Housing Prices, Externalities, and Regulation in U.S. Metropolitan Areas

Stephen Malpezzi*

Abstract

Housing prices vary widely from market to market in the United States. The purpose of this study is to analyze the determinants of housing prices, with a particular focus on the effects of regulations in land and housing markets.

The basic unit of observation for this study is the city or metropolitan area. The basic method is to model house prices and rents in a simple supply-and-demand framework focusing on incomes, population changes, "noneconomic" determinants (such as topographical features), and other supply conditions (notably measures of the regulatory environment). The innovative part of the empirical analysis is constructing indices that reflect regulatory regimes in different markets.

Keywords: house prices; land use; regulations

Introduction

What determines housing prices? A number of recent studies have addressed this question, some of which are surveyed below. Virtually all studies consider demand-side factors, including income and demographic variables, and some studies focus on these exclusively.[1] Other demand-side variables include the effects of taxes and financing on prices, often through the user cost model of price determination (e.g., DiPasquale and Wheaton 1992; Follain, Hendershott, and Ling 1992).

Fewer studies have considered supply-side variables. Several studies have examined how changes in factor costs, especially land, affect housing output prices (e.g., Follain 1979; Smith 1976). Others have focused on underlying determinants of such changes, such as unionization, productivity growth in construction, and land use and other regulations (e.g., Colwell and Kau 1982; Dowall and Landis 1982; Katz and Rosen 1987; Pollakowski and Wachter 1990). While addressing each of the major categories, this article focuses particularly on determinants related to regulation. However, in studying the effects of regulation on housing prices it is important to keep in mind the benefits of regulation as well as the costs. The benefits generally stem from externalities.

* Stephen Malpezzi is Assistant Professor in the Department of Real Estate and Urban Land Economics and an associate member of the Department of Urban and Regional Planning at the University of Wisconsin, Madison. Valuable comments were made on previous versions by Jesse Abraham, Man Cho, James Follain, Isaac Megbolugbe, Dowell Myers, and Anthony M. J. Yezer, as well as participants at the 1993 and midyear 1994 American Real Estate and Urban Economics Association meetings and at the Fannie Mae Housing Price conference. This research was supported by a grant from the Graduate School of the University of Wisconsin. All opinions and remaining errors are the sole responsibility of the author.

[1] For example, Mankiw and Weil's controversial 1989 article and the many corrections to it, such as that by Green and Hendershott (1992).

This study attempts to measure some of the costs and benefits of housing market regulation, using some simple partial-equilibrium models estimated with data from large metropolitan areas. It investigates several questions:

1. Are more stringent regulatory environments associated with higher housing prices (the principal cost of regulation)?

2. Are more stringent regulatory environments associated with lower external costs or higher benefits, as measured by commute times, racial segregation, unemployment, and homeownership rates?

3. In light of this and other evidence, which cities seem to have regulatory environments where costs are in line with benefits, and which (if any) are excessively stringent?

4. How can this research be extended to analyze more benefits and externalities, and how can the regulatory side of the model be specified in more detail?

The Simple Geometry of Externalities and Regulation

No one would be, or should be, surprised at a finding that regulations raise housing prices. That is exactly what they are designed to do. What is at issue is how much they raise prices, compared with any benefits they confer.

A very simple model of regulation is presented in figure 1.[2] Consider a single housing market in which (for the moment) all housing units are identical.[3] Suppose that in the absence of regulation the supply and demand curves are S_1 and D_1, respectively, which are based on private costs and benefits for housing units, and the market reaches equilibrium at point A. This equilibrium will maximize private and social welfare, unless some externality or other market failure is present. Suppose there are one or more externalities that raise the social costs of housing above their private costs; social costs are denoted by S_2. Then clearly A is "too much" housing at "too low" a price. If public agents were perfectly informed, they could, in principle, regulate the supply of housing so that the socially preferable outcome B was reached.

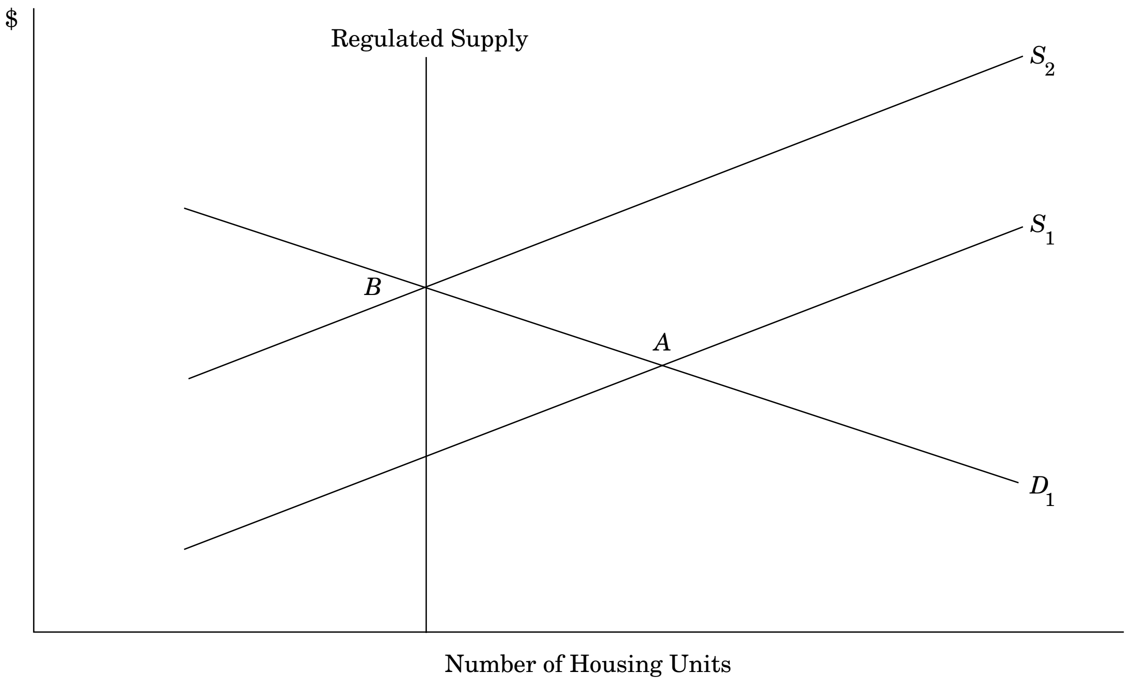
What potential externalities could raise the social costs of housing above private costs and hence, in principle, require regulation? Among many candidates are the following:

1. *Congestion*. Building additional housing units in a community generally increases traffic locally (although it may reduce total commuting distance).

[2] Crone (1983) presents a more technically sophisticated model of externalities and land use regulation.

[3] This model is very simple but sufficient to motivate our general discussion of externalities, regulation, and prices. The argument can be extended from number of units to (for example) density, height restrictions, and restrictions on particular uses. Fischel (1990) and Pogodzinski and Sass (1990) survey a wider range of such models.

Figure 1. **Case 1: Cost Externalities Exist; Optimal Regulation Is Imposed**



2. *Environmental costs*. Building additional housing units may reduce the local supply of greenspace; reduce air quality; and increase pressure on local water, sanitation, and solid waste collection systems (although again the global impact is less clear).

3. *Infrastructure costs*. Costs may rise as communities invest to grapple with environmental problems and congestion. Effects will depend on whether the particular community has yet exhausted economies of scale in the provision of each type of infrastructure.

4. *Fiscal effects*. In addition to the obvious effects from the above, demand may increase for local public services (education, fire and police protection, new residents believing libraries should be open on Sundays in contradiction to local custom). New residents may or may not pay sufficient additional taxes to cover the marginal costs.

5. *Neighborhood composition effects*. New households may be different from existing households. If existing households prefer living with people of similar incomes, or the same race, they will perceive costs if people different from them move in.

If such externalities are large and are correctly measured by the regulating authority, and if the specific policy instrument used to regulate is sufficiently precise, regulation can correct for these externalities.[4] But even if such externalities exist, departures from the preceding rather stringent requirements could leave society worse off in practice.

[4] This discussion also ignores the issue of who exactly bears these costs. For the moment, assume that winners are taxed and losers are compensated so as to share costs "fairly." And note that governments may decide that some externalities, such as a preference for racial segregation, are not legitimate.

Strictly speaking, not all benefits from regulation are external. Many regulations, for example, confer on some households a private benefit whose cost is borne by other households. But to the extent such transfers are purely private,[5] these are largely a redistribution rather than a net change in social costs and benefits. I say "largely" rather than "exactly" because a dollar's benefit to one household may not equal a dollar's cost borne by another, depending on—presuming the existence of—a particular social welfare function. While the extent and nature of such redistribution is of great interest, it is largely outside the scope of this article.

Not all potential externalities associated with housing raise costs. Many arguments suggest that other externalities exist that increase social benefits beyond private benefits. Potential external benefits include the following:

1. *Productivity and employment*. A well-functioning housing market is generally required for a well-functioning labor market. In particular, labor mobility may be adversely affected and wages may rise to uncompetitive levels if housing markets are not elastic.

2. *Health benefits*. At least at some level, less crowding and improved sanitation may be associated with lower rates of mortality and morbidity.

3. *Racial and economic integration*. One person's external cost may be another person's external benefit if some households value heterogeneity, for themselves or for others. For those particularly concerned about employment of low-income households or minorities, concerns about the productivity and employment effects mentioned earlier are reinforced.

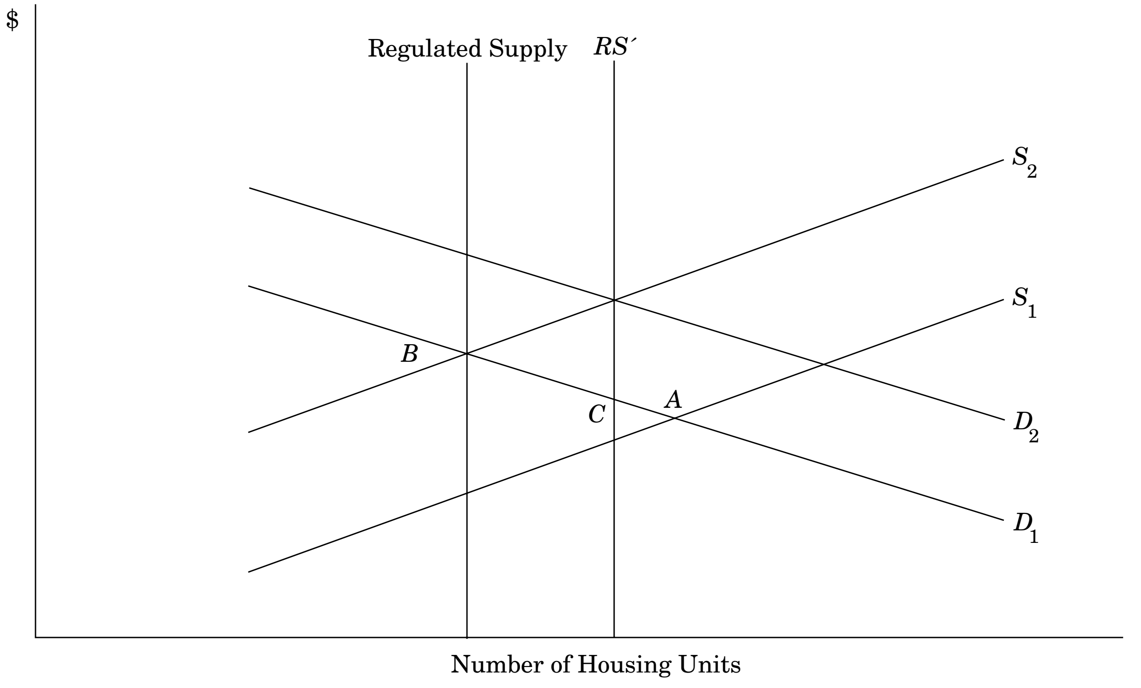
4. *Externalities associated with homeownership*. More housing units or lower housing prices may be associated with greater opportunity for homeownership. Homeownership has been argued to be associated with many desirable social outcomes, ranging from improved maintenance of the housing stock to greater political stability.

Externalities on the benefit side are represented in a stylized way in figure 2, in which a benefit-side externality is added to figure 1, driving a wedge between demand D_1, based on private benefits, and the social demand curve D_2, which includes the externality. Note that the optimum regulated output shifts considerably, to RS´. As most real-world housing markets will have multiple externalities, successful regulation—regulation that on balance more or less does correct for market failure rather than leading to a situation even worse than the suboptimal market outcome—makes very high demands on the regulator's knowledge and ability to translate that knowledge into effective policy instruments.

Many studies have attempted to calculate the cost of housing market regulation in one or a few markets, but only a few have attempted to estimate these costs across a range

[5] "Private" in the sense of "generating no externalities," not necessarily in the sense of "due to the actions of private individuals."

Figure 2. **Case 2: Cost and Benefit Externalities Exist; Regulation Is Far from Optimal**



of markets.[6] Many studies have attempted to measure the existence and size of some external benefit in housing markets, though these have rarely been related to the regulatory environment. In fact, despite much discussion and assertion, surprisingly little literature exists to confirm the existence of or to measure most of the specific externalities *across a range of markets* on either the cost side or the benefit side. Given the large number of case studies (see below), the existence of these externalities is hardly in doubt. In addition, observing revealed behavior leads to the conclusion that many people must believe such externalities exist. In fact, U.S. housing policy is inconsistent. When considering land use regulation, revealed behavior suggests that cost-raising externalities dominate. When considering financial policies, tax breaks, and other housing subsidies, it appears that extra social benefits dominate.

Previous Research

Some of the relevant literature has already been discussed in the introduction, and some (primarily related to measurement issues) is discussed below. Here I briefly survey three parts of the literature. The first is that related to the existence and size of externalities that are the rationale for regulation. The second part surveys selected studies of housing price determination. The third part discusses the effect of regulations on externalities and prices.

[6] Examples of case studies of one or a few markets include those of Colwell and Kau (1982), Dowall and Landis (1982), Katz and Rosen (1987), Pollakowski and Wachter (1990), and Cho and Linneman (1993).

Housing Market Externalities

Few previous studies of externalities have actually fit into the cross-city framework.[7] Rather, the typical study has examined the effect of various externalities on property values, usually using hedonic indices. Examples of the many studies that have demonstrated the existence of measurable externalities in one or a few markets include studies of the externality effect of waste disposal sites (e.g., Smolen, Moore, and Conway 1992), nonresidential land uses (Li and Brown 1980; Thibodeau 1990), multifamily housing (Crone 1983; Ihlanfeldt and Boehm 1987; Peterson 1974), noise (Nelson 1982), and traffic and congestion (Hughes and Sirmans 1992).

Studies that have found externality effects to be small or not measurable include that of Nourse (1963), which found few externalities for public housing projects in St. Louis. The null results may be scarce in the literature because externalities are large and pervasive, but the scarcity might also result from the bias economic journals have against publishing null results.

Because most of these studies are of one or a few markets, their generalizability is open to question. Exceptions include the literature showing that house prices (and, in some studies, population changes) are systematically affected in many metropolitan statistical areas (MSAs) by so-called blight flight externalities such as race (Follain and Malpezzi 1981a; Mills and Price 1984), low income (Follain and Malpezzi 1981b), and fiscal stress (Bradford and Kelejian 1973; Follain and Malpezzi 1981b).

Housing Prices across Cities

The literature on cross-city price determination is somewhat more developed.[8] One of the best studies of cross-MSA prices remains that of Ozanne and Thibodeau (1983). They constructed a cross-section model explaining prices derived from hedonic indices in 59 large metropolitan areas, described in Malpezzi, Ozanne, and Thibodeau (1980). Separate reduced forms are estimated for owners and renters. Independent variables include the median household income, the number of households, the percentage of nonelderly single households, the percentage of black or Hispanic households, an MSA-specific nonhousing price index, the mortgage interest rate, a dummy for the presence of an ocean or large lake, the number of municipalities per capita, construction costs, the price of farmland, taxes, wages, and utilities. Higher incomes and demographics were associated with higher rental prices, implying inelastic supply. Incomes and most demographic variables had no significant effect on the owner-occupied sector. Three of five cost input variables affected rents; only farmland price statistically affected house price. There is little information to be gleaned on regulatory or other supply-side constraints. Dispersion of municipal powers was found to lower the price of housing.[9] The dummy variable

[7] Diamond and Tolley (1982) provide an excellent overview of the role of externalities and house prices.

[8] Of course, there is also a large related literature on house prices over time (e.g., Abraham and Schauman 1991; Case and Shiller 1989; Dougherty and Van Order 1982; Peek and Wilcox 1991; Topel and Rosen 1988). See also the related literature on land prices across cities (e.g., Black and Hoben 1984; Guidry, Shilling, and Sirmans 1991; Shilling, Sirmans, and Guidry 1991).

[9] In an oft-cited paper, Hamilton (1978) posited that if suburban jurisdictions were "large," they would perceive a downward-sloping demand curve for housing and use restrictive regulation to exploit their market power.

for cities on large lakes or oceans was associated with higher rents but had no discernible effect on owner-occupied prices.

Segal and Srinivasan's (1985) study focused on land use regulations. They estimated a simultaneous-equations model of housing price inflation for 51 MSAs between 1975 and 1978. Inverting demand, price is a function of the city's housing stock and income, population, and mortgage rates. Inverting supply, price is a function of the stock, the percentage of land removed from development by regulation, and the Boeckh index of construction costs. Price changes were constructed from a weighted average of Federal Home Loan Bank Board data on new and existing single-family houses sold in 1975 and 1978. The fraction of otherwise available land off-limits to development between 1975 and 1978 was gathered from interviews with local officials in 51 MSAs. In a simple tabulation, controlled cities have annual house price increases 3 percent higher than those in uncontrolled cities. In the multivariate model, the figure is reduced to 1.7 percent.

Hendershott and Thibodeau (1990) studied 18 MSAs from 1982 to 1985. They modeled National Association of Realtors (NAR) prices as a function of income (wage and nonwage), a geographic variable (the land supply index of Rose 1989a), and, following Hamilton (1978), the number of municipal governments per capita. Prices were positively and significantly related to income and negatively but insignificantly related to Rose's geographic constraint and the number of governments.

Blackley and Follain's (1991) study focused on 34 large MSAs, in two cross sections: 1974–75 and 1977–78. They developed a five-equation static model of supply and demand for rental and owner-occupied housing, plus tenure choice and vacancy rates. They found that housing prices were driven primarily by the cost of land and construction inputs. Rents were affected by property taxes and interest rates and by the number of governments (more governments were associated with lower prices, consistent with the White-Hamilton hypothesis). No link was found between price and output, implying elastic supply in the aggregate. Income and demographics drive tenure choice.

Abraham and Hendershott (1993) analyzed Freddie Mac repeat sales price indices for 29 MSAs from 1977 to 1991. Changes in prices were a function of changes in employment, real after-tax interest rates, incomes, and construction costs (measured using National Income and Product Accounts and R. S. Means Company data). Their model explained about 40 percent of changes, and all variables worked as expected. Also, they found that their model was better fitted with Freddie Mac data than with NAR data. Transport cost variables were tried in preliminary work but dropped from their final results. No regulatory variables were included.

Several studies have investigated Hamilton's thesis using the number of municipal governments per capita as a proxy for this market power. It is hypothesized that MSAs with fewer governments per capita tend to have more restrictive regulation and, hence, higher housing prices (see also White 1975).

One issue is whether the number of jurisdictions per capita is really a good measure of market power. Another, perhaps more serious, is suggested by the "insider-outsider" distinction, as developed in labor economics. Exclusionary land use policies certainly benefit insiders at the expense of outsiders. Insiders may well find it easier to capture the regulatory process in a small jurisdiction; larger jurisdictions, which are more heterogeneous, may be harder to capture, or put another way, the interests of insiders are more diffuse. If the number of governments is a reasonable proxy, this would suggest that more governments per capita would be associated with stricter regulation and higher housing prices.

To summarize, the existing literature on cross-city housing prices usually focuses on a set of demand-side variables typically including income and demographic variables. Some studies add employment, racial composition of the MSA, and mortgage rates. Supply-side variables are more diverse across studies. Some studies include input cost measures (e.g., Boeckh construction costs, wages, or land prices). Some include geographic constraints, mainly large bodies of water. A few studies use the number of municipal governments per capita, as suggested by Hamilton (1978). But of the articles surveyed, the only study of housing prices in cross section using a direct regulatory measure was Segal and Srinivasan's land use measure.[10] I now turn to an examination of some other measures of regulatory restrictiveness.

Measuring Regulation and Other Supply-Side Constraints

Several studies have attempted to measure "regulation" across markets, and a few of these have examined the effects of regulation on land and housing prices. Segal and Srinivasan (1985), already discussed above, surveyed planning officials and collected their estimates of the percentage of undeveloped land in each MSA rendered undevelopable by land use regulations. Using a simple ordinary least squares (OLS) model of house prices, they found that the percentage of developable land removed by regulation had the hypothesized effect on house prices.

In the same journal issue, Black and Hoben (1985) developed a categorization of MSAs as "restrictive," "normal," or "permissive," using a survey questionnaire from planning officials. They appeared to base this categorization on a series of questions from which they scored "areas most openly accepting growth" as +5 and those where growth was "most limited" as –5. Black and Hoben found a simple correlation of –0.7 between their index and 1980 prices for developable lots.

Chambers and Diamond (1988) used data apparently derived from the Urban Land Institute (ULI) questionnaire in a simple supply-and-demand model for land. They found what they characterized as mixed results; for example, in their equation explaining 1985 land prices, average time for development project approval had a positive and significant effect on land prices, but it had a negative and insignificant effect in the 1980 regressions. In another study using the ULI data, Guidry, Shilling, and Sirmans (1991) found that the average 1990 lot price in 15 "least restrictive" cities was $23,842 but that in 11 "most restrictive" cities the average was $50,659.

Rose (1989a, 1989b) constructed an index that measured land removed from development by natural constraint and (in Rose 1989b) used the number of governments, à la Hamilton, as a proxy for additional regulatory constraint. City by city, Rose carefully measured the area removed from development by natural constraint (mainly water) and used a simple monocentric model of a city to take into account that an acre removed close to the central business district has a greater effect than an acre farther out. He found using Federal Housing Administration and ULI land price data for 45 cities that the natural and contrived restrictions explained about 40 percent of the variation in land

[10] Several studies have used the Urban Land Institute regulatory measures in examining land prices across MSAs.

prices; about three-quarters of this was due to natural restriction and about one-quarter apparently due to regulation.

States as well as local governments regulate land use. In the 1970s the American Institute of Planners (AIP 1976) collected a great deal of information about state land use and environmental regulations. Shilling, Sirmans, and Guidry (1991) found that cities in states with more restrictive land use regulations had higher land prices. The elasticity of price with respect to state land use controls was estimated to be 0.16.

Other articles have presented regulatory measures without much empirical analysis of their effects. The U.S. Department of Housing and Urban Development (HUD 1991) and the National Multi Housing Council (1982) collated data on types of rent control regimes in various cities. A very ambitious study by the Wharton Urban Decentralization Project carried out by Peter Linneman, Anita Summers, and others (see Buist 1991; Linneman et al. 1990) collected a number of regulatory measures, described in more detail below.

Each of these studies makes important contributions, but each has its shortcomings. Only Segal and Srinivasan directly study the effects of their regulatory measure on housing prices, although several articles (Black and Hoben, Rose, Shilling et al.) do study the effects on land prices. None considers possible benefits from regulation. Some make particularly strong assumptions; for example, Rose's measure assumes that each city has the same population density gradient.[11] Looked at another way, none of the studies that model the housing market pay much attention to direct measures of regulation (although several examine the number of local governments as a proxy).

The aims of this article, then, are (1) to extend and improve the regulatory measures, (2) to focus on housing prices (in contradistinction to land prices), (3) to more carefully model other determinants of housing prices, and (4) to consider the effects on externalities (endogenize the benefit side).

A Simple Model and Its Implementation

A Model of Housing Prices, Including Regulation and Externalities

I begin by considering the demands for rental and owner-occupied housing separately. Following a standard model of a housing market, the demand-side determinants of each tenure's quantity of housing services demanded, Q^D_{hr} and Q^D_{ho}, are the relative prices of rental and owner-occupied housing (P_{hr} and P_{ho}, respectively); a vector of income and wealth variables **I**; and a vector of demographic variables **D**:

$$Q^D_{hr} = f(P_{hr}, \mathbf{I}, \mathbf{D}),$$

$$Q^D_{ho} = f(P_{ho}, \mathbf{I}, \mathbf{D}). \qquad (1)$$

[11] Edmonston (1975) reports gradients ranging from –0.01 to 0.81 for 57 large cities in a single year. A natural extension of Rose's work would be to use city-specific density gradients from previous studies or from analysis of census data. Another natural extension would be to report natural and regulatory constraints separately.

Supply depends on the price of housing, topographical constraints (denoted **G**), and a vector of regulations affecting supply (denoted **R**):[12]

$$Q_{hr}^{S} = f(P_{hr}, \mathbf{G}, \mathbf{R}),$$
$$Q_{ho}^{S} = f(P_{ho}, \mathbf{G}, \mathbf{R}). \quad (2)$$

In equilibrium, substitution results in two reduced-form equations of price determination:

$$P_{hr} = f_1(\mathbf{I}, \mathbf{D}, \mathbf{G}, \mathbf{R}, e_1),$$
$$P_{ho} = f_2(\mathbf{I}, \mathbf{D}, \mathbf{G}, \mathbf{R}, e_2). \quad (3)$$

The error terms e_i are added because the relations are of course stochastic.

Next I consider tenure choice. Following (for example) Megbolugbe and Linneman (1993) and Blackley and Follain (1988), I specify a tenure choice model that is driven by the relative prices of each tenure, by income, and by demographics, but in which regulation may affect tenure. The MSA-specific rate of homeownership can be expressed as

$$T = f_3(P_{ho}, P_{hr}, \mathbf{I}, \mathbf{D}, \mathbf{R}, e_3). \quad (4)$$

Notice that regulation **R** can affect tenure directly but also indirectly through its partial effect on prices (see the discussion of direct and indirect effects in footnote 12).

Next I specify the additional outcomes representing possible benefits of regulation. In light of the discussion above, I hypothesize that, in addition to affecting P, Q, and T, regulation could affect the following:

1. Average commuting times (to the extent that regulation can on balance correct congestion externalities)

2. The extent of racial segregation (to the extent that regulation favors neighborhood insiders at the expense of outsiders)

3. Occupants' perceptions of the quality of their neighborhoods (for reasons including those just listed)

[12] Most models also note that supply prices depend on the prices of inputs (P_i). Good data on input prices, especially land, are not available. However, the prices of inputs are themselves determined by variables on the right-hand side (**G** and **R**), so we can substitute those directly for P_i. In other words, the observed effects of, say, a change in the regulatory environment on output supply price occur partly directly and partly through effects on the price of inputs, or

$$\frac{dP_h}{d\mathbf{R}} = \frac{\partial P_h}{d\mathbf{R}} + \frac{\partial P_h}{\partial P_i} \cdot \frac{dP_i}{d\mathbf{R}}.$$

That is, with this model and these data it is possible to determine the change in price due to a change in, say, regulation but not to decompose this change into direct output price and indirect input price effects. Output price effects can stem from regulation's effect on the elasticity of substitution between inputs.

Following the literature, average commuting time (denoted C), racial segregation (denoted S), and perceptions of neighborhood quality (denoted N) are potentially functions of income, housing prices, demographics (including racial composition of the MSA), and regulation. On commuting see, for example, Domencich and McFadden (1975) and Meyer, Kain, and Wohl (1966). Representative models of segregation can be found in Schnare (1974) and Yinger (1979). The literature on neighborhood quality includes Boehm and Ihlanfeldt (1991), Brown (1980), and Diamond and Tolley (1982). The determinants of these outcomes can be represented as follows:

$$C = f_4(P_{ho}, P_{hr}, T, \mathbf{I}, \mathbf{D}, \mathbf{R}, S, e_4),$$

$$S = f_5(P_{ho}, P_{hr}, T, \mathbf{I}, \mathbf{D}, \mathbf{R}, e_5), \quad (5)$$

$$N = f_6(P_{ho}, P_{hr}, T, \mathbf{I}, \mathbf{D}, \mathbf{R}, S, e_6).$$

The hypotheses that segregation affects commuting time and neighborhood opinions are conditionally entertained, but we have no expectation that commuting time or neighborhood ratings affect segregation. Again, regulation can affect these outcomes directly or through intervening variables such as house prices and tenure.

Thus the initial model consists of seven equations: rental price, owner-occupied price, tenure choice, commuting time, segregation, neighborhood quality, and an additional instrumental equation for the quantity of housing services. Generally the model will be specified as linear in the logarithms of the levels of variables (such as price, income, and population) and linear in the changes, ratios (such as the percentage of owner-occupiers), and dummy variables. The MSA is the unit of observation. All equations are estimated with least squares.

Data

Prices. For the measure of price, three candidate series were examined: (1) median house values and contract rents as reported by the decennial census, (2) sales price data collected by NAR (1991), and (3) hedonic price indices such as those reported by Thibodeau (1992).[13]

Each of these measures has advantages and disadvantages. Census median house values and rents are available for all MSAs, by far the broadest coverage in cross section; but they are available only every 10 years, and they are not really price indices but stock and flow measures of expenditure.[14] NAR data are available for a wide range of MSAs (currently 129) and in a timely fashion (quarterly, with a short lag). But they too are not pure price measures and are based on transactions reported by multiple listing services, which may not be representative of the entire market. And there are no rent data.

[13] Other price measures could be considered, such as those reported by Haurin, Hendershott, and Kim (1991).

[14] In addition, rents are collected for the renter stock, not the entire stock, and median values for the owner-occupied stock. The contract rent data include the effect of utilities included in rent. Owner-occupant appraisals have wide variances, but the bias in aggregate measures should be small. See Follain and Malpezzi (1981c).

Hedonic price indices offer the best approximation to a pure price index (Malpezzi, Ozanne, and Thibodeau 1980) but are costly to construct, and data are available for only a limited number of cities, with a substantial lag.

Loosely speaking, then, the tradeoff is as follows: If timeliness is important, the NAR data have some advantage (that is not important for the present purpose, which is to explain a single cross section of housing prices). If degrees of freedom are an issue (they are), census data offer the most. But clearly hedonic price indices are preferred on theoretical grounds.

Since the NAR and census data are not true price indices but are correlated with prices, we can treat this as an empirical issue. In fact, in cross section the census medians are highly correlated with other measures. The correlation between 1990 census median values and 1990 NAR median sales prices is 0.98. The correlation between Thibodeau's American Housing Survey price indices for the early 1980s and the corresponding NAR price index is 0.95. Given the high correlation among these indices, this article relies on the census measure, particularly since the number of degrees of freedom is an issue.

Measuring "Regulation." One of the focal points of this article is the construction of indices that reflect regulatory regimes in different markets. Regulations that are potentially of interest include rent controls, land use and zoning regulations, infrastructure policies, and building and subdivision codes.

Candidate measures, most of which have already been discussed above, are presented in table 1. The discussion relies heavily on the data collected by the Wharton research project, documented by Linneman et al. (1990) and Buist (1991). I constructed geographic variables by visually inspecting maps of each metropolitan area. Rent controls were measured by the National Multi Housing Council (1982) and HUD (1991).

Ideally, we could make use of all this regulatory information, and over time we hope to. As a practical matter, many of the studies that construct these measures must limit themselves to a manageable number of MSAs. The union of these sets is rather small, so we have to make some choices about which regulatory data to rely on most in our initial work. Black and Hoben's index was not available at the time of this study.[15] The state regulatory measures are useful, but our expectation is that local regulations matter more than state regulations, and these measures are also older than other data collected. The rent control index, Rose's geographic land supply index for 40 cities, and Segal and Srinivasan's percentage of land for 50 cities are discussed somewhat, but the focus is on the Wharton measures.

How does one construct an aggregate measure of "regulation"? Two approaches were tried. First, simple additive indices were constructed in which heavier regulation increased the size of the scale.[16] But the implicit weighting of different regulatory components, and of values within components, is arbitrary. Is rent control as powerful as zoning? Is moving from a permissive to a normal environment the same as moving from

[15] Black and Hoben unfortunately did not publish their actual index.

[16] Somerville (1994) uses some of the same components as our index, without aggregation.

Table 1. **Summary of City-Specific Measures of Supply-Side Constraints**

Measure/Study	Description	Advantages	Disadvantages
Wharton regulatory practices data, collected by Linneman et al. (1990; see Buist 1991)	Response to questions about development process in 60 large MSAs	Good coverage of development process	More "subjective" measure; limited to 60 cities
State land use (AIP 1976)	Data on presence/absence of state land use regulations	Good focus on land use and related environmental regulations; broad (if unfocused) coverage	State, not MSA, is unit of observation; dated (late 1970s)
ULI regulatory index (Black and Hoben 1985)	Based on response to questionnaires from 30 cities (+5 = progrowth, –5 = antigrowth)	Good coverage of development process	Based on "subjective" assessments by local experts; raw data not published
Percentage of land removed from development by regulation (Segal and Srinivasan 1985)	Percentage of land unavailable for development in 51 cities, based on questionnaires	Potentially robust measure of land regulation	Seeming inconsistencies in some local responses
Rose's (1989a) land supply index	Percentage of land removed from development by bodies of water, for 40 cities	Excellent conceptually	Limited sample; sensitive to assumption of gradient (assumed exogenous)
Geographic restrictions (this study)	Limitations by large bodies of water, state and national boundaries, adjacent MSAs, for 200 MSAs	Wide coverage	Based on simple perusals of maps; could be improved with more geographic sophistication
Measures of monopoly zoning power (Fischel 1981; Hamilton 1978; Rose 1989b)	Number of municipalities (Hamilton) or townships and municipalities with zoning power (Fischel)	Wide coverage	Muddled effects of "competitiveness" and "insider-outsider ratio"
Rent control measures (this study)	Presence and type of rent control, based on HUD (1991), National Multi Housing Council (1982), other sources	Wide coverage	Rent control may affect prices directly, but probably more of a proxy for other regulatory devices

normal to restrictive? And what about the many hundreds of specific regulations that we have not measured?

An alternative is to use some data reduction method. Our problem is that there is an unobservable random variable (or variables) we call "regulation" for convenience. We observe a number of variables that are presumably correlated with this unobservable—for example, the presence or absence of rent control, state environmental regulations, and land made off-limits by regulatory constraint. Factor analysis is a natural method to use in such a situation (Johnson and Wichern 1988). We applied the most straightforward method, that of principal components. This method can reduce a large number of regulatory variables to a smaller number of principal components that contain most of the information in the full set. However, preliminary work revealed that factor scores were highly correlated with simple additive scales, so hereafter I report results from that simple procedure.

To construct the simple measure, REGTEST, we added the unweighted values of seven variables collected by the Wharton team:

1. APPTIME: Change in approval time (zoning and subdivision) for single-family projects between 1983 and 1988 (1 = shortened considerably, 2 = shortened somewhat, 3 = no change, 4 = increased somewhat, 5 = increased considerably)

2. PERMLT50: Estimated time between application for rezoning and issuance of permit for a residential subdivision less than 50 units (1 = less than 3 months, 2 = 3 to 6 months, 3 = 7 to 12 months, 4 = 13 to 24 months, 5 = more than 24 months)

3. PERMGT50: Similar to PERMLT50 but for single-family subdivision greater than 50 units

4. DLANDUS1: Acreage of land zoned for single-family housing as compared with demand (1 = far more than demanded, 2 = more than demanded, 3 = about right, 4 = less than demanded, 5 = far less than demanded)

5. DLANDUS2: Similar to DLANDUS1 but for multifamily housing

6. ZONAPPR: Percentage of zoning changes approved (1 = 90 to 100, 2 = 60 to 89, 3 = 30 to 59, 4 = 10 to 29, 5 = 0 to 9)

7. ADQINFRA: Wharton scale for adequate infrastructure—roads and sewers (1 = much more than needed, 2 = slightly more than needed, 3 = about right, 4 = less than needed, 5 = far less than needed)

As some readers of previous drafts have commented, our interpretation that these measures reflect mainly supply-side phenomena can be debated. Certainly demand conditions can affect each of these measures to some degree. Our maintained hypothesis is that in markets with elastic supply, and a correspondingly elastic regulatory environment, the land and housing markets will usually be close to equilibrium despite reasonable variations in demand; in addition, in the estimates below we control for variations in demand directly.

Another point to note about these measures is that they are constructed from a reduced information set; there are literally hundreds of individual regulations and possible candidate measures. Our maintained hypothesis is that there is some correlation between included and excluded measures. Thus the measures we construct are best interpreted as proxies for some unmeasured latent variable “regulation.” This implies that the coefficients of the models below should not be taken literally as the exact partial effects of individual components.

Figures 3 and 4 are plots of census median contract rents and house values against the unweighted sum of these regulatory variables, REGTEST. The bivariate relationship between them is strong and quite possibly nonlinear. Chicago had the lowest value of REGTEST, 13, while San Francisco and Honolulu had values of 29. The lowest possible score is 7, and the highest 35.

State-level regulatory data were from AIP (1976), which collected detailed information on state regulation of land use and related interventions. We constructed a series of dummy variables on the presence or absence of the following:

1. State comprehensive land use planning
2. State coastal zone management plans
3. State wetlands management regulations
4. State floodplain management
5. State designation of some locations as “critical” for land use regulation
6. State enabling legislation for “new towns”
7. State requirement for environmental impact statements
8. State regulations preempting local regulations for “developments of greater than local impact”

As with the Wharton data, we experimented with data reduction techniques but settled on a simple additive index, SREG1, with a range from 0 to 8.[17] Figures 5 and 6 are plots of the median contract rents and house values against the state-level index.

Our final regulatory variable is the simplest. Based on National Multi Housing Council (1982) and HUD (1991) reports, we constructed a dummy variable for the presence of rent control, RCDUM. Our regulatory measures and house price data are presented in table 2.

Other Variables. Income is measured by metropolitan per capita income (levels and changes), and demographic considerations are captured by the level of population and its

[17]Note that the AIP data were collected some years before the rest of the data. In general, more states probably have such regulations today than had them in the late 1970s. To some extent we are thus measuring which states were most aggressive in enacting such legislation.

Table 2. **Selected Regulatory Variables**

City	City-Specific Regulatory Index (Wharton Data)	State Regulatory Index (AIP Data)	Rent Control Dummy	Census Median House Value ($)	Census Median Contract Rent ($ per Month)
San Francisco (SF), CA	29	6	1	332,400	663
Honolulu (HON), HI	29	*	0	283,600	615
Sacramento (SAC), CA	26	6	0	136,700	465
San Diego (SD), CA	26	6	0	186,700	564
Boston (BOS), MA	26	6	1	186,100	581
New York (NYC), NY	26	5	1	209,000	455
Los Angeles (LA), CA	25	6	1	226,400	570
San Jose (SJS), CA	25	6	1	289,400	715
Newark (NWK), NJ	25	5	1	191,400	513
Philadelphia (PHL), PA	24	3	0	100,800	435
Miami (MIA), FL	24	2	0	86,500	422
Albany (ALB), NY	23	5	1	99,300	375
Pittsburgh (PIT), PA	23	3	0	55,600	289
Allentown (ALN), PA	23	3	0	102,400	395
Charlotte (CTE), NC	22	4	0	72,300	362
Fort Lauderdale (FTL), FL	22	2	0	91,800	497
Cincinnati (CIN), OH	22	2	0	71,100	310
Toledo (TOL), OH	22	2	0	59,700	298
Indianapolis (IND), IN	21	5	0	66,800	342
Syracuse (SYR), NY	21	5	0	77,300	362
Houston (HOU), TX	21	4	0	64,300	339
Akron (AKR), OH	21	2	0	63,600	316
Cleveland (CLV), OH	21	2	0	74,100	332
Memphis (MEM), TN	21	2	0	64,800	297
Rochester (ROC), NY	20	5	0	86,600	400
Baltimore (BLT), MD	20	4	0	101,200	399
Providence (PRV), RI	20	3	0	131,100	425
Orlando (OR), FL	20	2	0	84,300	447
Atlanta (ATL), GA	20	2	0	89,800	411
Columbus (COL), OH	20	2	0	72,200	342
Birmingham (BIR), AL	20	1	0	59,200	260
Tulsa (TUL), OK	20	1	0	58,900	287
Hartford (HRT), CT	19	5	1	170,900	512
Greensboro (GRN), NC	19	4	0	71,300	300
Portland (PRT), OR	19	4	0	72,300	374
Richmond (RCH), VA	19	3	0	79,300	375
Kansas City (KCM), MO	19	2	0	66,500	346
Youngstown (YNG), OH	19	2	0	50,400	265
Salt Lake City (SLC), UT	19	2	0	71,000	313
Grand Rapids (GRP), MI	18	5	0	54,500	286
Milwaukee (MIL), WI	18	5	0	76,900	376
San Antonio (SAN), TX	18	4	0	57,300	316
Mobile (MOB), AL	18	1	0	55,300	237
Phoenix (PHX), AZ	18	1	0	85,300	394
Oklahoma City (OKC), OK	18	1	0	54,500	286
Detroit (DET), MI	17	5	0	68,300	363
Buffalo (BUF), NY	17	5	1	74,000	292
New Orleans (NO), LA	17	4	0	70,000	301
Denver (DEN), CO	17	3	0	87,800	377
Tampa (TAM), FL	17	2	0	71,300	377
Minneapolis (MIN), MN	16	6	0	88,700	444
St. Louis (STL), MO	16	2	0	70,000	320

Table 2. **Selected Regulatory Variables** *(continued)*

City	City-Specific Regulatory Index (Wharton Data)	State Regulatory Index (AIP Data)	Rent Control Dummy	Census Median House Value ($)	Census Median Contract Rent ($ per Month)
Dallas (DAL), TX	15	4	0	83,000	393
Gary (GRY), IN	14	5	0	58,100	299
Dayton (DAY), OH	14	2	0	65,000	308
Chicago (CHI), IL	13	3	0	111,200	425

*Not available.

growth. The census income and demographic variables were collected from the *State and Metropolitan Area Data Book* (U.S. Bureau of the Census 1986) and from Census Bureau CD-ROM files. Homeownership is straightforwardly the percentage of each MSA's households in owner-occupied housing, from the 1990 census. As a flow measure of the quantity of housing services, we used the number of building permits in each metropolitan area as reported in the U.S. Bureau of the Census's annual C-40 reports.

Congestion is proxied by the average census round-trip commuting time in 1990 in each MSA. Segregation is measured as the percentage of blacks who live in neighborhoods that are at least 90 percent black, from Farley (1993), as presented in Turner (1992). Measures of geographic constraint were constructed from maps of each MSA. Dummy variables represent whether the MSA is adjacent to a coastline (ocean or large lake) and whether the unit is adjacent to one or more large parks, military bases, or reservations.

Results

Results from a Simple Model of Price Determination

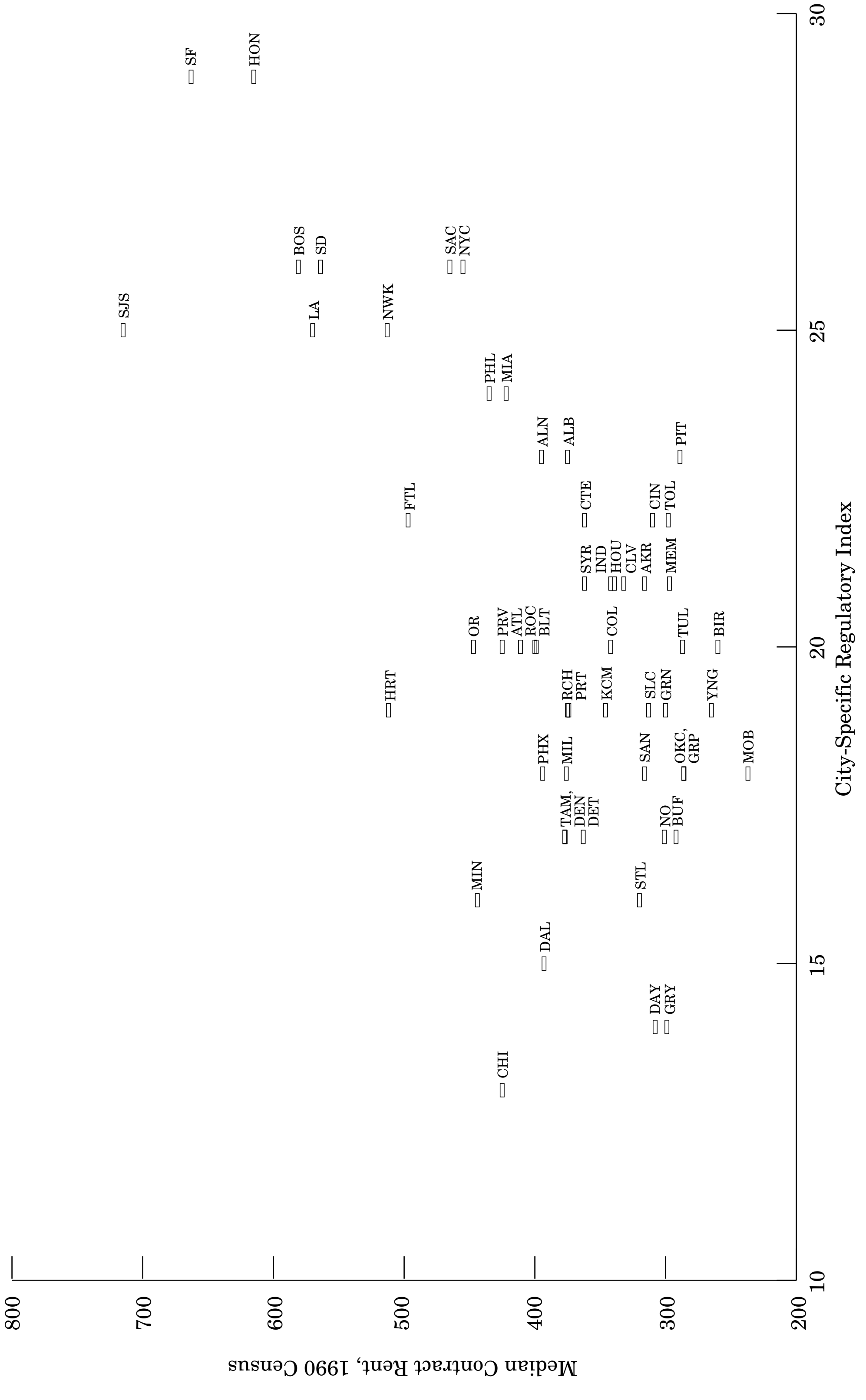
Results from simple OLS regressions determining rents and house values, using logarithmically transformed census data as the dependent variable, are presented in tables 3 and 4.[18] The fit of the equations is quite good for such a cross-section model, and most variables fit expectations. The value model performs slightly better than the contract rent model.

Among significant determinants of rents appear to be population and income, especially population changes and income levels. Cities next to large parks and bodies of water may have higher rents, but the estimates are imprecise. Of the regulatory variables, only the state index performs strongly. A joint test of all the regulatory variables rejects the null hypothesis (presumably driven by the state variable).

For the value equation, most of the variables have the correct sign and reasonable standard errors. Notice that the effect of REGTEST is strongly quadratic. An F test for

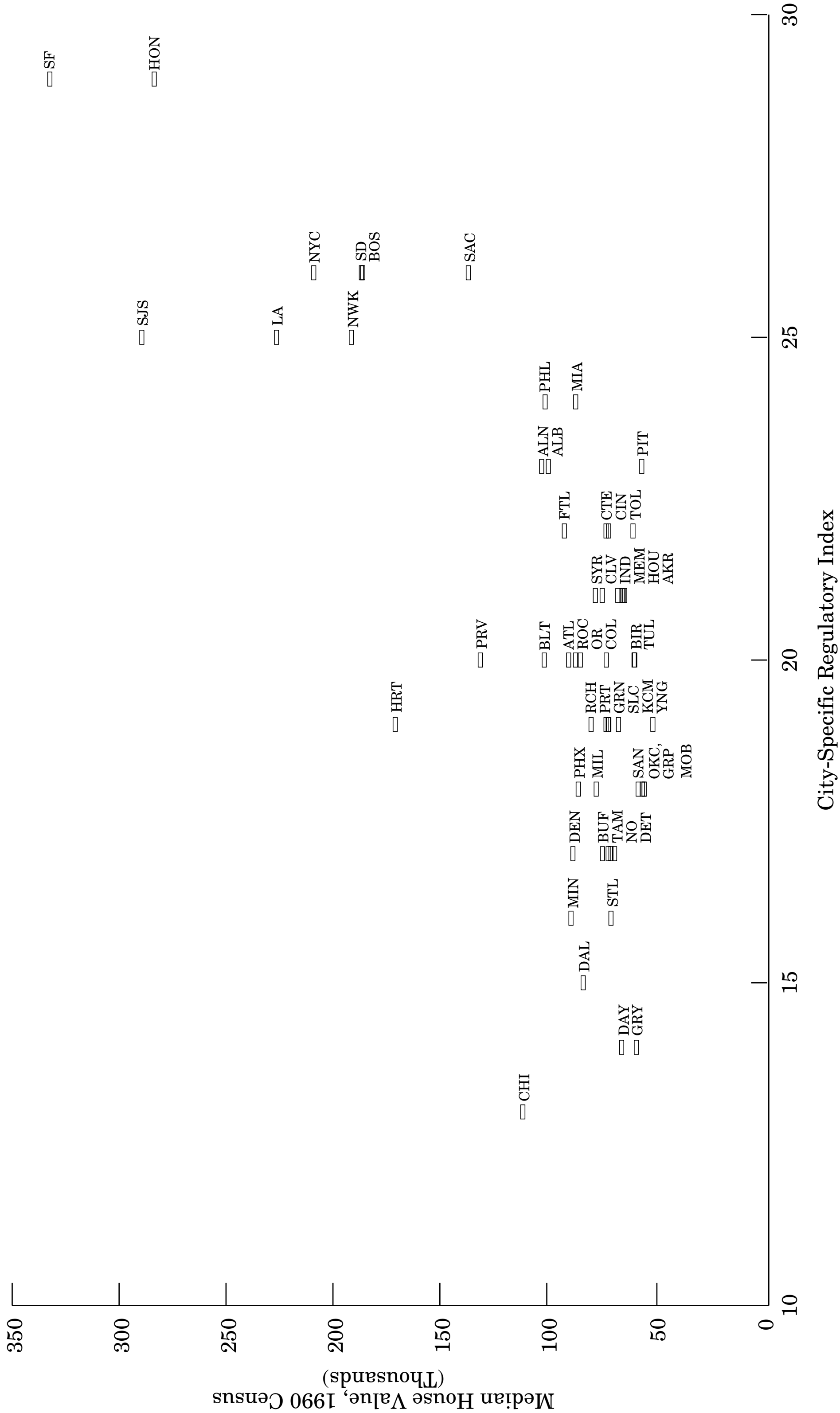
[18] We also experimented with two- and three-stage least squares estimation, given the simultaneity in this system and the possibility that errors may well be correlated across cities. But these techniques lost substantial degrees of freedom, as not all variables in all equations are available for all cities. The reduction to as few as 13 degrees of freedom, and the fact that the attractive properties of these estimators are obtained only in large samples, lead us to rely on OLS results.

Figure 3. **Median Monthly Contract Rent ($) versus City-Specific Regulatory Index (Wharton Data)**



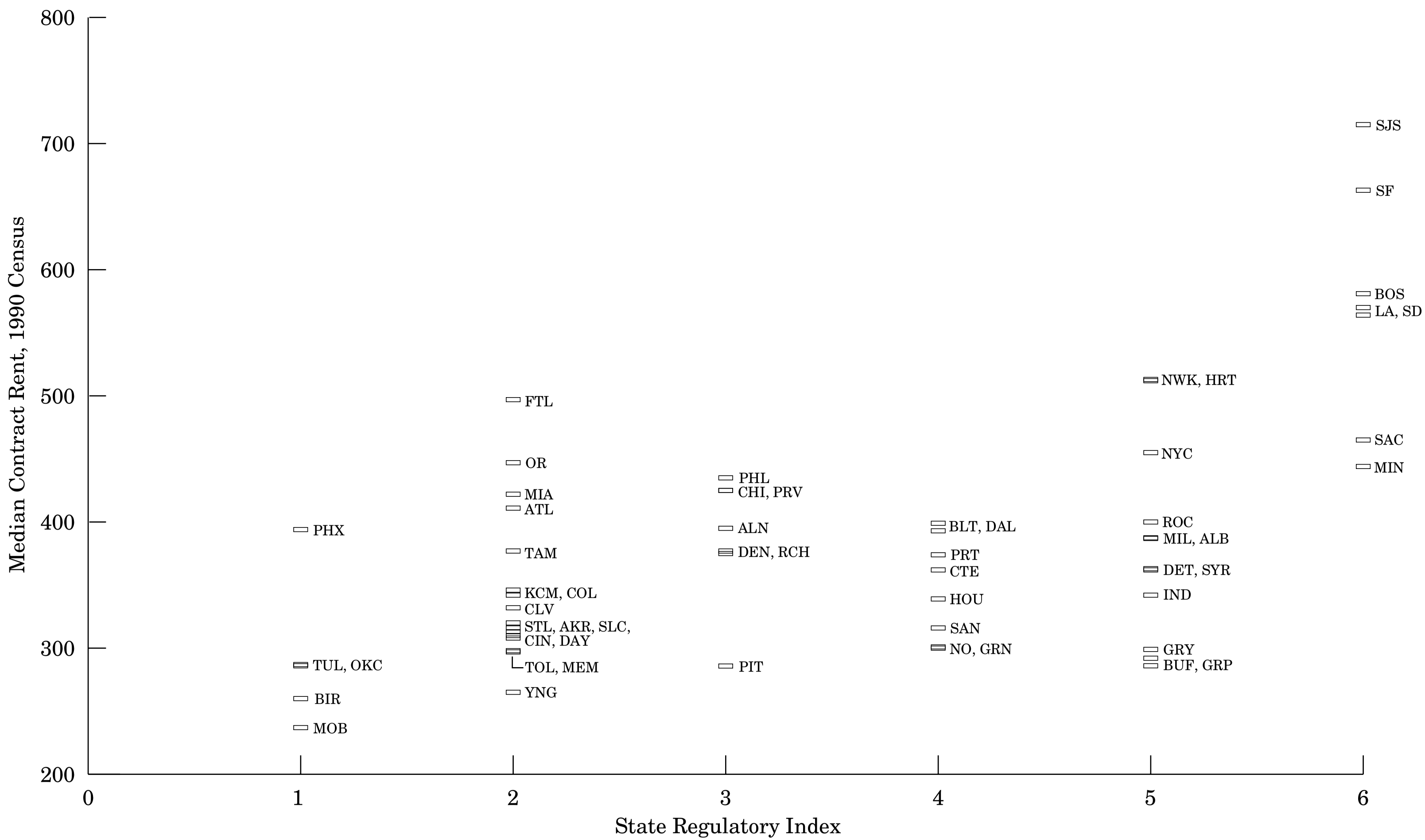
Note: See table 2 for a definition of the acronyms used in this figure.

Figure 4. **Median House Value ($) versus City-Specific Regulatory Index (Wharton Data)**



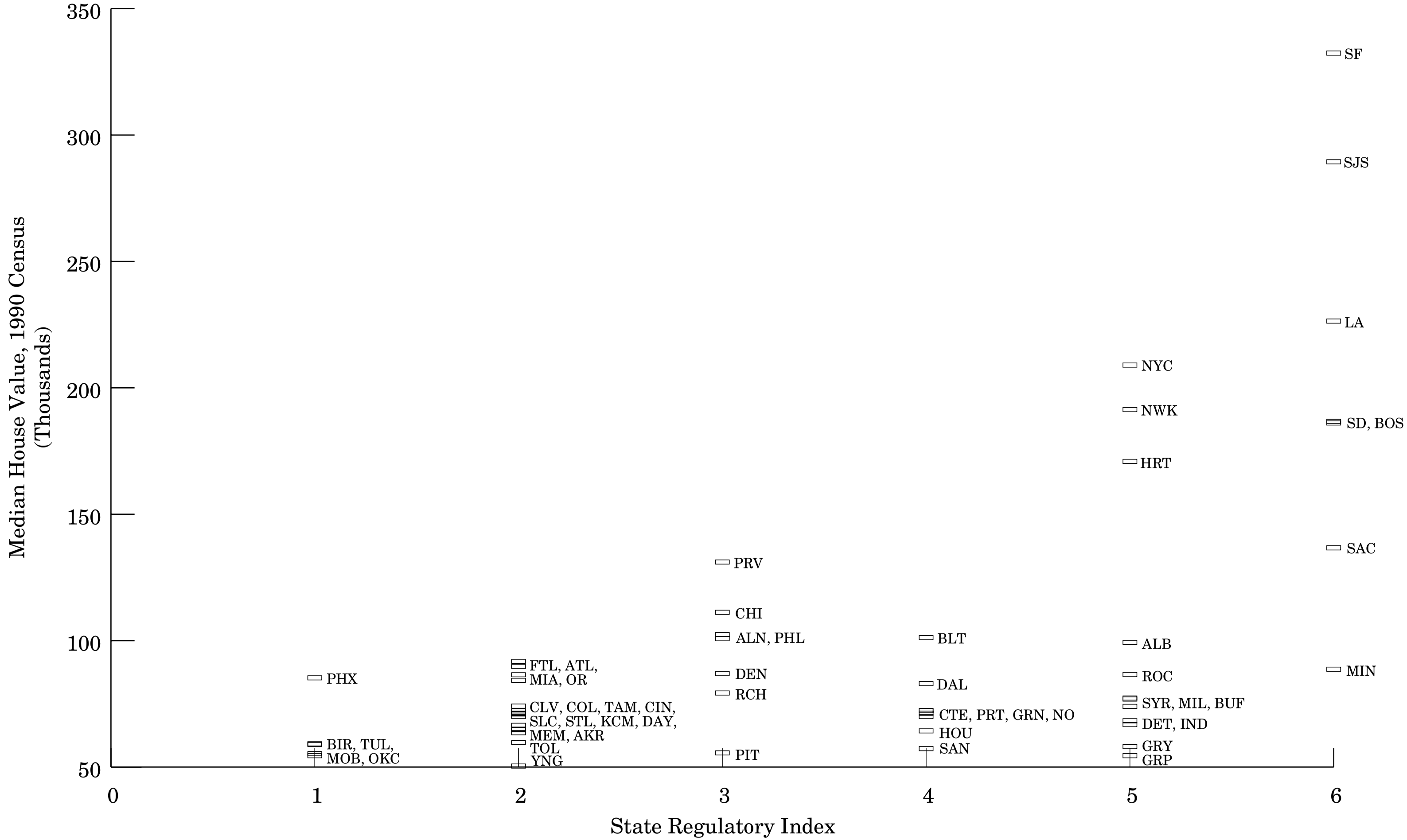
Note: See table 2 for a definition of the acronyms used in this figure.

Figure 5. **Median Monthly Contract Rent ($) versus State Regulatory Index (AIP Data)**



Note: See table 2 for a definition of the acronyms used in this figure.

Figure 6. **Median House Value ($) versus State Regulatory Index (AIP Data)**



Note: See table 2 for a definition of the acronyms used in this figure.

Table 3. **Reduced Form, Census Median Contract Rent (Dependent Variable: Log Median Rent, 1990 Census)**

Variable	Parameter Estimate	Standard Error	t for H_0: Parameter = 0	Prob > |t|	Variable Definition
INTERCEP	0.1182	1.7080	0.07	0.945	Intercept
LMPOP90	0.0386	0.0265	1.46	0.153	Log MSA population, 1990
DMP8090	5.4909	1.7196	3.19	0.003	Annual growth in MSA population, 1980–90
LMYPC90	0.5395	0.1480	3.64	0.001	Log MSA annual per capita income, 1990
MRDYP987	2.3288	1.3368	1.74	0.090	Annual growth in real MSA per capita income, 1979–87
ADJPARK	0.1001	0.0631	1.59	0.121	Adjacent to large park, military base, or reservation
ADJWTR	0.0371	0.0359	1.03	0.308	Adjacent to coast or major lake
SREG1	0.0292	0.0124	2.35	0.024	Sum of AIP state regulatory variables
RCDUM	0.0109	0.0630	0.17	0.864	Rent control dummy
REGTEST	–0.0324	0.0504	–0.64	0.525	Regulatory index from Wharton data
REGSQ	0.0012	0.0012	0.98	0.332	Square of REGTEST

Note: R^2 = 0.85; adjusted R^2 = 0.81; degrees of freedom = 48; F = 21.671 (p = 0.0001).

the regulatory variables (SREG1, RCDUM, REGTEST, and REGSQ) again rejected the null hypothesis. To get a rough-and-ready measure of their joint effect, we calculated the estimated percentage increase in rents and values given a movement 0 to 1 for RCDUM, and from the first to the third quartile for the other regulatory variables.[19] Using this as a measure of moving from a lightly regulated environment to a heavily regulated environment, we find that the coefficients in tables 3 and 4 suggest that rents would rise by 17 percent and house values by 51 percent. These are strong effects, but then these are fairly large changes in regulatory environments.

The focus of this article is on price, but regulations will presumably affect the quantity of housing services as well. We therefore also estimated a permits equation (table 5) and found that a change in regulation as above reduced permits by an estimated 42 percent.

[19] Specifically, an increase in SREG1 from 2 to 5, in REGTEST from 18 to 22.5, and in REGSQ from 324 to 506.

Table 4. **Reduced Form, Census House Value (Dependent Variable: Log Median House Value, 1990 Census)**

Variable	Parameter Estimate	Standard Error	t for H_0: Parameter = 0	Prob > |t|	Variable Definition
INTERCEP	9.5002	2.7074	3.51	0.001	Intercept
LMPOP90	0.0419	0.0420	1.00	0.325	Log MSA population, 1990
DMP8090	3.3618	2.7257	1.23	0.225	Annual growth in MSA population, 1980–90
LMYPC90	0.2746	0.2346	1.17	0.249	Log MSA annual per capita income, 1990
MRDYP987	5.8866	2.1190	2.78	0.008	Annual growth in real MSA per capita income, 1979–87
ADJPARK	0.2374	0.1000	2.38	0.023	Adjacent to large park, military base, or reservation
ADJWTR	0.0805	0.0569	1.42	0.165	Adjacent to coast or major lake
SREG1	0.0392	0.0197	1.99	0.054	Sum of AIP state regulatory variables
RCDUM	0.2348	0.0999	2.35	0.024	Rent control dummy
REGTEST	–0.2124	0.0799	–2.66	0.011	Regulatory index from Wharton data
REGSQ	0.0062	0.0020	3.16	0.003	Square of REGTEST

Note: R^2 = 0.89; adjusted R^2 = 0.86; degrees of freedom = 48; F = 30.711 (p = 0.0001).

Tenure Choice Results

Regulation can affect tenure choice directly or indirectly through intervening price variables, as illustrated in table 6 for the homeownership equation. Regulation appears to have little direct effect; individual and joint tests do not generally reject the null hypothesis. But indirect effects are also important. That is, we want to calculate the "impact multiplier":[20]

$$\frac{dT}{d\mathbf{R}} = \frac{\partial T}{\partial \mathbf{R}} + \frac{\partial T}{\partial P_{hr}} \cdot \frac{dP_{hr}}{d\mathbf{R}} + \frac{\partial T}{\partial P_{ho}} \cdot \frac{dP_{ho}}{d\mathbf{R}}. \qquad (6)$$

[20] An impact multiplier is the sum of the direct effect plus a one-round effect through intervening variables (see Intriligator 1978).

Table 5. **Reduced Form, Permits (Dependent Variable: Log Average Housing Permits per Capita, 1989–91)**

Variable	Parameter Estimate	Standard Error	t for H_0: Parameter = 0	Prob > |t|	Variable Definition
INTERCEP	–17.4095	5.2487	–3.32	0.002	Intercept
LMPOP90	–0.0604	0.0818	–0.74	0.465	Log MSA population, 1990
DMP8090	28.6948	5.3836	5.33	0.000	Annual growth in MSA population, 1980–90
LMYPC90	1.0130	0.4551	2.23	0.032	Log MSA annual per capita income, 1990
MRDYP987	–0.0774	4.1794	–0.02	0.985	Annual growth in real MSA per capita income, 1979–87
ADJPARK	–0.0571	0.1958	–0.29	0.772	Adjacent to large park, military base, or reservation
ADJWTR	–0.2139	0.1110	–1.93	0.062	Adjacent to coast or major lake
SREG1	0.0632	0.0384	1.65	0.108	Sum of AIP state regulatory variables
RCDUM	–0.5963	0.1950	–3.06	0.004	Rent control dummy
REGTEST	0.2798	0.1553	1.80	0.080	Regulatory index from Wharton data
REGSQ	–0.0070	0.0038	–1.83	0.075	Square of REGTEST

Note: R^2 = 0.73; adjusted R^2 = 0.66; degrees of freedom = 46; F = 9.738 (p = 0.0001).

Regulation raises house values (which tends to reduce homeownership) and raises rents (which tends to increase homeownership). How would this sort out? Regulation raises both rents and values but raises values more than rents (see tables 3 and 4 and their discussion). Thus, even given the similar size of rent and value coefficients in table 6 (0.23 versus –0.16), the negative homeownership effect of regulation through an increase in value is greater than the corresponding positive homeownership effect from regulation-induced increases in rent. Taken together, the movement from a lightly regulated environment to a heavily regulated one (as defined above) decreases the homeownership rate by about 10 percentage points (the median rate for our sample of MSAs is 65 percent).

Congestion, Segregation, and Neighborhood Effects

Regulation has little clear effect on our other measures of externalities, at least as estimated in this cross-MSA fashion. The joint effect of regulatory variables on

Table 6. **Determinants of MSA Homeownership Rate (Dependent Variable: Percent Owner-Occupied Units, 1990)**

Variable	Parameter Estimate	Standard Error	t for H_0: Parameter = 0	Prob > | t |	Variable Definition
INTERCEP	1.5935	0.8768	1.82	0.078	Intercept
LV90MED	–0.1629	0.0589	–2.76	0.009	Log median house value, 1990 census
LR90MED	0.2282	0.0934	2.44	0.020	Log median rent, 1990 census
LMPOP90	–0.0439	0.0109	–4.03	0.0003	Log MSA population, 1990
DMP8090	–2.4418	0.7916	–3.08	0.004	Annual growth in MSA population, 1980–90
LMYPC90	0.0022	0.0715	0.03	0.976	Log MSA annual per capita income, 1990
MRDYP987	1.3234	0.5860	2.26	0.030	Annual growth in real MSA per capita income, 1979–87
ADJPARK	0.0598	0.0270	2.22	0.033	Adjacent to large park, military base, or reservation
ADJWTR	–0.0086	0.0147	–0.58	0.563	Adjacent to coast or major lake
SREG1	0.0028	0.0053	0.53	0.602	Sum of AIP state regulatory variables
RCDUM	–0.0456	0.0284	–1.61	0.116	Rent control dummy
REGTEST	0.0180	0.0227	0.79	0.434	Regulatory index from Wharton data
REGSQ	–0.0005	0.0006	–0.91	0.369	Square of REGTEST

Note: R^2 = 0.74; adjusted R^2 = 0.65; degrees of freedom = 48; F = 8.590 (p = 0.0001).

segregation is not significant; neither is the effect of price (table 7). Taking the impact multipliers at face value, moving to a strict regulatory environment appears to reduce segregation substantially,[21] but the apparent effect is swamped by the variance of the estimates. Nothing in our equation seems to much affect neighborhood ratings except possibly the percentage of owner-occupiers, and on balance the impact multiplier is effectively zero (table 8).

The joint effect of regulatory variables on commuting time (our proxy for congestion) also requires some thought (table 9). The direct regulatory variables have little effect, except

[21] The point estimate of the percentage of blacks living in neighborhoods that are more than 90 percent black falls by 15 percent.

Table 7. **Determinants of Farley Black Isolation Index (Dependent Variable: Farley Black Isolation Index, 1990)**

Variable	Parameter Estimate	Standard Error	t for H_0: Parameter = 0	Prob > | t |	Variable Definition
INTERCEP	310.1906	416.8412	0.74	0.466	Intercept
MBPCT90	106.7980	30.9428	3.45	0.003	Percent black population in MSA, 1990
LV90MED	–33.8111	26.3216	–1.28	0.215	Log median house value, 1990 census
LR90MED	23.7040	42.5497	0.56	0.584	Log median rent, 1990 census
LMPOP90	4.4130	3.9814	1.11	0.282	Log MSA population, 1990
DMP8090	–546.6892	269.2619	–2.03	0.057	Annual growth in MSA population, 1980–90
LMYPC90	2.5327	41.7203	0.06	0.952	Log MSA annual per capita income, 1990
MRDYP987	344.7478	265.4492	1.30	0.210	Annual growth in real MSA per capita income, 1979–87
ADJPARK	–7.5687	8.8799	–0.85	0.405	Adjacent to large park, military base, or reservation
ADJWTR	2.8307	5.3074	0.53	0.600	Adjacent to coast or major lake
SREG1	–2.7301	1.9667	–1.39	0.182	Sum of AIP state regulatory variables
RCDUM	9.5733	11.2944	0.85	0.408	Rent control dummy
REGTEST	–12.3518	8.4713	–1.46	0.162	Regulatory index from Wharton data
REGSQ	0.2877	0.2184	1.32	0.204	Square of REGTEST

Note: R^2 = 0.85; adjusted R^2 = 0.74; degrees of freedom = 31; F = 7.848 (p = 0.0001).

for the state index, which shortens the time. Markets with high values have more or less the same commuting times as those with low values. But markets with higher rents have substantially lower commuting times. The joint effects, taking the point estimates and constructing an impact multiplier, appear to reduce average commuting time slightly—the substantial movement in regulatory environment described above reduces it by about 3 minutes. For comparison, the average commuting time in our sample was 48 minutes.

Of course all these particular numerical results are arbitrary, in the sense that they are based on the choice of a large and arbitrary change in the independent (regulatory)

Table 8. **Determinants of Excellent Neighborhood Rating (Dependent Variable: Percent Rating Neighborhood Excellent)**

Variable	Parameter Estimate	Standard Error	t for H_0: Parameter = 0	Prob > |t|	Variable Definition
INTERCEP	0.5573	1.1434	0.49	0.631	Intercept
LV90MED	0.0160	0.0632	0.25	0.803	Log median house value, 1990 census
LR90MED	0.0790	0.1358	0.58	0.566	Log median rent, 1990 census
POO90	0.2754	0.1665	1.65	0.112	Percent owner-occupied units, 1990
LMPOP90	–0.0383	0.0133	–2.88	0.009	Log MSA population, 1990
DMP8090	0.2373	1.0609	0.22	0.825	Annual growth in MSA population, 1980–90
LMYPC90	–0.0347	0.1241	–0.28	0.783	Log MSA annual per capita income, 1990
MRDYP987	0.0435	0.7851	0.06	0.956	Annual growth in real MSA per capita income, 1979–87
ADJPARK	–0.0061	0.0280	–0.22	0.829	Adjacent to large park, military base, or reservation
ADJWTR	–0.0058	0.0180	–0.32	0.749	Adjacent to coast or major lake
SREG1	–0.0020	0.0062	–0.32	0.755	Sum of AIP state regulatory variables
RCDUM	0.0348	0.0294	1.18	0.249	Rent control dummy
REGTEST	–0.0067	0.0240	–0.28	0.783	Regulatory index from Wharton data
REGSQ	0.0001	0.0006	0.08	0.934	Square of REGTEST

Note: R^2 = 0.64; adjusted R^2 = 0.43; degrees of freedom = 35; F = 3.011 (p = 0.0110).

variables. They are also subject to change as the specification and method of estimation vary. Other benefit measures (e.g., environmental variables) remain to be tested. But we believe that these first results are sufficient to demonstrate that regulation substantially affects house prices (rents and asset prices) and tenure choice.

Table 9. **Determinants of MSA Commuting Time (Dependent Variable: Average Daily Commuting Time, 1990)**

Variable	Parameter Estimate	Standard Error	t for H_0: Parameter = 0	Prob > |t|	Variable Definition
INTERCEP	–95.4497	52.7259	–1.81	0.077	Intercept
LV90MED	3.4531	4.3385	0.80	0.430	Log median house value, 1990 census
LR90MED	–14.0620	7.4732	–1.88	0.067	Log median rent, 1990 census
POO90	–36.0742	11.2201	–3.22	0.002	Percent owner-occupied units, 1990
LMPOP90	5.3041	0.9200	5.76	0.0001	Log MSA population, 1990
DMP8090	16.0571	62.6626	0.26	0.799	Annual growth in MSA population, 1980–90
LMYPC90	15.2149	5.0118	3.04	0.004	Log MSA annual per capita income, 1990
ADJPARK	–1.8974	1.7111	–1.11	0.274	Adjacent to large park, military base, or reservation
ADJWTR	0.9895	1.0412	0.95	0.347	Adjacent to coast or major lake
SREG1	–0.8434	0.3850	–2.19	0.034	Sum of AIP state regulatory variables
RCDUM	–0.4063	2.1440	–0.19	0.851	Rent control dummy
REGTEST	–1.0407	1.6432	–0.63	0.530	Regulatory index from Wharton data
REGSQ	0.0296	0.0415	0.71	0.480	Square of REGTEST

Note: R^2 = 0.78; adjusted R^2 = 0.72; degrees of freedom = 54; F = 12.736 (p = 0.0001).

Conclusion

Summary

Our results suggest that regulation raises housing rents and values and lowers homeownership rates. The increase in rents and values is broadly consistent with a number of city-specific studies, some of which are discussed above; this lends credence to the idea that those individual market studies are part of a larger pattern. While this is to our knowledge the first study to focus directly on the relationship between regulation and tenure choice, it is broadly consistent with two previous sets of studies suggesting that (1) tenure depends on relative prices of renting and owning and (2) regulation affects rents and house prices.

No statistically significant effect was found on racial segregation or on neighborhood ratings. Effects on aggregate commuting times were small. Thus, so far we have mainly documented the existence of costs without finding much in the way of benefit. That does not mean there are no benefits—there are many more possible benefit candidates, some of which we can measure and add (e.g., we can experiment with environmental and fiscal measures). And the lack of benefit at the aggregate MSA level does not mean there is no benefit to some inhabitants (see the discussion of the insider-outsider distinction above).

Future Research

Clearly much remains to be done along the lines laid out in this article. Next steps for extending this work include the following:

1. Develop a dynamic model, and study changes as well as levels of prices.

2. Develop a complementary model of input prices to differentiate direct effects of regulation on housing prices from those through increases in the price of inputs (i.e., study the elasticity of substitution).

3. Further study the role of metropolitan governmental structure in the spirit of White and of Hamilton.

4. Study additional candidate benefits and costs of regulation, such as environmental and fiscal externality measures, wages, and labor mobility.

5. Further analyze census rents and values versus “true price” measures, including user cost measures.

6. Further refine the regulatory measures, including additional work on data reduction issues, and collect data on *changes* in regulations.

7. Further endogenize the model, including studying the determinants of the regulatory environment itself.

Over a longer run, an obvious extension is to collect better data on regulatory practices across cities and over time. Further spatial disaggregation would be desirable—for example, studying the effect of regulation on central-city versus suburban prices (see Follain and Malpezzi 1981a). We are currently working on modeling changes and estimating the price elasticity of the supply of housing by regulatory environment.

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