THE EFFECT OF LAND USE REGULATION ON HOUSING AND LAND PRICES

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Abstract

This paper investigates the effects of land use regulation restrictiveness on house and vacant land prices. In contrast to prior studies, the index of restrictiveness is treated as an endogenous variable and estimated effects are allowed to vary by market setting. Using data on more than 100 Florida cities, a U-shaped relationship is found between the house and land price effects of greater regulation restrictiveness and the number of cities within the local housing market. Evidence is also provided showing that more restrictiveness increases the size of newly constructed homes.

I. Introduction

While many studies have investigated the effects of land use regulation on housing prices, there remains considerable uncertainty regarding these effects. Not only are the magnitudes of the effects in question, but Quigley and Rosenthal (QR, 2005) have recently suggested that regulation may only be symbolic in nature: "The net effect of adopting development restrictions may ultimately be symbolic only, meant to appease "not-in-my-backyard" (NIMBY) and other constituencies, but generally lacking the will or ability to implement true growth management in the face of population pressures." (page 84). In support of their argument, QR note that while many studies find significant price effects from greater regulation restrictiveness, a substantial number also show little or no effect on price.

In addition to producing mixed results, another characteristic of the regulation literature is that studies have been plagued by numerous methodological problems (which may help explain the variance in results). In their critique of the literature, QR highlight three major problems. One problem is that regulation restrictiveness measures have been treated as exogenous to housing price: "…a statistical association may show regulatory effect or may show that wealthier, more expensive communities have stronger tastes for such regulation." (QR, page 69). A second problem is that the measurement of house price is often crude, relying on owner-estimates or means (medians) unadjusted for housing quality. Ideally, the arms-length sale price of a home should serve as the dependent variable in studies investigating the effect of development restrictions on housing price. Finally QR emphasize that regulation restrictiveness measures have generally been weak and indirect, with the standard approach being the use of a summary index of regulatory indicators.

Another limitation of existing studies, not noted by QR, is that no allowance is made for the strong possibility that the effects of more stringent regulation on housing price may depend on the market setting. For example, where homebuyers have greater choice among communities, the elasticity of demand is expected to be high within a community with more restrictive regulation.[1] Hence, less of any regulation-induced increase in the cost of housing construction will be reflected in higher housing price. Instead, the higher cost is expected to be shifted backward to owners of vacant land. The effect of regulation on the price of vacant land has received scant attention in empirical studies. In addition, with more communities to choose from, homebuyers are more able to articulate their demand for regulation restrictiveness, which may also alter the effect of restrictiveness on housing price and should be accounted for in empirical models.

This paper exploits a unique database on Florida communities to estimate the effects of land use regulation restrictiveness on the prices of housing and vacant land. Actual sales prices are used as dependent variables and the regulation restictiveness measure is treated as an endogenous variable. Estimated effects are allowed to vary by market setting. As in prior studies, the restrictiveness measure is a summary index of individual land use management techniques that have been adopted by the jurisdiction. However, the bias in estimated effects resulting from measurement error in the regulatory variable is attenuated by treating the index as endogenous.

In addition to studying price effects, models are estimated which explore the effects of regulation restrictiveness on housing quantity. It is frequently hypothesized that builders shift up market in response to development restrictions, causing an increase in the supply of larger houses in comparison to smaller houses. The effects of regulations on both square feet of living area and lot size are investigated.

[1] This assumes, of course, that there is more variation in restrictiveness within a local housing market with a larger number of jurisdictions. The results presented later in the paper are consistent with this assumption.

Another unresolved issue within the land use regulation literature is whether the price effects of restrictiveness emanate from demand-side or supply-side changes within the housing market. Regulations may reduce housing supply by increasing developers' costs but many also increase demand through an amenity effect. Where land use regulation is more restrictive, there may be less sprawl, a more desirable mix of land uses, and less congestion of public infrastructure. The models estimated yield evidence, albeit indirect, on the supply versus demand-side issue.

There are four key findings. First, treating regulation restrictiveness as endogenous results in estimated house and land price effects that are substantially larger in absolute magnitude. Second, a U-shaped relationship is found between the house and land price effects of greater regulation restrictiveness and the number of cities within the local housing market. Third, the results suggest that the housing price effects of greater regulation restrictiveness reflect both higher demand and lower supply. Finally, greater restrictiveness increases both the interior space and lot sizes of newly constructed homes.

II. Model

Reduced form models relating local jurisdictions' land use regulation restrictiveness to the prices of single-family homes and vacant residential land are derived by first specifying the demand for and supply of housing within jurisdictions.[2] Beginning with demand, the demand for single-family housing within jurisdiction j of market k will depend on two sets of factors – those that vary across markets and those that affect the attractiveness of jurisdiction j relative to other jurisdictions within market k. Market-level factors include the number of households in k and those variables that affect the rate of homeownership in k (specifically, average income, average household size, and the relative cost of owning versus renting). Within k, the relative

[2] Vacant residential land is land that is zoned for residential use.

attractiveness of j to homebuyers depends on its public services (PS_{jk}), property tax rate (t_{jk}), land use restrictiveness (R_{jk}), and the price of a constant-quality single-family home (P_{jk}). Representing all market-level factors by a market fixed effect (FH_k) results in the following demand function for single-family homes in jurisdiction j of market k:

$$H^d_{jk} = f(FH^d_k, PS_{jk}, t_{jk}, R_{jk}, P_{jk}) \quad (1)$$

The supply of single-family housing to jurisdiction j in market k will also depend on market-level factors (specifically, construction costs) and those variables affecting the profitability of building in j relative to other jurisdictions in market k. The latter include j's price of constant-quality housing, the price of vacant residential land (PV_{jk}), and R. R can increase the residential developer's cost by lengthening the review process and by increasing permit and compliance costs.[3] Representing the market-level supply factors again by a fixed effect, the supply function of single-family homes to jurisdiction j in market k can be written:

$$H^s_{jk} = f(FH^s_k, PV_{jk}, R_{jk}, P_{jk}) \quad (2)$$

Given (1) and (2), the equilibrium price of housing in j depends on the market fixed effect and the jurisdictional level supply and demand shifters:

$$P^e_{jk} = f(FH_k, PS_{jk}, t_{jk}, R_{jk}, PV_{jk}) \quad (3)$$

Turning next to the market for residential vacant land, the demand for vacant land in jurisdiction j of market k depends on those factors that affect the profitability of building homes in j, which include market-wide factors and j's price of constant-quality housing, regulation restrictiveness, and price of vacant residential land:

$$VL^d_{jk} = f(FL^d_k, P_{jk}, GM_{jk}, PV_{jk}) \quad (4)$$

[3] Compliance costs are payments to engineers, surveyors, and attorneys in order to satisfy specific rules and regulations that govern changes in the local jurisdiction's land use map.

The supply of residential vacant land in j will depend on j's price of raw land (PR_j), regulation restrictiveness, and price of residential land:

$$VL^{s}_{jk} = f(PR_{jk}, R_{jk}, PV_{jk}) \quad (5)$$

R is included in (5) because it may affect the cost of converting raw land into residential lots. For example, the time and monetary costs involved in rezoning agricultural land may vary directly with R.

The equilibrium price of vacant residential land in jurisdiction j of market k depends on the demand and supply shifters identified in (4) and (5):

$$PV^{e}_{jk} = f(FL_k, P_{jk}, R_{jk}, PR_{jk}) \quad (6)$$

Finally, the demand for, supply of, and equilibrium price of raw land (RL) in j can be expressed as:

$$RL^{d}_{jk} = f(FR_k, PV_{jk}, R_{jk}, PR_{jk}) \quad (7)$$

$$RL^{s}_{jk} = C_{jk} \quad (8)$$

$$PR^{e}_{jk} = f(FR_k, C_{jk}, R_{jk}, PV_{jk}) \quad (9)$$

where FR_k is the market fixed effect and C_{jk} is the total amount of developable raw land in j.

From the market equilibrium equations (4), (7), and (9), the following reduced form price equations for single-family homes, vacant residential land, and raw land are obtained:[4]

$$P^{e}_{jk} = f(F_k, PS_{jk}, t_{jk}, R_{jk}, C_{jk}) \quad (10)$$

$$PV^{e}_{jk} = f(F_k, PS_{jk}, t_{jk}, R_{jk}, C_{jk}) \quad (11)$$

[4] The reduced form of the structural equation system is derived for three reasons. First, estimates of the structural parameters would require the estimation of simultaneous equations models that would be difficult to identify. Second, my primary interest is in the effect of R on the equilibrium prices within the housing and vacant residential land markets, which is what the reduced form directly provides. Third, as described below, R can be interacted with a number of variables to explore whether the price effects of R are emanating from supply or demand changes, so even without estimating the structural system, evidence on the supply versus demand issue can be obtained.

$$PR^{e}_{jk} = f(F_k, PS_{jk}, t_{jk}, R_{jk}, C_{jk}) \quad (12)$$

Equations (10) and (11) underlie the empirical models that are described in the next section. While the estimation of a raw land price model is suggested by (12), the data include too few raw land sales to study these effects.

Assume that higher R raises development costs, resulting in the community having less housing supply. The effect on the price of housing will depend on two factors: 1) the effect of R on the level of housing demand, and 2) the elasticity of demand within the jurisdiction. Both of these factors are expected to vary with the number of competing jurisdictions within the local housing market.

Consider three cases: a market with just a few jurisdictions (I), a market with an intermediate number of jurisdictions (II), and a market with many jurisdictions (III). In I homebuyers will find it difficult to articulate their demand for R, given their other locational preferences. The latter preferences relate to proximity to work, a home and neighborhood type, and a public services/taxes package – all of which may dominate achieving the optimal R in making the location decision. Limited choice also suggests that more of the higher development costs resulting from higher R will be borne by homebuyers – i.e., the elasticity of demand is expected to be relatively low in I. Hence, in I the higher R community will have a higher housing price (point b versus point a in Figure 1.I).

In II homebuyers will find it easier to avoid bearing the cost of regulation and they are more able to articulate their preference over R. Whether the price effect from higher R in II is greater than in I will depend on the increase in elasticity relative to the increase in demand that results from the greater jurisdictional choice. Because of the many locational needs that households seek to satisfy, the rise in demand may be relatively small. In II the difference in housing price between the high and low R communities (point d versus point c in Figure 1.II) would therefore be smaller than in I.

In III, where there are many jurisdictions to choose among, homebuyers can efficiently Tiebout sort across communities to closely approximate their preferences over all locational factors, including R. If R's effect on demand is sufficiently strong, in III the price difference between high and low R communities (from point e to point f in Figure 1.III) may be larger than in II.

The above case descriptions suggest that there will be a U-shaped relationship between the price effect of higher R and the number of competing jurisdictions within the housing market. Certainly, other relationships are possible depending on how the elasticity of demand and the extent of Tiebout sorting vary with the number of jurisdictions within the local housing market. However, it is clear from Figures 1.I – 1.III that the empirical model should allow for a nonlinear relationship between the price effect of more stringent land use regulation and the number of competing jurisdictions.

III. Estimated Equations

Before describing the estimated equations in detail, it is helpful to provide an overview of the estimation strategy. Cross-sectional price equations are estimated using a remarkably rich database that includes thousands of individual sales transactions from 105 Florida jurisdictions located in 24 counties. The data, which were compiled from a variety of sources (see Table 1), also include extensive information on the property's characteristics and the neighborhood and jurisdiction within which the property is located. Estimated models all include market fixed effects, which are defined at the county level. Florida only has 67 counties and therefore the typical county is large in both population and land area. Moreover, each county is a separate school district. A unique feature of the models is that they control for variation within counties in the property's access to the coast (for coastal counties) and access to the center of the CBD (for MSA counties).

The basic price equation estimated for single-family homes can be expressed as:[5]

$$ln\ P = ß_0 + ß_1 S + ß_2 N + ß_3 J + ß_4 R + ß_5 Y + ß_6 M + ß_7 (M * dCBD)$$

$$+ ß_8 (M * dCOAST) + \varepsilon \qquad (13)$$

where P = sales price

S = structural characteristics (log of square feet of living area, log of lot size in acres, age)[6]

N = neighborhood characteristics (median income, % black, % Hispanic, and % renter of census tract in 2000)

J = jurisdictional controls (% change in population 1990 – 2000, form of government, chief planner's perception of school crowding, per capita public service expenditures, millage rate, raw land acreage, proportion college 2000, proportion owners 2000, proportion white 2000, proportion black 2000, proportion elderly 2000, and average household income 1999)

R = land use regulation restrictiveness measure

Y = sale year dummy variables (2002, 2001, reference year is 2000)

M = county dummy variables

M*dCBD = county dummy variable * linear distance in miles between property and CBD center for property in county that is part of MSA

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[5] The statistical fits of linear and log-linear models were compared. Because the R-squares of these two models are not comparable, the comparison of fits involved predicting price from the log-linear model given the predicted value of *ln* price. The square of the correlation between predicted and actual price can be compared with the R-squared obtained from the linear model (Wooldridge, 2000, p. 204). In all cases the log-linear model was found to provide the superior fit.

[6] All of the continuous variables were alternatively tried using their logged and original values. Logging living area and lot size improved the fit of the model.

M*dCOAST = county dummy variable * linear distance in miles between property and coast for property in coastal county

Variable definitions, their sources, and mean values are provided in Table 1. The primary data source is the abbreviated property tax rolls that each county must submit annually to the Florida Department of Revenue for auditing purposes. From these rolls all properties were extracted that sold during the three year period 2000-2002.[7] Properties whose sale was classified by the county property appraiser as less than arm's length were dropped from the sample. Although Florida has 67 counties, sales were also restricted to the 24 counties for which complete data were available for multiple jurisdictions and a digitized parcel identification map was available. These maps allowed precise GIS measurements of distances, provided accurate lot size measurements, and avoided the need to address match in assigning parcels to census tracts and jurisdictions. The counties without digitized maps tended to be both small and rural.[8]

In addition to the county tax rolls and parcel maps, other sources of data include the 2000 Census, which is used for the neighborhood variables and some of the jurisdictional level controls, and the Florida Department of Financial Services, who provided millage rates and per capita public service expenditures for each local jurisdiction for the year of the house sale (i.e., 2000, 2001, or 2002)[9]. Two jurisdictional control variables – the chief planner's perception of school crowding and the jurisdiction's form of government – come from a questionnaire that the chief planner of each local jurisdiction responded to in 2001.[10] The planner was asked to rank the severity of school crowding within her city on a 5-point scale (1=none, 5=severe) and

[7] Because there were more than a half million home sales, to satisfy computational constraints the number of sales taken from any single jurisdiction was limited to a random subsample of 1000 observations. This limitation was not necessary for residential vacant land sales.
[8] These maps were provided by the Florida Department of Revenue, which has a policy requiring each county to develop a map. Not all counties have satisfied the requirement.
[9] Expenditures covered library, sewer, solid waste, road, park, fire, and police services.
[10] This was a mail survey with telephone and email follow up. Roughly 65 percent of the state's cities and unincorporated areas responded to the survey. The survey was administered by the DeVoe Moore Center at Florida State University under the direction of Richard Feiock.

whether the government structure of the jurisdiction is council-manager, mayor-council, or commission. It is frequently argued in the public administration literature that professional city managers increase government efficiency. If this is true, the resulting cost-savings should get capitalized into property values. It should be noted that school districts in Florida are county-wide and therefore differences in perceived school quality across districts are captured by the county fixed effects.

Raw land acreage within each jurisdiction is obtained by summing up the acres of land of those properties that are identified on the tax rolls as “agriculturally zoned” and “acreage not zoned agricultural”. The former category includes cropland, timberland, and grazing land. The latter category encompasses a wide variety of cases, including land owned by Indian tribes, utility companies, and land companies. Because the development potential of the two types of raw land that are identified on the rolls may differ, separate totals for each are included as independent variables in the model.

Finally, there is the test variable – the measure of land use regulation restrictiveness (R). The most popular method for measuring R has been to form a restrictiveness index by simply summing up the number of individual restrictiveness measures used by the jurisdiction, with subjective weightings sometimes applied to individual measures.[11] Jurisdictions with higher index values are assumed to have more stringent regulatory environments pertaining to housing development. This approach is also used here, with R equaling the number of restrictive land use

[11] Quigley and Raphael (forthcoming), Malpezzi (1996), Pollakowski and Wachter (1990), Cho and Linneman (1993), Levine (1999), and Mayer and Somerville (2000) all construct an index of this type.

management techniques (out of a total of 13) currently used by the jurisdiction.[12] The individual techniques and the percentage of jurisdictions that use each technique are listed in Table 2.[13]

The use of an index for measuring restrictiveness can be criticized for its imprecision. However, the validity of the index used here is suggested by the results presented in Table 3. The correlation coefficients reported in the table indicate that R is higher in those communities that have been found in prior studies to be more restrictive; namely, those that are wealthier, with higher proportions of whites and homeowners (Baldassare and Protash, 1982; Burnell and Burnell, 1989; Donovan and Neiman, 1992; Bates and Sonterre, 1994). Additional evidence validating R comes from a regression for the year 2000 of the jurisdiction's planning expenditures on R, population, and the percentage change in population (1990 to 2000). The estimated coefficient on R ($104,435) is statistically significant (p value = .043). More restrictive land use regulation imposes greater implementation and enforcement costs on jurisdictions, which in Florida are borne by planning departments.

To address the endogeneity of R, 2SLS models are estimated. The use of Florida data provides a unique opportunity for obtaining instrumental variables for R. In 1985 Florida passed the Growth Management Act (GMA), which required that all jurisdictions within the state develop a comprehensive land use plan and a set of land development regulations supporting the plan.[14] Plans were developed in the late 1980s and were reviewed and approved by Florida's Department of Community Affairs over the 1988-1992 time period. The current restrictiveness of a community's land use regulations largely reflects decisions embodied in its comprehensive plan. Because there was heavy citizen input, it is reasonable to assume that these decisions were

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[12] My index is most similar to the index used by Quigley and Raphael (forthcoming). They sum over a total of 15 individual measures, with many of these measures for California cities similar to the ones that I employ for Florida cities.

[13] The percentages in this table are based on those cities and unincorporated areas that responded to the planners' survey and provided complete data (n=327).

[14] The full title of the GMA is the Omnibus Growth Management and Local Government Comprehensive Planning and Land Development Regulation Act. Fla. Stat. 163.3161-.3215 (1985).

affected by the characteristics of the community in 1990. Hence, the following jurisdictional variables from the 1990 Census are used to instrument R: the proportion of adults possessing a college degree, the proportion of residents over the age of 55, the proportion white, the proportion black, the proportion of households who owned their home, and the average household income in 1989. Of course, the values of these variables in 1990 are correlated with their values in the year 2000. Moreover, the 2000 values may be correlated with unobservables (such as school quality and public safety) that affect the observed sale prices over the 2000-2002 time period. The 2000 values of the variables are therefore included among the set of jurisdictional controls, both because they are useful proxy variables and their inclusion reduces the possibility that the instruments are not exogenous to housing price.

There are two reasons for instrumenting R in equation (13): 1) as noted, residents of communities with higher housing values may demand more restrictive regulations (causing some degree of reverse causation), and 2) R measures the actual degree of restrictiveness with some error. The former implies a positive OLS bias, while the latter implies a negative bias. Therefore, the sign of the bias cannot be predicted.[15]

In addition to R, per capita public service expenditures (PS) and the millage rate (T) must also be treated as endogenous variables. More expensive homes tend to be located in communities with larger residential tax bases per capita, which will affect PS and/or T. The following jurisdictional variables are used to instrument PS and T: the percentage of homeowners who claimed the homestead exemption in 1995, per capita intergovernmental transfers in 1993, per capita revenue from taxes other than the property tax in 1993, and per

[15] While the set of structural characteristics excludes some variables that hedonic price studies have found affect house price, a number of reasons suggest that the omission of these variables has not biased the results. First, a number of these variables (e.g., dummy variables for whether the house has a basement or central air conditioning) display little variance across housing units in Florida. Second, omitted structural (and neighborhood variables) are proxied by the extensive set of neighborhood and jurisdictional controls included in the model. Nevertheless, potential omitted variable bias could be listed as another reason for instrumenting R.

capita miscellaneous revenue (e.g., fines, fees, and charges) in 1993. Lagged values of the variables are used because by going back in time there is less chance that the values are not exogenous.[16]

Moving on to the reduced form price equation estimated for vacant residential land, the theoretical model presented earlier suggests that this model should mirror the one estimated for single-family homes. The N, J, R, Y, M, and M interaction variables are identical between the two models. R, PS, and T are again treated as endogenous and the same set of instrumental variables is employed. Two differences between the land and housing models are that the dependent variable in the former model is the natural log of price per acre and this model only includes a single property characteristic – the log of lot size in acres.

IV. Results from Estimating the House Price Models

Table 4 presents four sets of results for single-family homes. In columns (1) and (2) R is treated as exogenous and endogenous, respectively.[17] In column (3) R (endogenous) is interacted with variables representing the size of the house. Finally, in column (4) R (endogenous) is interacted with the number of cities in the county and its square.[18]

[16] In Florida the assessed values of homesteaded homes can only increase 3 percent per year or by the rate of inflation, whichever is lower, according to state statutes. Non-resident homeowners cannot claim the homestead exemption and therefore their assessed values are not capped. In jurisdictions where a higher percentage of the homes are not exempt millage rates tend to be lower and public service expenditures per capita tend to be higher. Per capita revenue from taxes other than the property tax reflects a wide variety of local option sales, fuel, beverage, and tourism taxes. Despite the fact that non-property tax revenue per capita is measured with a long lag, local option taxes may affect the current attractiveness of the community and therefore be capitalized into the sales prices of homes. However, excluding the non-property tax revenue per capita variable from the set of instrumental variables had little effect on the results.

[17] PS and T are treated as endogenous in all of the columns of Table 4 and in all subsequent tables.

[18] Interactions between R and other variables require that the interaction variables also be treated as endogenous variables. In reduced form regressions of the endogenous variables on all of the exogenous variables including the identifying instruments, the instruments are jointly significant at the one percent level in all cases (i.e., for all of the 2SLS results presented in Table 4 and in subsequent tables). In the reduced form models the signs on the estimated coefficients of the instrumental variables are as expected.

Interestingly, the statistical significance of R varies between columns (1) and (2) – it only has a significant price effect when treated as endogenous.[19] The estimated coefficient (.03) implies that adding an additional restrictiveness measure to the restrictiveness index increases house price by 3 percent. In column (3), houses are divided into three size classes: small (less than 1349 square feet of interior living space), medium (between 1349 and 2245 square feet) and large (greater than 2245 square feet).[20] The interactions of R with medium and large size are not statistically significant, while the estimated coefficient on R alone is significant and is of similar magnitude (.05) to that reported in column (2). These results suggest that a unit increase in R causes a similar percentage change in house price, regardless of the size of the house. However, this implies that R causes a larger absolute dollar increase in the price of larger homes. There is no reason to believe that an increase in R causes a greater reduction in the supply of larger in comparison to smaller homes.[21] A plausible explanation for the results is that R is a normal good, with higher income households willing to pay a premium to live in those communities with a higher level of land use regulation restrictiveness.

In column (4) R is interacted with the number of cities in the county and the number of cities squared.[22] The estimated coefficients on R and the two interaction variables are individually and jointly significant. The relationship between the price effect of R and the number of cities implied by these coefficients is shown in Fiqure 2, which confirms the expectation that the relationship is U-shaped. The price effect declines with the number of cities

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[19] A Hausman test rejects the null hypothesis that R is exogenous with a probability value of .000. Only robust standard errors are reported in the tables because estimated residuals are heteroskedastic.

[20] The square footage cutoffs defining the size categories are based on the first and third quartile points of the size distribution for the sample of sales transactions.

[21] In fact, the evidence presented below in section VI suggests that higher R increases the supply of larger homes relative to smaller homes.

[22] The unincorporated area of the county is counted as one of the county's cities. The data provide a favorable distribution of jurisdictions by the number of cities in the county: 43 jurisdictions are located in counties with 20 or more cities, 38 jurisdictions in counties with less than 20 but 10 or more cities, and 24 jurisdictions are in counties with less than 10 cities.

until the county has 13 cities.[23] At this point the price effect is not significantly different from zero. Beyond this point the price effect rises with the number of cities.

The estimated effects of the control variables are generally highly significant with expected signs[24] The results obtained with a number of these variables are worth mentioning because they are either interesting or may appear anomalous.

Focusing first on results of interest, housing prices are lower in jurisdictions with the council-manager in comparison to those with the mayor-council form of government. The evidence, therefore, fails to support the hypothesis that local governments operate more efficiently if they have professional managers and suggests these governments may actually be less efficient. These results are consistent with studies that have used expenditure-based measures to compare the efficiency of the two types of government (Deno and Mehay, 1987; Hayes and Change, 1990; Davis and Hayes, 1993)[25]

Another interesting result obtained with the control variables is that school crowding reduces property value. There has been considerable controversy in Florida over an amendment recently added to the state constitution by a voter referendum to reduce class size. Changes in property values that may result from these reductions have not played a role in the debate over whether this amendment should be rescinded (as the Governor has advocated). These results suggest that property value and consequent tax base improvements should be part of the decision calculus.

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[23] In Florida, 50% of the counties have 4 or fewer cities, 25% have 5, 6, or 7 cities, and 25% have more than 7 cities. Broward, Palm Beach, and Miami-Dade have more than 30 cities.

[24] The year and county dummy variables and the interaction of the latter with the property's distances to the CBD and the coast yielded expected results. For example, prices are higher in south than in north Florida, prices decline as distance to either the CBD or coast increases, and properties sold for more in 2002 and 2001 than in 2000. These results are not reported in the interest of keeping the tables to a reasonable length. These results, however, are available upon request.

[25] Of course, these results are subject to alternative interpretations. For example, mayors serve as an advocate of their city and this could positively affect homebuyer perceptions. This also could account for the price difference observed between the two types of government.

Among the control variable results that may appear perplexing is that housing prices are higher in neighborhoods and in cities containing more renters. This can be explained as a locational effect, since apartments signal proximity to other commercial activity, such as stores and offices that have positive impacts on nearby property values. Another anomalous result is that the average household income of the jurisdiction negatively effects house price. The proportion of adults who are college educated and household income are highly correlated and the former variable has a positive, significant effect on house price. The education variable may be capturing a school quality effect, leaving higher income to reflect a city more distant from jobs.

V. Results from Estimating the Land Price Models

Table 5 presents three sets of results for vacant residential land. In columns (1) and (2) R is treated as exogenous and endogenous, respectively. In column (3) R is interacted with the number of cities in the county and its square. As is true for single-family homes, the absolute magnitude of the estimated effect of R on vacant land is larger when R is treated as endogenous. Here, however, the estimated effect is negative, with the price per acre declining about 6 percent for a unit increase in R. These results suggest that greater regulation restrictiveness increases developers' costs and that the increase in house price fails to offset these higher costs.

The interaction of R with the number of cities variables again yields significant results, with the implied relationship between the land price effect of R and the number of cities in the county again being U-shaped (see Figure 3). There is, therefore, consistency between the house and land price results. The minimum price effect in Figure 3 occurs for jurisdictions within a county containing 10 cities. The price effects are significantly less than zero for jurisdictions in counties with more than 3 cities and less than 17 cities. These results provide further evidence that an increase in R increases developers' costs, and that they will pay less for land where there is less of an offset to these costs in the form of higher housing prices.

In Figure 3, the price of land is not affected by an increase in R if there are only 3 cities in the jurisdiction's county. Within this type of county Figure 2 shows that a unit increase in R raises house price by about 5 percent. A 5 percent increase in the average sales price of the sample ($159,000) equals $7,950. The implication is that each additional restrictive measure adopted by the jurisdiction, on average, raises the developer's cost by almost $8,000. Because this is an implied and not a direct estimate (obviously, the use of actual cost data would be preferred), it is only suggestive. Nevertheless, the magnitude of the effect lends support to the argument that higher R reduces housing supply in a nontrivial fashion.[26]

The results obtained with the control variables are largely consistent with those reported for single-family homes. Comparing the regression results which included the number of cities interactions – column (4) of Table 4 and column (3) of Table 5, only four variables have different signs: per capita government expenditures, non-agricultural acreage, average household income, and school crowding. The estimated effect of an independent variable in the land price model reflects its effect on house price, as well as, its correlation with developers' costs not captured by differences in R. This may explain why the above variables have opposite effects in the house price and land price models.

VI. The Effect of Land Use Regulation Restrictiveness on House Size

Where R is higher the mix of new housing supply may contain a higher proportion of larger homes if developers believe that their higher regulatory costs can more easily be shifted

[26] The finding that housing supply is strongly affected by greater land use regulation restrictiveness is consistent with the findings of Glaeser, et al. (2005). They find that price-to-construction cost ratios have spiraled upward since 1970, which they argue can only be explained by greater restrictions on residential development. Indirect evidence on the importance of regulation restrictiveness in accounting for cross-national variation in housing prices is provided by Glaeser and Gyourko (2003).

forward to the homebuyer if the house is larger in size. There is a basis for this belief if the higher costs that result from higher R are roughly a fixed amount regardless of price, implying that these costs are a larger percentage of less expensive homes.[27]

To investigate the effect of R on house size the following question is addressed: given that a new home is going to be built within a jurisdiction, certeris paribus, will that home contain more interior square footage if R is higher? Figure 4 shows that the homebuyer will continue to add space to his new home until the marginal benefit (MB) and marginal cost (MC) of an additional square foot are equal. The MB curve will lie farther to the right the higher the buyer's income and the larger his family size. It will also be more rightward the lower the price of land, since land and structure are complements for single-family homes. The MC curve will lie farther to the left where construction costs are higher. If higher R causes a relative increase in the supply of larger homes, the MC curve will be flatter, resulting in the buyer building a larger home.

To test this hypothesis, a model is estimated that uses the square footage of newly constructed homes (homes built over the years 1995-2002) as the dependent variable.[28] In addition to R, regressors overlap to a considerable extent the variables used to estimate the house price models. Because the income and family size of the individual homebuyer are not available, the neighborhood median income and the average family size of homeowners living in the neighborhood (a new variable not included in the house price models, but reported in the 2000 census) serve as proxy variables. All of the jurisdictional and locational variables included in the house price models are also included in the square footage model because these variables register spatial differences in the price of land. Construction costs are assumed to vary across but not

[27] Burge and Ihlanfeldt (forthcoming, 2005) find that there is a fiscal motive behind exclusionary land use regulation. Because smaller, less expensive homes impose a greater fiscal deficit on the community, R-induced costs may actually be higher for smaller in comparison to larger homes. However, as long as costs rise less than proportionately with size, builders would have an incentive to shift up-market.

[28] Going back to 1995 kept the number of jurisdictions included in the sample above 100, but somewhat shorter or larger time frames yielded similar results.

within counties and therefore are part of the county fixed effect. R, PS, and T are again treated as endogenous variables in the square footage model, because people living in larger homes may demand higher R and larger homes tend to be found in communities with larger residential tax bases per capita.

Results are presented in Table 6. A unit increase in R adds 30 square feet to the home. While highly significant, the effect is modest in size. To illustrate, if a home is built within the jurisdiction with the maximum R (8) in comparison to the minimum R (1) found among the sample of 105 jurisdictions, the average size new home within the sample (2000 square feet) would increase in size by 10 percent.

As an alternative to square feet of living area as the size measure, Table 6 also reports the results obtained from using the lot size (in acres) of the home as the dependent variable. A unit increase in R increases lot size by .027 acres. Since the average new home sits on one-third of an acre, moving from the minimum to the maximum R jurisdiction would increase lot size by 57 percent. Higher R, therefore, increases both house and lot size, with the magnitude of the effect being larger in the latter case.

An alternative approach toward gauging the magnitude of the effects is to consider the implied change in home value caused by the R-induced increases in interior space and lot size. Based upon the coefficients on the latter variables obtained from estimating the house price equation (as reported in Table 4) and the coefficients on R obtained from estimating the size equations (as reported in Table 6), a unit increase in R implies that the increases in house and lot size would together increase home value by roughly 1.8 percent. Moving from the minimum to the maximum R jurisdiction would therefore cause a 12.6 percent increase in the price of a newly constructed home.

VII. Conclusions

The results presented in this paper suggest that land use regulation has important effects on the prices of housing and vacant land. The results also suggest that estimates of these effects may be biased if the measure of land use regulation restrictiveness is treated as exogenous to housing price or if estimated effects are not allowed to vary by market setting. Evidence is also provided that newly constructed homes are larger where regulation restrictiveness is higher.

The results are relevant to a number of issues that have been raised within the land use regulation literature. First, the failure of some studies to find significant price effects from greater restrictiveness, as noted by QR, may simply reflect mismeasurement of the regulatory environment. This paper has dealt with the measurement error issue by taking an instrumental variables approach, which yields stronger estimated effects than those obtained from models which treat the regulation variable as exogenous. Hence, the bias resulting from exogenous regulation appears to be more closely related to measurement error than to reverse causation. If the latter problem was dominant, treating R as endogenous would have resulted in smaller estimated price effects.

Second, there has been a major concern that restrictive land use regulation reduces the affordability of single-family homes. The results suggest that this will depend on the number of competing jurisdictions within the local housing market. Where homebuyers' choice is limited, they will bear the lion's share of R-induced increases in development costs. This is generally expected to be the case in Florida, where the typical market offers little jurisdictional choice. But within many metropolitan areas throughout the United States there may be sufficient choice to cause a significant portion of these costs to be shifted backward to landowners. Where costs are shifted forward, the results suggest a serious erosion in housing affordability. A unit increase in the restrictiveness index is found to increase the price of housing by 5 percent. Moreover, the size of the house will also increase, which will further increase the average home price by 1.8 percent.

Finally, there is the issue of whether higher R impacts price from the supply or demand sides of the housing market. Again, this will depend on the degree of jurisdictional choice. While supply is less in more restrictive communities regardless of market setting (assuming similar increases in development costs), demand is greater only where there is sufficient choice for homebuyers to articulate their demand for regulation by Tiebout shopping across communities.

While this paper has addressed a number of the methodological shortcomings found in prior work on land use regulation, much work remains to be done. Clearly, there is a need for better measurement of the restrictiveness of individual jurisdictions, since instrumental variable methods are a second-best alternative for dealing with measurement error, even when attractive instruments for restrictiveness are available. Other important research areas include assessments of the costs and benefits of specific regulations, the effect of regulation on new construction, and analysis of the factors that explain variation in jurisdictions' degree of restrictiveness over space and over time.[29]

[29] See Glaeser and Gyourko (2005) who offer five testable hypotheses for why restrictiveness has increased over time within most local jurisdictions.

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Table 1
Variable Descriptions, Sources and Means

Variables	Source	Mean	
		Single Family	Vacant Land
Dependent Variables			
House price	County tax roll	158921	
Land price/acre	County tax roll		100843
Property Characteristics			
Sq ft living area	County tax roll	1900	
Lot size in acres	GIS map	.29	.83
Age	County tax roll	22	
Second structure	County tax roll	.02	
Location Variables			
Distant coast, miles	GIS map	2.6	3.2
Distance cbd, miles	GIS map	13.1	14.8
Neighborhood Variables			
Median income ($1,000)	2000 census	46.5	45.8
% Black	2000 census	10.0	6.4
% Hispanic	2000 census	12.1	7.0
% Renter	2000 census	24.5	14.9
Jurisdictional Variables			
Per capita PS exp	Dept. Fin. Serv.	510	476
Millage rate	Dept. Fin. Serv.	21.0	19.5
School crowding	Planners survey	3.6	3.9
Form of gov. – manager	Planners survey	.85	.95
Form of gov. – mayor	Planners survey	.13	.04
Form of gov. – commission	Planners survey	.02	.01
Ag. Acreage (10,000)	County tax roll	4.2	12.1
Non-ag. Acreage (10,000)	County tax roll	43.4	162.8
Proportion college graduates	2000 census	.24	.19
Proportion 55 or older	2000 census	.28	.31
Proportion owner-occupants	2000 census	.71	.80
Proportion white	2000 census	.72	.82
Proportion black	2000 census	.12	.07
Ave. hh income ($1,000)	2000 census	54	51
% Δ pop, 1990-2000	1990,2000 census	36	41
Regulatory index	Planners survey	3.93	5.44
Number of observations		63085	57343
Number of counties		24	24
Number of jurisdictions		105	92

Table 2
Land Use Restriction Measures

Land Use Management Techniques Used in Last Two Years:	Percentage of Jurisdictions that Use the Technique:
1. Farm Preservation Policies	5.2
2. Development Impact Fees	55.4
3. Large Lot Zoning	16.0
4. Open Space Zoning	19.6
5. Population/Building Caps	5.5
6. Environmental Preservation Zoning	35.5
7. Provision of Public Facilities by Developers	33.6
8. Urban Service Boundary	17.1
9. Annual Limit on Building Permits	69.4
10. Moratorium on Growth	8.9
11. Time Required to Review Residential Projects Increasing	11.3
12. Environment Impact Assessment Required for Small Projects	12.2
13. Zero Lot Line Housing Prohibited	72.5
Number of Jurisdictions	327
Average Number of Techniques Used Across Jurisdictions	3.6
Percent of Jurisdictions Using Two or Fewer Techniques	30.4
Percent of Jurisdictions Using Four or Fewer Techniques	73.0

Table 3
Correlations Between Regulation Stringency Index and Community Characteristics

Regulation Stringency Index with	Spearman Rank Correlation Coefficients
Average Household Income	.197
	(.000)[a]
Proportion College Graduates	.136
	(.014)
Proportion Homeowners	.131
	(.018)
Proportion White	.076
	(.172)
Proportion Black	-.110
	(.047)

[a]p-values in parentheses.

Table 4
Results for Single-Family Homes[a]

	(1)	(2)	(3)	(4)
Regulation Variables				
Index	-.00064	.03092**	.05026**	.09007**
	(.00148)[b]	(.00366)	(.01556)	(.02493)
Index * medium size			-.02743	
			(.02753)	
Index * large size			.00397	
			(.02046)	
Index * # cities				-.01400**
				(.00259)
Index * # cities^2				.00053**
				.00007
Property Characteristics				
Log living area	.96262**	.96381**		.95519**
	(.00587)	(.00589)		(.00644)
Log lot size	.04304**	.04305**	.10907**	.04694**
	(.00279)	(.00280)	(.00323)	(.00289)
Age	-.00224**	-.00209**	-.00469**	-.00214**
	(.00012)	(.00012)	(.00014)	(.00012)
Second structure	-.01226	-.01040	.04653**	-.00298
	(.01063)	(.01072)	(.01207)	(.01118)
Medium living area			.42737**	
			(.10498)	
Large living area			.74464**	
			(.07989)	
Neighborhood Variables				
Median income	.00326**	.00309**	.00482**	.00357**
	(.00015)	(.00015)	(.00020)	(.00019)
% Black	-.00572**	-.00582**	-.00664**	-.00574**
	(.00014)	(.00014)	(.00015)	(.00014)
% Hispanic	-.00372**	-.00398**	-.00404**	-.00375**
	(.00024)	(.00025)	(.00030)	(.00026)
% Renter	.00120**	.00119**	.00172**	.00124**
	(.00012)	(.00012)	(.00015)	(.00012)
Jurisdictional Variables				
Per capita expenditure	.00013**	.00020**	.00020**	.00005
	(.00002)	(.00002)	(.00002)	(.00003)
Property tax rate	-.02394**	-.02260	-.02191**	.02884**
	(.00212)	(.00217)**	(.00270)	(.00259)
FOG - manager	.01218	-.02623**	-.04100**	-.11930**
	(.00707)	(.00771)	(.00922)	(.01497)
FOG - commission	-.26050**	-.41478**	-.44213**	-1.08945**
	(.01940)	(.02580)	(.02927)	(.11373)

Ag. acreage	-.00061*	-.00125**	-.00142**	-.00040
	(.00029)	(.00031)	(.00036)	(.00031)
Non-ag. acreage	.00002	-.00002	-.00002	-.00004
	(.00002)	(.00002)	(.00002)	(.00003)
Proportion college	1.01643**	.78014**	.73469**	1.05412**
	(.04981)	(.05407)	(.07078)	(.10815)
Proportion owners	-.18245**	-.13666**	-.23465**	-.18268**
	(.02377)	(.02464)	(.03840)	(.04265)
Proportion white	-.24099**	-.22973**	-.26713**	.16404**
	(.03477)	(.03490)	(.04422)	(.06572)
Proportion black	-.01347	.14802**	.25690**	.67974**
	(.03098)	(.03455)	(.04146)	(.08911)
Proportion elderly	.50729**	.64325**	.83733**	-.18268**
	(.02553)	(.02776)	(.03681)	(.04432)
Average income ($1,000)	-.00316**	-.00157**	-.00035**	-.00269**
	(.00037)	(.00039)	(.00053)	(.00059)
School crowding	-.02267**	-.03346**	-.03443**	-.01989**
	(.00188)	(.00217)	(.00257)	(.00367)
% Δ population	.00082**	.00072**	.00079**	-.00005**
	(.00005)	(.00006)	(.00007)	.00013
# cities in county				.10392**
				(.00870)
Square of # cities				-.00302**
				(.00031)
Observations	63085	63085	63085	63085
R^2	.726	.724	.656	.713

(1) Regulatory index assumed exogenous. Per capita government expenditures and property tax rate instrumented.
(2) Regulatory index, per capita government expenditures, and property tax rate instrumented.
(3) Index, index*medium size, index*large size, government expenditure, property tax rate instrumented.
(4) Index, index*# cities, index*# cities^2, government expenditures, tax rate instrumented.
[a] All equations include year of sale dummy variables, county dummy variables, county*dCBD for metro counties, and county*dCOAST for coastal counties.
[b] Robust standard errors in parentheses, ** significant at 1% level, * significant at 5% level, by a two-tailed test

Table 5
Results for Vacant Residential Land[a]

	(1)	(2)	(3)
Regulation Variables			
Index	-.02595**	-.06527**	.15419**
	(.00648)[b]	(.00977)	(.05639)
Index * # cities			-.08244**
			(.01290)
Index * # cities^2			.00422**
			(.00059)
Property Characteristics			
Log lot size	-.56476**	-.56366**	-.56626**
	(.00504)	(.00504)	(.00521)
Neighborhood Variables			
Median income	.01733**	.01735**	.01768**
	(.00042)	(.00042)	(.00046)
% Black	-.01564**	-.01558**	.01570**
	(.00057)	(.00057)	(.00007)
% Hispanic	-.00152**	-.00120**	-.00070
	(.00063)	(.00063)	(.00074)
% Renter	.00619**	.00582**	.00611**
	(.00060)	(.00060)	(.00063)
Jurisdictional Variables			
Per capita expenditure	-.00070**	-.00070**	-.00056**
	(.00009)	(.00009)	(.00019)
Property tax rate	-.14217**	-.12930**	-.09210**
	(.01037)	(.01060)	(.02042)
FOG – manager	.11563**	.13016**	-.12644
	(.03441)	(.03393)	(.07893)
FOG - commission	-.70644**	-.39728**	-7.59878**
	(.13394)	(.14351)	(1.12457)
Ag. acreage	-.01115**	-.00844**	-.00463**
	(.00123)	(.00132)	(.00211)
Non-ag. acreage	-.00005	-.00002	.00039**
	(.00003)	(.00003)	(.00006)
Proportion college	2.61633**	2.62499**	1.15154**
	(.29435)	(.29375)	(.41881)
Proportion owners	-2.20304**	-2.58789**	-3.32179**
	(.21346)	(.21444)	(.37732)
Proportion white	.97745**	1.16201**	4.63631**
	(.24199)	(.24389)	(.60110)
Proportion black	3.13321**	2.82000**	6.46639**
	.34223	(.33876)	(1.06840)
Proportion elderly	1.45880**	1.16564**	-.16065
	(.25695)	(.25407)	(.43610)

Average income ($1,000)	-.00143	-.00004	.01993*
	(.00212)	(00212)	(.00441)
School crowding	-.01043	.01717	.00756
	(.00911)	(.01040)	(.02251)
% Δ population	.00000	.00046	-.00104
	.00044	(.00044)	(.00091)
# cities in county			1.18267**
			(.14431)
Square of # cities			-.04367**
			(.00535)
Observations	57343	57343	57343
R^2	.788	.788	.628

(1) Regulatory index assumed exogenous. Per capita government expenditures and property tax rate instrumented.
(2) Regulatory index, per capita government expenditures, and property tax rate instrumented.
(3) Index, index*# cities, index*# cities^2, government expenditures, tax rate instrumented.
[a] All equations include year of sale dummy variables, county dummy variables, county*dCBD for metro counties, and county*dCOAST for coastal counties.
[b] Robust standard errors in parentheses, ** significant at 1% level, * significant at 5% level, by a two-tailed test.

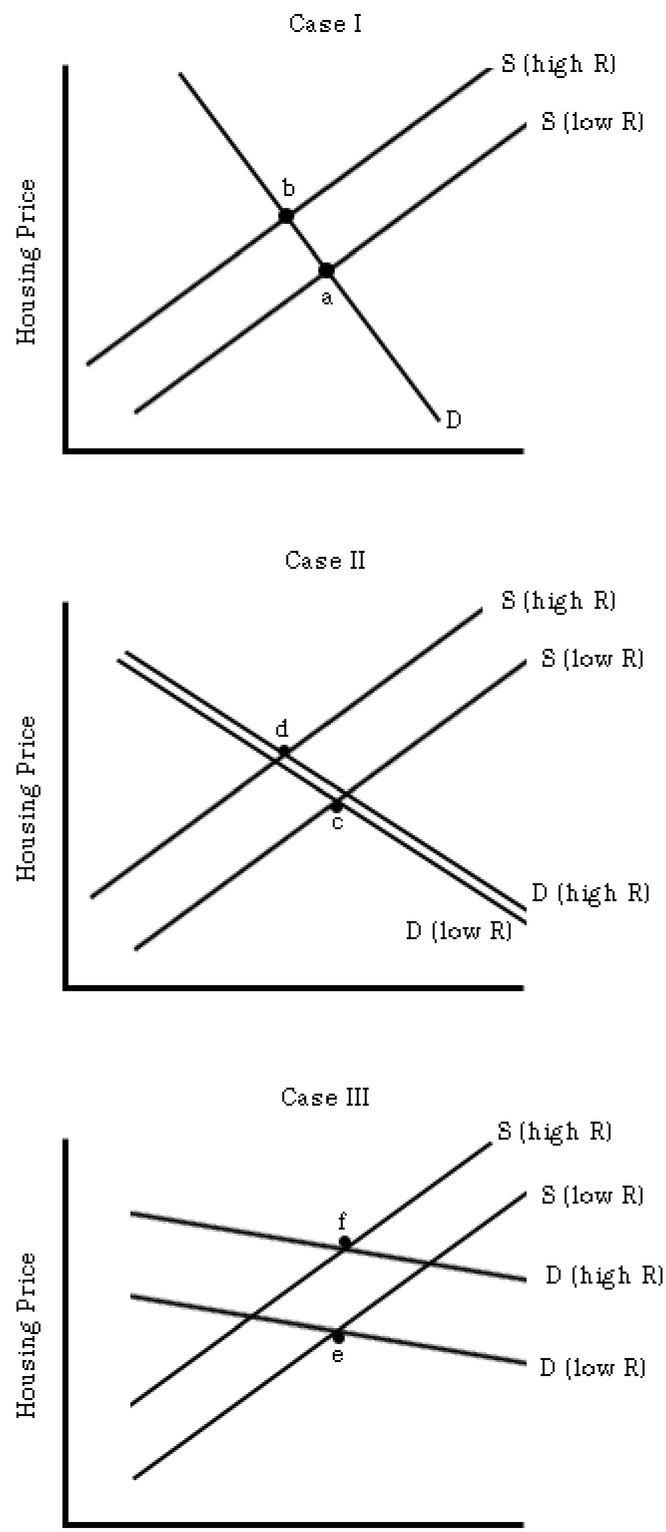
Table 6
The Impact of Regulation Index on the Size of Newly Constructed Single-Family Homes

	Dependent Variable	
	Square footage living area	Lot size in acres
Regulation index	30.197**	.02717*
	(11.763)[a]	(.01172)
Neighborhood Variables		
Median income	14.923**	-.00130*
	(.804)	(.00056)
Household size, owners	105.418**	.10075**
	(25.195)	(.01908)
% Black	-6.203**	-.00110
	(.643)	(.00095)
% Hispanic	-6.346**	-.00415**
	(1.032)	(.00065)
% Renter	1.928**	-.00106**
	(.535)	(.00028)
Jurisdictional Variables		
Per capita expenditure	.151	.00044**
	(.093)	(.00015)
Property tax rate	13.511	-.00575
	(8.137)	(.00902)
FOG – manager	-156.662**	.01031
	(33.536)	(.03489)
FOG - commission	335.335	-.09289
	(188.447)	(.10063)
Ag. Acreage	5.842**	.00357**
	(.962)	(.00122)
Non-ag. Acreage	-.034	.00001
	(.041)	(.00003)
Proportion college	143.007	.26828
	(233.777)	(.15125)
Proportion owners	-427.654**	-.04211
	(124.012)	(.08872)
Proportion white	-369.765	-.35336*
	(228.706)	(.15192)
Proportion black	-505.666	-.75179**
	(330.189)	(.17250)
Proportion elderly	541.481**	-.14692
	(146.382)	(.08989)
Average income ($1000)	13.764**	.00177
	(1.527)	(.00119)
School crowding	-39.350	-.03290*
	(9.565)	(.01572)

% Δ population	-.145**	.00004
	(.026)	(.00003)
Observations	17861	17861
R^2	.354	.183

[a] Robust standard errors in parentheses, ** significant at 1% level, * significant at 5% level, by a two-tailed test.

Figure 1
The Effect of Higher Land Use Regulation Restrictiveness on Housing Price



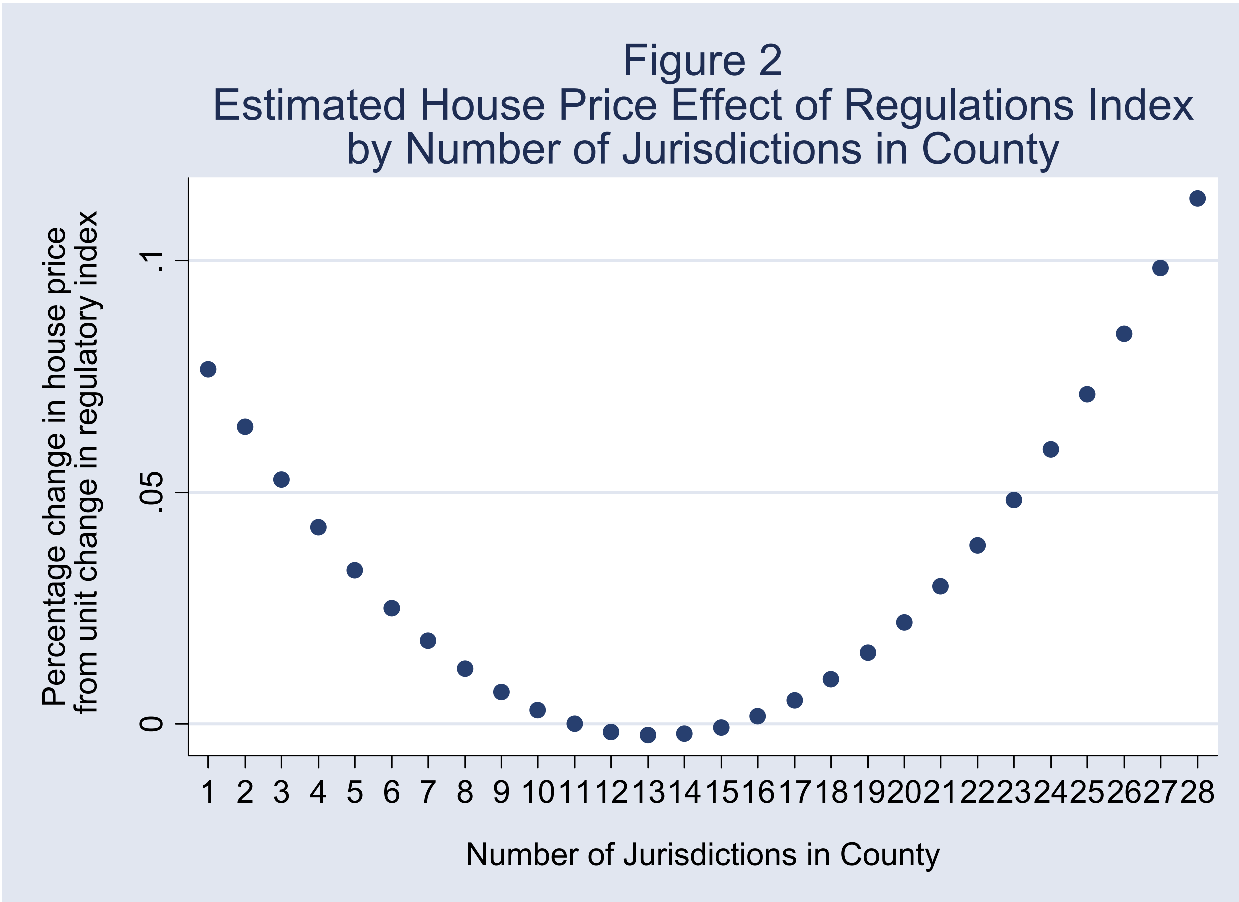


Figure 2
Estimated House Price Effect of Regulations Index
by Number of Jurisdictions in County
Percentage change in house price
from unit change in regulatory index
0
.05
.1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Number of Jurisdictions in County

Figure 3
Estimated Land Price Effect of Regulations Index
by Number of Jurisdictions in County

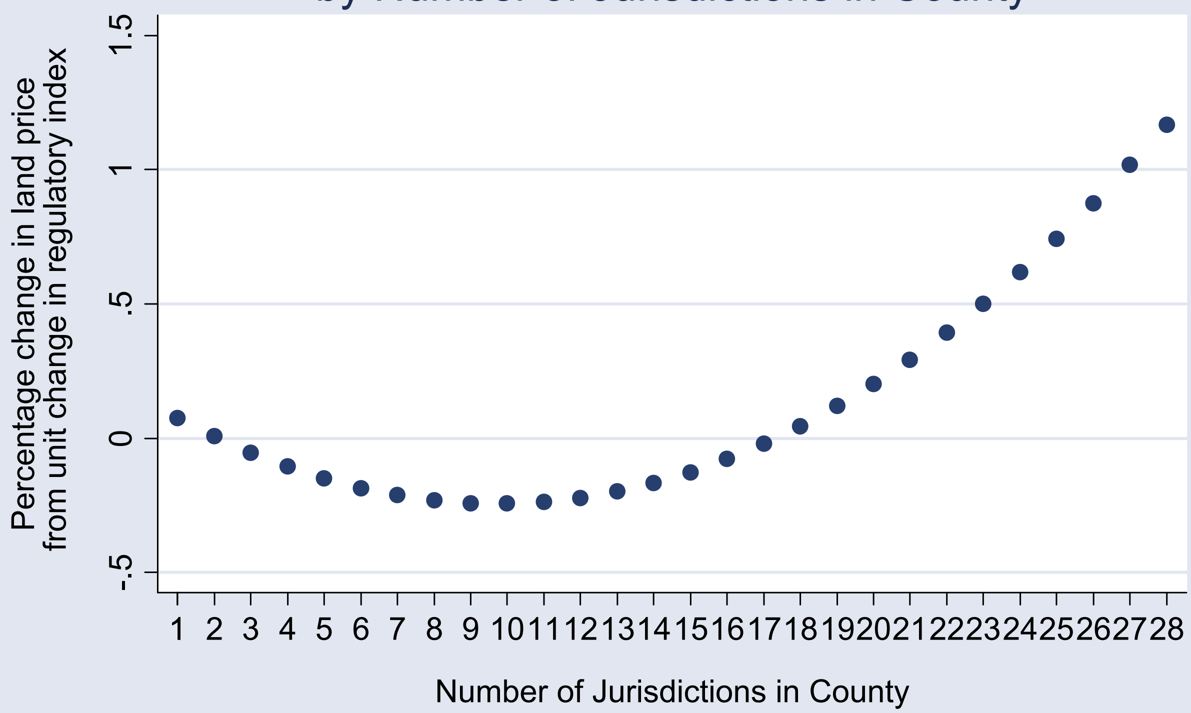


Figure 4
Optimal House Size and Land Use Regulation Restrictiveness