variable, their coefficients all are significant and all suggest that the subprime cities' tendency to experience greater swings is stronger if they are also more constrained in regulation or has less developable land. Because we interpret the extra price movements in subprime cities as the result of the mortgage-credit supply expansion, these estimates suggest that the regulatory and geographic constraints amplify house prices' responses to an initial housing demand shock, turning it into bigger booms and bigger busts.

We now use four hypothetical cities in Figure 2 to interpret the estimated coefficients, with the boom as the example: suppose the initial demand is D_0 for all cities. City 1 has a profile that is identical to our sample mean, in particular, it has the mean mortgage rejection rate in 1996, and faces the average level of regulation. After the credit expansion occurs, the new demand is $D_{1,mean}$. The supply of housing, denoted S_{mean}, remains the same. Hence, the price rise is segment E in Figure 2 which is equal to the coefficient on the constant in the regression α_0. City 2 has a regulation score that is one standard deviation (which is normalized to 1 nationwide) higher than the sample mean, and otherwise the same profile as city

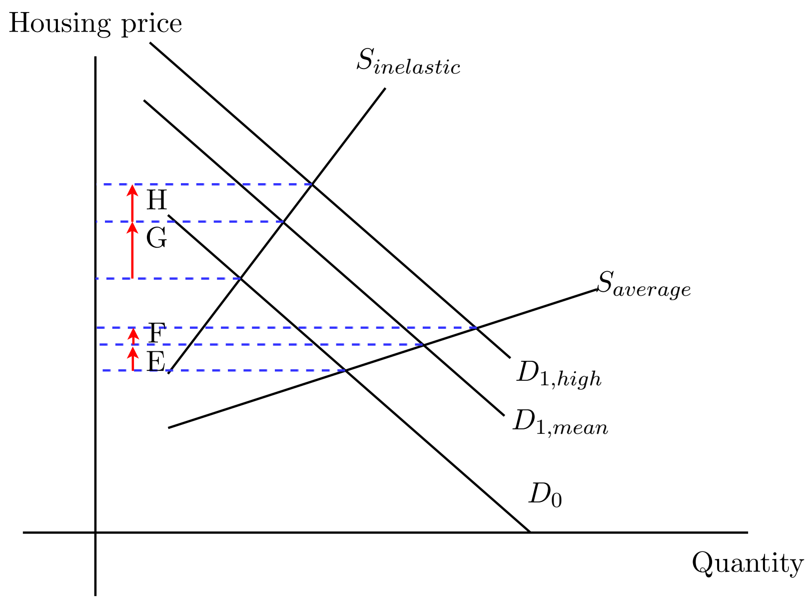

Figure 2: Decomposition of price growth in the credit boom

1.

Let its supply be $S_{inelastic}$. Hence, the price rise in city 2 due to the same credit expansion is G and the extra rise compared to city 1 is $(G - E)$, corresponding to the coefficient on regulation α_r. City 3 experiences a higher level of credit expansion but is otherwise identical to city 1. It has a 12.18% (one standard deviation) higher mortgage rejection rate in the 1990s, and its new demand is $D_{1,high}$.

Hence, the price growth in city 3 is $(E+F)$, which is equal to $\alpha_0 + \alpha_c \cdot 12.18$ in the regression equation. City 4 have supply $S_{inelastic}$ and new demand $D_{1,high}$, but is otherwise identical to city 1. Its price growth due to the credit expansion is $(G+H)$. Comparing city 4 to city 3, the difference in price growth is $(G+H-E-F)$, which is equal to $\alpha_r + \alpha_{cr} \cdot 12.18$ in the regression equation. Hence, α_r and α_{cr} determine whether regulation is associated with price growth in significant ways.

Using the results in column (2) and (4) of table 4, we calculate the effects of credit expansion, regulation and geographic constraint on price changes in the four cities for both the boom and bust periods.

The calculations are tabulated in table 5. From the first panel of 5, we can see that if a city has a regulation score that is one standard deviation higher than city 1, it is predicted to have a 5.54% greater increase in price during the boom. If, in addition, it also has a 1996 mortgage rejection rate that is one standard deviation higher than city 1, then the growth in price will be 13.46% higher. Similarly, if the proportion of undevelopable land in a city is one standard deviation (19.24%) higher, the city is predicted to have an 8.85% higher growth in price during the boom. If the city also has a 1996 mortgage rejection rate that is one standard deviation higher, then the growth in price will be 20.29% higher. Both regulation and geographic constraints significantly magnify the price gain during the boom, but the effect of geographic constraint is particularly strong.

Correspondingly, during the bust, if a city has a regulation score that is one standard deviation greater, its housing price is predicted to decrease further by -4.44%. If it also has a 1996 mortgage rejection rate that is one standard deviation higher, then the drop in price will be 13.82% greater. If the undevelopable land in a city is one standard deviation (19.24%) higher, the city is predicted to have a 5.19% greater drop in price during the bust. If the city also has a 1996 mortgage rejection rate that is one standard deviation higher, then the drop in price will be 13.38% greater. The effects of regulation and geographic constraint on prices were similar during the bust.

5 Robustness checks and discussion

5.1 Alternative specification and measure for credit expansion

We conduct two robustness checks in Table 6. In columns (1) and (3), we allow for interactions between the 1996 mortgage rejection rate and the city-profile variables from the 2000 census (the population size and density, the average household income, the share of urban population, the unemployment rate and the housing vacancy rate). This is a kitchen-sink type approach to test whether the coefficients on the interactive terms between land constraints and the credit variable can retain their signs and significance with the presence of numerous other interactive terms. The new regressions show that they do: land constraints (geographic or man-made) are still associated with amplified responses of the prices to the proxy for local impacts of credit expansions.

In column (2) and (4), we use an alternative measure of credit expansion. We replace the mortgage rejection rate in 1996 with the percentage of high-interest-rate mortgage loans that were originated between 2004 and 2006. The results are similar to those in Table 4: a higher percentage is correlated with a bigger boom and a bigger bust; its interactive term with land constraints all have the expected signs and mostly have statistical significance at the 5% level.

Under all these specifications, the geographic and regulatory constraints are consistently correlated with bigger booms and bigger busts; all relevant coefficients have statistical significance better than 5%.

5.2 Focusing on state-level regulation

We recognize that, although more stringent regulation is associated with bigger price booms and busts, the causation between regulation and price movements can run in both directions. Unlike in the case of geographic constraints, cities can change their land use regulation, and their decisions might have been influenced by the level of and the changes in house prices. Added to the concern is that the factor analysis that was used to construct the overall regulatory index loaded heavily on the "Approval Delay Index (ADI)," which could be a function of construction activity and the price movements. The survey behind WRLURI was conducted in 2005. Could the regulations measured at the time have responded to the price gain between 2000 and 2005? To provide a robustness check, we estimate the models using state-level regulation indices. Among the eleven subcomponent of the WRLURI, two are at the state level: the state political involvement index (SPII) and the state court involvement index (SCII), developed by Foster and Summers (2005). The SPII measures the extent to which the executive and legislative arms of a state promote greater state-wide land use restrictions between 1995 and 2005. The SCII measures the tendency of the judicial system of a state to uphold municipal land use regulations. The score reflects the court's deference to municipal control, with a score indicating that the courts is more restrictive regarding its localities' use of certain land-use tools. The state-level indexes are likely to be exogenous to city-level movements in house prices, particularly so with SCII, under the assumption that courts do not judge based on house prices.

In columns (1) and (3) in Table 7, we use SPII to replace the WRLURI in both the boom and bust equations. In column (2) and (4), we use SCII to replace the WRLURI. In the four columns, we can see the results regarding regulation are similar to Table 4. In particular, both state-level constraints are positively correlated with the sizes of booms and busts. The biggest departure is that the coefficient on the interaction term between SCII and the mortgage rejection rates during the boom is now essentially zero. The coefficients on all the other three interactive terms retain their signs and significance.

5.3 Comparison to Glaeser et al. (2008) regarding the bust periods

Glaeser et al. (2008) showed that geographic constraint was positively associated with price gain during housing booms, but they find no evidence for its association with the price drop during the bust in the 1990s. In column (4) of Table 4, we show that cities with greater geographic constraint did experience a greater decline in price between June 2006 and July 2009. The difference is likely due to the different sample periods. The bust phase in Glaeser et al. (2008) is between 1989 and 1996; ours is between 2006 and 2009. We conduct a series of experiments to confirm the source of difference is indeed the sample periods.

First, we exclude differences in model specifications as the cause. We estimate the equations following the specification in Glaeser et al. (2008) by removing the land use regulation from the model. Columns (1) and (3) of Table 8 are specifications similar to Glaeser et al. (2008). In columns (2) and (4), we also interact geographic constraint with credit expansion. In all four specifications, we find a strong negative relationship between geographic constraint and price change during the bust.

For final confirmation, we repeat the bust equations, for both episodes of housing busts, with the same price index used in Glaeser et al. (2008), the Federal Housing Finance Agency's (FHFA) House Price Index (formerly OFHEO House Price Index). We calculate the price changes between 1989 and 1996 (the bust phase in Glaeser et al. (2008)) and those between 2006 and 2009, and use the resulted changes as the dependent variables to be explained. The price index is available only for MSAs, so the regressions are at the MSA level. In the years between the two busts, however, the US Office of Management and Budget changed the area composition of MSAs. This creates difficulty in comparisons over time because the geographic constraint from Saiz (forthcoming) is measured for MSAs that were defined under the old federal standard, while the FHFA index is now published under the new standard. To solve the problem, we focus on areas that were largely not influenced by the change, which we define as areas where more than 90% of residents belong to the same MSA before and after the change (even if the name of the MSA changed). The estimations in Table 9 use all such areas that have available data. We are able to confirm the finding in Glaeser et al (2008) for the episode between 1989 and 1996: there is no correlation between geographic constraint and the size of the bust in that period. However, when we look at the new episode between 2006 and 2009, we do find a statistically significant relationship: more constrained areas (geographically and regulation-wise) experienced a bigger bust. Our findings regarding the latest bust episode are therefore robust to using the FHFA index. Furthermore, the source of difference in our findings from those in Glaeser et al. (2008) is the sample periods.

5.4 The price legacy of the credit expansion

Besides the effects of credit expansion during the boom and bust, we are also interested in whether the credit expansion in the last decade contributed to price gain in July 2009 relative to January 2000. For this purpose, we reestimate specifications (1) and (2) in Table 4, but with price change between January 2000 and July 2009 as the dependent variable. Table 10 shows that, while geographic constraint was associated with price gain over the whole period, credit expansion did not contribute to price gain, although its interaction with geographic constraint has a positive and marginally significant effect.

6 Conclusion

Stringent land use regulation and restrictive geography reduce the supply elasticity in housing markets. In a housing boom with rising demand, the lower elasticity forces house prices to increase by more. In the subsequent bust, however, the drop in the price may or may not be bigger in the more constrained areas. On one hand, greater price booms likely lead to greater corrections. On the other hand, a smaller number of houses can be constructed in those areas during the boom, and the downward pressure on prices from housing stock is smaller during the bust.

Using data from 326 US cities, our study examines empirically how residential land use regulation, geographic land constraint and credit expansion are related to the swing of house prices between January 2000 and July 2009. The regulation data is from Gyourko et al. (2008). The geographic data at metropolitan level is from Saiz (forthcoming). We use the mortgage-application rejection rate in 1996 to proxy for the local impact of the nationwide mortgage-credit supply expansion, following the approach in Mian and Sufi (2008a). We find that cities that are more regulated or have less developable land experienced greater price gains between January 2000 and June 2006, and greater price declines between June 2006 and July 2009. In addition, the natural and man-made constraints both amplified the responses of house prices to an initial demand shock arising from the mortgage market, turning the shock into a greater price gain and subsequently a greater loss. Finally, over the entire period, cities that had more marginal borrowers before the credit expansion did not experience greater growth in housing prices, indicating that the subprime expansion did not leave a positive legacy on the price front.

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Table 1: Summary statistics

Variable	Mean	Standard deviation	Min	Max	Obs.
Housing price change between Jan 2000 and June 2006 (%)	71.30	58.11	-33.70	470.27	326
Housing price change between June 2006 and July 2009 (%)	-19.57	16.61	-59.75	36.38	326
Wharton Residential Land Use Regulatory Index	0.16	0.87	-1.94	3.46	326
Proportion of undevelopable area in Saiz (2008) (%)	30.58	19.24	1.04	79.64	326
Proportion of mortgage applications denied in 1996 (%)	26.24	12.18	4.77	65.13	326
Proportion of high-cost mortgage loans between 2004 and 2006 (%)	25.86	11.52	5.39	70.32	326
Change in employment between 2000 and 2006 (%)	3.81	9.16	-12.62	45.65	326
Change in median household income between 2000 and 2006 (%)	11.49	7.30	-.91	29.18	326
Change in employment between 2006 and 2009 (%)	-3.00	3.93	-11.90	9.52	326
Population density in 2000 (1000s of people)	3.81	4.04	0.16	52.86	326
Population in 2000 (1000s of people)	141.93	531.03	10.05	8,008.28	326
Mean household income in 2000 (1000s of dollars)	61.43	23.07	29.39	226.43	326
Proportion of urban population (%)	98.79	3.24	76.30	100.00	326
Unemployed rate (%)	5.36	2.76	1.30	16.10	326
Proportion of vacant housing units (%)	5.84	4.31	0.90	39.90	326

Table 2: Housing price boom and bust in subsamples

Subsamples with	Average price gain 2000-2006	Average price loss 2006-2009	Obs.
more stringent regulation	82.00	-23.91	163
	(4.27)	(1.16)	
less stringent regulation	60.60	-15.23	163
	(4.68)	(1.34)	
more undevelopable area	95.08	-23.86	163
	(4.46)	(1.16)	
less undevelopable area	48.11	-15.68	163
	(3.98)	(1.35)	
more mortgage rejections	87.74	-21.22	163
in 1996	(4.72)	(1.48)	
less mortgage rejections	54.86	-17.93	163
in 1996	(3.99)	(1.08)	
more high-interest loans	84.88	-21.17	163
between 2004 and 2006	(5.40)	(1.55)	
less high-interest loans	57.72	-17.97	163
between 2004 and 2006	(3.19)	(0.98)	

Note: the numbers in the parentheses are the standard errors of means.

Table 3: Correlation coefficients

Variable	1	2	3	4	5	6
1, Housing price change between Jan 2000 and June 2006 (%)	1					
2, Housing price change between June 2006 and July 2009 (%)	-0.56*	1				
3, Wharton Residential Land Use Regulatory Index	0.24*	-0.27*	1			
4, Proportion of undevelopable area (%)	0.48*	-0.39*	0.25*	1		
5, Proportion of mortgage applications denied in 1996 (%)	0.33*	-0.14*	-0.13*	0.02	1	
6, Proportion of high-cost mortgage loans between 2004 and 2006 (%)	0.18*	-0.10	-0.23*	-0.10	0.73*	1

Note: the * indicates that the correlation coefficient is statistically significant at the 5% level.

Table 4: Main results

Variables	$\frac{P_{2006}-P_{2000}}{P_{2000}}$ (1)	$\frac{P_{2006}-P_{2000}}{P_{2000}}$ (2)	$\frac{P_{2009}-P_{2006}}{P_{2006}}$ (3)	$\frac{P_{2009}-P_{2006}}{P_{2006}}$ (4)
regulation	4.87 (2.21)**	5.54 (2.14)***	-4.32 (0.93)***	-4.44 (0.92)***
undevelopable land (%)	0.55 (0.13)***	0.46 (0.13)***	-.30 (0.04)***	-.27 (0.04)***
rejection (%)	0.03 (0.25)	0.17 (0.26)	-.46 (0.1)***	-.48 (0.1)***
regulation*rejection		0.48 (0.17)***		-.29 (0.08)***
undevelopable land*rejection		0.04 (0.01)***		-.01 (0.003)***
Δ employment 2000-2006 (%)	1.21 (0.38)***	1.03 (0.36)***		
Δ median HH income 2000-2006 (%)	3.94 (0.37)***	3.95 (0.36)***		
Δ employment 2006-2009 (%)			1.29 (0.23)***	1.27 (0.22)***
population density in 2000	0.8 (0.49)	0.61 (0.47)	-.23 (0.14)	-.20 (0.14)
population in 2000	-.006 (0.003)*	-.006 (0.003)**	0.0009 (0.0007)	0.001 (0.0007)*
mean HH income in 2000	-.09 (0.1)	0.03 (0.08)	-.06 (0.04)	-.11 (0.04)***
proportion of urban population (%)	0.36 (0.44)	0.43 (0.44)	-.11 (0.27)	-.11 (0.26)
unemployment rate (%)	1.94 (1.34)	2.38 (1.35)*	0.76 (0.44)*	0.45 (0.42)
proportion of vacant housing units (%)	-.43 (0.77)	0.005 (0.77)	-.23 (0.28)	-.32 (0.26)
Const.	70.81 (2.10)***	71.19 (2.03)***	-19.32 (0.79)***	-19.64 (0.79)***
Obs.	326	326	326	326
R^2	0.6	0.63	0.3	0.34
F statistic	74.43	82.82	16.09	14.18

Notes: (1) The variables shown on the top row are dependent variables, measured in percents. (2) The numbers in the parentheses are robust standard errors. (3) *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels. (4) All columns are estimated by OLS. (5) All right-hand-side variables are demeaned, such that the coefficients on non-interaction variables measure the marginal effects at the sample mean.

Table 5: Regulation, geography, credit and the housing boom and bust

	city 1	city 2	city 3	city 4
regulation and the boom				
mortgage rejection rate, % in 1990s	mean	mean	mean+12.18%	mean+12.18%
regulation index	mean	mean+1	mean	mean+1
price change based on regression coefficients,	71.73	76.57	73.92	83.76
difference in price change relative to city 1, %	-	4.84	2.19	12.03
geography and the boom				
mortgage rejection rate, % in 1990s	mean	mean	mean+12.18%	mean+12.18%
share of undevelopable land, %	mean	mean+19.24%	mean	mean+19.24%
price change based on regression coefficients, %	71.73	80.86	73.92	92.74
difference in price change relative to city 1, %	-	9.13	2.19	21.01
regulation and the bust				
mortgage rejection rate, % in 1990s	mean	mean	mean+12%	mean+12%
regulation index	mean	mean+1	mean	mean+1
price change based on regression coefficients, %	-19.90	-23.77	-25.87	-33.03
difference in price change relative to city 1, %	-	-3.87	-5.97	-13.13
geography and the bust				
mortgage rejection rate, % in 1990s	mean	mean	mean+12%	mean+12%
share of undevelopable land, %	mean	mean+19%	mean	mean+19%
price change based on regression coefficients, %	-19.90	-25.24	-25.78	-33.64
difference in price change relative to city 1, %	-	-5.34	-5.88	-13.74

Table 6: Robustness checks

Variables	$\frac{P_{2006}-P_{2000}}{P_{2000}}$ (1)	$\frac{P_{2006}-P_{2000}}{P_{2000}}$ (2)	$\frac{P_{2009}-P_{2006}}{P_{2006}}$ (3)	$\frac{P_{2009}-P_{2006}}{P_{2006}}$ (4)
regulation	5.63	4.82	-4.05	-4.54
	(2.22)**	(2.15)**	(0.93)***	(0.91)***
undevelopable land (%)	0.4	0.49	-.25	-.31
	(0.12)***	(0.12)***	(0.04)***	(0.04)***
rejection (%)	-.71		3.26	
	(4.71)		(1.96)*	
regulation*rejection	0.45		-.23	
	(0.15)***		(0.08)***	
undevelopable land*rejection	0.04		-.01	
	(0.009)***		(0.003)***	
high interest loans (%)		0.38		-.41
		(0.24)		(0.11)***
regulation*high interest loans		0.26		-.30
		(0.17)		(0.08)***
undevelopable land*high interest loans		0.04		-.007
		(0.008)***		(0.003)**
Δ employment 2000-2006 (%)	1.00	0.97		
	(0.32)***	(0.35)***		
Δ median HH income 2000-2006 (%)	3.97	4.26		
	(0.35)***	(0.38)***		
Δ employment 2006-2009 (%)			1.43	0.96
			(0.22)***	(0.23)***
census profile in 2000	included	included	included	included
census profile in 2000*rejection	included		included	
Const.	48.83	72.33	78.90	-20.19
	(122.67)	(2.11)***	(51.60)	(0.82)***
Obs.	326	326	326	326
R^2	0.64	0.63	0.38	0.32
F statistic	76.07	69.95	11.31	14.19

Notes: (1) The variables shown on the top row are dependent variables, measured in percents. (2) The numbers in the parentheses are robust standard errors. (3) *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels. (4) All columns are estimated by OLS. (5) All right-hand-side variables are demeaned, such that the coefficients on non-interaction variables measure the marginal effects at the sample mean. (6) The census profile in 2000 includes the following variables: population density in 2000, population in 2000, mean household income in 2000, the fraction of urban population, the unemployment rate and the proportion of vacant housing units.

Table 7: Robustness checks: state level regulation

Variables	$\frac{P_{2006}-P_{2000}}{P_{2000}}$ (1)	$\frac{P_{2006}-P_{2000}}{P_{2000}}$ (2)	$\frac{P_{2009}-P_{2006}}{P_{2006}}$ (3)	$\frac{P_{2009}-P_{2006}}{P_{2006}}$ (4)
state political involvement index	8.31		-5.93	
	(1.97)***		(0.84)***	
state court involvement index		13.41		-7.05
		(2.77)***		(1.62)***
undevelopable land (%)	0.45	0.43	-.24	-.24
	(0.13)***	(0.14)***	(0.04)***	(0.05)***
rejection (%)	0.14	-.09	-.44	-.31
	(0.26)	(0.27)	(0.1)***	(0.11)***
state political involvement*rejection	0.36		-.28	
	(0.17)**		(0.08)***	
state court involvement Index*rejection		-.02		-.37
		(0.24)		(0.12)***
undevelopable land*rejection	0.04	0.04	-.01	-.008
	(0.009)***	(0.01)***	(0.003)***	(0.004)**
Δ employment 2000-2006 (%)	1.02	1.07		
	(0.35)***	(0.35)***		
Δ median HH income 2000-2006 (%)	3.74	3.69		
	(0.37)***	(0.37)***		
Δ employment 2006-2009 (%)			1.31	1.30
			(0.22)***	(0.21)***
census profile in 2000	included	included	included	included
Const.	70.03	70.66	-18.85	-18.47
	(2.02)***	(2.14)***	(0.74)***	(0.82)***
Obs.	326	326	326	326
R^2	0.63	0.63	0.39	0.36
F statistic	92.49	109.61	21.17	20.9

Notes: (1) The variables shown on the top row are dependent variables, measured in percents. (2) The numbers in the parentheses are robust standard errors. (3) *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels. (4) All columns are estimated by OLS. (5) The census profile in 2000 includes the following variables: population density in 2000, population in 2000, mean household income in 2000, the fraction of urban population, the unemployment rate and the proportion of vacant housing units.

Table 8: Geography and the bust in cities

	$\frac{P_{2009}-P_{2006}}{P_{2006}}$	$\frac{P_{2009}-P_{2006}}{P_{2006}}$	$\frac{P_{2009}-P_{2006}}{P_{2006}}$	$\frac{P_{2009}-P_{2006}}{P_{2006}}$
Variables	(1)	(2)	(3)	(4)
undevelopable land (%)	-.35	-.33	-.36	-.35
	(0.04)***	(0.04)***	(0.04)***	(0.04)***
rejection (%)	-.46	-.48		
	(0.1)***	(0.1)***		
undevelopable land*rejection		-.01		
		(0.004)***		
high interest loans (%)			-.37	-.37
			(0.11)***	(0.11)***
undevelopable land*high interest loans				-.01
				(0.003)***
Δ employment 2006-2009 (%)	1.22	1.20	0.84	0.8
	(0.24)***	(0.23)***	(0.25)***	(0.25)***
census profile in 2000	included	included	included	included
Const.	-19.35	-19.28	-19.38	-19.65
	(0.81)***	(0.8)***	(0.82)***	(0.8)***
Obs.	326	326	326	326
R^2	0.25	0.28	0.23	0.25
F statistic	14.35	12.77	14.74	13.3

Notes: (1) The variables shown on the top row are dependent variables, measured in percents. (2) The numbers in the parentheses are robust standard errors. (3) *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels. (4) All columns are estimated by OLS. (5) All right-hand-side variables are demeaned, such that the coefficients on non-interaction variables measure the marginal effects at the sample mean. (6) The census profile in 2000 includes the following variables: population density in 2000, population in 2000, mean household income in 2000, the fraction of urban population, the unemployment rate and the proportion of vacant housing units.

Table 9: Geography and the bust in Metropolitan Statistical Areas

	$\frac{P_{1996}-P_{1989}}{P_{1989}}$	$\frac{P_{2009}-P_{2006}}{P_{2006}}$	$\frac{P_{2009}-P_{2006}}{P_{2006}}$
Variables	(1)	(2)	(3)
undevelopable land (%)	-.07	-.22	-.20
	(0.1)	(0.05)***	(0.06)***
regulation			-5.07
			(1.65)***
Δ employment 1990-1996 (%)	0.73		
	(0.27)***		
Δ employment 2006-2009 (%)		2.32	2.05
		(0.42)***	(0.42)***
Const.	18.53	6.57	5.16
	(5.20)***	(2.08)***	(2.14)**
Obs.	59	59	59
R^2	0.16	0.62	0.66
F statistic	6.32	67.1	61.32

Notes: (1) The variables shown on the top row are dependent variables, measured in percents. (2) The numbers in the parentheses are robust standard errors. (3) *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels. (4) All columns are estimated by OLS.

Table 10: Legacy of credit expansion

	$\frac{P_{2009}-P_{2000}}{P_{2000}}$	$\frac{P_{2009}-P_{2000}}{P_{2000}}$
Variables	(1)	(2)
regulation	0.91	0.85
	(1.83)	(1.83)
undevelopable land (%)	0.33	0.31
	(0.08)***	(0.09)***
rejection (%)	-.20	-.19
	(0.2)	(0.19)
regulation*rejection		-.11
		(0.13)
undevelopable land*rejection		0.01
		(0.006)*
Δ employment 2000-2009 (%)	0.94	0.95
	(0.2)***	(0.19)***
census profile in 2000	included	included
Const.	30.50	30.29
	(1.54)***	(1.56)***
Obs.	326	326
R^2	0.26	0.26
F statistic	15.79	13.38

Notes: (1) The variables shown on the top row are dependent variables, measured in percents. (2) The numbers in the parentheses are robust standard errors. (3) *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels. (4) All columns are estimated by OLS. (5) All right-hand-side variables are demeaned, such that the coefficients on non-interaction variables measure the marginal effects at the sample mean. (6) The census profile in 2000 includes the following variables: population density in 2000, population in 2000, mean household income in 2000, the fraction of urban population, the unemployment rate and the proportion of vacant housing units.

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