Do Land Use Regulations Stifle Residential Development? Evidence From California Cities

Kristoffer Jackson[a]

University of California – Irvine

ABSTRACT: This paper estimates the extent to which the supply of new housing is restricted by land use regulations using a panel of California cities from 1970-1995. While land use regulation is found to significantly reduce residential development, controlling for unobserved heterogeneity using city and year (two-way) fixed effects notably reduces the magnitude of the estimates. This result suggests that studies based on cross-sectional policy variation, which predominate this literature, may overestimate the effects of land use regulation. Using the two-way fixed effects model, the implementation of an additional land use regulation is found to reduce residential permits by an average of 4%, which comes through effects on both multi-family and single family units. Of the regulations measured, those categorized as zoning and general controls have the strongest effects. The partial effects of individual regulations show that while some significantly reduce development, others actually have a large positive impact.

Keywords Land use regulation – Zoning – Housing supply – Housing market – California

JEL classification R31 (Housing Supply and Markets), R52 (Land Use and Other Regulations), R58 (Regional Development Planning and Policy)

---

[a] E-mail: kip.r.jackson@gmail.com. Tel: +1-949-333-9536. Sincere thanks to Ned Levine for providing regulatory data for this paper. Jan Brueckner, David Neumark, and two anonymous referees provided significant and helpful comments and suggestions. The paper also benefitted from comments from Gregory Burge and participants of the UC-Irvine Economics Student Colloquium and CSU-Fullerton Applied Microeconomics Seminar. All errors are my own.

1 Introduction

Since the beginning of the 20^{th} century, cities and counties across the United States have turned to land use regulation in various forms to manage the location, rate, and type of development that occurs in their communities. These policies are among the most controversial aspects of local political action – sometimes even affecting outcomes of local council and mayoral elections (Lewis and Neiman, 2000).

The effects of land use restrictions have been explored extensively, but primarily in terms of their impact on housing prices. Recent additions to this literature find land use regulation to positively affect housing prices. While this positive relationship may stem from an increased willingness-to-pay for housing in communities that more strictly control development, many researchers take it as support for the theoretical prediction that land use regulation restricts the supply of new housing. This paper focuses on the extent to which this restriction actually occurs.

Relatively few studies have attempted to estimate the extent to which land use regulation stifles new residential development. Moreover, the majority of those papers that have endeavored to do so rely upon cross-sectional policy variation, which precludes the ability to control for unobserved local characteristics. This paper shows, among other things, that the effect of land use regulation on residential development may be overestimated if unobservables are not taken into account. Using a panel of regulatory data, the paper estimates the effects of various land use regulations, individually and collectively, on residential development in California cities from 1970-1995. Given California's rapid population growth during much of this period, along with the extensive use of voter initiatives and the localized nature of its land use authority, many growth controls and other land use regulations were adopted across the state during these years.[1] Using city and year (two-way) fixed effects, the approach employed in this paper effectively compares the changes in residential development in cities that raised the restrictiveness of their land use regulations to the changes in development in cities that did not.

[1] Glaeser (2013) discusses the role these regulations likely played in the dramatic price growth experienced in California between 1970-1990.

The data suggest that the implementation of an additional land use regulation reduces the housing stock by about 40 units per year, for the average city. Residential permits are reduced by an average of about 4% per restriction. Land use regulation reduces new construction for both single and multi-family housing, but the effect on the latter is much larger. Of the regulations measured, those categorized as zoning and general controls have the strongest effects, again with much stronger effects on multi-family dwellings. An analysis of the partial effects of each regulation shows the important result that while some policies reduce residential development, others actually increase it. Thus, although the regulatory indices that dominate the literature may offer the best measure of the stringency of a community's regulatory environment, this sort of aggregation masks some important underlying effects.

The next section of this paper gives a brief review of the existing literature. Section 3 contains a description of the dataset employed in this study. The formal analysis of the data is contained in Section 4. Section 5 concludes.

2 Relevant Literature

Over the last four decades, researchers have developed an enormous literature empirically exploring the effects of local land use regulation. The vast majority of these studies have focused on the correlation between housing or land prices and the presence of land use regulation. While there is not strong consensus in the early literature, many recent studies find housing prices to be positively related to land use regulation.[2] Although this positive correlation is thought to be driven (at least partially) by supply-side factors, relatively few researchers have attempted to actually quantify the supply restriction that theory suggests would occur in the market for new housing following the adoption of (more) land use regulation.[3]

[2] See Fischel (1990) for a review of the early literature. This literature is also summarized well by Quigley and Rosenthal (2005), which contains more recent contributions. See also Glaeser and Gyourko (2003), Ihlanfeldt and Shaughnessy (2004), Glaeser et al. (2005), Mostafa et al. (2006), Hui et al. (2006), Ihlanfeldt (2007), Chakraborty et al. (2010), Zabel and Dalton (2011), Caldera and Johansson (2013), and others.

[3] Ihlanfeldt (2004) provides a brief summary of the literature relating land use restrictions to residential housing development.

The bulk of the current literature exploring this relationship uses cross-sectional variation in local regulatory regimes and finds that land use regulation (measured in several different ways) significantly reduces housing construction. Thorson (1997) finds that an increase in the minimum lot size significantly reduced housing starts in rural areas of McHenry County, Illinois. Mayer and Somerville (2000) use data from 44 U.S. metropolitan areas to show that areas with more stringent regulatory environments issue up to 45 percent fewer single family housing permits than less-regulated areas. Levine (1999) estimates that each additional land use regulation adopted by cities and counties in California led to 884 fewer housing units being built across that state between 1980-1990. Quigley and Raphael (2005) use an earlier version of the regulatory data from Levine (1999) and find that land use regulation reduces the stock of single family housing, while having no effect on multi-family housing.

Although most of the existing work suggests land use regulations restrict growth, some studies have found evidence to the contrary. In their 1992 monograph, Glickfeld and Levine describe the immense population growth that took place in California in the 1980s, as well as the land use restrictions that followed. They run a few basic time series regressions of residential permits from 1973-1988 on the annual number of land use regulations enacted statewide and then separately for various metropolitan areas throughout the state. These regressions lead them to conclude that the regulations did not significantly affect new construction. Pendall (2000) uses cross-sectional data from over 1,000 jurisdictions in the 25 largest metropolitan areas to estimate the effect of various land use regulations on housing starts and affordability. He finds that while residential construction is reduced by zoning laws that only allow for low-density development, urban growth boundaries, adequate public facilities ordinances, and building permit caps have little or no effect on the construction of new housing.

A handful of authors have used panel techniques to examine the relationship between various land use regulations and housing construction, but with no less discordant results than from the cross-sectional studies. While Dempsey and Platinga (2013) find that urban growth boundaries reduce the probability of development, Sims and Schuetz (2009) show that wetland protection bylaws do not significantly impact residential development. Skidmore and Peddle

(1998) and Burge and Ihlanfeldt (2006) examine the effects of impact fees on housing construction using panel regulatory data for jurisdictions in Illinois and Florida, respectively. The former study finds that the adoption of impact fees reduces residential development, while the latter finds that impact fees increase construction of single family housing.[4]

The approach taken in this paper is most similar to that of Glaeser and Ward (2009). These authors use a panel of regulatory data to determine the effects of minimum lot sizes, stringent wetlands bylaws, septic regulations, and subdivision rules in Greater Boston. The effects of the latter three regulations are analyzed individually and collectively by way of a dynamic regulatory index, which sums the values of indicators for each of the three regulations. They find that land use regulation significantly reduces the issuance of building permits, with the effect coming primarily through subdivision rules. Despite the thoroughness of this study, the data only cover the Boston metropolitan area, so the generalizability of its findings may be limited.

This paper fills a void in the current literature by more accurately estimating the effects of land use regulation on the type and amount of new housing development in California. By exploiting within-city variation in the timing of adoption for various land use regulations, this paper uses two-way fixed effects regressions to identify the effects of land use regulation on residential development. Additionally, the novel dataset used in this study documents the annual number of permits issued for each city in California between 1970-1995.

3 Data Description

3.1 Regulatory Data

The data utilized here come from several different sources. The regulatory data are composed of responses to two surveys of California land use officials. The first survey was administered in 1989 (Glickfeld and Levine, 1992) and the other in 1992 (Levine et al., 1996). The jurisdictions represented in these two surveys account for 99.9% of the land area of

[4] The theoretical model in Burge and Ihlanfeldt (2006) predicts this would occur when impact fees reduce exclusionary regulations and increase the percentage of proposed projects that are approved for construction.

California and 99.4% of the 1990 population (Levine, 1999). The data contain eighteen dummy variables indicating which of the various land use restrictions had been adopted in each jurisdiction as of 1992. Table 1 displays the eighteen regulations measured in the data, as well as the variable names used in this paper. The policies are grouped by whether they are intended to regulate residential or non-residential development. Additionally, the residential land use regulations are categorized according to the nature of each policy. These classifications essentially follow those put forth by Glickfeld and Levine (1992).[5]

Glickfeld et al. (1999) and Levine (1999) also use the regulatory data employed in this analysis, while Glickfeld and Levine (1992), Landis (1992), Brueckner (1998), and Quigley and Raphael (2005) each use an earlier version of the dataset, containing information from the first survey only. The main explanatory variable used by all of these researchers is a static index for the stringency of land use regulation in each jurisdiction at the time of the survey, constructed by summing the number of restrictions in place out of the total number of restrictions measured.[6] [7] The analysis in this paper exploits an underutilized aspect of this dataset – the reported year in which each restriction was adopted. Assuming survey respondents accurately reported the years in which the various land use regulations were adopted, these data are as if

---

[5] There are a few notable differences between Glickfeld and Levine's (1992) classification and the one used in this paper. First, the previous authors only included the first of the two surveys, so the variables representing subdivision limits and infill requirements are not included in their listing. Limitations on the number of subdivisions that can be created within a given time frame clearly fit with the population control devices, since these attempt to stunt growth. Policies requiring that developed areas are substantially developed before new construction can occur (i.e., infill development requirements) fit most naturally with the zoning control policies, since these are intended to affect the way in which development occurs within the city, rather than to stop its growth. When infill requirements are grouped as a population control, rather than a zoning control, the estimates in Section 4.3 are stronger, but the results of the paper are unchanged. The second difference between Glickfeld and Levine's (1992) categorization and the one used here is that the previous authors classify residential and non-residential adequate public facilities ordinances (APFOs) in a category of their own. Since this paper is primarily concerned with the effects of residential land use regulations, residential APFOs are classified as zoning controls, given that they are most similar in nature to those policies. They may also fit with population control regulations, since they essentially cap the size of the city until adequate infrastructure is in place. When residential APFOs are, instead, treated as a population control, the estimates in Section 4.3 are somewhat stronger, but the results of the paper remain unchanged.

[6] Levine (1999) also explores the effect of various land use restrictions individually.

[7] Using other data sources, Ihlanfeldt (2007), Malpezzi (1996), and several other researchers construct similar additive indices using cross-sectional regulatory data.

the survey was implemented each year during the panel.[8] Using information on the timing of adoption, dynamic indicators are constructed for the presence of each land use restriction. Following Glaeser and Ward (2009), these indicators are then used to construct dynamic indices of regulatory stringency. The effects of these policies on housing development are then estimated – individually and collectively (through the indices).

As shown in Figures 1 and 2, while some form of land use regulation was in place in many California cities in 1970, the adoption of these policies increased dramatically starting in the mid-1980s. The most common residential land use regulations adopted since 1985 are floor area ratio restrictions, adequate public facilities ordinances, and reductions in the permitted density of the city (see Figure 3). By 1993, each of these policies had been implemented in 118 or more of the cities in the sample.

Do neighboring cities adopt similar regulatory patterns? Brueckner (1998) answers this question using an earlier version of the regulatory data used in this paper. He finds the level of land use regulation employed in cities across the state of California to be positively related to levels in nearby cities. Likewise, the data used for this analysis, show a positive and statistically significant relationship in the regulatory environment of neighboring cities. Logistic regressions show that the presence of a particular regulation in a given city significantly increases the probability that city's nearest geographical neighbor has also adopted the policy for all but six of the regulations measured.[9] Moreover, the number of land use regulations adopted in these cities is significantly related to the number adopted in their nearest-neighboring city.[10] Coastal

[8] It is likely that respondents were able to report these years quite accurately, given that the vast majority of these policies were implemented just a few years before the surveys were administered (see Figures 1-3). Moreover, as survey participation was voluntary, there is no reason to think that respondents who were unsure of the adoption years would take their best guess rather than leave the question blank (as a number of them did).

[9] Given the interdependencies in the regulatory regimes of nearby locales, these regressions are not used to make causal claims, but only to explore correlations in the adoption of land use regulation. The policies that spill over less often are: reductions in the permitted height of commercial buildings, subdivision limits, rezoning residential land to open space, infill development requirements, and residential and commercial adequate public facilities ordinances.

[10] In particular, each additional land use regulation adopted by a city is associated with an average increase of about a third of one land use regulation in the city's nearest neighbor.

cities have an average of 0.518 more land use regulations than those not on the coast. The most heavily regulated areas are in the southern coastal region and the San Francisco Bay area.[11] [12]

3.2 Residential Building Permit and Other Data

Annual data on the number of new construction permits issued in each city in California come from the California Housing Foundation's Construction Industry Research Board (CIRB). CIRB's California Construction Review provides insight regarding the health and activity of the home building industry in the state. In particular, they maintain data on the annual number of single family, multi-family, and total residential permits issued in every city and county in California from 1970 to present. These data can be used to investigate whether different land use regulations have a differential impact on the type of development that occurs within a given jurisdiction. Figure 4 shows the cyclical pattern of permit issuance over the time frame of this analysis, while Table 2 contains summary statistics.

Permit data are used to construct several outcome variables for the analysis. While the majority of the existing literature explores the impact of regulation on changes in new construction (e.g., Glaeser and Ward (2009), Mayer and Sommerville (2000), and others), some authors have considered its effect on changes in the housing stock (e.g., Quigley and Raphael (2005), Pendall (2000)). Effects of both kinds are estimated in Section 4 of this paper.

After matching incorporated cities in the regulatory data with 1970-2000 Census data, the sample contains 402 cities. The latest year of enactment for any of the land use regulations measured in the data is 1993. Therefore, the panel dataset created for this analysis spans the period 1970-1995. The State of California Department of Finance provides annual population estimates for each city during this time frame, but any other potential covariates that are

---

[11] Each of these regions contains about one-third of the more heavily regulated cities, where "more heavily regulated" is defined using various threshold numbers of regulations enacted.

[12] While both of these regions experienced positive population growth between 1970-1995, both saw slower growth rates after the proliferation of land use regulation in the late 1980s. Moreover, these more regulated areas have experienced much less population growth in the last decade than areas farther inland, providing some evidence that land use regulation continues to affect growth patterns. However, the link between population growth and land use regulation is likely through prices, which, as discussed above, reflect both supply- and demand-side factors.

available for every city in California must come from the decennial Census data.[13] For non-Census years, covariate values are obtained via linear interpolation. This method assumes that demographic changes occur linearly over time within each city. This may be a strong assumption, but the fact that the interpolated population values are almost perfectly correlated with the actual state estimates (correlation = 0.9999) lends some credibility to the method.[14]

4 Analysis

A key advantage of using panel data is the ability to control for unobserved characteristics that may contaminate estimates in a cross-sectional analysis. If not taken into account, these unobservables could lead to biased estimates of the effect of land use regulation, since they are likely to affect the rate of new construction and to be correlated with the adoption of regulation. To the extent that these unobservables are time-invariant and/or contemporaneously common to all cities, the two-way fixed effects approach employed in this paper produces unbiased estimates of the effect of interest. Using this approach, the effects of land use regulations are identified by comparing within city changes in residential development in cities that adopted more regulation in that year to associated changes in cities that did not. The base model specification for this analysis is of the form:

$$Y_{ct} = \alpha + R_{ct}\beta + \varphi_c + \tau_t + \varepsilon_{ct} \ , \qquad (1)$$

where Y_{ct} is either a measure of the percentage change in the housing stock or the natural logarithm of permits issued (either total residential, multi-family, or single family) in city c and year t. R_{ct} represents the regulatory measure in city c in year t. φ_c is a vector of city dummies intended to capture unobserved characteristics that are city-specific and constant over time (such as local weather, established reputation of schools, and other fixed amenities). τ_t represents a vector of year dummies to control for time-varying factors that affect housing

[13] The U.S. Census Bureau also produces annual population estimates, but for years prior to 1990, these are only available online at the county, state, and national geographic levels.

[14] This finding is especially promising given that the state's estimates come from the average of several independent and fairly comprehensive methods that account for, among other things, changes in school enrollment, births, voter registration, and California drivers' license address change filings.

construction and are contemporaneously common to all cities (such as interest rates, costs of construction, and other cyclical factors).

It is important to note that although two-way fixed effects regressions eliminate potential sources of bias stemming from city-specific time-invariant factors, as well as contemporaneous factors common to all cities, they do not account for the possibility of dynamic selection in the adoption of land use regulation. That is, since cities may change idiosyncratically over time, and since land use regulation is primarily a function of current local conditions (which may also affect housing development), city and year fixed effects may fail to capture all potential sources of bias.

The next specification adds time-varying demographic and housing characteristics in an attempt to purge the estimates of any bias stemming from dynamic selection in the adoption of land use regulation. This specification takes the form:

$$Y_{ct} = \alpha + R_{ct}\beta + \varphi_c + \tau_t + X_{ct}\lambda + \varepsilon_{ct} \ , \qquad (2)$$

where each variable is as defined above, and X_{ct} is a vector of demographic and housing control variables for city c in year t. In particular, this vector includes median income, percent white, percent black, percent owner-occupier, percent foreigner, percent of housing units that are currently occupied, the percent of housing in rural areas, and, for some of the specifications, population size.

As mentioned above, the use of time-varying demographic and housing characteristics may eliminate some potential sources of bias not captured by city and year fixed effects, since these variables are potentially correlated with both the adoption of land use regulation and the construction of new housing. However, these covariates may themselves be, to some degree, endogenously determined by the presence of various land use regulations. To the extent that these controls are endogenous, their inclusion in the regression could result in overadjustment, biasing the estimated effect of land use regulation toward zero. Thus, estimates from this specification may represent a lower bound of the magnitude of the causal effect of interest.

Lastly, proper consideration must be given to the correct adjustment of the standard errors obtained through this analysis. Although land use regulation is generally implemented at the city level, growth is a regional phenomenon (Glickfeld and Levine (1992)). This fact suggests the error terms in the city-level regressions above are likely correlated among nearby cities. Similarly, observations of the same city over time are not independent. The presence of spatial and/or serial autocorrelation makes inference based on standard OLS estimates of the covariance matrix incorrect. To allow for heteroscedasticity, cross-sectional spatial correlation, and city-specific serial correlation, standard errors are adjusted following the approach of Conley (1999) and Conley (2008).[15] This method consists of estimating standard errors using a weighted average of spatial and serial autocovariances. The weights, which come from Bartlett kernels, decline linearly from 1 to 0, with a weight of 0 assigned to cities beyond prespecified threshold distances (in space and time). The thresholds used throughout this analysis are 100 km (or, about 62 miles) and 10 years.[16]

4.1 Effects of Regulatory Stringency – General Index

The first set of specifications measures the stringency of land use regulation (that is, the variable R_{ct} in equations (1) and (2)) using a dynamic regulatory index, which sums the number of restrictions in place out of the eighteen that are measured in the data. Although, as discussed above, numerous scholars have used this simple additive measure of land use regulation, there is no reason to think this is the best measure of each city's regulatory environment. An alternative method of data reduction, used by Malpezzi (1996), Gyourko et al. (2008), and others, is to construct a measure of regulatory stringency using weights from a factor analysis of the regulatory data. When carried out upon these data, the resulting factor scores are quite highly correlated with the simple sum, so the additive index is used throughout this paper.[17] Given the construction of the regulatory index, the estimated effect is the expected impact of imposing an additional land use restriction within a city.

---

[15] This analysis was carried out using the *ols_spatial_HAC* Stata program from Hsiang (2010).

[16] Other thresholds were tested for robustness, but none yielded meaningful differences from the results discussed below.

[17] Pearson's correlation coefficient = 0.7027 if factors are rotated and 0.9646 if they are not. Using the first factor from the factor analysis, estimates of the effect of land use regulation are uniformly larger in magnitude for each specification, but the results are not qualitatively different from those reported here.

The effect of land use regulation is estimated first using a measure of the annual percentage change in the housing stock, which is computed as

$$\text{Percentage change in housing stock}_{ct} = \frac{\text{Total Residential Permits}_{ct}}{\text{Housing Stock}_{ct\text{-}1}} \quad .$$

Since housing stock counts are only available for census years, annual estimates are obtained following the approach of Saks (2008a) and Saks (2008b). This method estimates each year's housing stock as the stock in the previous year plus the number of permits issued that year, minus an annual adjustment factor set to equate the housing stock estimates in each census year to the counts reported by the U.S. Census Bureau. Disaggregated housing stock data (i.e., the number of single family and multi-family structures) are not available from each of the required censuses, so this variable is only computed for overall residential development.

Since the housing stock is proportional to population, an alternative way to construct the previous measure is to divide permits by lagged population.[18] This method, which is roughly equivalent to permits per capita, is preferred to the former one, since the state of California provides rigorous annual population estimates for each city over the relevant time frame. Estimates of the effect of land use regulation using both measures are presented in the top two panels of Table 3. The bottom three panels of Table 3 contain similar estimates corresponding to regressions with the dependent variable being the natural logarithm of permits (either total residential, multi-family, or single family).

To highlight the contribution of fixed effects regressions, column (1) of Table 3 shows, for the different outcome variables, the estimated effect of land use regulation using a pooled model similar to the cross-sectional ones typically used in the existing literature.[19] The pooled estimates are uniformly larger in magnitude than those from the two-way fixed effects

[18] A regression of population on the census reported housing stock yields an extremely precise estimate of 2.58.

[19] Cluster-robust standard errors are shown in column (1) of Tables 3 and 4 because the program used to produce Conley standard errors is not compatible with pooled regression models. The pooled estimates are shown only to contrast with the fixed effects estimates and are not to be interpreted themselves, so these potentially incorrect standard errors do not affect the conclusions of the paper.

regressions (in columns (2) and (3) of Table 3).[20] This disparity suggests models that fail to account for unobserved heterogeneity may overstate the negative effect of land use regulation on housing development. Nonetheless, even after controlling for such heterogeneity, regulation has a sizable and statistically significant impact on the growth of both the stock and flow of housing.

Comparing columns (2) and (3) of Table 3, it is clear that, irrespective of the dependent variable used, when control variables are included the magnitude of the estimated effect is somewhat smaller. A portion of this decrease may be due to a reduction in omitted variables bias, but, as discussed above, at least some of it is potentially attributable to overadjustment. Thus, the estimates in column (3) serve as lower bounds for the magnitude of the effect of interest. Estimated coefficients and standard errors for the control variables from the regressions in column (3) of Table 3 are contained in Appendix A. This table indicates that, with the exception of population size, the coefficient on each of the controls is statistically significant for at least some of the specifications.

The results in the top panel of Table 3 suggest that after controlling for time-invariant city characteristics and contemporaneous factors common to all cities, a one-unit increase in the regulatory index reduces housing supply by an average of 0.2% per year. Using the estimates in the second panel of Table 3, each additional land use regulation is leads an average reduction of 0.7-0.8 permits per 1,000 residents. For both of these dependent variables, the estimates imply that for the average city in the sample (with 21,740 housing units and population of about 55,140), each land use regulation reduces the housing stock by about 40 housing units per year.

While the top two panels of Table 3 contain estimates of the effect of land use regulation on growth in the housing stock, the bottom three display estimates of the effect on residential permit issuance. These estimates indicate that each additional land use regulation leads to about a 4% reduction in the number of new residential permits issued. Although the effect is

[20] When control variables are included in the pooled regression models, the estimated effects of regulation are somewhat less negative than those reported here, but still uniformly larger (in magnitude) than in the fixed effects regressions, so the qualitative results are the same.

significant for both multi-family and single family dwellings, the former is more affected by land use regulation, with 6-6.5% fewer permits issued per regulation.

As mentioned above, the difference in estimates from the pooled and fixed effects regressions hints at omitted variables bias in the pooled regressions. However, it is important to note that the attenuating effect of measurement error from misreported years of adoption is exacerbated by the use of fixed effects. Thus, some of the observed difference between the pooled and fixed effects regression estimates may be due to measurement error. The fact that the vast majority of regulations were enacted within a few years of the two land use surveys lends some credibility to respondents' recall of the years of adoption for these regulations, suggesting that this type of measurement error may be limited. However, the sparse amount of variation in the timing of adoption also means that even small amounts of measurement error could have a significant attenuating effect on the estimated impact of regulation. With no other (independent) measure of regulation over this time frame, the degree to which measurement error is a factor cannot be assessed empirically.[21] Thus, while the panel regression techniques employed here may provide better estimates of the effect of interest than those from cross-sectional studies, the potential role of measurement error suggests that inferences from this analysis should be made with the appropriate caveats.

4.2 Effects of Regulatory Stringency – Residential Index

Table 4 is structured identically to Table 3, but the regulatory measure sums only the number of restrictions that are intended to directly impact residential development. That is, this measure omits the restrictions classified as "Commercial/Industrial" in Table 1. Using this measure of regulation, the estimated effects on the growth in the housing stock (in the top two panels of Table 4) are uniformly larger in magnitude than those in Table 3. This result is not

[21] In an attempt to verify the timing of the regulatory data used in this paper, land use officials in nearly every city across the state of California were contacted. Very few were willing (or able) to verify the years of adoption for the various regulations. Those who were willing to cooperate were generally only able to provide rough estimates for the years of adoption. These estimates tend to be consistent with the data, but are not precise enough to provide any real information about the presence of measurement error.

surprising, since this measure of regulatory stringency is more relevant to residential development and, therefore, is expected to have a bigger impact on the housing stock.

Using the estimates from Table 4, each additional residential land use regulation adopted by a community is associated with an average reduction of about 0.3% of its housing stock, or 1 fewer permit per 1,000 residents per year. These estimates suggest that for the average city in the sample, each residential land use regulation reduces the housing stock by about 55-65 units per year.

The estimated effect of land use regulation on housing construction is fairly robust to whether or not the regulatory index includes non-residential regulations, though more sensitive to the inclusion of covariates. The average reduction in permit issuance following the adoption of an additional residential regulation is, again, around 4%. However, this measure of regulatory stringency is associated with larger reductions in multi-family permits and smaller reductions in single family permits. This result suggests the construction of single family units depends more heavily on a community's overall regulatory environment, while multi-family dwellings are more strongly affected by the particular policies that are intended to regulate residential development.

4.3 Effects of Regulatory Stringency – Disaggregated Residential Indices

In order to identify which types of policies are particularly deleterious to new construction, the regulatory measure is decomposed into the categories in Table 1. As before, the panel structure of the data allows for the construction of dynamic indices for each of the categories, so identification of the estimated effects comes from within-city and within-year variation. Table 5 contains regression estimates for each of the separate indices with the dependent variables measuring growth in multi-family and single family permits separately. The results in Table 5 show that one of the strongest forces in restricting housing construction is local zoning policy. The estimated effect of those zoning ordinances measured in the data is a reduction of about 10% for multi-family development. For single family development, the estimated effect is a reduction of about 2-5%, but when time-varying controls are included, this estimate is not statistically distinguishable from zero. The other important restriction index, *General controls*, represents the number of general or miscellaneous land use restrictions enacted in each city. This index sums indicators for the adoption of a growth management element in the city's general plan and the presence of "other" restrictions (i.e., ones other than those asked about in the two surveys). Although the estimated effects of this index are large and statistically significant for multi-family development, they are difficult to interpret, since the data contain no information as to the nature of the "other" restrictions reported.

4.4 Effects of Individual Land Use Regulations

Finally, the partial effects of each land use regulation are estimated.[22] For these regressions, R_{ct} in equations (1) and (2) is a vector of indicators for the land use policies in place in city c in year t. For the most part, the expected sign of the coefficient on each of these regulations depends on the particular implementation of each policy. For example, if a city caps the number of building permits issued within a given time frame, does this limit apply to single family units or multi-family units, or both? Unfortunately, specific information of this type was not collected with the regulatory surveys, so it is difficult to say, *a priori*, what sign we should expect to see for the coefficient on each regulation. Thus, the analysis in this section is primarily exploratory.

As shown in Table 6, several of the restrictions have a significant negative impact on new construction, while others have a significant positive effect. This important result is obfuscated by the use of more aggregated regulatory measures, like those that dominate the literature. Aggregate measures are generally used (as in this paper) on the grounds that they may be the best proxy available for the overall regulatory environment of a community. However, the fact that development is stimulated by some regulations and stymied by others

[22] The indicator for "Other measure to control rate, intensity, type and distribution of development" is omitted from these regressions, given the ambiguity of this variable. However, the regression coefficients are almost identical when this variable is included as a regressor, so the results remain unchanged.

suggests that null results from the use of aggregate regulatory indices may be due to offsetting effects, rather than the absence of any effect.

The key variables in these regressions are indicators for each regulation, and the estimated equations are semi-logarithmic, so the precise interpretation of the coefficients in Table 6 is not quite as straightforward as before. As shown by Kennedy (1981) and discussed by Giles (2011), the estimated proportional impact, $\hat{p}_j$, of a dummy variable, D_j, on the dependent variable, Y, is $\hat{p}_j = \left[exp\left(\hat{c}_j - 0.5\hat{V}\left(\hat{c}_j\right)\right)\right] - 1$, where $\hat{c}_j$ is the estimated coefficient on D_j and $\hat{V}(\cdot)$ is the estimated variance. While Table 6 contains the estimated coefficients ($\hat{c}_j$), the reported effects that follow are the estimated proportional impacts, calculated as shown above.

Restrictions on the number of residential building permits that can be issued in a given time frame could potentially constrain both single and multi-family development, but the estimates in Table 6 suggest that it works entirely through single family housing. The same is true for restrictions on the floor area ratio of buildings. After controlling for the effects of the other land use regulations, the proportional impact of building limits on single family housing construction is between 26-32%. For floor area ratio restrictions, this proportional impact is a reduction between 10-23%.

If binding, a reduction in the permitted residential density of a city is expected to significantly reduce new construction of multi-family housing units, and this expectation is borne out in the data. In terms of the proportional impact, cities that reduced permitted densities experienced about a 36% reduction in the issuance of multi-family housing permits.

Cities that enacted either subdivision limits or requirements mandating voter approval in order to increase residential densities also saw large reductions in the construction of multi-family dwellings. In particular, the estimates and standard errors in Table 6 suggest the proportional impact of each of these policies is about a 45% reduction in multi-family permits issued.

Even after controlling for the effects of the other land use restrictions, the adoption of a growth management element in a city's general plan has a large impact on both single and multi-family housing construction (about a 34% reduction in each). This finding is consistent with the idea that additional costs associated with bureaucratic uncertainty in the development process may be substantial enough to significantly reduce or displace new construction (Staley, 2001). Also consistent with this interpretation is Mayer and Somerville's (2000) finding that regulations that add delays to the development process are especially harmful to residential development. Alternatively, this estimated effect might actually reflect the impact of some other land use regulations brought about by the adoption of the growth management element, but not measured in these data. Unfortunately, further exploration into this hypothesis is not possible using these data, since there is no information regarding the content of the growth management elements that were adopted.

The estimates in Table 6 suggest that several of the residential regulations measured in the data increase residential construction. For example, the implementation of an urban growth boundary boosts the construction of single family homes. This result supports the conjecture that, if not binding initially, zoning may appear to follow the market immediately after a zoning change (see Thorson (1994)). Urban growth boundaries have been shown to increase the value of new homes (e.g., Cho et al. (2008)), so it is not surprising that development would accelerate until abutting on the established boundary.

Residential development also increases following the adoption of a policy requiring infill development, as well as one that requires a super-majority council vote to increase residential density. While more research is needed to help explain the former correlation, the latter one may suggest that in the face of future political uncertainty, developers hasten to build on developable land in the present.

Interestingly, Table 6 also reveals that even after controlling for residential land use regulations, two policies not explicitly intended to affect residential development do just that. Cities that restricted the amount of commercial square footage that could be built in a given time frame saw multi-family permits rise considerably following the implementation of this constraint. In addition, those communities that adopted a policy reducing the permitted height of commercial or office buildings experienced a decrease in the construction of both single and multi-family housing. If such a policy drives out commercial employment, it should not be surprising that cities that enact these policies see less residential construction. Nevertheless, the link between non-residential land use regulations and residential development should be explored in future work.

5 Conclusion and Discussion

This study has shown that land use restrictions significantly reduce cities' housing supply and new construction, but, perhaps, to a lesser degree than suggested by cross-sectional analyses. The data reveal that those regulations defined as zoning controls and general controls are the strongest deterrents to development, resulting in substantial reductions primarily in multi-family construction.

The regulations classified as population controls do not have a significant impact on development. This result is surprising, since these policies appear to be explicit restrictions on growth. While this finding may suggest that these constraints were either not binding, or not enforced, disaggregating the index into its component parts shows offsetting effects from some of the individual policies. In particular, for single family housing, the positive effect of urban growth boundaries almost exactly offsets the effect of residential permit limitations.

Although Pollakowski and Wachter (1990) suggest that "land-use constraints collectively have larger effects than individually," this study has shown that individual constraints can have rather sizable effects. Moreover, since some of the regulations curtail development, while others boost it, aggregate measures of land use regulation potentially mask important elements of the relationship between land use regulation and residential development.

While the use of fixed effects regressions may amplify the attenuating effect of measurement error, they are employed here to eliminate (or reduce) omitted variables bias. One potential source of bias is the presence of fixed geographic constraints. Insofar as these constraints are positively correlated with regulatory stringency, the effects of regulation will be overstated. This is the case for coastal California cities, which face geographic constraints to development, and are, as previously mentioned, more likely to adopt land use regulation.[23]

Another source of heterogeneity that could bias cross-sectional estimates is unobserved attitudes about growth. Local governments in cities (or years) where growth is perceived negatively are more likely to adopt a greater number of land use regulations. They are also more likely use informal, ad hoc forms of regulation to hinder development.[24] This proposition suggests that estimates of the effect of land use regulation on residential development using cross-sectional variation are likely to be biased downward by omitted factors. In other words, such estimates may overestimate the negative effect of formal land use regulations on residential construction. To the extent that attitudes about growth and other potential sources of bias are city or year specific, the two-way fixed effects estimator resolves this issue and produces unbiased estimates of the effect of interest.[25]

The results of this paper are consistent with the idea that bureaucratic and political uncertainties are important factors in residential development. The effect of bureaucratic uncertainty may contribute to the large reductions in residential building permit issuance following the incorporation of a growth management element into a city's general plan. Political uncertainty is represented by the adoption of a policy requiring a supermajority council vote in order to increase residential density, which has huge effects on development.

This paper's findings provide grounds for future work exploring the relationship between these various land use regulations and residential development. For example, future work could investigate the link between commercial and industrial land use regulation and residential development.

---

[23] To the extent that geographic constraints can be adequately measured (e.g., Saiz (2010)), this source of bias can be controlled for in cross-sectional analyses. However, the fixed effects estimator removes the effects of these time-invariant attributes whether or not they are even observable.

[24] Landis (1992) discusses various ways in which local governments can use informal regulation to retard growth; for example, they may refuse to annex vacant land or extend utility services to developing areas.

[25] While we may be interested in the combined effect of formal and informal land use regulation on residential development, the latter is difficult to measure and, in many cases, beyond the purview of policymakers. Hence, the focus of this paper is on the effects of formal land use regulation.

References

Brueckner, J.K., 1998. Testing for Strategic Interaction Among Local Governments: The Case of Growth Controls. Journal of Urban Economics 44(3), 438-467.

Burge, G. and Ihlanfeldt, K., 2006. Impact Fees and Single-Family Home Construction. Journal of Urban Economics 60(2), 284-306.

Caldera, A. and Johansson, Å., 2013. The Price Responsiveness of Housing Supply in OECD Countries. Journal of Housing Economics 22(3), 231-249.

Chakraborty, A., Knaap, G., Nguyen, D., and Shin, J., 2010. The Effects of High-density Zoning on Multifamily Housing Construction in the Suburbs of Six US Metropolitan Areas. Urban Studies 47(2), 437–451.

Cho, S., Chen, Zhou, and Yen, S.T., 2008. Urban Growth Boundary and Housing Prices: The Case of Knox County, Tennessee. The Review of Regional Studies 38(1), 29-44.

Conley, T.G., 1999. GMM Estimation with Cross Sectional Dependence. Journal of Econometrics, 92(1), 1-45.

Conley, T.G., 2008. Spatial Econometrics. In S.N. Durlauf and L.E. Blume (Eds.), *New Palgrave Dictionary of Economics* (Palgrave MacMillan, New York), pp. 741-747.

Dempsey, J.A. and Platinga, A.J., 2013. How Well Do Urban Growth Boundaries Contain Development? Results for Oregon Using a Difference-in-Difference Estimator. Regional Science and Urban Economics 43(6), 996-1007.

Fischel, W. 1990. *Do Growth Controls Matter? A Review of Empirical Evidence on the Effectiveness and Efficiency of Local Government Land Use Regulation.* Cambridge, MA: Lincoln Institute of Land Policy.

Ganong, P. and Shoag, D., 2013. Why Has Regional Income Convergence in the U.S. Declined? HKS Working Paper No. RWP12-028.

Giles, D. E., 2011. Interpreting Dummy Variables in Semi-logarithmic Regression Models: Exact Distributional Results. Econometrics Working Paper EWP 1101, Department of Economics, University of Victoria.

Glaeser, E., 2013. A Nation of Gamblers: Real Estate Speculation and American History. American Economic Review 103(3), 1-42.

Glaeser, E. and Gyourko, J., 2003. The Impact of Zoning on Housing Affordability. Economic Policy Review 9(2), 21-39, Federal Reserve Bank of New York.

Glaeser, E., Gyourko, J. and Saks, R., 2005. Why is Manhattan So Expensive: Regulation and the Rise in House Prices. Journal of Law and Economics 48(2), 331-370.

Glaeser, E. and Ward, B., 2009. The Causes and Consequences of Land Use Regulation: Evidence from Greater Boston. Journal of Urban Economics 65(3), 265-278.

Glickfeld, M. and Levine, N., 1992. *Regional Growth ... Local Reaction: The Enactment and Effects of Local Growth Control and Management Measures in California.* Cambridge, MA: Lincoln Institute of Land Policy.

Glickfeld, M., Fulton, W., McMurran, G. and Levine, N., 1999. *Growth Governance in Southern California.* Claremont Graduate University Research Institute.

Gyourko, J., Saiz, A., and Summers, A., 2008. A New Measure of the Local Regulatory Environment for Housing Markets: The Wharton Residential Land Use Regulatory Index. Urban Studies 45(3), 693-729.

Hsiang, S.M., 2010. Temperatures and Cyclones Strongly Associated with Economic Production in the Caribbean and Central America. Proceedings from the National Academy of Sciences USA 107(35), 15367-15372.

Hui, E.C.M., Lam, M.C.M, and Ho, V.S.M., 2006. Market Disequilibrium and Urban Land Shortages: Analysis of Policy and Patterns in Hong Kong. Journal of Urban Planning and Development 132(2), 80-88.

Ihlanfeldt, K.R., 2004. Exclusionary Land-Use Regulations within Suburban Communities: A Review of the Evidence and Policy Prescriptions. Urban Studies 41(2), 261-283.

Ihlanfeldt, K.R. and Shaughnessy, T.M., 2004. An Empirical Investigation of the Effects of Impact Fees on Housing and Land Markets. Regional Science and Urban Economics 34(6), 639-661.

Ihlanfeldt, K.R., 2007. The Effect of Land Use Regulation on Housing and Land Prices. Journal of Urban Economics 61(3), 420-435.

Levine, N., Glickfeld, M., and Fulton, W., 1996. *Home Rule: Local Growth Control ... Regional Consequences.* Report to the Metropolitan Water District of Southern California and the Southern California Association of Governments. Los Angeles, CA.

Levine, N., 1999. The Effect of Local Growth Controls on Regional Housing Production and Population Redistribution in California. Urban Studies 36(12), 2047–2068.

Lewis, P.G. and Neiman, M., 2000. Residential Development and Growth Control Policies: Survey Results from Cities in Three California Regions. Occasional Paper, Public Policy Institute of California.

Malpezzi, S., 1996. Housing Prices, Externalities, and Regulation in U.S. Metropolitan Areas. Journal of Housing Research 7(2), 209-241.

Mayer, C.J. and Somerville, C.T., 2000. Land Use Regulations and New Construction. Regional Science and Urban Economics 30(6), 639-662.

Mostafa, A., Wong, F.K.W., and Hui, E.C.M., 2006. Relationship between Housing Affordability and Economic Development in Mainland China – Case of Shanghai. Journal of Urban Planning and Development 131(1), 62-70.

Pendall, R., 2000. Local Land Use Regulation and the Chain of Exclusion. Journal of the American Planning Association 66(2), 125-142.

Pollakowski, H.O. and Wachter, S.M., 1990. The Effects of Land-Use Constraints on Housing Prices. Land Economics 66(3), 315-324.

Quigley, J.M. and Raphael, S., 2005. Regulation and the High Cost of Housing in California. American Economic Review 95(2), 323-328.

Quigley, J.M. and Rosenthal, L.A., 2005. The Effects of Land Use Regulation on the Price of Housing: What Do We Know? What Can We Learn? Cityscape: A Journal of Policy Development and Research 8(1), 69-137.

Saiz, A., 2010. The Geographic Determinants of Housing Supply. The Quarterly Journal of Economics 125(3), 1253-1296.

Saks, R.E., 2008a. Job Creation and Housing Construction: Constraints on Metropolitan Area Employment Growth. Journal of Urban Economics 64(1), 178-195.

Saks, R.E., 2008b. Reassessing the Role of National and Local Shocks in Metropolitan Area Housing Markets. Brookings-Wharton Papers on Urban Affairs, 95-126.

Sims, K.R.E. and Schuetz, J., 2009. Local Regulation and Land-Use Change: The Effects of Wetlands Bylaws in Massachusetts. Regional Science and Urban Economics 39(4), 409-421.

Staley, S.R., 2001. Ballot-Box Zoning, Transaction Costs, and Urban Growth. Journal of the American Planning Association 67(1), 25-37.

Thorson, J.A., 1994. Zoning Policy Changes and the Urban Fringe Land Market. AREUEA Journal 22(3), 527-538.

Thorson, J.A., 1997. The Effect of Zoning on House Construction. Journal of Housing Economics 6(1), 81-91.

Table 1
Land use restrictions and variable names

Residential	
Population control	
Population growth limits	[population limit]
Restrictions on the number of residential building permits	[residential permit limit]
Established urban limit line or greenbelt beyond which development is not permitted	[urban growth boundary]
Restrictions on number of new subdivision lots that can be created within given time frame	[subdivision limit]
Zoning control	
Restrictions on structural floor area that can be built on a given parcel	[floor area ratio]
Reduced permitted residential density	[reduce density]
Rezoned residential land to open space or less intense use	[open space]
Phased development areas where development approval is deferred until existing developed areas are substantially developed	[infill]
Requirement of adequate service levels as a condition for approval of a residential development (i.e., adequate public facilities ordinances)	[adequate public facilities]
Political control	
Requires voter approval to increase residential densities	[voter approval]
Requires super-majority council vote to increase residential densities	[supermajority approval]
General control	
Adopted growth management element in general plan	[growth mgmt]
Other measure to control rate, intensity, type and distribution of development	[other]
Commercial/Industrial	
Adequate service levels required as a condition for approval of commercial or industrial development	[commercial adequate public facilities]
Reduced permitted height of commercial/office buildings	[reduce height]
Rezoned commercial/industrial land to less intense use	[less intense]
Restricts commercial square footage that can be built within given time frame	[sqft commercial]
Restricts industrial square footage that can be built within given time frame	[sqft industrial]

Table 2
Summary statistics for housing data

	Mean	Standard Deviation	Min	Max	N
Total residential permits	365	1,094	1	23,783	8,545
Multi-family permits	189	816	0	22,124	8,544
Single family permits	176	399	0	8,784	8,545
Housing stock	21,740	76,688	281	1,318,835	7,961

Notes: The housing outcomes data come from the annual publications of the California Construction Review (1970-1995) by the California Housing Foundation's Construction Industry Research Board.

Table 3
Coefficient on number of land use regulations enacted

Dependent Variable	(1)	(2)	(3)
Total Residential Permits$_{ct}$ / Housing Stock$_{ct-1}$	-0.0045**	-0.0021**	-0.0020**
	[0.0005]	(0.0003)	(0.0003)
N	7849	7849	7849
Total Residential Permits$_{ct}$ / Population$_{ct-1}$	-0.0017**	-0.0008**	-0.0007**
	[0.0002]	(0.0001)	(0.0001)
N	8472	8472	8472
Log(Total Residential Permits)	-0.156**	-0.046**	-0.039**
	[0.02]	(0.01)	(0.01)
N	8545	8545	8545
Log(Multi-Family Permits)	-0.239**	-0.065**	-0.060**
	[0.02]	(0.02)	(0.02)
N	6272	6272	6272
Log(Single Family Permits)	-0.065**	-0.040**	-0.031**
	[0.01]	(0.01)	(0.01)
N	8456	8456	8456
City FEs	No	Yes	Yes
Year FEs	No	Yes	Yes
Controls	No	No	Yes

Notes: Cluster-robust standard errors are shown in square brackets. Conley standard errors are in parentheses. The key variable in each of these regressions is a dynamic index that sums the number of land use regulations that have been enacted in each city. Control variables for the top two panels include median income, percent white, percent black, percent owner-occupier, percent foreigner, percent of housing units that are currently occupied, and the percent of housing in rural areas. For the bottom three panels, the controls also include population size. Significance at the 5% and 1% level is denoted by * and **, respectively.

Table 4
Coefficient on number of residential land use regulations enacted

Dependent Variable	(1)	(2)	(3)
$\frac{\text{Total Residential Permits}_{ct}}{\text{Housing Stock}_{ct-1}}$	-0.0065**	-0.0033**	-0.0029**
	[0.0007]	(0.0005)	(0.0005)
N	7849	7849	7849
$\frac{\text{Total Residential Permits}_{ct}}{\text{Population}_{ct-1}}$	-0.0025**	-0.0011**	-0.0010**
	[0.0003]	(0.0002)	(0.0002)
	8472	8472	8472
Log(Total Residential Permits)	-0.205**	-0.043**	-0.030*
	[0.02]	(0.01)	(0.01)
N	8545	8545	8545
Log(Multi-Family Permits)	-0.322**	-0.081**	-0.071**
	[0.03]	(0.02)	(0.02)
N	6272	6272	6272
Log(Single Family Permits)	-0.080**	-0.034*	-0.018
	[0.02]	(0.01)	(0.01)
N	8456	8456	8456
City FEs	No	Yes	Yes
Year FEs	No	Yes	Yes
Controls	No	No	Yes

Notes: Cluster-robust standard errors are shown in square brackets. Conley standard errors are in parentheses. The key variable in each of these regressions is a dynamic index that sums the number of land use regulations that have been enacted in each city. Control variables for the top two panels include median income, percent white, percent black, percent owner-occupier, percent foreigner, percent of housing units that are currently occupied, and the percent of housing in rural areas. For the bottom three panels, the controls also include population size. Significance at the 5% and 1% level is denoted by * and **, respectively.

Table 5
Results of disaggregated indices regressions

Dependent Variable:	Log(Multi-Family Permits)		Log(Single Family Permits)	
Population controls	0.006	0.032	0.014	0.004
	(0.04)	(0.04)	(0.03)	(0.03)
Zoning controls	-0.099**	-0.099**	-0.049**	-0.022
	(0.04)	(0.04)	(0.02)	(0.02)
Political controls	-0.189	-0.194	0.078	0.057
	(0.15)	(0.14)	(0.08)	(0.08)
General controls	-0.192*	-0.186*	-0.097	-0.074
	(0.08)	(0.08)	(0.06)	(0.06)
City FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes
N	6272	6272	8456	8456

Notes: Conley standard errors are in parentheses. The key variables in each of these regressions are dynamic indices that sum the number of different types of land use regulations that have been enacted in each city. Control variables include population size, median income, percent white, percent black, percent owner-occupier, percent foreigner, percent of housing units that are currently occupied, and the percent of housing in rural areas. Significance at the 5% and 1% level is denoted by * and **, respectively.

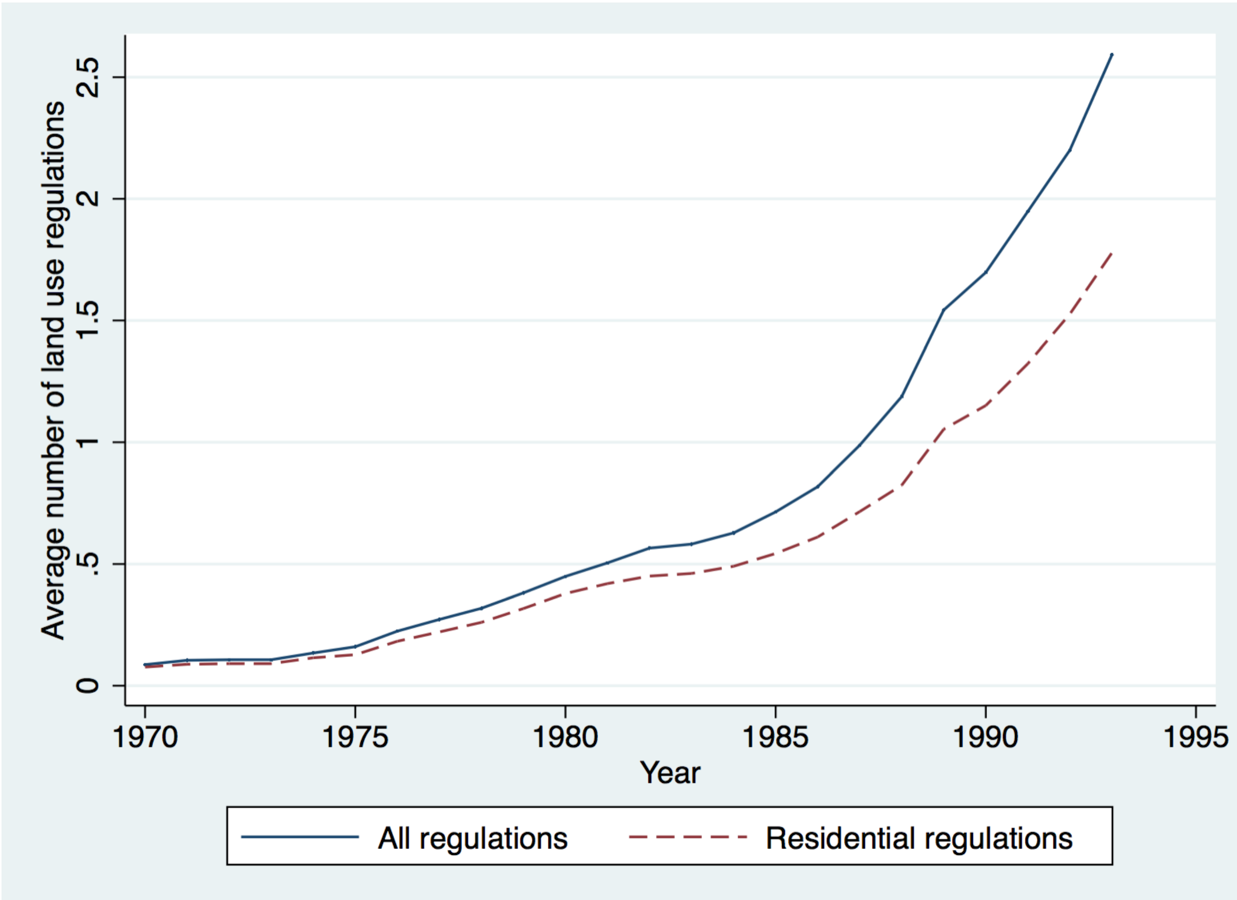
Table 6

Results of individual restrictions regressions

Dependent Variable:	Log(Multi-Family Permits)		Log(Single Family Permits)	
Residential				
Population growth limit	0.283	0.259	0.032	0.021
	(0.17)	(0.17)	(0.11)	(0.11)
Residential permit limit	-0.029	0.067	-0.343**	-0.256**
	(0.15)	(0.15)	(0.09)	(0.09)
Urban growth boundary	-0.057	-0.056	0.305**	0.244**
	(0.12)	(0.12)	(0.06)	(0.05)
Subdivision limit	-0.509**	-0.514**	0.178	0.090
	(0.20)	(0.20)	(0.15)	(0.15)
Floor area ratio restrict'n	-0.095	-0.052	-0.237**	-0.090*
	(0.08)	(0.08)	(0.04)	(0.04)
Reduction in permitted	-0.380**	-0.432**	0.055	0.007
residential density	(0.09)	(0.09)	(0.06)	(0.06)
Rezoned residential land	-0.175	-0.123	-0.128	-0.102
to open space	(0.13)	(0.13)	(0.11)	(0.11)
Infill development	0.221*	0.259**	0.374**	0.415**
requirement	(0.09)	(0.10)	(0.06)	(0.06)
Adequate public facilities	-0.016	-0.027	-0.026	-0.040
(residential)	(0.11)	(0.11)	(0.07)	(0.07)
Voter approval required	-0.528**	-0.490*	0.057	0.054
to increase density	(0.20)	(0.19)	(0.08)	(0.08)
Supermajority council	1.280**	1.171**	0.622**	0.576**
vote to increase density	(0.34)	(0.33)	(0.22)	(0.22)
Growth management	-0.340*	-0.325*	-0.413**	-0.344**
	(0.15)	(0.15)	(0.08)	(0.08)
Non-Residential				
Adequate public facilities	-0.095	-0.066	-0.017	0.000
(commercial)	(0.11)	(0.12)	(0.05)	(0.06)
Reduce permitted height	-0.258**	-0.293**	-0.190**	-0.252**
of comm. buildings	(0.10)	(0.10)	(0.05)	(0.05)
Rezoned comm. land	0.006	0.035	-0.091	-0.061
to less intense use	(0.12)	(0.12)	(0.06)	(0.06)
Commercial square	0.485**	0.444*	-0.038	-0.096
footage limit	(0.18)	(0.18)	(0.13)	(0.12)
Industrial square footage	-0.306	-0.279	-0.185	-0.092
limit	(0.20)	(0.20)	(0.13)	(0.13)
City FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes
N	5884	5884	7937	7937

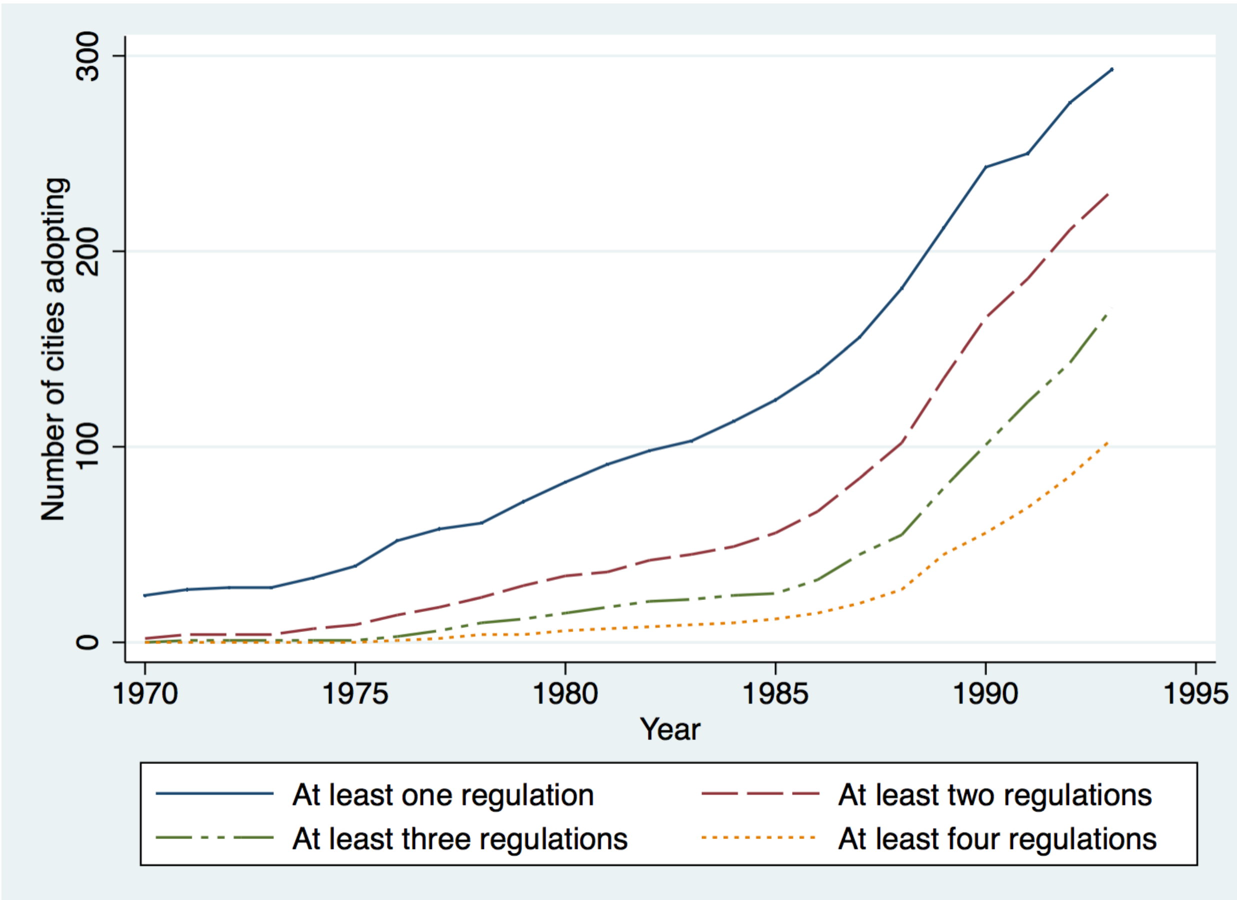
Notes: Conley standard errors are in parentheses. The key variables in each of these regressions are indicator variables for the various land use regulations. Control variables include population size, median income, percent white, percent black, percent owner-occupier, percent foreigner, percent of housing units that are currently occupied, and the percent of housing in rural areas. Significance at the 5% and 1% level is denoted by * and **, respectively.

Figure 1
Average number of land use regulations adopted over time



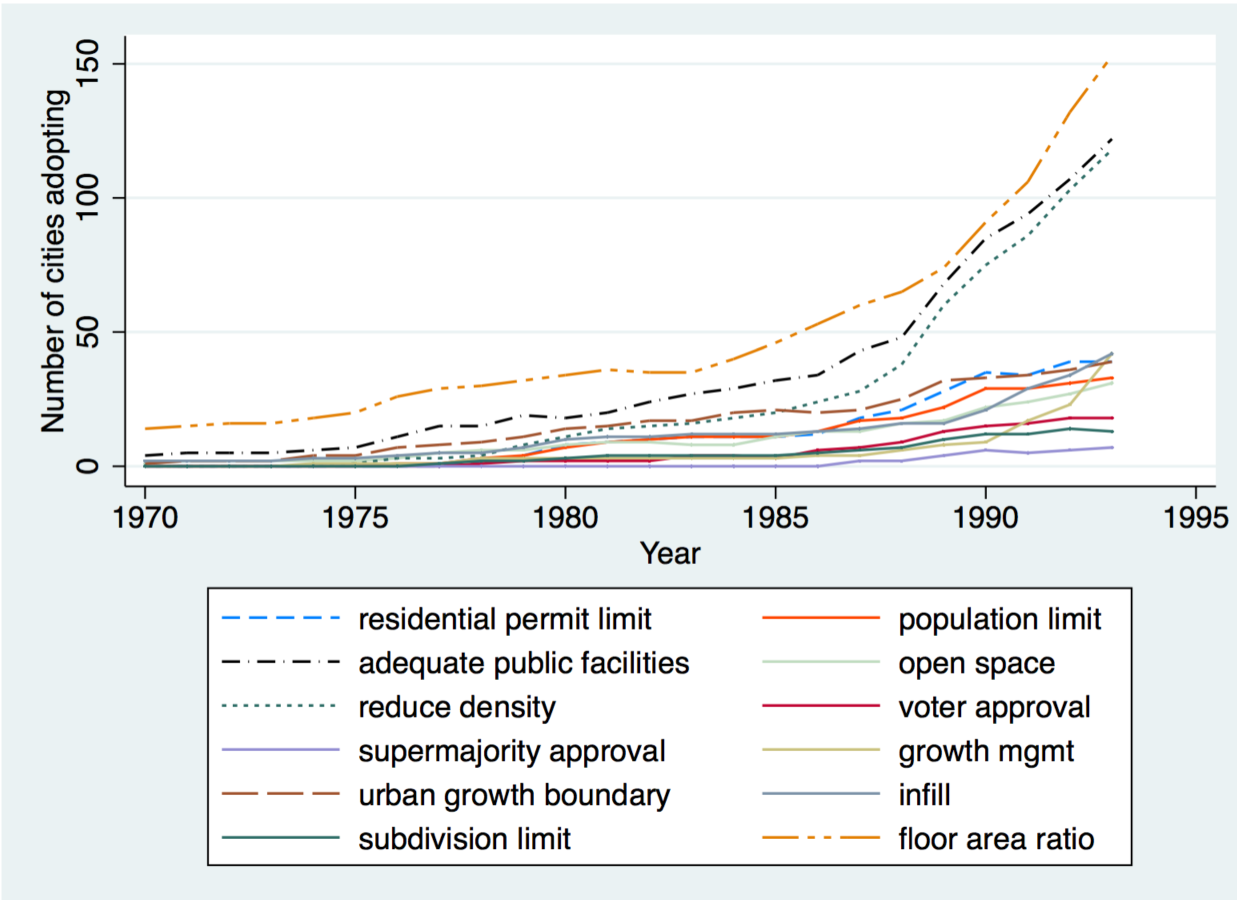
Source: Responses from two surveys of local land use authorities in 402 California cities

Figure 2
Number of cities adopting land use regulation over time



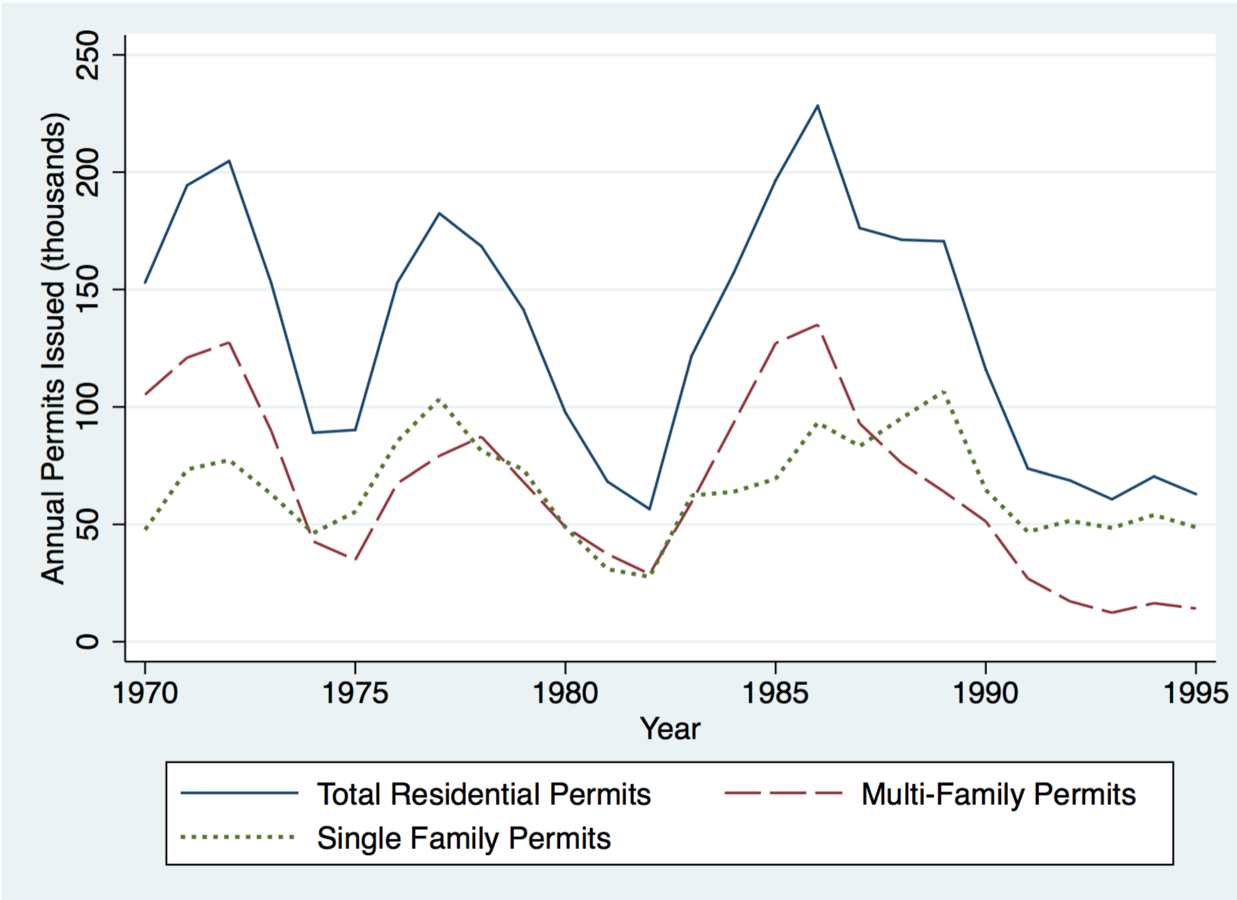
Source: Responses from two surveys of local land use authorities in 402 California cities

Figure 3
Number of cities adopting each residential land use regulation over time



Source: Responses from two surveys of local land use authorities in 402 California cities

Figure 4
Housing permits in California



Source: California Housing Foundation's Construction Industry Research Board

Appendix A

Control variable coefficients and standard errors from column (3) of Table 3

Dep.Variable:	$\frac{Permits_{ct}}{Housing\ Stock_{ct-1}}$	$\frac{Permits_{ct}}{Population_{ct-1}}$	Log(Permits)	Log(MF Permits)	Log(SF Permits)
% white	-0.0605**	-0.0245**	-1.2304**	-1.9045**	-0.7041**
	(0.0085)	(0.0032)	(0.2881)	(0.3508)	(0.2568)
% black	-0.0862**	-0.0343**	-2.2888*	-1.7897	0.2678
	(0.0208)	(0.0083)	(1.0159)	(1.3267)	(0.7496)
% owner-occupier	-0.0002	-0.0001	-0.0347**	0.0414	-0.0447**
	(0.0004)	(0.0001)	(0.0130)	(0.0213)	(0.0145)
% foreigner	-0.0062**	-0.0015**	-0.2536**	0.0470	-0.3667**
	(0.0011)	(0.0005)	(0.0827)	(0.1761)	(0.0706)
% housing occupied	-0.4029**	-0.1643**	-3.9276**	-3.6774*	-6.0370**
	(0.0769)	(0.0248)	(1.2508)	(1.6957)	(1.2005)
% housing rural	-0.0015	-0.0005	-0.1918	-0.0294	-0.1705*
	(0.0020)	(0.0009)	(0.1009)	(0.1381)	(0.0839)
median income ('000)	-0.0002**	-0.00003	-0.0098**	0.0012	-0.0157**
	(0.0001)	(0.00002)	(0.0021)	(0.0039)	(0.0016)
population ('000)	–	–	-0.0003	-0.0006	-0.0006
			(0.0005)	(0.0005)	(0.0004)
N	7849	8472	8545	6272	8456

Notes: Conley standard errors are in parentheses. Significance at the 5% and 1% level is denoted by * and **, respectively.