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REGULATION AND THE HIGH COST OF HOUSING IN CALIFORNIA

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Abstract

This paper analyzes the effect of regulation governing land use and residential construction upon the course of housing prices in California. We explore the linkage between regulation and housing prices using a series of housing price indices that we estimate from the Public Use Microdata Samples (PUMS) of the 1990 and 2000 Census of Population and Housing as well as a detailed cross-sectional information on land use regulation and growth controls taken from a survey of California cities. We explore a number of avenues by which regulatory stringency may impact housing outcomes. First, we assess whether housing is more expensive in more regulated cities. Second, we assess whether growth in the city-level housing stock over the period of a decade depends on the degree of land-use regulation at the start of the decade. Finally, we estimate the price elasticity of housing supply for regulated and relatively unregulated cities. Our results suggest that current regulations have powerful effects on housing outcomes.

1. Introduction

During the three year period ending in July 2003, the cost of living in the U.S. increased by 6.7 percent, and real output increased by 4.5 percent. But housing costs in California simply exploded. Housing prices in San Diego County increased by 63 percent. Sales prices of owner occupied housing in Santa Barbara County increased by 63 percent. Prices increased by 60 percent in this three-year period in Los Angeles County and in Monterey County.

Figure 1 reports the estimated distribution of house price appreciation in California cities during this period. The figure reports the average three-year house price appreciation in the top one third of California cities, the middle third, and the bottom third.[1] The Figure illustrates that for one-third of the political jurisdictions that govern local land use in California, prices have increased by an average of more than thirty percent *per year* for the past three years. For the bottom third, the rate of increase has been about four percent per year.

These large recent price increases coupled with historically high housing costs in the state suggest that California housing markets differ along many dimensions from those in the rest of the country. One important difference concerns the degree of regulation governing land use and residential construction. California represents the most extreme example of autarky in land use regulations of any U.S. state. Cities in the state are essentially free to set their rules independently, with little oversight from regional or state authorities. Cities are required to submit plans for the allocation of vacant land to development (called housing "elements"), but there are few sanctions if sufficient land is not reserved for regional housing needs and no sanctions at all if cities subsequently deny developers permission to build on that land. There is

[1] The rates of appreciation are the simple city averages within groups and are not weighted by the distribution of sales or dwellings across cities.

no “as of right” allowing developers to proceed with construction when projects comply with existing regulations.

This planning regime interacts with state tax policies which limit the effective property tax to one percent of acquisition cost but which also allow cities a share in the sales tax receipts generated within their borders. The fiscal incentives -- to favor retail development over housing construction, to favor development of expensive housing over moderately priced housing, and to discourage the construction of housing -- are played out in negotiations between developers and cities over increases in the stock of housing.

This paper analyzes the effect of regulation governing land use and residential construction upon the course of housing prices in California. We explore the linkage between regulation and housing prices using a series of housing price indices that we estimate from the Public Use Microdata Samples (PUMS) of the 1990 and 2000 Census of Population and Housing as well as a detailed cross-sectional information on land use regulation and growth controls taken from a survey of California cities (Glickfeld and Levine, 1992). We explore a number of avenues by which regulatory stringency may impact housing outcomes. First, we assess whether housing is more expensive in more regulated cities. Second, we assess whether growth in the city-level housing stock over the period of a decade depends on the degree of land-use regulation at the start of the decade. Finally, we estimate the price elasticity of housing supply for regulated and relatively unregulated cities.

Our results suggest that current regulations have powerful effects on housing outcomes. Both rental and owner-occupied housing is more expensive in regulated cities. Growth in the housing stock due to new construction is less the greater the degree of regulatory stringency. Finally, the price elasticity of supply is lower in more regulated cities. In all, the results indicate that the land-use regulatory regimes of many California cities aggravate the already high price of housing in the state.

2. Data and Methodology

We explore the effects of local land use regulation on housing costs by developing a city-level index of regulatory stringency for California cities. We relate this measure of regulation to a set of housing price measures for 1990 and 2000 estimated from the Public Use Microdata Samples (PUMS) of the U.S. Census of Housing and Population. With these data, we explore a series of simple hypotheses about the ways in which regulation affects the costs of housing and the overall sensitivity of the housing stock to change in price. Before discussing these tests, however, we describe the price measures and the measures of regulation stringency.

A. *Estimating geographic and inter-temporal variation in housing costs*

Hedonic methods are commonly used to measure the extent to which prices of otherwise identical housing units differ by location or differ over time in the same geographical location. The hedonic characteristics of dwelling units are related to their sales prices or monthly rents using standard multivariate statistical methods. The parameter estimates and forecasts from these models yield measures of the prices of standardized dwellings over time and space.

In many cases, these hedonic measures are developed from specialized sample surveys, from data maintained by brokers, or other market participants. Regular systematic surveys of hedonic characteristics and house prices are undertaken by the American Housing Survey (AHS) and the decennial U.S. Census. The AHS collects detailed information on housing costs and dwelling unit attributes for a nationally representative sample of housing. The sampling frame, however, does not permit estimation of hedonic price indices by city (or by census "place" in the jargon of the Census). Although the AHS national sample is surveyed biannually, the size of this sample is too small to estimate reliable price indices by metropolitan area, let alone by cities or "places" within metropolitan areas (Malpezzi et. al. 1998).

The Public Use Microdata Samples (PUMS) from the U.S. censuses contain large numbers of observations on households and dwellings, but a more limited number of measurable housing characteristics. Malpezzi et. al. (1998) used the 1990 PUMS to estimate area-specific housing price indices for 272 Primary Metropolitan Statistical Areas (PMSA) for the U.S. They compared these estimates to those obtained using the AHS by Thibodeau (1995), which relied upon a much larger set of housing unit characteristics. For the metropolitan housing markets that are included in these two studies, a regression of the PUMS-based index on the AHS-based index yields a slope coefficient of one and a correlation coefficient of 0.95. Thus, a hedonic index based upon the PUMS approximates quite closely the more detailed index that could be estimated using the AHS. We rely upon this to estimate a series of constant quality housing price indices for California cities using large sample sizes reported in the 1990 and 2000 PUMS.

For reasons of confidentiality, the PUMS data do not identify the political jurisdiction within which any observed dwelling is located. As an alternative, the Public Use Microdata Area (PUMA) each containing each observation is identified. It is thus possible to impute each sampled dwelling unit to political jurisdiction by knowing the proportion of the population of each PUMA that lies within each census place. Most PUMAs in California are located within a single city, but many PUMAs are split across several cities. Thus, we employ a probabilistic procedure for allocation housing units across cities before estimating place-specific hedonic models.

We allocate housing units to political jurisdictions in the following manner. First, we estimate the proportion of housing units from each PUMA in California that is located in each of the census places in the state.[2] Call this proportion the "allocation factor." Next, we match each housing unit in the PUMS identified by PUMA to all cities which contain a portion of that PUMA. Thus, a housing unit contained within a PUMA that includes both part of the city of Santa Barbara as well as the city of Carpenteria would be allocated to both places. Next, we multiply the allocation factor by the housing weight from the PUMS to reflect the proportional allocation of the PUMA across its constituent census places.[3] We then estimate a hedonic regression for each city, where all observations in the regression are weighted appropriately (-- i.e., by the modified housing weight).

The hedonic models are estimated by regressing the log of house values or rent on indicators of all of the housing characteristics measured in the PUMS. Appendix Table A1 lists the housing characteristics included in these models. The census reports information on the number of rooms, the number of bedrooms, the age of the unit, the number of units in the structure, whether the unit is a condominium, and whether the unit has complete kitchen and plumbing facilities. We also include a measure of the number of persons per room in the unit, following Follain and Malpezzi (1980) and Malpezzi et. al. (1980), to account for the effect of crowding on depreciation. This variable should negatively affect the value of owner-occupied units and positively affect the cost of rental accommodations. We estimate separate models for owner-occupied units and for rental units. For the owner-occupied units, we use owner self-

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[2] This relies upon the "geographic correlation engine "at the University of Missouri website http://mcdc2.missouri.edu/websas/geocorr2k.html. Since the definitions of PUMAs change across census years, we calculated geographic correlation matrices for both 1990 and 2000. The allocation of PUMAs to places relies on the fact that both geographic units are built up from census blocks. The proportion of housing units in each PUMA located within a given place is used in calculating the allocation factors for these matrices.

assessments of value. For the rental units, we use contract rents as our measure of housing costs. These models are estimated for 407 separate California cities using 1,000,000 observations on dwellings. Appendix Table A1 summarizes the average coefficient estimates. It summarizes statistical results for both rental units and owner-occupied units for 1990 and 2000. On average, the parameter estimates are plausible in magnitude and are quite precisely estimated.

We use the averages of the housing characteristics listed in Appendix Table A1 for the entire state in 1990 for owner-occupied and rental units, together with the city-specific hedonic regression models to estimate the market price (in logarithms) of the average owner-occupied unit and rental unit for each city for 1990 and for 2000. Thus, our index measures the cross-city variation in the price of a constant quality unit over time, with separate measures for the owner-occupied and rental housing stock in each city.) Variations in these indexes over time and space are the principal dependent variables in the subsequent analysis.

Figures 3 and 4 report the distributions of the within-city changes in the price of constant quality owner-occupied between 1990 and 2000. In both owner and renter markets, the median city experienced an increase in housing costs of approximately 28 percent during the decade. The distribution of price increases for owner-occupied housing however, is bimodal, with a cluster of cities experiencing relatively modest increases in housing prices (between 0 and 16 percent) and nearly a fifth of cities experiencing quite large increases in housing prices (greater than 50 percent). In the rental market, the majority of cities experienced rent increases of roughly 15 to 30 percent.

B. *Measuring housing market regulation*

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[3] Note, the sum of these housing weights within cities yields a count of housing units which is nearly identical to housing unit counts from the census summary files by place.

Local ordinances regulating the use of land, the extent of growth, and the type of growth permitted may all contribute to high housing prices. Explicit growth controls, such as urban service boundaries or growth moratoria, reduce the quantity of developable land and thus the ability of housing supply to adjust to changes in demand. Moreover, minimum quality standards, large lot zoning (intended to reduce density), and "fiscal zoning" (designed to minimize the fiscal impact of land use), are likely to restrict further the supply of housing.

These regulations are prevalent in California cities. We rely on a survey of city managers conducted by the California League of Cities during the early 1990s (Glickfeld and Levine, 1992) to measure their prevalence. The survey was designed to measure inter-city variation in land-use planning provisions, and it included a detailed set of questions on growth control measures that each city had in place at the time of the survey.

Table 1 lists fifteen growth control regulatory provisions widely adopted in California cities. Roughly half of these regulate residential development directly. A third regulate commercial development, and the remainder are general growth control measures included in the city's general plan (regulating both residential and commercial development) such as urban limit lines and growth management elements. The table also indicates the proportion of the 407 cities that have adopted each provision. Roughly half of all cities have adopted provisions requiring adequate pre-existing service levels for residential and commercial development. Nearly half had added recent provisions to their general plans reducing permissible density and reducing the permissible height of commercial and industrial buildings. Among the more extreme growth control measures are those requiring supermajority city council votes for increasing densities ("upzoning") and requiring voter approval for upzoning. Relatively small proportions of cities had adopted these provisions in the early 1990s. On average, cities have adopted two or more of the provisions.

We measure the regulatory stringency of a given city by the number of these growth control measures they had adopted.[4] Figure 5 reports the relative frequency distribution of cities by the number of growth control measures that were in force at the time of the survey. Roughly one fifth of cities had none of these measures in place at the time of the survey, while another forty percent had adopted one or two of these provisions. Beyond these relatively low levels of regulation, there are many cities that required a number of these provisions in their land-use regulation. Geographically, the most regulated cities in California lie along the coast (for example, San Louis Obispo on the central coast has 12 such provisions) or are wealthy cities located in major metropolitan areas (for example, Walnut Creek, Palo Alto, Mill Valley, Del Mar).

C. *Exploratory Relationships*

We explore several simple hypotheses to assess the impact of regulation on housing costs in California cities. We begin with the obvious; we measure the extent to which housing costs are higher in cities with more stringent regulation. A number of researchers have explored this relationship using special purpose surveys of housing prices and regulatory measures (for example, Green 1999, Malpezzi 1996, Malpezzi and Green 1996, and Pollakowski and Wachter 1990). We assess whether we can reproduce this finding using the California data on regulation, together with price information from the census. We test cross-sectional relationships at two

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[4] In results not reported in here, we explored the effects of controlling for each measure independently, without substantial differences in the results. Thus throughout the paper, we use the sum of the growth-control provisions as one of our chief explanatory variables.

points in time, 1990 and 2000. We also test whether the change in housing costs over the decade is larger in more regulated cities.

Next, we investigate the link between regulatory stringency at the beginning of the 1990s and the growth of the housing stock over the subsequent decade. Using data on residential building permits issued by each city between 1990 and 2000, we assess whether the growth in the housing stock (as measured by permits issued) is affected by the regulatory stringency of the city. We test for the effect of additional regulatory provision, with and without controls, upon the decennial change in housing prices.

Finally, we present a simple test for variations in housing supply elasticities among relatively regulated and relatively unregulated cities. Several studies have estimated the impact of the overall municipal regulatory environment on housing supply. Using aggregate data for U.S. metropolitan areas, Mayer and Somerville (2000) found that heavily regulated areas have considerably lower levels of new housing construction and low housing supply elasticities. Green, Malpezzi, and Mayo (1999) found a simple cross-MSA relationship. Here, we assess whether a similar pattern holds for California cities by stratifying the sample into cities that are more intensely regulated and those less intensely regulated; we test for differences in the relationship between the change in the housing stock and the change in housing prices. We discuss this test in greater detail below.

3. Empirical Results

A. *Housing Costs and the Degree of Regulatory Stringency*

Figures 6 and 7 report the relationship between our housing price indices and the degree of growth-control regulation at the city level. The figures depict the averages of these constant-quality price indices by the number of growth control restrictions in place during the early 1990s. Figure 6 presents these profiles for the prices of owner-occupied housing, while Figure 7 presents averages for the rental market. In both figures, we report separate tabulations for 1990 and 2000.

The figures show a clear positive relationship between the average price of a constant quality unit of housing and the degree of anti-growth regulation. Housing price and rental rates are roughly 30 to 50 percent higher in the most regulated cities relative to the least regulated cities. Moreover, if we omit the one anomolous city with twelve growth restriction measures, housing costs -- rents and house values -- rise monotonically with the degree of regulation.

Table 2 explores this relationship further using a series of linear regressions. For each measure of housing prices, the table presents the estimated coefficient on the growth control regulation index using three dependent variables: the 1990 housing price index, the 2000 housing price index, and the within-city changes in the housing price index over the decade. For each dependent variable, the table presents results for two specifications: a simple bivariate regression of housing prices on the regulation measure, and a regression of the housing price index on the regulation measure and a set of dummy variables, one for each of the 58 counties in California. The first specification summarizes the relationships presented in Figures 6 and 7 and tests the significance of the linear relationship. The second specification tests for a relationship within county, and thus controls for much of the inter-regional difference in amenities and housing demand that characterizes the state of California.

The unadjusted cross sectional regression results suggest that each of these regulatory measures adopted by a city is associated with a 3 percent (1990) and 4.5 percent (2000) increase in the prices of owner occupied housing. These estimates are statistically significant at the one percent level of confidence. Moreover, housing prices grew at a faster rate in more regulated cities, with each growth control measure adding 1.1 percentage points to the change in housing prices over the decade (significant at the one percent level of confidence). Adjusting for county level fixed effects reduces the point estimates considerably. For the cross-sectional results, the effect of an additional growth control measure declines from between 3 and 4.5 percent to approximately 1 percent. Nonetheless, these marginal effects are still significant, indicating that within counties the more regulated cities have higher housing prices. Adjusting for fixed effects eliminates the positive correlation between the change in housing prices over the decade and the degree of regulation at the beginning of the decade.

The results for renter-occupied units are similar. In the models omitting county fixed effects, there are statistically-significant cross-sectional relationships between log rents and the degree of regulation, although the point estimates are somewhat smaller than the marginal effects on owner occupied housing prices. In addition, a bivariate regression of the within-city change in rents over the decade on the degree of regulation at the beginning of the decade yields a positive and highly significant relationship. The cross-sectional relationships survive adjusting for county fixed effects, though the coefficients on the regulation measures are again reduced by the inclusion of county fixed effects in the specification. Controlling for county effects eliminates the within-city relationship between growth in rents and regulation.

Housing prices and rents are indeed higher in cities with more stringent regulation of development and land use. These results are consistent in both cross sections analyzed.

B. *Growth in the Housing Stock via New Construction and the Degree of Regulatory Stringency*

Local land use regulations restricting and managing urban growth is likely to (1) inhibit increases in the supply of housing available at a given point in time, and (2) dampen the responsiveness the housing stock to increases in demand over time. In this section and the next, we explore whether the sensitivity of housing supply depends on the stringency of land use regulation.

To do so, we first estimate the growth in the housing stock during the 1990s that is attributable to new construction. We add residential building permits issued by for each city,[5] for new single family and multi-family units over the decade to the number of dwellings at the beginning of the decade and compute log growth in the housing stock (relative to 1990) attributable to new construction. We then assess whether growth in the housing stock via new construction is related to the extent of regulation at the beginning of the decade.

Table 3 presents regression estimates of the effect of growth restrictions on growth in the housing stock through new construction between 1990 and 2000. The dependent variables in Table 3 are the log-change in all housing units, the log-change in single-family units, and the log-change in multi-family housing units. For each dependent variable, the table presents a simple regression of the growth in housing units on the number of restrictions as well as a regression that also includes the change in the relevant housing price index over the decade.[6] The change in the price indices is a proxy for variation in housing demand across cities. Thus, the coefficient on the restrictions variables in the second regression for each dependent variable is interpreted as the effect of growth restriction measures on growth in the housing stock, holding constant the extent of price pressure observed over the decade.[7]

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[5] Annual building permit data come from the CIRB.

[6] For the single-family unit models, we use the change in the owner-occupied price index as the key control variable, while for the multi-family unit growth model we use the change in the rental price index. For the overall growth model, we calculate the weighted average of the changes in the owner-occupied and rental price indices, using the proportion of housing units in 1990 that are owner-occupied and renter-occupied as weights.

[7] To eliminate the effect of a few outlier cities, we restrict the sample of cities analyzed in this table to those where growth in the housing stock over the decade does not exceed 100 percent. All regression are weighted by the number of units in 1990.

For all units, the number of restrictions is negatively correlated with growth in the housing stock, although this coefficient is insignificant when the change in the price index is omitted from the regression. Including the change in the price index is marginally significant and negative (at the ten percent level of confidence). The results are considerably stronger for single family units. Here, growth restrictions exert a negative effect on growth in the number of single family units in both specifications, with the results increasing slightly when the change in the relevant price index is added to the specification. Finally, there is no evidence of a relationship between growth in the multi-family unit housing stock and the number of growth restrictions.

C. *The Relationship between the Price-Elasticity of Housing Supply and the Degree of Regulation*

In all regressions, the change in the price index is positively correlated with the change in housing units. Since both variables are expressed in logarithms, the coefficient on the price index can be interpreted as an estimate of the price elasticity of housing supply. While the OLS estimates presented in Table 3 suffer from a clear identification problem, the basic results suggest an alternative test for an effect of growth restrictions on housing supply. Namely, does the elasticity of housing supply differ between more regulated and less regulated cities? Here, we estimate housing supply elasticities for more and less regulated cities.

We define less regulated cities as those with either one growth restrictions or zero growth restrictions and more regulated cities as those with two or more growth restrictions.[8] To account for the endogeneity of the change in the price index, we construct an instrumental variable that forecasts employment growth in the city using state-level employment trends. Specifically, we

[8] The median city has two such measures in effect at the time of the survey.

calculate the distribution of employment by three-digit SIC codes for each city at the beginning of the decade,[9] and we calculate the percentage growth in employment at the state level for each of the industrial categories. We use the initial employment distribution for each city and employment growth at the state level to forecast the growth in employment for each city that would have occurred based on state employment trends. This variable predicts shifts in the demand for housing in the locality. It is independent of supply conditions, since variation in this variable is determined by the overall growth rate of the state and the pre-determined industrial composition of each city's employment base. This predicted employment growth variable provides our instrument for changes in the price index over the decade.

Figure 8 presents a scatter plot of the average increase in the housing price indices[10] against the change in the log of employment predicted by initial conditions in the city and state employment growth by SIC. The size of the bubbles in the scatter plot corresponds to the number of housing units in the municipality in 1990 (and, given the sampling frame of the PUMS, correlates closely with the number of observations used to estimate the price indices). There is a clear positive correlation between the employment growth forecast and the change in the average price index. This first stage relationship is significant at the one percent level for the weighted price changes, the change in the owner-occupied price index, and the change in the rental price index.

Table 4 presents the principal results. Panel A presents estimation results where the dependent variable is the log change in the housing stock and the key explanatory variable is the weighted average change in the price indices. Panel B presents results for owner-occupied units,

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[9] We do this using the 1990 PUMS data along with our geographic allocation matrix.

while Panel C presents results for rental units. For unregulated cities and regulated cities, we estimate two models. First, we show a reduced form regression of the quantity change on the predicted change in employment. Next, we present and instrumental variables estimate of the coefficient on the log price change (the supply elasticity) when the predicted change in employment is used as an instrument.

For the growth in the overall housing stock, we find a marginally significant (at the 8 percent level) and positive supply elasticity for unregulated cities and a negative and marginally significant (at the 7 percent level) negative effect for regulated cities. The results are somewhat weaker for the owner-occupied housing units (no measurable elasticity in unregulated cities and a marginally significant negative effect of a log price change in regulated cities). The strongest contrast occurs in the rental market. For unregulated cities, the IV estimate of the price elasticity of supply is approximately 0.36. For regulated cities, the estimate is zero.

4. Conclusion

In summary, our analysis reveals several patterns consistent with the proposition that land-use regulation increases housing costs in California cities. First, we find a positive relationship between the degree of regulatory stringency and housing prices for both owner-occupied units as well as rental units. This relationship is evident in both the 1990 and 2000 cross-sections as well as for the changes in housing prices and rents over the decade. To be sure, the degree of regulation in a state may in and of itself be a function of early growth pressures and housing price increases. A more thorough analysis of this relationship would explore

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[10] In this graph, the change in the price indices is the weighted average of the change in the owner-occupied index and the change in the rental index, where the weights are the proportion of units that are owner-occupied and renter occupied in 1990.

instrumental variables strategies whereby exogenous shifters of the degree of land-use regulation are employed to identify a direction of causation. Possible candidates include measures of the political orientations of the residents of different California cities or the degree of racial and ethnic heterogeneity. In subsequent drafts, we intend to explore this in more detail.

We also find evidence that new housing construction is lower in more regulated cities relative to less regulated cities. Holding constant the change in the price indices over the decade, we find that the change in the housing stock driven by new construction over the decade is muted in cities with greater degrees of regulation, with each regulatory measure reducing growth in the housing stock by roughly 0.3 percentage points. While this relationship may be driven by unobserved differences in the changes in housing demand over the decade, this is unlikely. As the initial results suggest, housing price appreciation in more regulated cities exceeded the comparable price changes in less regulated cities. These two results combined indicate that those cities with the greatest increases in housing demand experienced the lowest increases in new housing supply.

Our strongest evidence of an impact of regulation on housing costs comes from the estimates of the supply elasticity of housing for regulated and unregulated jurisdictions. Using a plausibly exogenous predictor of changes in housing demand, we find that the responsiveness of the housing stock via new construction is weaker in more regulated cities relative to less regulated cities. Moreover, the difference in responsiveness is greatest for the supply of multi-family housing units, the source of supply that is most frequently the target of regulation.

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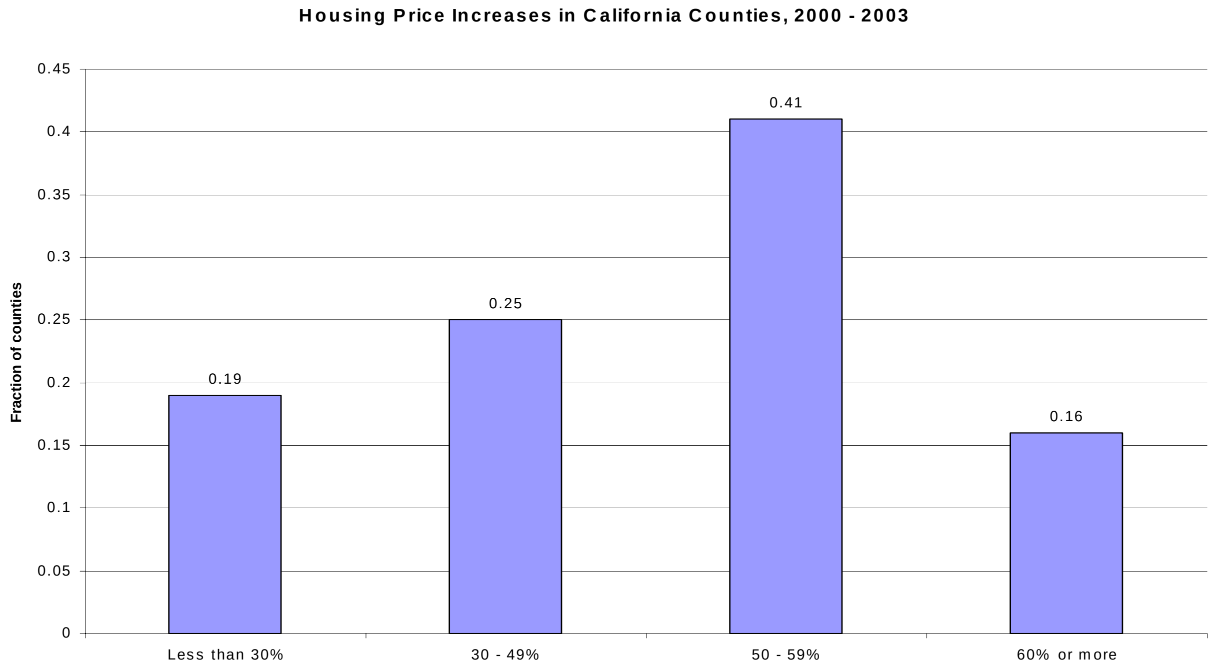
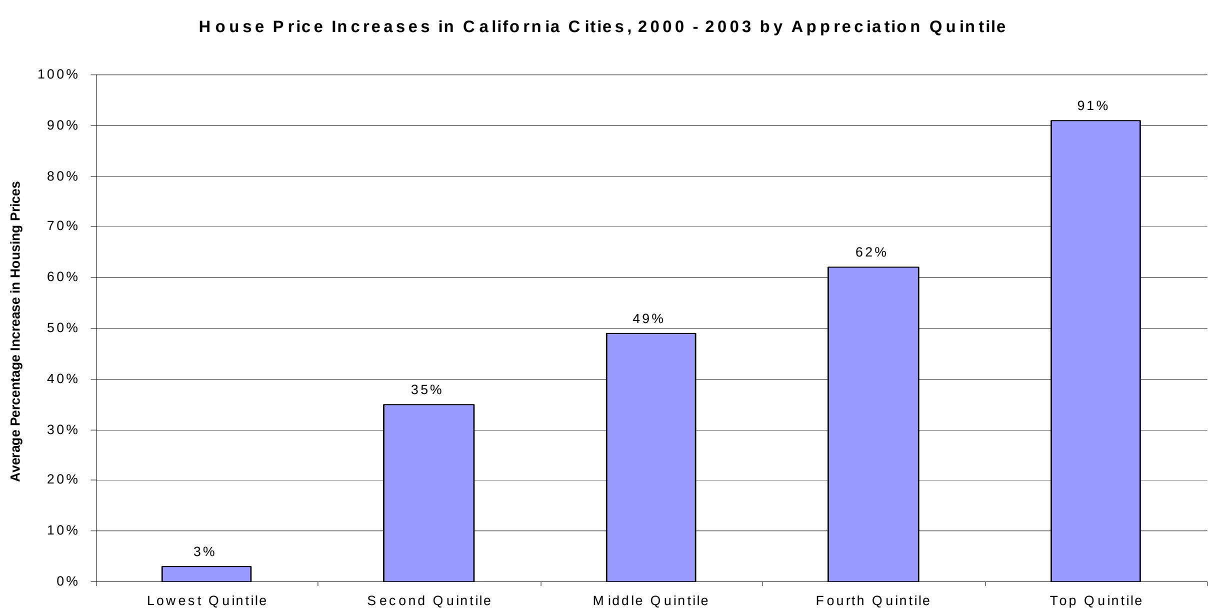
Figure 1



Source: Dataquick Information Systems, August 2000 – July2000.

Figure 2



Source: Dataquick Information Systems, August 2000 – July 2000.

Figure 3

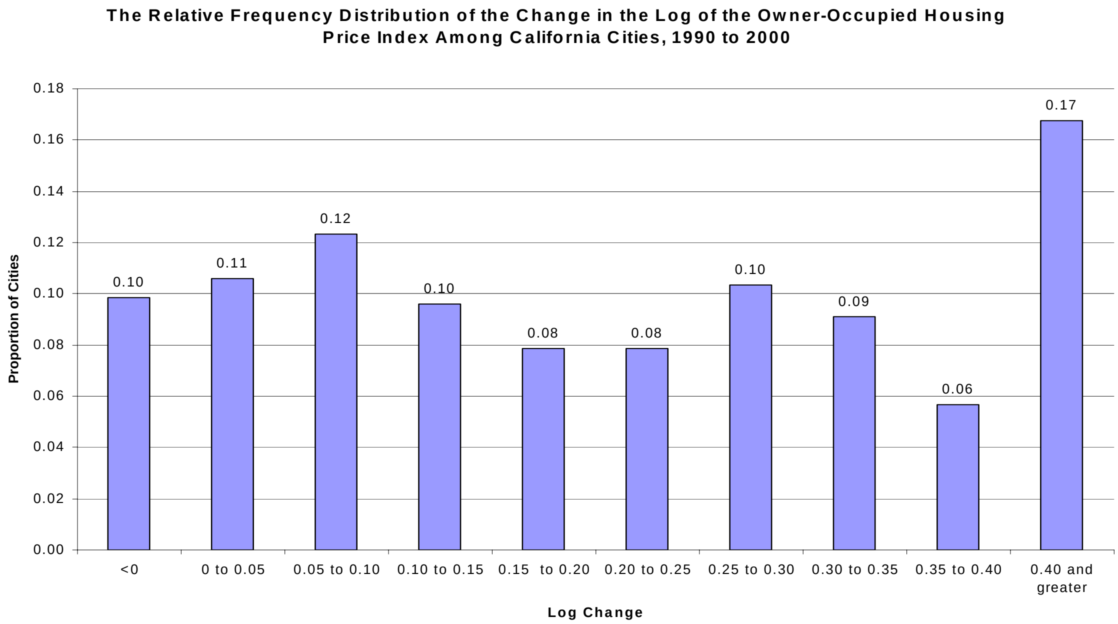


Figure 4

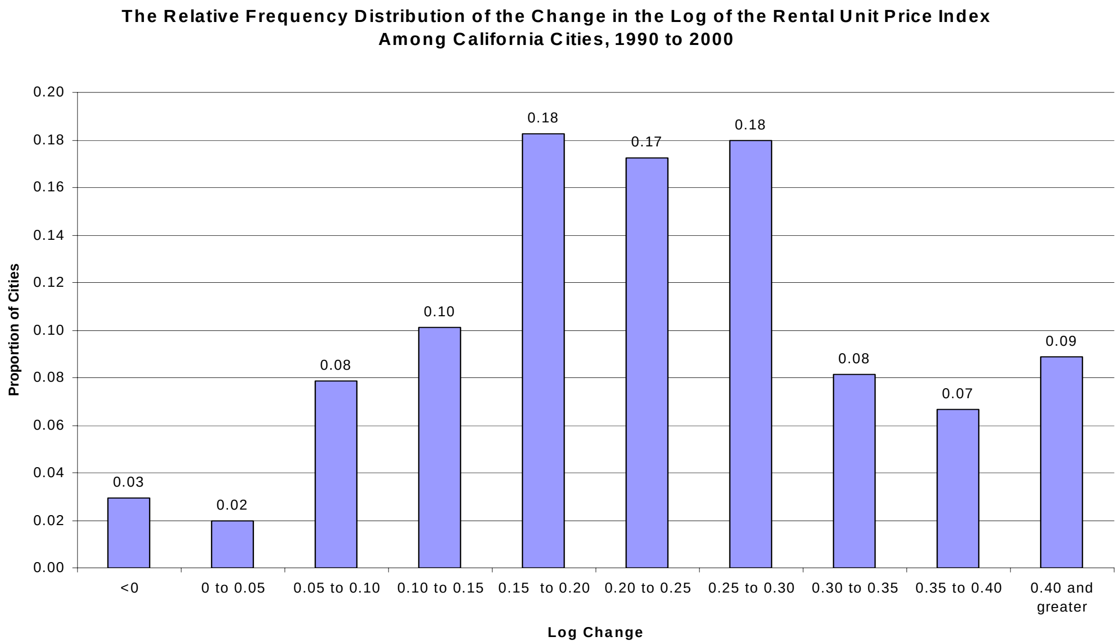


Figure 5

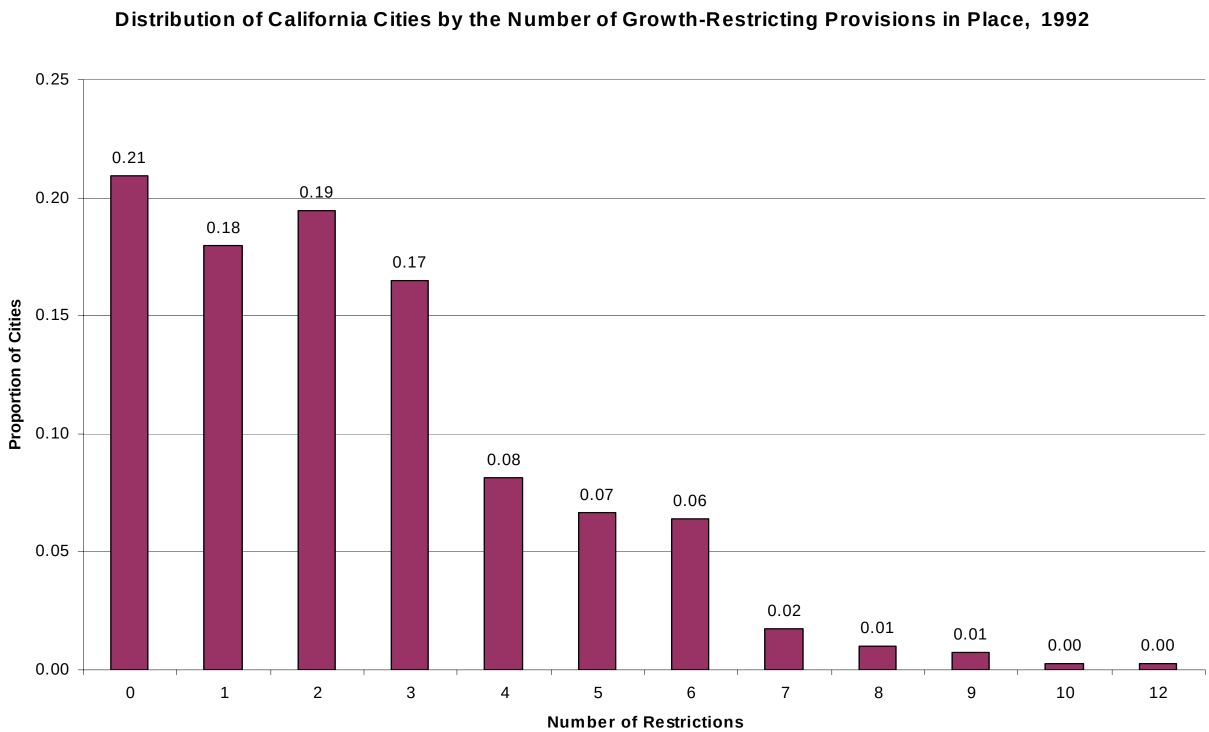


Figure 6

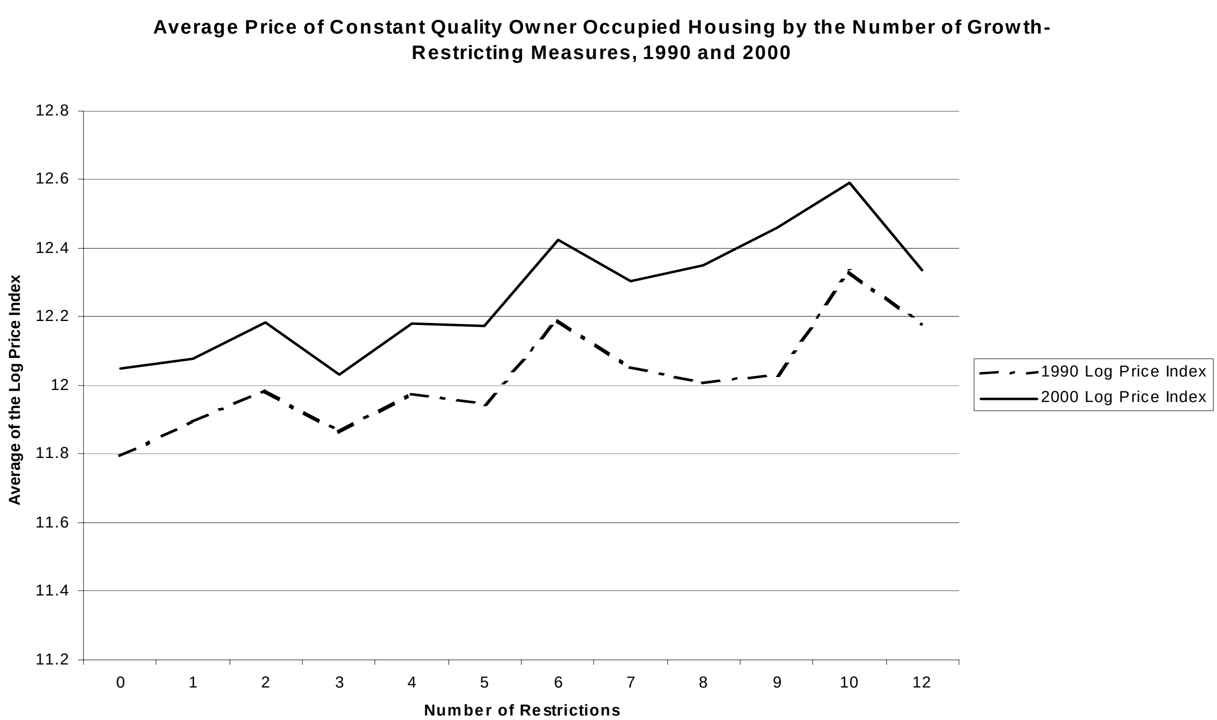


Figure 7

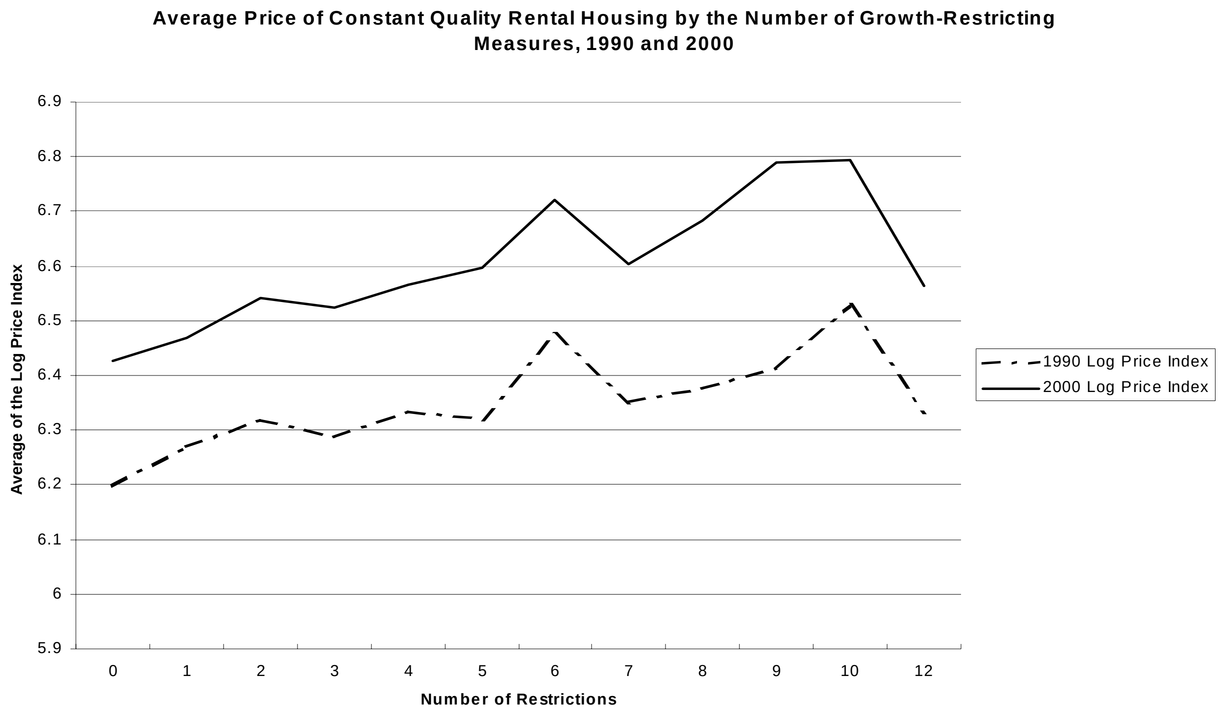


Figure 8

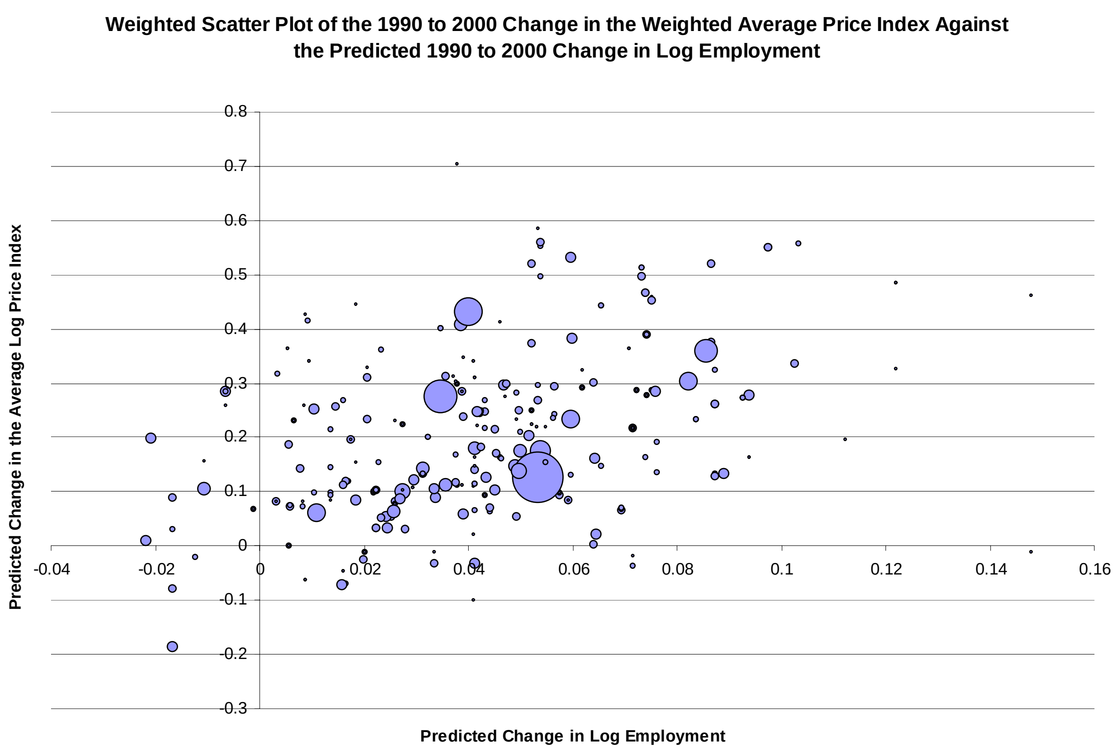


Table 1
Growth Control Measures Adopted in California Cities, 1992

Specific Measure	Proportion of Cities Adopting this Measure*
Measure restricting residential building permits in a given time frame	0.33
Measure limiting population growth in a given time frame	0.29
Measure requiring adequate service levels for residential development	0.49
Measure rezoning residential land to agriculture or open space	0.28
Measure reducing permitted density by general plan or rezoning	0.48
Measure requiring voter approval for residential upzoning	0.22
Measure requiring super majority council vote for residential upzoning	0.15
Measure requiring adequate service level for approval of commercial / industrial development	0.47
Measure restricting commercial square footage that can be build within a given time frame	0.23
Measure restricting industrial square footage that can be built within given time frame	0.21
Measure rezoning commercial/industrial land to less intense use	0.38
Measure reducing permitted height of commercial/office buildings	0.45
Adopted growth management element in general plan	0.36
Measure establishing urban limit line	0.31
Other measures to control development	0.34
Number of measures	2.12

Source: Glickfeld and Levine, 1992.
*Out of 407 California cities for which price and rent indices can be estimated.

Table 2
Regression Estimates of the Effect of the Number of Growth Restrictions on Rental and Owner-Occupied Housing Prices

	Dependent Variable: Price Index for Owner-Occupied Housing (in logarithms)			Dependent Variable: Price Index for Rental Housing (in logarithms)		
	1990	2000	Δ (2000-1990)	1990	2000	Δ (2000-1990)
No controls	0.031 (0.007)	0.045 (0.008)	0.011 (0.003)	0.015 (0.004)	0.023 (0.004)	0.008 (0.002)
County fixed effects	0.010 (0.004)	0.011 (0.005)	0.001 (0.002)	0.006 (0.002)	0.008 (0.003)	0.002 (0.002)

Standard errors are in parentheses. Figures in the table provide the coefficient on the number of growth restricting measures that each city had in place at the time of the survey. The first specification includes nothing but the number of restrictions in the specification. The second specification includes a full set of county fixed effects.

Table 3
Regression Estimates of the Effects of Growth Restriction on the Log Change in the Housing Stock Caused by New Permitted Units, 1990 to 2000

	Log Change in All Units[a]		Log Change in Single-Family Units[b]		Log Change in Multi-Family Units[c]	
Number of restrictions	-0.002 (0.002)	-0.0031 (0.0017)	-0.004 (0.002)	-0.005 (0.002)	0.001 (0.001)	0.000 (0.001)
Change in Price Index[d]	-	0.106 (0.003)	-	0.055 (0.034)	-	0.195 (0.030)

Standard errors are in parentheses. All regressions include a constant. The sample of cities used in each regression is restricted to observations where the change in the housing stock over the decade does not exceed 100 percent.

a. The change in the housing stock is measured by the log of the sum of owner-occupied units in 1990, rental units in 1990, and all residential building permits issued over the decade minus the log of the sum of 1990 owner-occupied and rental units.
b. The change in the housing stock is measured by the log of the sum of owner-occupied units in 1990 and new single-family residential permits issued over the decade minus the log of owner-occupied units in 1990.
c. The change in the housing stock is measured by the log of the sum of the rental units in 1990 and multi-family building permits issued over the decade minus the log of 1990 rental units.
d. For the first two regressions, the change in the price index is a weight average of the change in the rental and owner-occupied index, where the weights are given by the proportion of housing in 1990 that is owner occupied and rental. For the second two regressions, the change in the price index refers to the change in the owner-occupied price index. In the final two regressions, the change in the price index refers to the change in the rental units price index.

Table 4
IV Estimates of the Housing Supply Elasticity for Relatively Regulated and Relatively Unregulated Cities Using Regressions of the Log Change in the Housing Stock Against the Change in the Relevant Price Index

Panel A: Overall Change in the Housing Stock Against the Average Increase in Prices

	Unregulated Cities		Regulated Cites	
	Reduced Form	IV	Reduced Form	IV
Change in Average Price Index	-	0.171 (0.091)	-	-0.231 (0.137)
Predicted Change in Employment	0.436 (0.228)	-	-0.505 (0.261)	-
F-Stat[a] (P-Value)	-	70.842 (0.0001)	-	31.352 (0.0001)

Panel B: Change in the Single-Family Housing Stock Against the Increase in Owner-Occupied Housing Prices

	Unregulated Cities		Regulated Cities	
	Reduced Form	IV	Reduced Form	IV
Change in Owner-Occupied Price Index	-	0.074 (0.095)	-	-0.203 (0.132)
Predicted Change in Employment	0.237 (0.308)	-	-0.582 (0.351)	-
F-Stat[a] (P-Value)	-	65.271 (0.0001)	-	33.635 (0.0001)

Panel C: Change in the Multi-Family Housing Stock Against the Increase in Rental Housing Prices

	Unregulated Cities		Regulated Cities	
	Reduced Form	IV	Reduced Form	IV
Change in Rental Price Index	-	0.358 (0.115)	-	-0.036 (0.140)
Predicted Change in Employment	0.646 (0.198)	-	-0.045 (0.166)	-
F-Stat[a] (P-Value)	-	60.613 (0.0001)	-	15.399 (0.0001)

Standard errors are in parentheses. All regressions include a constant term.
a. This statistics is the F-statistic on the predicted employment change variable in the first stage regression of housing price indices on the predicted employment change.

Appendix Table A1
Average Regression Coefficients from the City-Specific Hedonic Models for Renter-Occupied and Owner-Occupied Units, 1990 and 2000

	Renter Coefficients, 1990	Renter Coefficients, 2000	Owner Coefficients, 1990	Owner Coefficients, 2000
Intercept	5.78	6.23	11.16	11.70
Persons per room	0.09	0.06	0.03	-0.04
Condo	0.13	0.00	-0.14	-0.13
Complete kitchen facilities	0.07	0.10	-0.06	-0.09
Two rooms	0.15	0.19	0.51	0.31
Three room	0.15	0.17	0.70	0.46
Four rooms	0.20	0.18	0.77	0.45
Five rooms	0.27	0.24	0.93	0.58
Six rooms	0.36	0.30	1.08	0.70
Seven rooms	0.40	0.35	1.22	0.83
Eight rooms	0.46	0.40	1.32	0.96
Nine rooms	0.48	0.38	1.45	1.12
Complete plumbing facilities	0.20	0.09	0.11	0.11
Unit, 2 to 5 years old	-0.04	0.00	-0.02	-0.09
Unit, 6 to 10 years old	-0.13	0.03	-0.08	-0.13
Unit, 11 to 20 years old	-0.13	0.00	-0.15	-0.20
Unit, 21 to 30 yeasr old	-0.16	-0.03	-0.27	-0.28
Unit, 31 to 40 years old	-0.20	-0.08	-0.31	-0.35
Unit, 41 to 50 years old	-0.25	-0.11	-0.33	-0.36
Unit, older than 50 years	-0.27	-0.15	-0.28	-0.35
Mobie home or trailer	-0.26	-0.40	-1.43	-1.57
Boat, tent, van, other	0.02	-0.30	-0.17	-1.32
Single-family detached	0.13	0.02	-0.03	0.01
Single-family detached	0.06	-0.06	-0.09	-0.10
Two family building	0.02	-0.12	0.06	0.02
Three-four family building	0.00	-0.15	0.02	-0.04
Five-to-nine family building	-0.02	-0.16	-0.03	-0.06
10-to-19 family building	0.00	-0.15	0.08	-0.01
20-to-49 family building	-0.01	-0.19	-0.03	0.07
50+ family building	0.00	-0.16	0.02	-0.11
Two bedrooms	0.06	0.02	-0.18	-0.10
Three bedrooms	0.24	0.21	-0.06	-0.02
Four bedrooms	0.33	0.29	-0.05	0.03
Five bedrooms	0.37	0.32	-0.04	0.06
Six bedrooms	0.30	0.27	0.01	0.13

The figures reported in the table are the averages of the regression coefficients on each variable from 400 plus city-level regressions of the respective measure of housing costs (either log rents or the log of owner-assessed house values) on all of the variables listed in the table.