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Spatial Spillovers of Land Use Regulation in the United States

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Abstract

Evidence of spatial dependence in land use regulatory levels was first found in Brueckner (1998) for California cities. Recent research has not incorporated this consideration despite the considerable consequences of the relationship. We seek to expand the empirical findings to a current, larger and more diverse data set for municipalities across the United States. Analyzing regulatory levels and their determinants from over 2,000 municipalities and 300 Metropolitan Statistical Areas, we find strong evidence of spatial dependence at the local level and aggregated metropolitan level. This suggests that political competition, rather than welfare maximization exclusively, may be influencing the level of regulations adopted.

JEL Classification: H23, H73, R28, R38
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1 Introduction

The motivation and consequences of land use regulation have been extensively studied in the literature.[1] The cause of variation in levels of land use regulation can be divided into two categories: regulation as a result of geographic considerations and regulation resulting from community preferences. The influence of geography on the level of regulation arises via safety concern justifications. Geographic considerations may make some areas uninhabitable and regulation against building or expanding in these areas is consistent with stylized facts. Regions that are particularly mountainous, close to water or have other natural boundaries tend to have high levels of regulation (Saiz, 2010).

In this analysis, our focus is on the community preference explanation of land use regulation. Two types of individuals are usually assumed to be affected by regulation levels, homeowners and renters/businesses. The most popular theory for the adoption of, and increase in, land use regulation is the desire of existing homeowners to maximize their housing values through increased levels of regulation (Fischel, 2001). This desire on the part of homeowners may come from a preference for wealth maximization and/or a preference for avoidance of low-income residents, or "snob zoning" (Ihlanfeldt, 2004). This preference arises from the recognition that income disparities place the tax burden more heavily on the relatively wealthy.

However, high regulation levels in surrounding areas may also have a negative spillover effect. When one area engages in snob zoning, the surrounding areas may see an influx of lower income households. This will increase the demand for lower priced homes and increase the tax burden of the relatively high income households. Under this line of reasoning we may see a "regulation arms race" as politicians compete for the votes of the current residents. At the same time, regulation adds a cost to housing development, which is passed on to renters and businesses (which rent commercial property). A regulatory arms race may result in a costly, higher-than-optimal level of regulation without reducing the proportion of low income

[1] See Quigley and Rosenthal (2005) for a review of land use regulation research.

households (since both areas now have high levels).

On the flip side, if one area reduces the regulation levels, renters and businesses may choose to locate in that jurisdiction rather than in the relatively high regulatory surrounding jurisdictions. Politicians who want to maximize their votes by increasing economic growth may wish to have relatively low regulation levels. When politicians start to compete on this margin we may observe a "race to the bottom" as jurisdictions try to have lower levels of regulations than their neighbors. The resulting regulatory levels will be low in both areas, perhaps hurting homeowners through lower house prices, but no renters or new businesses will relocate (since both areas now have low levels). Both of these possible outcomes, a regulation arms race or a race to the bottom, are dependent on the assumption that the level of regulation in one area is positively related to the level of regulation in surrounding areas.

Although the early work of Brueckner (1998) modeled the possibility of spatial dependence between California cities, recent work has not accounted for this possible relationship. In addition to testing for a shared spatial dependence with recent data, we extend the previous analysis in several ways. We employ a more diverse data set of over 2,000 observations relative to his 173 observations, we test for dependence at the smaller municipalities level and the larger metropolitan area and we also use an alternative method of geographic constraints. These extensions allow our results to be generalized to more communities than previous findings.

We find that after accounting for shared regional influences, regulatory levels are significantly influenced by the regulatory levels in surrounding communities, evidenced by a positive and significant spatial dependence coefficient. This relationship holds at the local level and at the larger Metropolitan Statistical Area (MSA) level. It is likely that political concerns are playing an influential role. Politicians recognize that their constituents observe the economic and political climate in surrounding areas to form an opinion about their political leaders. If citizens prefer policies in surrounding jurisdictions rather than current policies, they will punish their elected policymakers. This may be done at the polls or by "voting with their feet" and relocating to neighboring areas (Tiebout, 1956). Consequently, politicians concerned with re-election will account for the circumstances, including regulation levels, in surrounding areas when formulating and enacting policies. This finding suggests that analysis estimating the determinants of regulatory levels should account for this relationship to avoid biasing the effects of other influential factors.

2 Literature Review

There are several theories regarding demand side influences of regulatory levels. These include the negative externality argument, exclusionary and fiscal motivations, and the political influence hypothesis (described below). Our interest lies in the intersection of exclusionary zoning and political forces, although we attempt to control for other determinants, discussed in Section **??**.

Since the U.S. Department of Commerce first allowed local governments to impose regulations in 1926, many regulations have been enacted to improve social welfare in the presence of negative externalities (McDonald and McMillen, 1998). Communities may opt to zone residential areas separate from commercial areas when businesses emit noise, air and other types of pollutants. This separation benefits homeowners, who want to avoid these pollutants, and businesses, who are given more platitude when separated from residential areas. Further restrictions on development may be warranted on welfare-maximizing grounds for particularly harmful construction or business practices.

As urban areas develop, density may create its own negative externality in the form of congestion and ongoing construction. In this case regulation which limits growth may be desirable. Delaying growth, rather than limiting growth, may also be welfare improving if the externality cost of construction is sufficiently high. However, imposed corrections for market externalities, like regulation, carry the traditional risk of creating more inefficiencies than the remedy solves (Jr., 1987; Nelson, 1989). Land use regulation which restricts use of private property may reduce private land use efficiency to a greater extent than any realized gains from negative externality reductions (Ellickson, 1973; Siegan, 1977; Nelson, 1980; Fischel, 1987; Kmiec, 1981). Early alternative proposals, described by Ottensmann (1998), range from private contracts (Nelson, 1980), sellable zoning entitlements (Fischel, 1987), or nuisance laws (Siegan, 1977). We consider the influence of negative externalities generated by growth on regulatory levels by including a measure for growth.

In addition to correcting for negative externalities, regulation can designed to reduce the supply of new residents, referred to as "exclusionary zoning". Historically, this type of regulation allowed codified discrimination to occur as neighborhoods sought to prevent blacks, immigrants and other minorities from living in particular neighborhoods (Danielson, 1976). More recently, zoning may act to discourage low-income inhabitants (Ihlanfeldt, 2004) from residing in particular areas, sometimes referred to as "snob zoning". This may be done through regulatory measures which increase the cost of construction and consequently housing, to the point that low-income households cannot afford to live in these jurisdictions. Although this may reflect a preference for living apart from the poor, demand for zoning on this basis also has influential tax consequences. Publicly provided goods, such as education, are funded by property taxes. These taxes are proportional to the value of the house and as a result, large inequalities in housing values will place the tax burden for these goods disproportionately on the relatively rich.

In addition to the exclusionary aspect, zoning designed to discourage low-income households may have spillover effects to neighboring jurisdictions. Migration be prohibitively costly for low income households. Interstate migration patterns suggest that less educated, low income households move less than their more educated, richer counterparts (Kennan and Walker, 2011). If low income households are driven out of, or prevented from migrating into, a particular jurisdiction, neighboring jurisdictions will house larger numbers of low-income households. Given the cost associated with low-income housing, these jurisdictions may respond with similar regulations. Since the poor will likely reside in the general area, the end result is higher regulation levels for all jurisdictions, but no change in the proportion of low-income residents in any particular jurisdiction. Although our analysis is constrained to testing for the presence of spatial dependence, this welfare-reducing possibility is an important consideration of our findings.

Fiscally, demand for regulation may exist on the grounds of property value maximization. Homeowners desire to maximize wealth, of which housing equity is a significant component, and petition politicians to enact regulation which increases housing values (Fischel, 2001). Land use regulation is thought to reduce the supply of housing and increase the cost of new construction, both of which act to increase housing values (Ihlanfeldt, 2007; Zabel and Dalton, 2011; Glaeser et al., 2005). The magnitude of this effect is difficult to establish and the methods for extracting the effect of regulation on housing prices are not settled in the literature. A common technique is to estimate the portion of housing value increases over time that is not explained by other factors (income growth, population growth, etc). Glaeser and Gyourko (2002) estimated the effects of zoning on land values in forty cities and found price effects as high as $200,000 over time. Eicher (2008) extended a similar analysis to 250 cities and found that high regulatory levels have a stronger influence on house prices than income and population growth.

Ihlanfeldt (2007) details several issues with the literature (first described by Quigley and Rosenthal (2005)). The first is that it appears that housing prices, though treated as exogenous when examining the relationship between house price and regulatory levels, are likely endogenous. Additionally, regulatory environments are usually measured through an summary index, which may be "weak and indirect". Furthermore, Quigley and Rosenthal (2005) expresses skepticism that the reliance on survey data from homeowners for a measure of house prices is appropriate. Ihlanfeldt (2007) considers these issues in his analysis of the influence of land use regulation on house prices. He finds that a strong relationship between house price and land use regulation persists even after using data sets which avoid the pitfalls described above. More recently, Zabel and Dalton (2011) also find strong evidence of a positive influence of regulation on housing levels. Although our analysis does not rely on the presence of this relationship, the belief of individuals that land use regulation increases housing prices appears to be supported in the literature.

Regulation is often assumed to be determined by the potential and current residents in that respective jurisdiction. However, formally, land use regulations are imposed by political bodies and, consequently, may also be thought of as outcomes of a political influence. Theoretical models often pit renters and owners of undeveloped land, who would like less regulation, against homeowners who desire increased levels of regulation (Fischel, 2001; Ortalo-Magne and Prat, 2007; Hilber and Robert-Nicoud, 2009). Increased levels of regulation occur when homeowners have more political clout than owners of undeveloped land and decreased levels of regulation when the reverse is true.

The majority of the land use regulation analysis assumes that local government officials choose the level of regulation to maximize social welfare independent of the regulatory levels of other jurisdictions.[2] Public choice theory predicts that this may not be the case when the short-run interests of politicians are in conflict with the long-run interests of constituents. Politicians are assumed to maximize the chance of remaining in office by maximizing votes received in the next election. If we assume voters are mobile within reasonable proximity to current employment, politicians are now in competition for votes not only with the challenger, but also with politicians in neighboring jurisdictions. Consequently, politicians may choose regulation levels that are influenced by the choice of regulation levels in neighboring communities.

In many cases, this outcome is not in contrast with a social welfare maximization. However, the spatial interaction of political decisions can be an important determinant of regulation levels in the presence of significantly large negative externalities. A regulation arms race may ensue as an increase in regulation in a neighboring town can create a negative

[2] Notable exceptions include Brueckner (1998) and Nguyen (2009).

externality as low-income households migrate to the less regulated neighboring community. This increases the tax burden of the current residents and as a result, the residents desire increased levels of regulation to deter further migration of low-income households. But unless the town responds with an increase in regulation levels to such an extent that low-income households migrate back to their original neighborhoods, the current residents are worse off and the current residents in the neighboring community are better off. Politicians may be blamed for the reduction in welfare and punished during re-election. As a result, politicians may increase regulation levels in anticipation of neighboring areas increasing regulation. This initial increase may not be welfare maximizing, both in the local neighborhood and on a global scale as areas increase their absolute levels of regulation but not their relative levels.

If the consequence of land use regulation is only to increase housing prices and to deter particular residents, we would expect to see high levels of regulation in every township. On the contrary, there are many areas which have adopted very low levels of land use regulation, implying that there may be costs to community of increasing regulation. Land use regulation is a non revenue-generating tax that simply acts as a "shadow tax" on construction and increases the cost of doing business (Glaeser and Gyourko, 2009; Sunding and Swoboda, 2010).

Owners of undeveloped land and potential businesses would prefer, ceteris paribus, low levels of regulation and may exit or avoid communities where high levels of regulation are adopted and consequently reduce economic growth potential. In densely populated and growing areas, this additional cost may not have a large effect on the local economy, but in stagnating and undeveloped communities, the cost may substantial in terms of economic growth. Saks (2008) has observed such an effect, finding that areas with extremely high levels of regulation do not experience as large of a benefit from increased demand relative to areas with lower regulatory levels.

To our knowledge, Brueckner (1998) was the first to formally model spatial dependence of regulatory levels. He empirically tests the hypothesis that regulation is influenced by the regulation levels in surrounding communities and finds evidence of significant spatial dependence. He uses control variables at the city and county level in California and presents the results as an outcome of a social welfare maximizing function with two agents, renters and homeowners. These results prompt further research for several reasons. The first is that California communities have some of the highest levels of land use regulation levels in the country. Part of this trend is due to geographic considerations, which he controls for through the use of a dummy variable indicating if the town borders the Pacific Ocean. Geographic considerations are likely spatially correlated and it would be useful to see if there is spatial correlation in areas that do not have such high levels of regulation. Quigley and Raphael (2005) also note that California is unique with respect to the level of regulation permitted at the city level, with resulting relatively high regulation relative to the rest of the country.

Secondly, our hypothesis is conditional on the assumption that individuals are mobile between communities and this may not hold for larger cities and counties. We use a data set that is disaggregated to the municipalities level rather than the city level. Third, and most surprisingly, recent analysis has not allowed for the presence of spatial dependence as an explanatory factor. Although political influences are described, these influences are not empirically modeled to spill over into neighboring communities. It is useful to test more recent conclusions of the determinants of land use regulation when allowing for spatial dependence.

Finally, in addition to analyzing the spatial relationship at the local level, we test for evidence of spatial spillovers of regulation levels at the aggregated Metropolitan Statistical Area (MSA) level. Black and Hoben (1985) first analyzed the relationship between house prices and regulation at the metropolitan area. They developed an index for 30 MSAs and report a negative correlation between regulation levels and developable lots; this is consistent with the hypothesis that developed land with experience higher prices and undeveloped land lower prices. In addition to the previously mentioned studies of Glaeser and Gyourko (2002); Eicher (2008), Segal and Srinivasan (1985); Guidry et al. (1991); Malpezzi (1996) find evidence that house prices increase faster in highly regulated metropolitan areas while Downs (2002) uses a larger, more recent, sample and finds the effect is not present for all time periods. If developers and households account for cost of living considerations, of which housing costs are a large component, relative regulatory levels may also be influential at the MSA level.

Furthermore, there is evidence that areas with high levels of land use regulation may develop into "superstar cities". As modeled by Gyourko et al. (2006), cities that are not necessarily more attractive and may not offer more amenities than similar, but less regulated cities, may attract a disproportionately higher amount of high-income household residents. Using MSA level data from 1970-2000, they find that superstar cities do have a higher fraction of high-income families than their non-superstar counterparts. Consequently we may expect that lower income households are out-bid and may migrate to neighboring MSA's. As a result we may observe that, for reasons similar to those at the local level, neighboring MSA's may adopt higher levels of regulation than they would have otherwise. Whether the level of regulation in one MSA will have an effect on the level of regulation in a neighboring area depends in part if there are negative externalities generated at such an aggregated level.

3 Data and Methodology

3.1 Methodology

Brueckner (1998) introduces a formal motivation of spatial dependence of regulatory levels in an expanded model developed by Helsley and strange (1994), which was influenced by the work of Brueckner (1990, 57); Engle et al. (1992). The model is comprised of two cities in which the government chooses the level of regulation to maximize welfare and a third passive city that absorbs the population not residing in the other two cities.[3] The government of

[3]This passive city is used to ensure that the total population fits into the urban system. This assumption is needed when it is assumed that land consumption is fixed and to generate a closed form solution.

the two active cities chooses the level of regulation to maximize a weighted average of the utilities of renters and absentee landowners.

The utility of landowners is assumed to be increasing and total land rents while the utility of renters is assumed to be increasing in consumption and decreasing in the population.[4] When city 1 increases its level of regulation, the city size is reduced as a portion of the population migrates to city 2. This migration reduces the utility of renters in city 2 through reduced consumption caused by higher land rents and congestion. Due to the fact that utilities will be equalized across cities in urban equilibrium, the utility in city 1 will decrease through a fall in consumption as a consequence of higher land rents.

In this model the impact that the government's choice of regulation in city 1 has on the utility of renters in city 1 is independent of the level of regulation chosen by city 2. However, the impact of the choice of regulatory levels on landowners in city 1 is influenced by the regulatory levels in city 2. As the government in city 1 increases regulation, reducing city size, land rent is lost at the boundary of the city. This lost land rent in city 1 is lower than the less regulated city 2 because land rents are lower throughout the entire urban system the less regulated city 2 is. Therefore, the less regulation adopted by city 2, the less costly is is for city 1 to increase regulation and consequently, city 1 will adopt higher levels of regulation.

Due to the influence that surrounding cities regulatory levels have on landowners, the model predicts an inverse spatial relationship between regulatory levels chosen (referred to as "growth controls"). The solution yields a reaction function that implies a Nash equilibrium result that is inefficient relative to the outcome without regulatory growth controls. Brueckner (1998) points out that if some assumptions are changed (such as allowing variable land consumption) then the predicted spatial relationships can become positive over a range of regulation choices.

Brueckner (1998) tests the model using data from survey results of 173 California cities

[4]The inverse relationship between utility and population reflects costs associated with congestion.

and counties and finds significant evidence of spatial dependence. Similar to his empirical estimation, we interpret the coefficient on the regulatory levels in nearby jurisdictions as the slope of the reaction function. If this estimated coefficient is zero, there is no strategic reaction with respect to regulatory levels. If the coefficient is non-zero and significant, this confirms our hypothesis of spatial dependence. Brueckner (1998) concedes that his results provide evidence of interaction, but do not prove that the particular mechanism, described above, is the cause. Consequently, although our proposed explanation contributes another potential mechanism of the source of spatial dependence, our primary concern is determining the existence of spatial dependence.

The slope of the theoretical reaction function is considered by employing a spatial Durbin model with regional fixed effects. This model incorporates a spatial lag component of the dependent variable and of the independent variables for the surrounding neighbors. The neighbors are determined by creating a weighted average of the specified number of nearest neighbors[5]. The nearest neighbors are the jurisdictions who are closest in terms of linear distance. The optimal number of nearest neighbors is fairly arbitrary, but is typically between five and twenty (Sedgley et al., 2008). We separately run the specification using 1-10 neighbors as the nearest neighbor designation and conduct Bayesian analysis to determine the nearest neighbor specification which bests describes the data. Our analysis suggests that the appropriate number is 8, although estimates are consistent when the nearest number is 6,7 or 9 as well.

Spatially lagged values are included by multiplying the own observation dependent and independent variable vectors by a spatial weight matrix that represents the assumed spatial connection between communities. For our variable of interest, the spatial lag of regulatory levels, a weighted average of the regulatory levels in the closest 8 jurisdictions is included as a dependent variable. If the coefficient on this variable is positive and significant, this is evidence that the regulatory levels in surrounding jurisdictions influences the levels in the

[5]The code for this weight matrix comes from the script in Lesage's Matlab toolbox

observation. Beyond the presence of spatial dependence, this coefficient does not have any numerical interpretation (LeSage and Pace, 2009).

The spatial Durbin model is particularly useful because it reduces the impact of omitted variable bias when those omitted variables are spatially correlated (as we would expect to occur when regulation is due to geographic constraints) (LeSage and Pace, 2009). A spatial autoregressive model specification, in which a lag is only taken of the dependent variable rather than all variables, is included as a robustness check. Additionally, we employ regional fixed effects to account for regionally-specific attitudes toward regulation while also controlling for the influence of shared geography, both of which may influence the level of regulation.

The spatial durbin model takes the form:

$$v = \alpha + \rho W v + X\beta + W X\theta + \epsilon, \epsilon is N(0, \sigma^2 I),$$

where v is the log of the WRLURI, X is a matrix of city characteristics and regional controls, W is an nxn spatial weight matrix representing the neighbor relationship between cities and ρ is the coefficient of the influence of neighboring regulatory levels.[6] Following LeSage and Pace (2009), the data generating process is then:

$$v = (I_n - \rho W)^{-1}(\alpha + X\beta + W X\theta + \epsilon) \tag{1}$$

The spatial model allows us to calculate the direct, indirect, and total effects for each of

[6] For the local level specification we add 2 to every value of the index and 3 to every value of the MSA level index to ensure all positive numbers.

the independent variables. We can rewrite equation 1 as:

$$\begin{aligned}(I_n - \rho W)v &= X\beta + WX\theta + \alpha + \epsilon, \text{ then} \\ \text{Let } V(W) &= (I_n - \rho W)^{-1} \text{ and} \\ S_r &= V(W)(I_n * \beta_r + W\theta_r), \text{ then} \\ v &= \sum_{r=1}^{k} S_r(W)x_r + V(W)i_n\alpha + V(W)\epsilon\end{aligned} \tag{2}$$

The direct effect is the average effect that a change in the independent variable of an observation has on its own dependent variable and can be describes as $\frac{\partial v_i}{\partial x_{i,r}} = S_r(W)_{i,i}$. This coefficient includes the initial impact of the change in an independent variable on its dependent variable as well as feedback in the system. This feedback occurs when the change in the dependent variable causes changes in the other dependent variables of the system through the spatial weight matrix, which in turn feedback onto the initial dependent variable. The indirect effect represents the average spatial spillover effect that a change in an independent variable has on all other dependent variables, excluding its own dependent variable and can be describes as $\frac{\partial v_i}{\partial x_{j,r}} = S_r(W)_{i,j}$. The total effect is the sum of the direct and indirect effects. We focus on the direct effects, although the indirect and total effects are available upon request.[7] The presence of a spatially dependent relationship with respect to regulation will be evidences by a ρ coefficient that is positive and significant.

3.2 Data

The data on regulations is from the Wharton Residential Land Use Regulatory Index (WRLURI) developed by Gyourko et al. (2008). The index is created from a 2005 nationwide survey of towns and cities on local land use regulations. It uses responses from a question-

[7] For a complete discussion of the effects estimates, see LeSage and Pace (2009).

naire designed to capture three aspects of the regulatory environment: (1) the number and type of agencies involved in the process of zoning requests, (2) the current local regulation rules and (3) the effects of the regulation on development costs and time delays. Gyourko et al. (2008) also incorporate state-level regulatory action and policies, as well as a measure of "community pressure" to adopt further regulation.

The information was used to create a final index comprised of eleven sub-indices, including *local political pressure, state political involvement, state court involvement, local zoning approval, local project approval, local assembly, density restrictions, open space index, exactions index, supply restrictions and approval delay.* Gyourko et al. (2008) recommends use of an index which combines all of these features because the measures are highly correlated with one another. A cumulative score reflects the overall regulatory environment, with a lower score implying less regulatory interference. The index is standardized so that the sample mean is zero and the standard deviation is equal to one.[8]

The final data set incorporates responses from over 2,600 municipalities. We use 1970 values for most of the independent variables in order to avoid endogeneity (Glaeser and Ward, 2009). The 1970's marked the beginning of a rapid expansion in the regulatory environment that has persisted over time. These initial values of dependent variables have been found to largely determine the levels of regulation seen today. Therefore, we exclude communities from the Wharton data set for which the Census did not collected data for in 1970. We also exclude communities that are not considered to be places at all for data collection purposes and communities located in Hawaii and Alaska due to the spatial nature of our paper[9]. In all, we have 2054 community observations that we use to test for the presence of spatial dependence at the local level.

To apply the analysis at the metropolitan level, the Wharton data set provides at least one community observation from 291 MSA's. We use the metro weights in the Wharton data set to calculate the weighted average of the WRLURI value of all the communities that are

[8]For a complete explanation of the creation of the index refer to Gyourko et al. (2008).

[9]The excluded communities are mostly town and township observations from PA, NJ, NY, WI, and MI

located within an MSA to use as the MSA dependent variable. The communities that are not in recognizable MSAs are excluded from the analysis, leaving us with 1902 communities.

The data for the independent variables are from the HUD State of the Cities Data Systems web site and from the U.S. Census. In order to control for determinants of regulation related to snob zoning (zoning to deter low-income residents), we include as independent variables the percent of the population that are non-Hispanic whites, the percent of the population that are immigrants, the percent of the 25 and over population that has at least a Bachelor's degree, median household income, and the percent of homes that are owner occupied. Additionally, we include the log of land area, log of housing density and the census region.

At the MSA level analysis we also include a measure of developable land from Saiz (2010). This measure controls for determinants of zoning related to natural geographic determinants such as mountains, bodies of water and other safety issue variables. Unfortunately, this variable is not available at the local level analysis. For the local level analysis we rely on a measure of "coastal watershed", from the National Oceanic and Atmospheric Administration (NOAA). Following Gyourko et al. (2008), we also include a variable that represents if the community is a declining community. We calculate population growth for the community between 1970 and 1980 and designate communities as declining if they are in the bottom quartile of population growth over this time period. Variable means and standard deviations can be found in Table 1.

We expect the WRLURI to be increasing in measures of snob zoning and geographic constraint variables, and to be decreasing for declining communities. We expect the negative relationship between regulation and declining communities because these communities may be competing for businesses and consequently have less regulation and, additionally, are not in danger of becoming crowded due to population growth. We also include regional fixed effects that are given for the nine Census regions to account for regional variations in terms of shared geography and also with respect to differences in regional attitudes toward regulation.

Our excluded region is the Pacific and we expect that this region is associated with higher levels of regulation, largely due to geographic considerations. As such, it is expected that other regions are associated with relatively lower regulatory levels.

4 Results

4.1 Local Level Analysis

We run the specification with and without regional controls using a spatial Durbin model (SDM), a spatial autoregressive model (SAR) and a simple OLS model. Results from all three models under both specifications can be found in Table 2. The spatial Durbin model specification without regional controls can be found in column 1 while the results with inclusion of regional controls can be found in column 2. Similarly, the spatial autoregressive model results can be found in columns 3 and 4 while the OLS estimates can be found in columns 5 and 6.

Theory supports the use of the spatial Durbin model, although results are fairly similar in terms of direction of influence, but not magnitude, for all three models. With respect to the spatial Durbin model without regional controls, we find that higher values for the snob zoning variables of immigrants, income, and whites are associated with higher levels of regulation.[10] The effect of being classified as a declining city and percent owner occupied are negative, but insignificant for this specification. Higher levels of housing density and land area are both associated with *lower* levels of regulation. Although the effect of these two variables is surprising, it is possible that housing density and land area are not completely exogenous to the level of regulation. A higher level of regulation may result in lower housing densities in some areas by design, while increased levels of regulation may discourage expansion, leading to a decrease in land area. The associated effect of being on a coastal watershed is found to

[10]We restrict our discussion of results to relative magnitude and direction of influence due to the nature of our dependent variable. Since the regulatory levels are measured with an index, interpreting the numeric influence of a variable on an index is not particularly illuminating.

have a positive and significant influence, as expected.

When regional effects are added, the majority of our control variables maintain the same direction of influence but amend the level of significance for some variables. Land area, percent white and percent immigrant are now statistically insignificant, while declining city is still negative, but now significant. Percent owner occupied is now reported as positive, rather than negative, but insignificant. Central regions, both north and south, as well as the South Atlantic region have a statistically significant negative associated effect on regulatory levels. Other regions, with the exception of New England, also suggest a negative influence relative to the Pacific region, but the estimates are insignificant. The Pacific region engages in very high levels of regulation so the negative estimated effect with respect to other regions is not surprising. For both specifications, the spatial dependence coefficient, ρ, is positive and significant. As expected, the strength of the spatial dependence is less when regional controls are included. This difference when regional controls are included is likely due to the fact that neighboring jurisdictions tend to have similar geographies which influence the level of regulation.

We also consider the specification using the spatial autoregressive model. Relative to the estimates obtained using the Durbin model, the associated effect of land area is reported to be positive and significant when regional controls are employed. The magnitude and significance of our variable of interest, ρ, remains positive and significant. Results obtained when employing a simple OLS estimation are consistent with the spatial autoregressive results in terms of direction of influence and level of significance.

These results imply that the level of regulation in one jurisdiction *is* strongly related to the level of regulation in the neighboring district, even after controlling for regional influences and shared geography. The large magnitude and statistical significance of spatial dependence coefficient implies that the extent of competition between localities may be quite large. Given this relationship, estimates obtained without accounting for spatial dependence, even when regional influences and shared geography are accounted for, are going to be biased

(LeSage and Pace, 2009). For example, being classified as a declining city and percent of the population that is immigrants, have a much greater influence on regulatory levels in the SDM specification than the OLS specification.

4.2 MSA Level Analysis

To analyze the effect of neighboring MSA regulatory levels, we specify nearest neighbors as the ten closest MSAs and run the same specifications as in the local case. The estimates obtained for all models and all specifications are reported in Table 3. We first consider the spatial Durbin model estimates without regional controls. As expected, a city being classified as declining is associated with lower levels of regulation while percent immigrant is positive and significant significant. Percent immigrant, percent white and percent owner occupied are positive, but insignificant. Departing from the estimates obtained from the local specification, housing density is found to be positive, but insignificant while land area is negative and insignificant.

Our spatial dependence coefficient remains positive and significant at the MSA level. When we include regional controls, land area exerts a positive, but insignificant influence on regulatory levels. As expected, the magnitude of spatial dependence is lower than the specification without regional controls. The discrepancy between the two estimates suggests that regional geography does influence regulatory levels, as found by Saiz (2010). Omitting a control for this geographic influence makes spatial dependence appear more influential than it is, while at the same time, omitting a spatial dependence variable makes other considerations appear to have a different influence. All other variables report similar results when regional controls are included. Regional variables are insignificant for all areas for the SDM specification. New England, Mid Atlantic, East North Central and Mountain regions report a positive influence, while the rest are negative and all are insignificant.

We separately run the specification including the land index developed by Saiz (2010) for the MSA level analysis.[11] Estimates are nearly identical to the ones obtained using the coastal variable as the geographic influence. However, the inclusion of the undevelopable land index variable does lower the magnitude of influence the spatial dependence coefficient has on regulatory levels, as expected. The Saiz (2010) variable is much more comprehensive than a simple designation as a coastal area and is more likely to result in a better estimate of the true spatial relationship, which remains positive and significant.

The results of a simple OLS and spatial autoregressive model specification yield similar estimates that, in some cases, differ dramatically from the spatial Durbin model specification. The spatial autoregressive model, consistent with the spatial Durbin estimation, yields a positive and significant ρ coefficient in all specifications. Similar to the local level analysis, the OLS specification reports a significantly smaller influence of the size of the immigrant population and being a declining city than the SDM specification.

Ignoring the spatial dependence in this case would underestimate both the large degree of snob zoning with respect to immigrants that appears to be taking place and also the large influence of recent growth. The presence of a significant spatial relationship, even after controlling for regional influences, implies that MSAs may indeed be in competition with one another to either attract/keep homeowners (areas with high levels of regulation) or to attract/keep renters and businesses (areas with low levels of regulation).

5 Conclusion

Land use regulations impose significant costs to the community in the form of higher cost of doing business and higher cost of housing. It is thought that politicians may tend to increase regulatory levels to maximize housing values to maximize homeowners' welfare (Fischel, 2001). Largely excluded as an explanatory variable is the level of regulation in neighboring jurisdictions. Politicians compete for votes and voters with politicians in close proximity

[11] The land index is not available at the local level so we do not report the results of the full specification. These results are available upon request.

(Tiebout, 1956), and consequently will account for regulatory levels in these communities.

We do indeed find evidence that regulatory levels are significantly influenced by the levels of regulation in the surrounding jurisdictions. This is true at the local jurisdiction level and at the aggregated MSA level. These results confirm previous findings by (Brueckner, 1998), but extend the applicableness of his findings. We use over 2,000 community observations spread over the contiguous 48 states compared to the previous analysis of a cluster of townships in California. Additionally, by estimating the effects at the local level and the MSA level, we are able to extend the scope at which it appears politicians are engaging in competition.

This spatial dependence may be problematic from a social welfare perspective. With respect to regulatory levels, a neighboring jurisdiction adopting regulatory measures may entice a politician to adopt similar regulatory measures. In some cases, this may result in sub-optimal levels of regulation. If, for example, the purpose of the original regulatory action was to engage in snob zoning, low-income residents are driven to reside in surrounding jurisdictions. These jurisdictions adopt higher levels of regulation to avoid an influx of low-income residents. As a result, both areas have higher levels of regulation, which may be costly in terms of economic growth and construction costs, but the same proportion of low-income residents.

Similarly, MSAs wishing to attract businesses may reduce regulatory levels to decrease the cost of doing business. Neighboring MSAs engage in competition for these businesses by adopting low levels as well. The result is that both areas have low regulation levels, which may be detrimental to house prices without attracting new businesses. Our finding of neighboring regulatory levels acting as a determinant of regulatory levels suggests that policy analysts must account for the role that neighboring jurisdiction regulatory levels play in explaining regulatory levels observed. Estimates of the determinants of regulation that do not account for this relationship may be biased.

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Table 1: Variable Description

Variable	Source	Local Sample Mean (Std. Dev)	MSA Sample Mean (Std. Dev)
Log_WRLURI	Gyourko et al. (2008)	1.01	0.58
		(0.34)	(0.47)
Log_Land_Area	Census	2.24	7.27
		(1.20)	(0.89)
Log_Housing_Density	Author's Calculation (HUD)	5.94	4.11
		(1.13)	(1.07)
Coastal	Author's Calculation (NOAA Database)	0.32	0.43
		(0.47)	(0.50)
Declining_City	Author's Calculation (HUD)	0.25	0.25
		(0.43)	(0.43)
Median_Income	Census	8.24	7.43
		(3.18)	(1.59)
College_Grad_%	Census	12.38	11.24
		(8.83)	(4.23)
Immigrant_%	Census	86.4	83.16
		(17.63)	(13.49)
White_%	Census	3.61	3.64
		(4.02)	(3.33)
Owner_Occ_%	Census	64.27	61.2
		(13.07)	(6.96)
New_England	Census	.12	.09
		(.32)	(.28)
Mid_Atlantic	Census	.12	.12
		(.32)	(.32)
E_North_Central	Census	.20	.17
		(.12)	(.37)
W_North_Central	Census	.12	.08
		(.32)	(.28)
South_Atlantic	Census	.12	.18
		(.32)	(.38)
E_South_Central	Census	.05	.05
		(.22)	(.23)
W_South_Central	Census	.10	.12
		(.30)	(.32)
Mountain	Census	.06	.07
		(.24)	(.26)
Pacific	Census	.11	.12
		(.31)	(.33)
Observations		2052	291

Table 2: OLS Model Estimates, SDM and SAR Model Total Effect Estimates (Local Sample)

	SDM		SAR		OLS	
WRLURI						
Log_Land_Area	-0.198**	-0.101	0.035	0.067**	0.037**	0.053***
	(-2.46)	(-1.45)	(0.92)	(2.28)	(2.00)	(3.05)
Log_Housing_Density	-0.441***	-0.226***	-0.384***	-0.301***	-0.245***	-0.168***
	(-5.16)	(-2.98)	(-7.49)	(-6.92)	(-11.03)	(-7.42)
Coastal	0.538***	0.255**	0.566***	0.249***	0.621***	0.261***
	(5.12)	(2.47)	(5.76)	(2.79)	(14.59)	(5.30)
Declining_City	-0.145	-0.336*	-0.069	-0.188**	-0.038	-0.141***
	(-0.85)	(-1.82)	(-0.74)	(-2.52)	(-0.81)	(-3.08)
Median_Income	0.000***	0.000***	0.000***	0.000**	0.000***	0.000***
	(4.45)	(2.99)	(3.58)	(2.48)	(5.28)	(3.32)
College_Grad_%	-0.002	0.010	0.027***	0.024***	0.011***	0.013***
	(-0.18)	(1.21)	(5.64)	(6.58)	(4.76)	(6.46)
Immigrant_%	0.095***	0.057***	0.056***	0.029***	0.054***	0.024***
	(5.88)	(4.22)	(5.03)	(3.47)	(10.36)	(4.61)
White_%	0.006**	0.000	0.004*	-0.001	0.005***	-0.001
	(2.14)	(-0.02)	(1.69)	(-0.39)	(3.89)	(-0.75)
Owner_Occ_%	-0.016**	0.005	-0.004	0.002	-0.003	0.003
	(-2.26)	(0.70)	(-1.13)	(0.54)	(-1.50)	(1.49)
New_England		0.203		-0.064		0.151*
		(1.18)		(-0.46)		(1.90)
Mid_Atlantic		-0.112		0.067		-0.134*
		(-0.69)		(0.52)		(-1.73)
E_North_Central		-0.519***		-0.521***		-0.596***
		(-3.66)		(-4.04)		(-7.98)
W_North_Central		-0.819***		-0.967***		-1.001***
		(-5.49)		(-6.60)		(-12.46)
South_Atlantic		-0.295**		-0.498***		-0.499***
		(-2.42)		(-4.10)		(-6.92)
E_South_Central		-0.750***		-1.155***		-1.114***
		(-4.11)		(-6.33)		(-11.59)
W_South_Central		-0.818***		-1.063***		-1.003***
		(-5.41)		(-6.70)		(-12.54)
Mountain		-0.124		-0.478***		-0.428***
		(-0.76)		(-3.01)		(-4.68)
Constant	0.834**	0.259	0.290*	0.602***	0.199	0.667***
	(0.34)	(0.38)	(0.19)	(0.21)	(0.88)	(2.97)
rho	0.546***	0.454***	0.592***	0.483***		
	(0.03)	(0.03)	(0.02)	(0.03)		
R-squared	0.387	0.453	0.315	0.409	0.318	0.423

***, **, and * indicate statistical significance at 1%, 5%, and 10%.
With the exception of rho and the constant, t-statistics are reported in parentheses.
For rho and the constant, the standard deviation is reported in parentheses.
The spatial regressions are run using an 8 nearest neighbor weight matrix.
Results were calculated using James LeSage's Econometrics Toolbox for MATLAB.

Table 3: OLS Model Estimates and SDM and SAR Model Total Effect Estimates for the MSA Sample

MSA	SDM		SAR		OLS	
WRLURI						
Log_Land_Area	-0.008	0.016	0.327**	0.235**	0.016	0.047
	(-0.03)	(0.05)	(2.45)	(2.19)	(0.29)	(0.89)
Log_Housing_Density	0.006	0.253	0.387***	0.341***	0.046	0.186***
	(0.02)	(0.73)	(2.76)	(2.64)	(0.82)	(3.16)
Coastal	0.172	0.172	0.158	0.043	0.429***	0.233**
	(0.52)	(0.43)	(0.74)	(0.21)	(4.42)	(2.09)
Declining_City	-1.277**	-1.421**	-0.824***	-0.616***	-0.411***	-0.404***
	(-2.26)	(-2.29)	(-3.10)	(-2.77)	(-3.66)	(-3.71)
Median_Income	0.000	0.000	0.000	0.000	0.000	0.000
	(1.12)	(-0.13)	(-0.49)	(-0.86)	(1.54)	(-0.79)
College_Grad_%	0.006	0.007	0.051**	0.040**	0.024**	0.018*
	(0.12)	(0.13)	(2.04)	(2.07)	(2.36)	(1.88)
Immigrant_%	0.197***	0.156**	0.171***	0.114***	0.111***	0.054***
	(2.81)	(2.33)	(3.79)	(3.22)	(7.01)	(3.16)
White_%	0.009	0.010	0.021**	0.014*	0.019***	0.008*
	(0.59)	(0.59)	(2.25)	(1.70)	(5.10)	(1.79)
Owner_Occ_%	0.027	0.017	0.022	0.020	-0.008	0.003
	(0.83)	(0.54)	(1.24)	(1.46)	(-0.97)	(0.41)
New_England		0.298		0.098		0.421**
		(0.49)		(0.26)		(2.14)
Mid_Atlantic		0.194		-0.293		-0.204
		(0.36)		(-0.91)		(-1.18)
E_North_Central		0.181		-0.473		-0.508***
		(0.31)		(-1.40)		(-2.78)
W_North_Central		-0.374		-1.103***		-0.877***
		(-0.71)		(-2.77)		(-4.58)
South_Atlantic		-0.311		-0.468		-0.555***
		(-0.74)		(-1.58)		(-3.56)
E_South_Central		-0.653		-0.744*		-0.783***
		(-0.99)		(-1.76)		(-3.56)
W_South_Central		-0.504		-0.730**		-0.797***
		(-1.09)		(-2.06)		(-4.44)
Mountain		0.566		-0.041		0.186
		(0.94)		(-0.12)		(0.94)
Constant	-1.709*	-1.499	-2.590***	-2.364***	-2.591***	-1.790**
	(1.29)	(1.46)	(0.50)	(0.55)	(-3.54)	(-2.46)
rho	0.610***	0.529***	0.668***	0.562***		
	(0.06)	(0.08)	(0.05)	(0.06)		
R-squared	0.456	0.528	0.417	0.492	0.417	0.417

***, **, and * indicate statistical significance at 1%, 5%, and 10%.
With the exception of rho and the constant, t-statistics are reported in parentheses.
For rho and the constant, the standard deviation is reported in parentheses.
The spatial regressions are run using an 8 nearest neighbor weight matrix.
Results were calculated using James LeSage's Econometrics Toolbox for MATLAB.

Table 4: OLS Model Estimates and SDM and SAR Model Total Effect Estimates for the MSA Sample W/Unavailable Land Index

MSA	SDM		SAR		OLS	
WRLURI						
Log_Land_Area	-0.027	-0.150	0.277**	0.194**	-0.010	0.004
	(-0.09)	(-0.61)	(2.18)	(1.98)	(-0.17)	(0.08)
Log_Housing_Density	0.130	-0.048	0.368***	0.325***	0.060	0.173***
	(0.49)	(-0.16)	(2.68)	(2.66)	(1.05)	(2.84)
Declining_City	-1.145**	-1.288**	-0.882***	-0.568***	-0.481***	-0.440***
	(-2.00)	(-2.15)	(-3.22)	(-2.94)	(-4.09)	(-3.90)
Median_Income	0.000	0.000	0.000	0.000	0.000**	0.000
	(1.44)	(0.95)	(-0.09)	(-0.67)	(2.09)	(0.27)
College_Grad_%	0.072	0.073	0.062**	0.046**	0.033***	0.030***
	(1.28)	(1.40)	(2.41)	(2.39)	(3.03)	(2.83)
Immigrant_%	0.162**	0.179**	0.160***	0.105***	0.108***	0.057***
	(2.00)	(2.26)	(3.22)	(2.99)	(6.28)	(3.11)
White_%	0.003	0.001	0.019**	0.012	0.012***	0.004
	(0.17)	(0.05)	(2.00)	(1.63)	(3.11)	(0.91)
Owner_Occ_%	0.014	0.028	0.014	0.018	-0.009	0.004
	(0.50)	(1.03)	(0.82)	(1.43)	(-1.12)	(0.57)
Unavail_Land_Index	0.559	-0.934	0.352	-0.112	0.525**	0.042
	(0.67)	(-1.02)	(0.79)	(-0.30)	(2.46)	(0.19)
New_England		0.349		0.013		0.378
		(0.56)		(0.03)		(1.61)
Mid_Atlantic		0.223		-0.473		-0.311*
		(0.44)		(-1.41)		(-1.68)
E_North_Central		-0.288		-0.667*		-0.709***
		(-0.60)		(-1.95)		(-3.92)
W_North_Central		-0.726		-1.232***		-1.030***
		(-1.40)		(-3.02)		(-5.31)
South_Atlantic		-0.046		-0.564*		-0.581***
		(-0.12)		(-1.96)		(-3.66)
E_South_Central		-0.620		-0.890**		-0.900***
		(-1.13)		(-2.13)		(-4.20)
W_South_Central		-0.586		-0.901**		-0.923***
		(-1.38)		(-2.58)		(-5.14)
Mountain		-0.115		-0.181		-0.032
		(-0.24)		(-0.60)		(-0.17)
Constant	-1.957*	-1.492	-2.488***	-2.312***	-2.078***	-1.415*
	(1.44)	(1.53)	(0.50)	(0.54)	(-2.79)	(-1.97)
rho	0.561***	0.430***	0.647***	0.509***		
	(0.07)	(0.09)	(0.06)	(0.07)		
R-squared	0.418	0.505	0.384	0.460	0.348	0.488

***, **, and * indicate statistical significance at 1%, 5%, and 10%.
With the exception of rho and the constant, t-statistics are reported in parentheses.
For rho and the constant, the standard deviation is reported in parentheses.
The spatial regressions are run using an 8 nearest neighbor weight matrix.
Results were calculated using James LeSage's Econometrics Toolbox for MATLAB.