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No Renters in My Suburban Backyard: Land Use Regulation and the Rental Housing Market in Massachusetts

WORKING PAPER 07–03

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Last revised:
June 20, 2007

Abstract

For several decades, academics and policymakers have argued that the ability of low- and moderate-income families to move into desirable suburban areas is constrained by the high cost of housing in those areas. Local zoning ordinances and other forms of land use regulation are believed to contribute to increased housing prices by reducing supply and increasing the size and quality of new housing. Restrictions on rental housing in particular are likely to reduce prospects of mobility for low- and moderate-income families. In this paper, I employ an instrumental variables approach to examine the effects of regulations on the quantity and price of rental housing in Massachusetts, using historical municipal characteristics to instrument for current regulations. Results suggest that communities with less restrictive zoning issue significantly more building permits for multifamily housing but do not have significantly lower rents. The lack of differences in rents across communities may reflect spillover effects and regional supply constraints. The analysis of rents may also be confounded by the thinness of the rental market and development of subsidized housing under the state's affordable housing law.

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I would like to thank the Joint Center for Housing Studies at Harvard University for financial support. This paper has benefited greatly from comments by Eric Belsky, Ingrid Ellen, Rema Hanna, Rachel Meltzer and participants in several seminars, including the Joint Center's Rethinking Rental Housing Symposium, the Wagner School's doctoral research colloquium, and the NYU School of Law's Colloquium on the Law, Economics and Politics of Urban Affairs. All remaining errors and omissions are my own.

Section 1: Introduction

In his seminal book, "Opening Up the Suburbs," Anthony Downs argues that the "exclusion of most poor, near-poor and ethnic minority households from many of our suburban areas…will eventually undermine achievement of one of our fundamental goals: true equality of opportunity" (Downs 1973, p. vii). To the extent that poor households are denied access to affluent suburbs, they may also be excluded from the opportunities provided by higher-income communities, such as access to employment, better quality schools and other public services, and an improved physical environment. Although some of the exclusion stems from the very low incomes of the poor (a result of low skills and poor employment potential), Downs argues that some of the problem is due to artificially high housing prices, created by strict building and zoning codes. By setting minimum standards for structure size, lot size and building materials and methods, affluent localities raise the costs of housing beyond the reach of many households. Although Downs' argument is not universally accepted, many academics and policymakers have acknowledged the potentially exclusionary effects of zoning, notably in the famous Mount Laurel decisions by the New Jersey Supreme Court (N.J. 1975).

In subsequent years, a considerable body of academic research has attempted to quantify the effects of local zoning ordinances on the supply and cost of housing; see Quigley (2006) for a review of recent research. Most studies on the effects of land use regulation either focus on owner-occupied housing or implicitly assume that the impacts on owner-occupied and rental housing are similar. However, given many suburban jurisdictions' preferences for low-density housing (or economically and racially homogenous communities), we might expect local regulation of multifamily structures

intended for rental housing to be particularly stringent. Such restrictions could have important policy implications for the unsubsidized portion of what is traditionally called "affordable" housing; although the majority of American households own their homes, most low- and moderate income households rent housing in the low-cost segment of the private housing market. In this paper, I examine whether local land use regulations have constrained production and increased costs of rental housing in Massachusetts.

Massachusetts offers an interesting setting to test for regulatory impacts on rental housing. Rents in Massachusetts are quite high relative to other parts of the country; the median monthly contract rent in the Boston metropolitan area was $727, well above the national average of $519, and third highest among the ten largest PMSAs (after San Francisco and Washington, DC), according to the 2000 census. Yet new construction of rental housing is fairly scarce; as shown in Figure 1, 79 of the cities and towns in the Boston metropolitan area issued no permits for new multifamily construction between 2000 and 2005, while another 57 issued permits for fewer than 50 units during the six-year period. The state's legal environment and history are conducive to strict land use regulations, combining a strong tradition of home rule by local governments, aesthetic and cultural preferences for low-density housing consistent with the character of New England towns, and highly fragmented political authority across a large number of small cities and towns, each of which contains only a small fraction of the metropolitan area's labor force and housing stock.

One of the primary challenges to identifying the effects of land use regulations is the probable endogeneity of zoning; regulatory stringency is likely to be correlated with unobservable local preferences over growth and development that may directly impact

housing market outcomes. To correct for possible endogenous regulations, I use an instrumental variables approach to estimate the effects of local land use regulations on Massachusetts' rental market. In the first stage, I predict current regulations as a function of historical municipal characteristics, specifically housing density, type of municipal government and educational attainment. Second stage regressions estimate the effects of instrumented regulations on multifamily permits and rents, controlling for standard demand- and supply-side variables. The measures of regulation are constructed using a uniquely detailed dataset on local zoning in 187 cities and towns in eastern and central Massachusetts.

Results of the IV analysis suggest that regulations affect production of new multifamily housing but do not provide evidence of a significant impact on rents. A one percent increase in the number of multifamily lots allowed under local zoning is associated with approximately 0.6 percent increase in multifamily units authorized by building permits, controlling for other variables. However the coefficient estimates from regressions on the relationship between regulations and rents are statistically not distinguishable from zero, and the magnitude is also close to zero. The null result on rents may reflect spillover effects of regulations across regulations, yielding a relatively low level of regional multifamily construction. The analysis could also be confounded by the thinness of the rental market and the development of subsidized housing under the state's affordable housing law.

In Section 2 of the paper, I briefly review the existing literature on the effects of land use regulations, with particular emphasis on studies that address the rental market. Section 3 describes the type and stringency of rental housing regulation in Massachusetts;

Section 4 outlines the empirical strategy and data; Section 5 presents regression results and Section 6 concludes.

Section 2: Existing literature

There is an extensive theoretical and empirical literature on the effects of zoning and land use regulation on land values, housing prices and housing supply. I provide a brief review of the most relevant general literature and a more detailed discussion of the relatively few papers that address the effects of regulations on rental housing specifically.

2.1 General literature on regulations

The theoretical basis for the effects of regulation on land values has been explored in a number of papers that modify the standard monocentric city model of land rents (see, for example, Capozza and Helsley 1989; Fujita 1982 and Wheaton 1982). Growth controls – such as greenbelts or urban growth boundaries – will drive up the value of developed land and existing housing prices by constraining the supply of land. Brueckner (1990) argues that the effect on the value of undeveloped land is ambiguous: although growth controls may delay the receipt of rents or reduce the allowable density, mild growth controls may raise total rents by reducing negative population externalities. More traditional types of zoning, such as minimum lot sizes, may reduce land values by lowering allowable density below the profit-maximizing point, but are likely to raise the price of finished housing by requiring high per-unit land consumption (Fischel 1985). Moreover, since such zoning encourages and strengthens Tiebout sorting, it is likely to lead to enclaves of high-income households with similar demand for high-quality public services; the quality of the services will be capitalized into higher land and house values

in jurisdictions with more restrictive zoning (Gyourko and Voith 1997, Oates 1969, Stull 1974). In most of these studies, the mechanism by which regulations affect prices is by changing the underlying value of land. Since house prices are simply the capitalized stream of house rents, the models implicitly assume that the effects of regulations on prices of owner-occupied and rental housing will be the same (barring any interactions between regulations and user cost of capital).

A considerable number of empirical studies have tested the effects of regulations on prices; although the magnitudes of the effects differ across studies, the majority of papers finds evidence that regulation increases prices and reduces the amount of new construction. Fischel (1990) provides a thorough review of the early empirical evidence. More recent papers have found increased prices both across submarkets within a single housing market (for example, Green 1999, Pollakowski and Wachter 1990) and across metropolitan areas (Malpezzi 1996, Glaeser and Gyourko 2001, 2002). A few studies have specifically tried to estimate the effects of regulations on supply elasticity and have concluded that, as expected, heavily regulated areas have lower levels of new construction and lower supply elasticities than less regulated metropolitan areas (Mayer and Somerville 2000, Green, Malpezzi and Mayo 1999).

2.2 Regulations and rental housing

A number of the empirical papers examining the effects of regulations on rents (and indeed, the literature on regulations in general) use California as an example; this likely reflects both the fact that California was one of the earliest states to see widespread adoption of local growth controls and the availability of relatively good data on such controls. In 1988, the League of California Cities surveyed cities and counties about their

use of growth controls, and a follow-up survey was conducted in 1992. Using the 1988 data, Levine and Glickfeld (1992) find a positive correlation between the number of multifamily units permitted and the number of growth control measures adopted by a locality; however since both variables are observed simultaneously, it is unclear which direction the causal arrow should go. Economic theory would predict that growth controls should reduce the total number of permits, so it seems likely that the positive correlation reflects a tendency of communities to adopt growth controls as a response to current high levels of development or prior growth. In addition, cities and counties with more growth control measures are also more likely to have adopted some inclusionary housing provisions, but actually produced fewer affordable housing units. In a later analysis using both the 1988 and 1992 surveys, Levine (1999) finds that growth controls reduce the number of rental units and increase median rent, although he finds no statistically significant relationship between controls and quantities or prices of owner-occupied housing. However, this study suffers from a number of methodological problems, including a lack of controls for other housing supply and demand determinants, endogeneity of the growth control measures (some of which preceded his baseline estimates), and a strong mechanical relationship between his dependent and independent variables (housing stock variables in 1980 and 1990). More recently, Quigley and Raphael (2005) use the same survey data in a more sophisticated analysis, using predicted changes in local employment as an instrument for housing demand shocks to identify the effects of growth controls on housing prices, rents and elasticity of supply. They find that the number of regulations is strongly positively correlated with rents, and that price elasticity of rental housing in regulated cities is much lower than in unregulated cities.

Besides the studies on California, several papers comparing rental housing markets across metropolitan areas also find effects of regulation. Green and Malpezzi (1996) conduct an exploratory analysis using several regulatory measures (primarily the Wharton data on state and MSA-level regulations and the share of land unavailable for development) and conclude that restrictive regulations drive up both rents and housing prices. They point out that restrictions on any type of new construction – not just low-cost housing – will reduce the supply and increase the price of low-quality, low-cost housing. An explanation of the mechanism by which restrictions on new construction reduce the affordable housing stock is offered by Somerville and Mayer (2002), who seek to identify how regulations (impact fees, growth controls and rent control) change the probability that individual rental units filter into or out of the affordable housing stock. They find that the likelihood of an affordable unit "filtering up" and becoming unaffordable increases with the presence of growth controls and impact fees, as well as a low overall elasticity of housing stock.[1]

In one final paper of note, Quigley and Raphael (2004) examine the role of regulations as one of several possible hypotheses for changes in rent burdens and the share of affordable rental stock over the past 40 years. They conclude that much of the change in the number of affordable units is due to changes in housing quality, some of which is likely driven by demand (such as the addition of plumbing and kitchen facilities), but that more recent improvements probably reflect minimum quality (or quantity) standards set by government regulations. Moreover, they point out that the

[1] The findings on rent control are more surprising; affordable uncontrolled units in neighborhoods with a high proportion of rent controlled stock are less likely to filter upwards, although this may reflect selection bias from poor quality housing or negative externalities from the presence of poorly maintained rent-controlled properties. In any case, given the relative scarcity of rent control compared to other forms of regulation, these findings are less relevant for the larger debate.

prices and rents of constant quality housing have been rising, consistent with the theory that regulations constrain new supply.

2.3 Questions for future research

Overall, the literature on land use regulations and rental housing suggests that regulations contribute to lower levels of construction, higher rents, and a decrease in the supply of low-cost, low-quality rental housing that constitutes the unsubsidized portion of the affordable housing stock. However, several important areas of research on the relationship between regulations and rental housing have not yet been addressed. First, most of the formal theoretical literature does not attempt to distinguish between rental and owner-occupied markets, and most treat "regulation" as a monolithic object, rather than the highly varied set of tools that actually comprise current zoning. Theoretical papers that explicitly consider potential differences in the effects of various forms of regulation on rental and for-sale housing would be a valuable addition. For instance, urban growth boundaries and other policies that constrain outward growth should, in the absence of other controls, encourage higher density development which is more appropriate for rental housing, while conventional minimum lot size regulations should lead to lower density housing that will probably be owner-occupied. Second, very little attention has been paid to the difference between formal "on-the-books" regulations and informal policies or implementation (one exception is Landis 1992, who suggests that implementation matters but does not empirically test for it, see also Sims and Schuetz 2007 for a discussion of wetlands regulations). Many of the growth controls surveyed in the studies of California, or the general zoning requirements included in the Wharton regulatory data, could apply to either rental or owner-occupied housing. But given some

of planning literature on opposition to low-income housing, it is reasonable to ask whether local governments choose to apply or enforce regulations differentially by the tenure of proposed developments. Similarly, it would be interesting to know to what extent regulations are applied differently to luxury rental housing versus standard quality projects. If reducing barriers to any new construction increases the likelihood that older existing housing will filter down into the affordable stock, this suggests that development of luxury rental housing, which may be politically more feasible, could increase the supply of affordable rental housing in the long run.

Section 3: Background on rental housing regulation in Massachusetts

Cities and towns in Massachusetts have a number of different tools available to regulate rental housing, and the type and stringency of regulations varies considerably across communities. Data on regulations are taken from the *Local Housing Regulation Database*, which contains detailed information on local zoning bylaws/ordinances and other forms of local land use regulation used by 187 cities and towns in eastern and central Massachusetts as of 2004. The database covers cities and towns within a 50 mile radius of Boston but excludes Boston itself; the area corresponds roughly, but not exactly, to the Boston-Worcester-Lawrence CMSA.[2]

Zoning bylaws (and other forms of local land-use regulation) rarely distinguish between owner-occupied and rental housing – traditionally zoning regulates development by use and structure type rather than tenure. Thus as a proxy for regulation of rental housing, in the remainder of this paper I focus on zoning specific to multifamily

[2] More information about the methodology used to develop the database can be found at www.pioneerinstitute.org/municipalregs/.

structures. Rental housing is most likely to be in multifamily buildings; as of 2000, approximately 64% of the rental units in the metropolitan area were in multifamily structures, as shown in Table 1. Most new construction intended for rental housing is multifamily; over 70 percent of the rental units added between 1990 and 2000 were in multifamily buildings. Although units in two-family structures make up about one-fifth of the current rental stock, only about half of two-family units are rented, while nearly 80 percent of multifamily units are rented. In a few communities, single-family detached units make up a significant fraction of the rental stock, as shown in Figure 2; most of these are communities with a small absolute number of rental units.

3.1 How do cities and towns regulate rental housing?

The ways in which rental housing is allowed, regulated and restricted are as numerous as the jurisdictions themselves. The most commonly used tools in Massachusetts are restrictions on the amount of land zoned for multifamily; procedural barriers to development; dimensional requirements; and resident age restrictions. In addition, the state's affordable housing law, which enables developers to override local zoning, is frequently used to develop rental/multifamily housing.

At the most basic level, zoning bylaws divide municipalities into "districts" and enumerate the uses that are allowed in each district. Cities and towns can most directly constrain rental housing by restricting the amount of land on which rental-appropriate structures can be built. In most communities, relatively little land is zoned to allow multifamily housing, townhouses or accessory apartments compared to the amount of land available for single-family houses which are typically owner-occupied. As shown in Figure 3, 70 percent of cities and towns allow single-family housing on at least 80

percent of their land, while over 60 percent of communities allow multifamily on less than 20 percent of their land area.

The second way in which municipalities restrict rental housing is to create procedural barriers to development, most commonly by requiring special permits. Whereas development of single-family structures in conventional subdivisions – by far the most typical form of owner-occupied housing – is generally allowed "as of right", most multifamily development in Massachusetts is allowed only by special permit. The specific requirements for obtaining a special permit – and thus the difficulty of obtaining the permit – vary considerably across communities, but in general the process gives local government agencies and residents a great deal of discretion to allow projects on a case-by-case basis. In some communities, the special permit granting process is relatively straightforward and predictable (at least to developers who have existing relationships with the Zoning Board of Appeals or other Special Permit Granting Authority), in other communities the special permit process essentially sets up a negotiation under which the developer can offer infrastructure upgrades or design concessions in exchange for obtaining the permit, and in other cases the process appears to be so difficult or uncertain that it may discourage developers even from applying for permits. Unfortunately there are no readily available data on approval rates of permit applications or length of time from application to permit that would enable researchers to quantify the difficulty of the process. Requiring special permits for multifamily development is relatively recent in Massachusetts zoning history; under the first wave of zoning bylaws adopted in the 1940s and 1905s, multifamily housing (like most other types of development) was allowed by right or prohibited altogether. Beginning in the 1970s, bolstered by a 1975 revision of

the state's zoning enabling law, Chapter 40A, communities began requiring special permits for multifamily housing as a matter of course (Schuetz 2006). As Figure 4 shows, just under one-third of communities still allow some multifamily to be developed as of right while approximately half allow multifamily only by special permit.[3]

Zoning regulations also establish dimensional requirements for multifamily housing, as for other types of land uses. The most common requirement for residential uses, the minimum lot size, often restricts multifamily housing to low densities more comparable to single-family developments. As shown in Figure 5, although communities are more likely to allow multifamily than single family on moderately-sized lots (under 30,000 square feet), they are also more likely to require very large lots (over 75,000 square feet) for multifamily than single family housing. Beyond minimum lot sizes, towns may have other dimensional requirements that make multifamily development quite onerous, such as building height caps, FAR restrictions or a high number of parking spaces per unit. If multifamily is allowed under cluster zoning provisions, the minimum lot size is generally relaxed but the regulations impose requirements for minimum parcel size and the percent of parcel preserved as open space.

A more subtle form of regulation that can apply to both rental and owner-occupied housing and is intended to reduce the fiscal burden from new development is the use of resident age restrictions. A trend which emerged in the late 1990s and has become especially popular in the past five years, such provisions allow development of multifamily housing only if occupants meet a minimum age requirement (usually 55). Often such housing is intended as part of a larger planned retirement community,

[3] These calculations include communities that allow multifamily only as part of cluster or planned unit development, both of which require special permits for the entire project.

including age-restricted single-family housing, assisted living and community facilities.[4] Approximately one-third of the communities surveyed have some provision for age-restricted multifamily and eight municipalities allow multifamily only if it is age-restricted. Although no data are available on tenure rates within age-restricted multifamily, anecdotally it appears that these units are more likely to be condominiums than non-elderly new multifamily developments. For this reason, the analysis in Section 5 will exclude districts that allow only age-restricted multifamily housing.[5]

Given the layers of complex regulations required to develop multifamily housing under conventional zoning, some developers in Massachusetts choose to bypass local zoning and develop rental housing using the state's Low- and Moderate-Income Housing law. Adopted in 1970, the "Anti-Snob Zoning Act" or Chapter 40B allows developers to apply under an expedited process for a permit to build housing that does not conform to local zoning, if a minimum percentage of the housing units are affordable to low- and moderate-income households. If the developer's application is denied by the local Zoning Board of Appeals, the state Housing Appeals Committee can override the Board's decision and order the issuance of the permit (Massachusetts Department of Housing and Community Development 2004). Chapter 40B is sometimes used by not-for-profit organizations to develop projects that are entirely affordable (usually including state or federal subsidies), but it is also frequently used by for-profit developers who wish to build at higher densities than would be allowed under conventional zoning. In such cases, the developers use internal cross-subsidies from the market-rate units to offset the

[4] The more recent type of age-restricted multifamily is almost exclusively market-rate, compared to earlier provisions for elderly-only low-income housing, such as HUD's Section 202 subsidy program.
[5] Approximately a dozen municipalities allow substantially more age-restricted multifamily than non-restricted, so excluding districts with only age-restricted multifamily makes very little difference to the measures of regulation described in Section 3.2 and is unlikely to alter regression results.

losses from the affordable units; the state law essentially serves as the lever to develop higher density market-rate rental housing (McLaughlin 2005). Unfortunately, there is no complete and accurate inventory of the housing that has been built under Chapter 40B, so it is difficult to assess either the effectiveness of the state law or the true effects of conventional zoning.[6] I will discuss some of the potential problems caused by this for my analysis in Sections 5 and 6.

3.2 Measuring the stringency of regulation

As indicated by the previous description of zoning tools, local regulation of rental housing in Massachusetts is both varied and complex. The complexity creates a challenge for quantitative research: how can regulation be measured consistently and objectively across jurisdictions to allow systematic analysis of its effects? Although it is impossible to create measures that capture every nuance and layer of zoning bylaws, I have developed measures which reflect the three dominant tools affecting rental housing: the amount of land zoned to allow multifamily housing, the procedural requirement of special permits, and the minimum lot size (Schuetz 2006). For purposes of this paper, I define multifamily housing as new construction of a residential structure with three or more dwelling units.[7] For each of the 186 cities and towns[8], I calculate the maximum number of multifamily lots that could potentially be developed under current zoning by

[6] The state Department of Housing and Community Development maintains the Subsidized Housing Inventory dataset, a list of completed 40B projects that are self-reported by towns, and a dataset on planned projects that have entered the development pipeline since roughly 2000. However, both datasets are incomplete and the information contained in them is inconsistent at best.

[7] I chose three-unit structures as the cutoff rather than five units because of the frequency of "triple-deckers", structures with three apartments each occupying a floor. Multifamily housing allowed by conversion of existing structures (either subdivision of single-family houses or conversion of non-residential structures) is excluded because such units are not counted in the Census Bureau's data on new construction residential permits. Relatively few jurisdictions allow substantially more multifamily through conversion than through new construction, so the regulatory measures do not change much with this omission.

[8] The city of Lowell is excluded from the analysis because the area of its zoning districts was not available.

dividing the land area of each zoning district allowing multifamily by the minimum lot size in that district, then aggregating across all districts, as shown in the equation below:

$$NumberLots = \sum \frac{Area_i}{LotSize_i}$$

I calculate the measure for multifamily lots allowed by right, by special permit, and by any process.[9] As shown in Figure 6, even communities that allow some multifamily by right have very few potential lots zoned; only 16 percent of communities allow more than 500 potential lots by right. By contrast, about half of the cities and towns have zoned more than 500 potential lots by special permit, and 11 percent allow more than 10,000 potential lots by special permit. No data are available on the current development status or use type lots zoned for multifamily housing.

Section 4: Empirical strategy and data description

One of the primary challenges to identifying the effects of land use regulations is the likely endogeneity of zoning; the type and stringency of zoning in a community is almost surely correlated with unobservable local preferences over growth and development that may directly impact housing market outcomes. Specifically, communities that prefer low-density, owner-occupied housing might, in the absence of restrictive zoning, find other ways to block development of rental housing, such as bringing lawsuits or organizing public protests to impede the development process, making it difficult to attribute causality to the regulations alone. To help correct for the

[9] A lot is a piece of land on which a single multifamily structure can be built. The number of units in the structure on a single lot will vary across communities, because of differences across zoning bylaws in definitions of minimum lot sizes. Some bylaws define lot sizes by the number of units, for instance, requiring 10,000 square feet for the first two units and 5,000 square feet for each additional unit. In these instances a lot is defined as the minimum size for a three-unit structure. Other bylaws set a standard minimum lot size that accommodates a range of building sizes. Unfortunately the differences in bylaws do not allow for a more consistent definition by number of units.

endogeneity of the regulations, therefore, I use an instrumental variables approach; in the first stage, I model the current stringency of multifamily zoning as a function of historical municipal characteristics, then in the second stage I regress housing market outcomes on the predicted values of the regulations, including controls for standard demand and supply determinants. Each stage of the analysis is discussed in more detail below.

4.1 First stage: Historical characteristics as instruments for regulations

In the first stage regression, I predict the problematic right-hand side variables – the number of lots zoned for multifamily housing, by right, by special permit and by either process – as a function of historical municipal characteristics. Since zoning regulations are adopted under the normal legislative process, the regulations reflect the communities' characteristics and preferences at the time of the bylaw's adoption. Moreover, zoning tends to be "sticky"; a comparison of bylaws over time for a sample of jurisdictions reveals that the fundamentals of zoning bylaws – such as the establishment of zoning districts or the uses allowed in those districts – are altered very rarely, perhaps once every 20 to 30 years. In Massachusetts, multifamily zoning emerged in two waves: by right zoning when bylaws were first adopted in the 1940s and 1950s, special permit zoning in the 1970s and beyond (Schuetz 2006). Thus the number of multifamily lots zoned by right can thus be predicted as a function of the communities' characteristics in 1940, prior to the adoption of their first zoning bylaw, while the number of multifamily lots zoned by special permit is a function of the characteristics in 1970. The municipal characteristics that most strongly predict current zoning are identified by Schuetz (2006); the rationale behind the selected characteristics is explained briefly below.

The number of multifamily lots zoned by right reflects the density of the housing stock prior to adoption of the first zoning bylaw and the type of municipal government. Many of the cities and towns in the Boston region had already experienced substantial development prior to the advent of zoning; thus when drawing their initial zoning maps, these communities tried to accommodate pre-existing housing patterns. Communities that had built more multifamily structures prior to their first zoning bylaw were more likely to allow a larger number of multifamily lots by right. In addition, the type of municipal government affected the stringency of early multifamily zoning by altering the relative influence of pro-growth and anti-growth interests in the political process. The town meeting form of government[10] more strongly reflects the preferences of homeowners, who are often hostile to multifamily development, while city councils may be more influenced by businesses and other interests favorable to development. Both types of legislative bodies primarily affect the development process by adopting or amending regulations; decisions about special permits or variances are handled through the Planning Board or Board of Appeals, which are composed of local volunteers. In the first stage regression, number of multifamily lots zoned by right is predicted by the density of housing in 1940, a dummy variable for city council, and a dummy variable for the city of Worcester.[11]

The number of multifamily lots allowed by special permit is a function of the community's affluence and composition of the housing stock in 1970, prior to the

[10] The town meeting is a form of directly democratic government unique to New England. Legislative decisions, such as zoning changes, are approved by referendum of eligible voters (or the sample who choose to attend town meetings), rather than an elected council or other representative body.

[11] Worcester is by far the largest city in the sample, with a population approximately four times larger than the next largest community, and allows roughly six times as many potential multifamily lots as the number allowed by the next in line.

adoption of special permits. In keeping with much of the previous literature on zoning, communities with more affluent, highly educated populations are more restrictive of high-density development.[12] Like the by-right multifamily zoning, regulation of multifamily by special permit also reflects the composition of the housing stock. Communities with a larger share of multifamily prior to the widespread use of special permits tended to zone more multifamily lots by special permit; review of historical zoning bylaws suggests that some communities may have kept their prior multifamily district boundaries but changed the zoning from by-right to special permit. The number of multifamily lots is predicted in the first stage as a function of the educational attainment and share of existing stock in multifamily housing in 1970, and a dummy variable for Worcester.

The general forms of the first-stage regressions are shown below:

(1) $By\ right\ lots_{2004} = f(Housing\ density_{1940}, City\ council, Worcester)$

(2) $Special\ permit\ lots_{2004} = f(Percent\ BA_{1970}, Pct\ multifamily_{1970}, Worcester)$

Brief descriptions and data sources for the variables are provided in Table 3; summary statistics for all variables are shown in Table 4. As shown in Figure 6, the distribution of the number of multifamily lots zoned is left-censored, with a large number of communities clustered at zero. This implies that some communities might wish to zone a negative number of lots (conceptually similar to banning multifamily housing both within and beyond their jurisdictions) but are prevented from doing so. Since left-censored dependent variables are likely to bias the coefficient estimates towards zero, the first stage regressions that are presented in Table 4 are estimated as tobit models rather than

[12] The communities in my sample were racially very homogenous in 1970; fewer than five communities had a non-white population of 5 percent or more. Therefore it is not possible in this study to test for racial discrimination in zoning patterns.

OLS.[13] When estimating the two stages simultaneously in Stata, I am not able to correct directly for censoring in the endogenous variable, raising the concern that the coefficient estimates on the instrumented values will still be biased. As a partial solution, I use the natural logarithm of the number of lots, which more closely approximates a normal distribution. Two other approaches are possible under the existing IV commands: one is to change the regulatory measure to a dummy variable indicating whether zoning allows any multifamily housing, the other approach is to use the continuous values only for observations with non-zero values of the endogenous variables. The first approach will sacrifice some of the true variation, since allowing 10 lots or 10,000 lots may have quite different effects on supply. The second approach is problematic given the large numbers of zero-value observations and the relatively small overall sample size. In Appendix Table 2, I show the results of IV models using both approaches; the direction and significance of results confirms the results in the primary analysis, although the point estimates are not comparable.

4.2 2nd stage: Estimating the effect of regulations on housing market outcomes

In the second stage of the analysis, I estimate cross-sectional reduced form regressions of housing market outcomes (permits, rents and prices) as a function of the predicted values of regulation obtained from stage one, as well as standard controls for housing demand and supply. The general form of the model is described below:

$$\text{Re}nts_{i2000} / Permits_{i2000-2005} = \beta_0 + \beta_1 \hat{R}_i + \beta_2 D_{i2000} + \beta_3 S_{i2000} + \varepsilon_i$$

where $\hat{R}_i$ is a predicted measure of regulatory stringency, D_i is a vector of housing demand variables, and S_i is a vector of housing supply determinants, and ε is a

[13] A comparison of the coefficients from the same specifications run as OLS rather than tobit models, shown in Appendix Table 1, confirms that OLS estimates are biased towards zero.

municipality-specific error term. Table 3 gives data sources and brief descriptions of each variable; summary statistics are shown in Table 4.

The primary dependent variables are median contract rents in 2000 and the total number of multifamily housing permits issued from 2000 to 2005, with additional regressions on the median value of owner-occupied housing in 2000 and total single-family permits from 2000 to 2005. The number of multifamily permits is left-censored at zero; I correct for this by using tobit models and show a comparison of the results in Appendix Table 1. Using median contract rents, as reported in the 2000 Census, is a slightly problematic measure of true rents since it does not account for differences across jurisdictions in rental housing quality. Several recent papers (Malpezzi, Chun and Green 1998, Quigley and Raphael 2004) have constructed hedonic price indices using household-level data from the Public Use Microdata Samples (PUMS), which have the advantage of allowing researchers to compare the rents and prices of constant-quality units across geographic areas. This methodology assigns housing units in each Public Use Microdata Area (PUMA) to each political jurisdiction within the PUMA and adjusts the housing weights by the proportion of housing in the PUMA contained in that jurisdiction. The hedonic regressions thus calculate a unique set of coefficients, and a unique predicted rent for a constant-quality unit, for each PUMA. Unfortunately, the limitations of the geographic identifiers prevent me from using this methodology to construct hedonic indices for cities and towns in my sample, essentially within one CMSA.[14] For the 187 regulating jurisdictions in my dataset, there are only 38 PUMAs, producing only 38 uniquely predicted rents for the same quality housing unit; this leaves

[14] Since the cities and towns in the regulation database were chosen on proximity to Boston rather than demographic or economic variables, the sample does not exactly correspond to the Boston-Worcester-Lawrence CMSA, but it is quite close.

too little variation in the dependent variable to identify the effects of regulations. Implications of using non-quality adjusted rent measures will be discussed further in the conclusions.

In addition to the predicted measures of regulation described in Section 4.1, the second-stage regressions control for standard demand- and supply-side housing determinants. The vector of demand-side variables includes the distance to Boston, the share of the population with a BA degree or higher (a measure of permanent income), and demographic characteristics, including age distribution, the share of foreign-born and the share of non-Hispanic whites in the population. I am unable to control for another typical indicator of housing demand, the quality of local public schools (measured here by scores on Massachusetts Comprehensive Assessment System tests), because it is almost perfectly correlated with the measure of permanent income. Controls for housing supply include two measures of land availability: the total land area and a dummy variable indicating that less than 20 percent of the land area is undeveloped.[15] The cost of two other inputs into housing supply – labor and materials – are not relevant, since all the cities and towns in my sample are within essentially the same metropolitan area, so the costs are unlikely to vary much across jurisdictions. To account for differences in the quality of the rental stock, in the rent regressions I include two somewhat crude measures of housing quality, the share of rental housing built before 1950 and the median number of rooms in rental units.

One methodological problem that I cannot correct is the confounding influence of development under the state's affordable housing law, Chapter 40B. From interviews with developers and town officials, it is apparent that a substantial fraction of the rental

[15] Undeveloped land is defined here as land in cropland, pasture, woody perennial, open land and forest.

housing built in Massachusetts (especially in affluent suburban communities) is developed under the 40B process and would not be permitted under conventional zoning. This causes problems for my analysis on both permits and rents. First, some communities that technically do not allow multifamily housing have issued permits for multifamily units, almost certainly under 40B. Second, if a significant portion of the rental stock in restrictive communities is affordable housing built under 40B, the rents in those highly restrictive places will be artificially low, reflecting the subsidies attached to the units. Both circumstances will tend to bias the estimated effects of the regulations on permits and rents towards zero. Unfortunately, given the available data, I cannot separate out development under conventional zoning from projects built by overriding zoning, or even identify with certainty which communities have had 40B projects.

Section 5: Effects of regulations on new housing construction and rents

Results of instrumental variables analysis support the hypothesis that stringent multifamily regulations constrain the development of new multifamily housing, but provide somewhat contradictory evidence on the effect of regulations on rents. The number of multifamily units authorized by permits increases by approximately 0.5-0.6 percent for an additional one percent in multifamily lots zoned, but the relationship between multifamily zoning and rents is statistically and substantively close to zero. The evidence also indicates that regulation measures are indeed endogenous; coefficients estimated using IV are approximately twice the magnitude of coefficients using observed values of regulation.

5.1 Predicting current regulations with historical characteristics

Table 4 shows the results of the first-stage tobit models predicting current zoning for multifamily housing as a function of historical community characteristics. As shown in Column 1, the number of multifamily lots zoned by right is increasing in pre-zoning housing density and greater for jurisdictions with city councils than those governed by town meetings. The coefficient on housing density suggests that moving from a pre-zoning density of about one unit per two acres of land (0.5 units/acre is approximately the mean) to one unit per acre is associated with an average increase of roughly 500 more lots zoned for by-right multifamily. Communities with city councils allow on average approximately 1,700 more by-right multifamily lots than those with town meetings, controlling for density. Both coefficients are significant at the one-percent level. In addition, the city of Worcester zoned over 40,000 more multifamily lots by right than other communities in the sample.

Column 2 shows that the number of multifamily lots allowed by special permit is decreasing in educational attainment of the population and increasing in multifamily share of existing stock. An increase of one percentage point in the population with college or graduate degrees in 1970 is associated with a decrease of 162 multifamily lots allowed by special permit, all else equal. A one percentage point increase in the share of housing units in multifamily structures in 1970 is associated with an increase of 130 multifamily lots zoned by special permit. Both coefficients are statistically different from zero at either the five- or one-percent level. The city of Worcester allows nearly 16,000 more multifamily lots by special permit than other communities, although only significant at 10 percent level.

The third column shows the results of predicting the combined number of multifamily lots. Since so many communities have no lots zoned by right, the values and determinants of the combined measure are mostly driven by the number of special permit lots. The primary determinant of special permit zoning, the 1970 multifamily housing share, also affects the total number of multifamily lots. Communities with city councils allow more total multifamily than those with town meetings, although only weakly significant. Worcester also zones more total lots than other communities. Neither 1940 housing density nor 1970 educational attainment have significant coefficients.

5.2 Regulations and new construction

Table 5 presents the results of regression analysis on the relationship between regulations and new multifamily construction. In brief, the number of new multifamily housing permits increases with the number of potential lots that could be developed under existing zoning, controlling for standard determinants of housing demand and supply. The results are strongly significant for lots allowed by special permit, but only marginally significant for lots allowed by right. Communities that are less restrictive of multifamily housing also issue more single-family permits, suggesting that regulation of rental housing may be indicative of the overall regulatory environment. Comparing results of models using observed and instrumented values for regulation suggests that the regulations are indeed endogenous, and that using observed values leads to an underestimate of the effect of zoning. The magnitude of the effect is relatively large; a one percent increase in multifamily lots allowed by zoning is associated with between one-half and two-thirds of a percent increase in multifamily units authorized by permits.

Columns 1 and 2 present results for tobit models of the log of multifamily permits as a function of the observed number of multifamily lots allowed under zoning (both by right and by special permit). The first column shows a simple bivariate regression on the regulatory measure; the second column adds controls for standard demand and supply determinants. The coefficients on the log of multifamily lots in both regressions suggests that less restrictive zoning encourages more permitting of multifamily housing; a one percent increase in lots zoned is associated with an increase in units permitted of about 0.34 to 0.42 percent. The magnitude of the point estimate decreases when controls for other determinants of housing development are added in Column 2. The coefficient estimates on the control variables perform as would be expected. The number of multifamily permits decreases with distance to Boston, since land values should decrease as we move farther from the central business district. More affluent communities (indicated by the share of the population with a college or graduate degree) issue fewer permits for multifamily, although the coefficient is only marginally significant. As expected, the number of permits increases with land area, since more land is available for new construction. None of the coefficient estimates on demographic controls – percent children, foreign-born, or non-Hispanic white population share – are statistically significant, probably reflecting the fact that the jurisdictions in the sample are demographically quite homogenous.

Columns 3 and 4 show the results of the same specifications in the first two columns, but instrumenting for the number of multifamily lots using the historical characteristics shown in Table 4. The magnitude of the coefficients on the instrumented regulatory measures nearly doubles, compared to the coefficients on the observed values;

these changes, together with the results of the Wald chi-squared test on the instruments (shown in the bottom two rows of the table), suggest that the measures of regulation are indeed endogenous. The results in Column 4 indicate that a one-percent increase in multifamily lots allowed by zoning is associated with an increase of about 0.65 percent in the number of multifamily units authorized by permits, controlling for standard demand and supply determinants, significant at the one-percent level. Given the additional complexity of the development process, it is not surprising that the implied elasticity is less than one; nonetheless, the magnitude suggests that actual supply is quite responsive to theoretical supply allowed under zoning.

Models 5 and 6 test the measures of regulation that incorporate procedural requirements. As shown in Column 5, although the coefficient on number of by-right lots is positive and the magnitude is similar to that of the total number of lots, the estimate is only weakly statistically significant. Although it might seem that communities are more likely to grant building permits if they allow multifamily by right, anecdotally it appears that most of the land zoned for by right development has already been built out. At a minimum, it would require costly redevelopment, and in many cases the land has already been fully built to capacity so that even redevelopment would not yield additional units. The coefficient on the number of potential lots allowed by special permit, shown in Column 6, suggests that a one-percent increase in special permit lots is associated with a 0.59 percent increase in multifamily permits issued. This magnitude is roughly comparable to that of the estimate on the combined measure, and the coefficient is also significant at the one-percent level.

The final column in Table 5 tests whether the amount of single-family new construction varies by multifamily regulations. Interestingly, the relationship between potential multifamily lots allowed by special permit and number of single-family permits is also positive and marginally statistically significant, although the magnitude is much smaller than that on multifamily permits. A one-percent increase in potential multifamily lots allowed by special permit is associated with a 0.08 percent increase in single-family permits, holding other factors constant. Since regulation of multifamily housing should have no direct influence on single-family construction, this suggests that the measure of multifamily zoning may be indicative of the overall regulatory stringency in the community. Some towns also define "multifamily housing" in their zoning to include townhouses, which the census bureau's construction statistics define as single family. Nonetheless, it seems reasonable that some communities may be generally less restrictive in their zoning of both rental and owner-occupied housing.

5.3 Regulations and the cost of housing

Table 6 shows the results of regression analysis on the relationship between rents and regulations. The results on rents are more ambiguous than those on permits; although some specifications indicate that rents decrease with less restrictive regulations, others indicate a slight positive relationship. Most coefficient estimates are only weakly statistically significantly and the magnitudes are extremely small.

The first two columns of Table 6 show results of OLS regressions on the log of median rent against the log of observed number of multifamily lots (by right and special permit). The bivariate regression (Column 1) suggests a relatively small and weak negative relationship between more lenient zoning and rents; a one percent increase in

multifamily lots zoned is associated with a 0.01 percent decrease in median rents, significant only at the ten percent level. However when control variables are added to the model (Column 2), even the weak significance disappears and the absolute magnitude of the coefficient becomes still smaller. Coefficient estimates on the control variables offer no surprises. Rents decrease with the distance to Boston, consistent with the monocentric city model. Rents are increasing with education or affluence of residents; this could indicate higher willingness to pay, a social premium to living in wealthy community, or higher quality public services (the share of population with college and graduate degrees is almost perfectly correlated with measures of MCAS scores). Rents are also increasing in the share of the population that is white, non-Hispanic. The positive and significant coefficient on the share of foreign-born may indicate that presence of immigrants increases demand for rental housing. Rents also rise with improved housing quality; relatively new rental stocks and larger average units are associated with higher rents.

The results using instrumented values of the regulatory measures reveal somewhat confusing patterns, although the significance and magnitude of most coefficient estimates suggests that there is essentially no predictable relationship between regulations and rents. Column 3 shows a bivariate OLS regression of rents on multifamily lots zoned, instrumenting for the regulations with the same historical variables. The coefficient implies a somewhat stronger negative relationship between lenient zoning and rents; a one percent increase in lots zoned is associated with a drop of 0.03 percent in median rent, significant at the one percent level. As with the observed values, however, adding control variables changes the sign of the coefficient to positive and decreases the absolute value and significance; the estimate in Column 4 implies a 2 percent increase in rents for

marginally less restrictive zoning, significant at the ten percent level. This result is counterintuitive; the analysis in Table 5 suggests that less restrictive zoning does encourage increased supply, which economic theory predicts should reduce prices.

Disaggregating multifamily lots zoned by different procedures offers some variation in results, but does not fully explain the surprising finding. The estimated sign on multifamily lots allowed by right (Column 5) is indeed negative, although only weakly significant and quite small; a one percent increase in by-right zoning is associated with a two percent drop in rents, controlling for other factors. Since by-right zoning does not appear to have a significant impact on levels of construction, the negative coefficient on rents may be an indication of negative amenity values in communities with older rental housing, rather than a loosening of supply. The coefficient on potential lots allowed by special permit (Column 6) is positive, although similarly small in magnitude and only weakly statistically significant from zero. This raises the question, if allowing more multifamily by special permit leads to increased multifamily construction, why would it not lead to a decrease in rents?

Two characteristics of the rental market in Massachusetts could be confounding the effect of the regulations. First, the geographic sample being examined includes a number of towns that have virtually no rental housing stock, in both absolute and relative terms, so that median rents for those communities may reflect idiosyncratic characteristics of individual developments. It is quite possible that the communities that allow more multifamily development are primarily permitting high-end luxury housing (including age-restricted rental housing as part of retirement communities intended for affluent seniors), so that their rental stock is of better quality and thus higher rent than

communities that are not adding new units.[16] Moreover, the thinness of the rental market in many towns is particularly problematic in light of the state's affordable housing law; if communities with highly restrictive zoning have a small number of rental units, many of which were developed with subsidies under Chapter 40B, then rents will be artificially low in these towns. Since I do not have reliable data on development under 40B, I cannot directly test for the relationship between subsidized housing and overall rents.[17]

The final column of Table 6 examines the relationship between multifamily lots allowed by special permits and prices of owner-occupied housing. The coefficient estimates on potential lots allowed by special permit appear to coincide with the results on single-family permits in Table 5. A one-percent increase in special permit multifamily lots is associated with an average 0.03 percent decrease in housing prices, controlling for other factors. It could be that communities that allow more multifamily development are expanding their housing stock sufficiently to take pressure off single-family prices, or it may be that zoning restrictiveness of multifamily housing is indicative of general zoning stringency, along dimensions that affect owner-occupied housing more directly.[18]

Section 6 Conclusions

Overall, the analysis of the relationship between multifamily housing regulation and rental market outcomes is suggestive that regulations constrain the development of

[16] I tried a number of robustness checks excluding communities with very small rental housing stock (fewer than 200 units or 10% of the total stock), communities in which a large share (50% or more) of multifamily housing is owner-occupied, or with a large share of rental housing in single-family structures. None of the results of these models were substantially different from those presented; because of the decrease in sample size, standard errors tended to increase while point estimates were quite similar.

[17] In robustness checks, I included the state's estimated count of 40B units in regression models; none of the coefficient estimates were close to significant, but it is impossible to know whether this reflects the true relationship or the poor quality of the data.

[18] A similar regression of prices on number of potential by-right multifamily lots also yielded a negative coefficient estimate, although not statistically significant.

new rental housing, but some questions remain unanswered. The results on permits provide reasonable evidence that communities that allow more potential multifamily lots by special permit develop more new multifamily housing. Allowing more potential multifamily by right has a less significant impact on new construction, probably reflecting the fact that most land zoned for by-right multifamily has long since been built out to capacity. The results also indicate that communities that are less restrictive of multifamily housing issue more single-family permits, suggesting that stringency of regulation across housing types may be correlated.

A puzzle emerges from the results on rents, however: less restrictive communities do not appear to have significantly lower rents. If the results on permits are correct, why is increased construction not reflected in lower rents? I offer several possible explanations for these results, three of which are essentially technical problems with the analysis, while the fourth reflects a more fundamental operation of housing markets.

One possible explanation is the weakness of measuring rents using median contract rents for the community. Rents reflect not only town-level characteristics that I have controlled for in the regression analysis (proximity to employment centers, demographics, local public services and land availability), but unit-specific characteristics, such as size and construction quality. However, unit-level data on rents and characteristics are not available at the city/town level, and the probabilistic matching process from AHS or PUMS data used to construct hedonic rent indices across MSAs is not effective within a single MSA. I include somewhat crude controls for housing quality, the share of rental housing built before 1950 and the median number of rooms

per rental unit, but it is possible that underlying differences in quality across towns could still be driving rent differentials.

A second potential problem with the analysis, which unfortunately cannot be corrected at this time either, is the influence of Massachusetts' Chapter 40B law. Ideally, I would be able to net out units developed under Chapter 40B (or other subsidized housing programs) from the analysis, to examine the effect of zoning only on housing units constructed in accordance with conventional zoning. The lack of a complete, accurate inventory of projects and units developed under Chapter 40B is a serious problem for housing researchers in Massachusetts; at least one effort is currently underway to survey communities in the Boston metropolitan area about their experiences under Chapter 40B that may enable better analysis in the future. Including measures of other forms of subsidized housing, such as low-income housing tax credit developments, could also help reduce this problem.

Third, the measures of regulation that I use – although considerably more comprehensive and nuanced than measures used in many of the empirical studies to date – may not fully capture cross-sectional differences in regulation. In particular, I cannot determine the true difficulty of the procedural barriers required to obtain a special permit. Since we know anecdotally that the likelihood of securing a special permit varies widely across communities, my measures may have a high ratio of noise to signal on the true strength of regulations. If that is true, however, it is surprising that the estimates on building permits reflect a fairly strong relationship to the regulatory measures.

The final possible explanation addresses a more substantive question on the operation of the housing market. While the data on permits can pick up highly localized

effects of regulations, it is possible that the effects of regulations on rents are more diffuse, as suggested in Glaeser, Schuetz and Ward (2006). That is, constraining multifamily development in one community should reduce the permits issued in that town, but a reduction in overall supply may increase rents not only in the highly restrictive town, but in its less restrictive neighbors as well. Alternatively, the lack of rent differentials may reflect relatively elastic demand for rental housing. Renters face lower transactions costs from moving across communities within a single housing market than homeowners and may be less willing to pay for some of the location-specific benefits that are capitalized into house prices (for instance, renters are less likely to have children and thus may care less about school quality), making it difficult for landlords to extract higher rents in restrictive communities. These general equilibrium effects could explain why my results do not show significant rent effects across communities within a single metropolitan area, which have previously been found in many of the empirical studies across multiple distinct housing markets (or of single-family prices within a single market). My analysis cannot rule out the possibility that zoning bylaws that constrain the development of rental housing in specific towns have contributed to higher rent levels in Greater Boston and Massachusetts more generally.

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Figure 1: Little new multifamily housing construction in Massachusetts, 2000-05

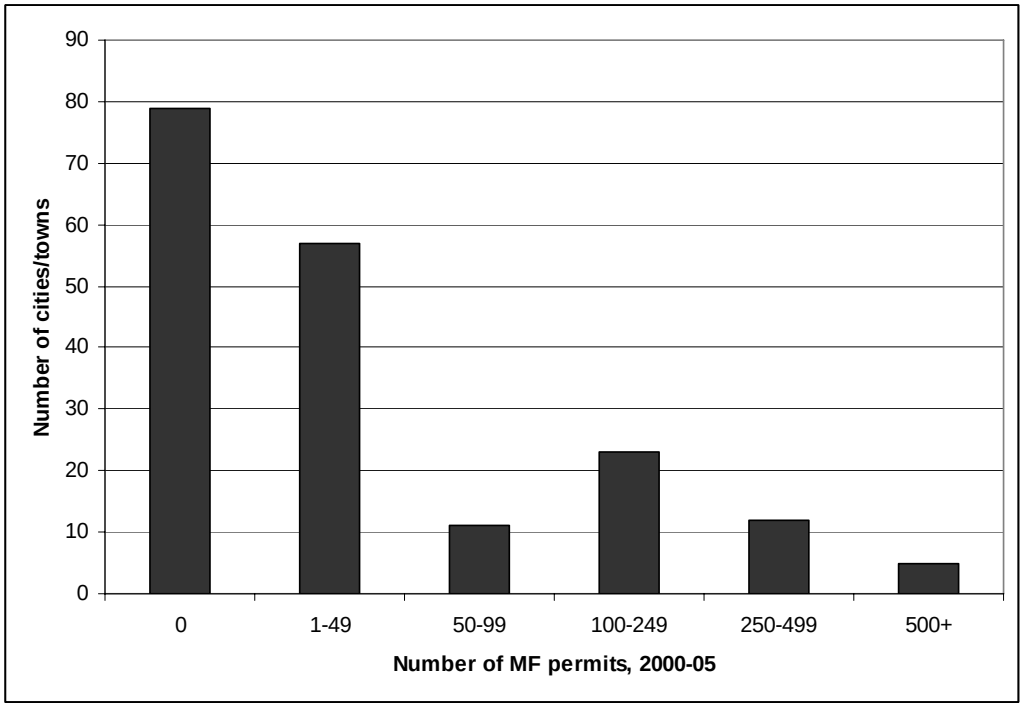

Figure 2: Non-multifamily share of rental housing stock, 2000

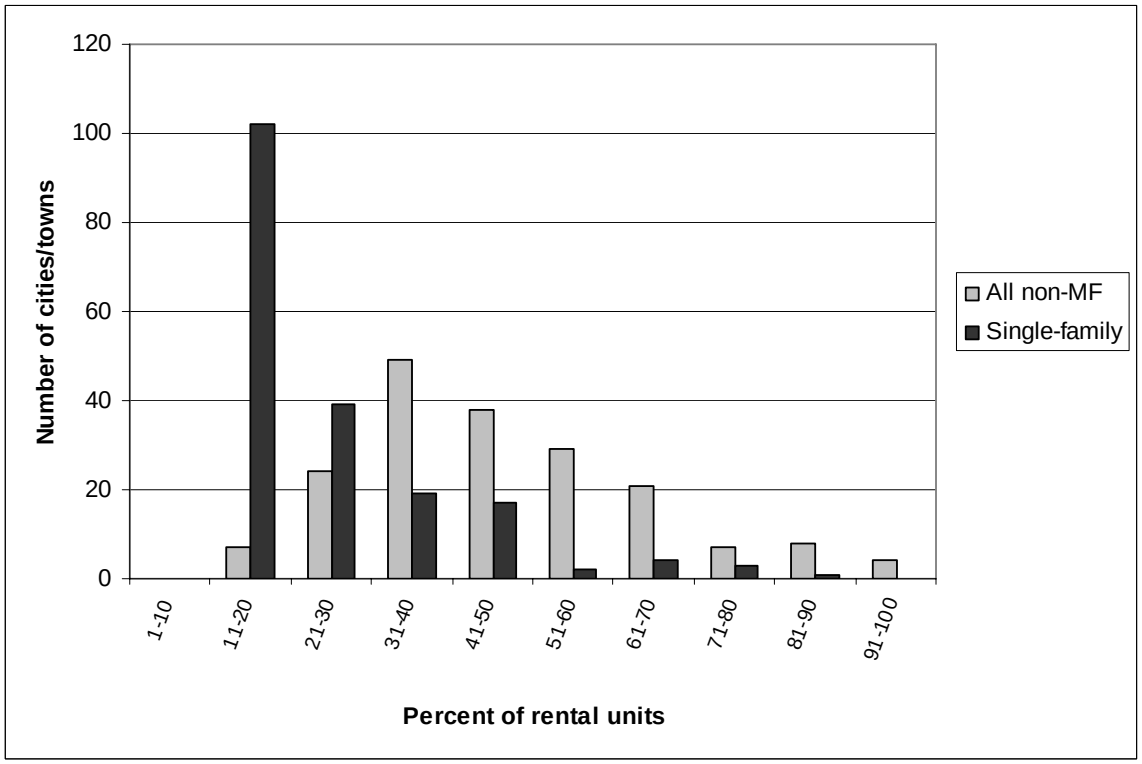

Figure 3: Land zoned for single-family and multifamily housing (2004)

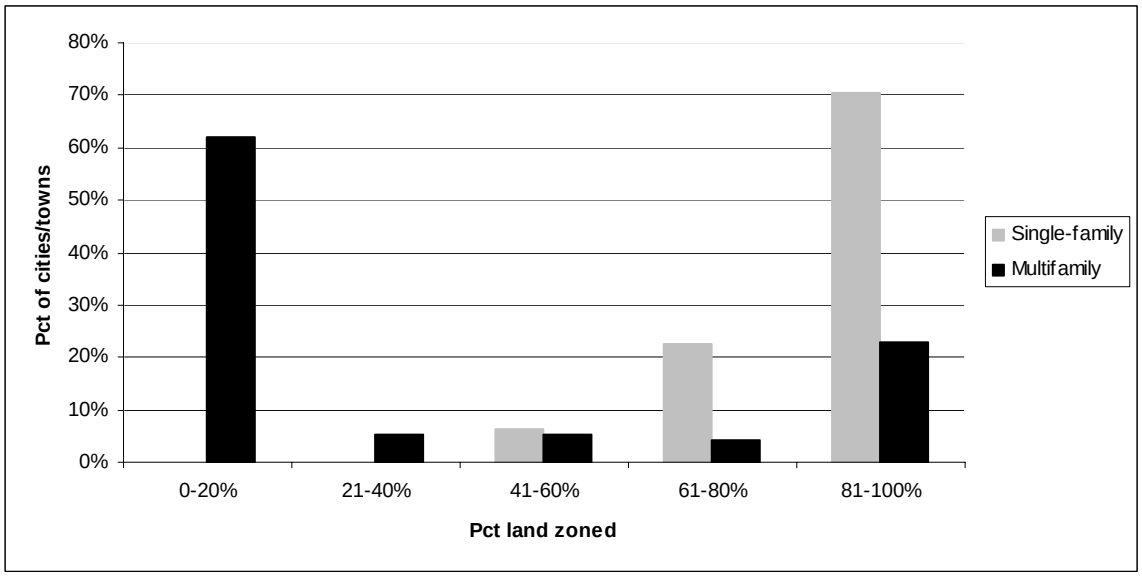

Figure 4: Procedural requirements for developing multifamily housing (2004)

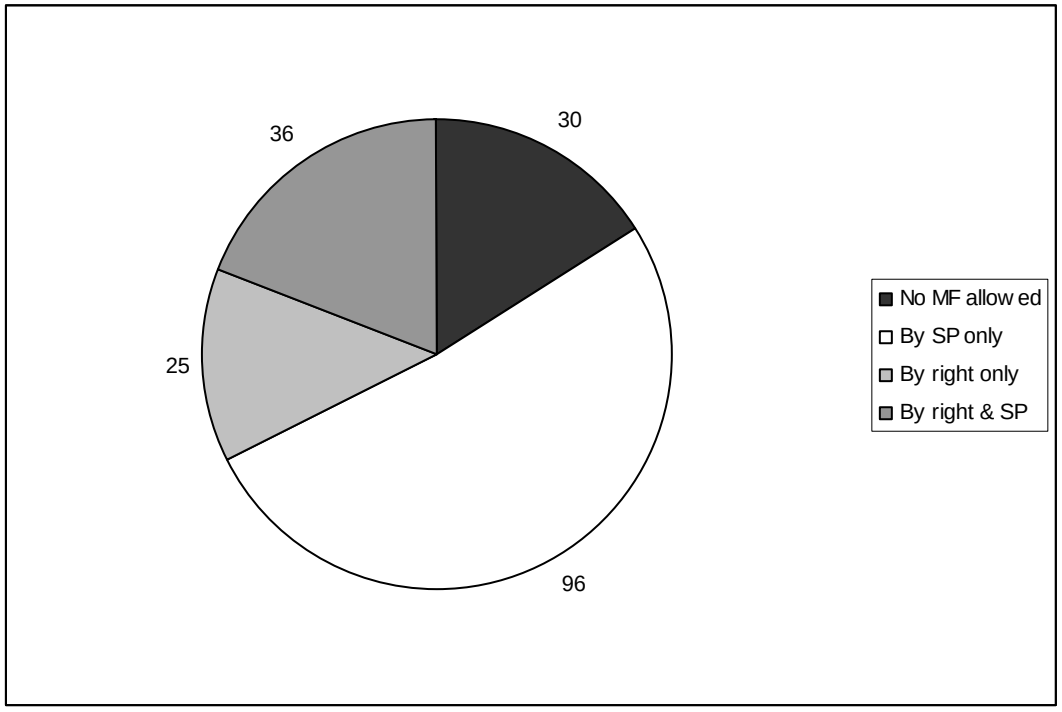

Figure 5: Minimum lot size requirements for single- and multifamily (2004)

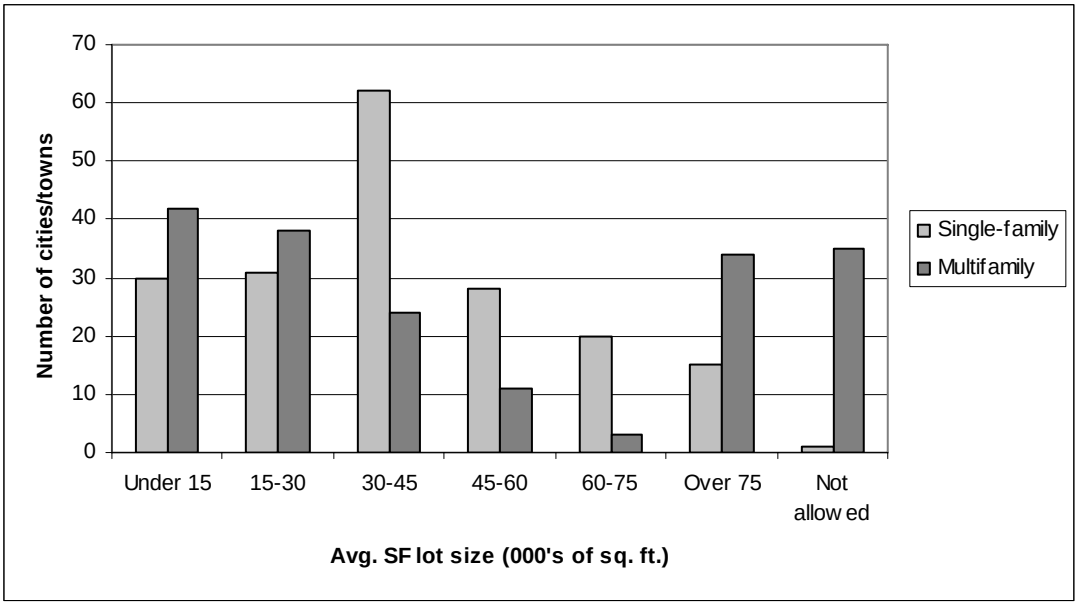

Figure 6: Comparison of potential multifamily lots measures

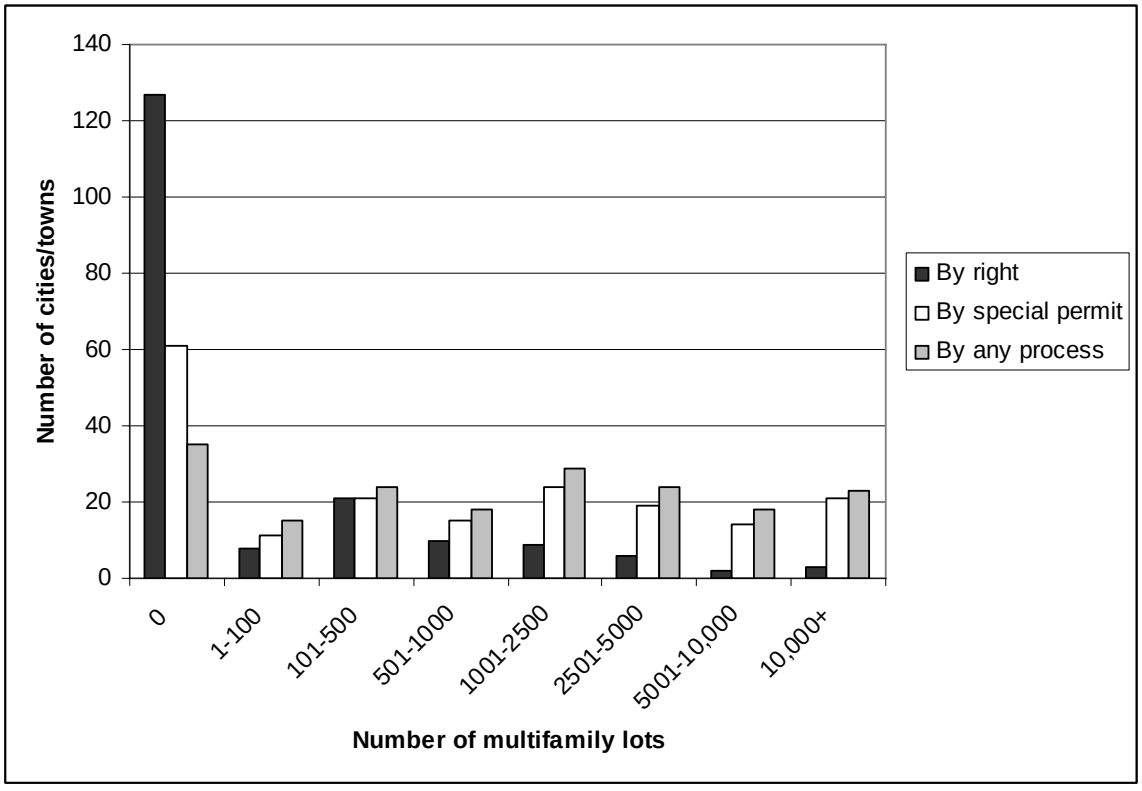

Table 1: Composition of rental stock in 2000, by decade built and structure type

Decade	Multifamily	2-family	Single-family detached	Townhouse	Other	Total
Pre-1940	22.6	12.2	4.1	1.0	0.0	39.9
1940-49	5.5	2.6	1.3	0.3	0.0	9.7
1950-59	6.3	2.4	2.4	0.4	0.0	11.5
1970-79	9.2	1.6	1.5	0.4	0.1	12.9
1980-89	16.5	1.5	1.3	0.6	0.2	20.2
1990-2000	4.2	0.6	0.6	0.4	0.1	5.8
Total	64.1	20.9	11.2	3.2	0.5	100.0

Source: Author calculations using PUMS 2000. "Other" includes mobile homes, boats and recreational vehicles.

Table 2: Variable definitions and data sources

Variable	Description (Year)	Data source
Dependent variables		
Log(rent)	Log of median contract rent (2000)	Census
Log(price)	Log of median owner-occupied housing value (2000)	Census
Log(MF permits)	Log of total multifamily units permitted (2000-05)	Census, New Residential Construction series
Log(SF permits)	Log of total single-family permits (2000-05)	Census, New Residential Construction series
MF permits/ hsg stock	Log of multifamily permits (2000-05)/housing units (2000)	Census of population and New Residential Construction series
Measures of regulation		
MF lots, 000s	Potential multifamily lots allowed (2004)	Local Housing Regulation Database
By right MF lots, 000s	Potential multifamily lots allowed by right (2004)	Local Housing Regulation Database
Special permit MF lots, 000s	Potential multifamily lots allowed by special permit (2004)	Local Housing Regulation Database
Instruments		
Housing density, 1940	Housing units/acre (1940)	Census
City council	Dummy = 1 if city council form of government; 0 if town meeting	MA Dept. of Housing & Community Development
Pct Ba plus, 1970	% of population with BA, graduate or professional degree (1970)	Census
Pct hsg stock in MF, 1970	% of housing units in MF buildings (1970)	Census
Worcester	Dummy = 1 for Worcester	
Control variables		
Distance to Boston	Distance in miles to Boston (constant over time)	Census
Pct BA, post-grad	% of population with BA, graduate or professional degree (2000)	Census
Pct < 18 yrs	% of population under 18 years (2000)	Census
Pct foreign born	% of population born outside U.S. (2000)	Census
Pct non-Hisp white	% of population white, non-Hispanic (2000)	Census
Less than 20% undev land	Dummy = 1 if less than 20% land area undeveloped (1999)	Mass GIS
Log(area)	Log of total area in acres (1999)	Mass GIS
Rental hsg stock, pre-1950	% of rental units in 2000 that were built before 1950	Census
Median rooms, rental hsg	Median number of rooms in rental housing units (2000)	Census
Any 40B?	Dummy = 1 if any 40B developments (2004)	MA Department of Housing & Community Development

Table 3: Summary statistics of variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Median rent	186	761	170	391	1400
Price	186	239,734	96,613	116,400	725,900
MF permits	186	131	302	0	2610
SF permits	186	269	247	3	2181
MF lots, 000s	186	4,194	8,184	0	66,631
By right MF lots, 000s	186	746	3,587	0	43,802
Special permit MF lots, 000s	186	3,448	6,695	0	40,402
Housing density, 1940	186	0.60	1.34	.01	10.33
City council	186	0.16	.37	0	1
Pct Ba plus, 1970	186	14.4	9.7	1.89	44.99
Pct hsg stock in MF, 1970	186	13.3	13.1	0	70.9
Distance to Boston	186	22.5	10.0	2.4	42.5
Pct BA, post-grad	186	39.0	16.7	10	83.4
Pct < 18 yrs	186	25.6	3.9	13.2	33.7
Pct foreign born	186	7.9	6.1	1.8	36.1
Pct non-Hisp white	186	91.5	9.3	34	99.5
Area	186	11,322	7197	796	61,734
Less than 20% undev land	186	0.10	.30	0	1
Rental hsg stock, pre-1950	186	41.3	15.0	5.1	77.0
Median rooms, rental hsg	186	4.13	0.51	3.1	6.2

Table 4: Predicting regulations with historical municipal characteristics

Dependent variable:	**By right MF lots**	**MF lots by special permit**	**Total MF lots zoned**
Variable:	(1)	(2)	(3)
Housing density, 1940	1,013***		-618
	(154)		(563)
City Council	1,718***		3,333*
	(601)		(1,888)
Worcester	42,116***	15,618*	53,369***
	(2,194)	(8,488)	(7,364)
Pct BA, post-grad 1970		-162**	-98
		(71)	(59)
MF share existing stock, 1970		131***	203***
		(50)	(60)
Observations	186	186	186

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Column 1 is a tobit model on the number of multifamily lots allowed by right; Column 2 is a tobit model of the number of multifamily lots allowed by special permit; Column 3 is a tobit model on the number of lots allowed by either process. Tobit models are used to adjust for the large number of communities that allow no multifamily by each process (i.e. left-censored data). Coefficients are directly interpretable as marginal effects.

Table 5: Effects of regulations on new housing construction, 2000-2005

Dependent variable:	**Log(MF permits)**						**Log(SF permits)**
Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log(MF lots)	0.419***	0.335***	0.740***	0.647***			
	(0.088)	(0.086)	(0.164)	(0.192)			
Log(By-right MF lots)					0.650*		
					(0.391)		
Log(SP MF lots)						0.586***	0.080**
						(0.204)	(0.034)
Distance to Boston, miles		-0.146***		-0.153***	-0.104**	-0.158***	-0.011*
		(0.037)		(0.038)	(0.043)	(0.040)	(0.006)
Pct BA, post-grad		-0.033*		-0.021	-0.036*	-0.027	-0.008*
		(0.020)		(0.022)	(0.021)	(0.022)	(0.004)
Pct < 18 yrs		-0.056		-0.009	0.019	-0.055	-0.011
		(0.085)		(0.092)	(0.115)	(0.092)	(0.020)
Pct foreign born		0.018		-0.004	0.036	0.016	-0.016
		(0.109)		(0.114)	(0.116)	(0.118)	(0.022)
Pct non-Hisp white		0.006		0.015	0.085	0.005	-0.002
		(0.062)		(0.064)	(0.083)	(0.067)	(0.013)
Log(area)		1.611***		1.355**	1.876***	1.383**	0.963***
		(0.549)		(0.585)	(0.584)	(0.606)	(0.128)
Less than 20% undev land		1.593		1.230	2.463**	1.703	0.078
		(1.142)		(1.205)	(1.251)	(1.235)	(0.265)
Observations	186	186	186	186	186	186	186
R-squared							0.47
Wald test chi2			5.99	3.51	1.21	3.47	
Prob > chi2			0.01	0.06	0.27	0.06	

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Columns 1 and 2 show tobit models on the log of multifamily permits(2000-2005) using observed values of the number of multifamily lots zoned. Columns 3-6 show results of tobit models, in which regulatory measures are instrumented for with housing density, city council, Pct BA plus 1970, and Pct multifamily housing 1970, as shown in Column 3 of Table 4. The last two rows show results of Wald Chi-squared test of exogeneity of the potentially endogenous zoning variables. Column 7 shows results of an OLS regression on log of single-family permits (2000-2005); SP MF lots is instrumented using Pct BA plus 1970 and Pct MF housing 1970, as shown in Table 4, Column 2.

Table 6: Effects of regulations on median rents and prices, 2000

Dependent variable:	**Log(rent)**						**Log(price)**
Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log(MF lots)	-0.010*	0.004	-0.029***	0.019*			
	(0.005)	(0.004)	(0.010)	(0.011)			
Log(By-right MF lots)					-0.019*		
					(0.010)		
Log(SP MF lots)						0.026*	-0.026*
						(0.015)	(0.014)
Distance to Boston, miles		-0.008***		-0.008***	-0.009***	-0.009***	-0.008***
		(0.001)		(0.001)	(0.002)	(0.002)	(0.002)
Pct BA, post-grad		0.004***		0.005***	0.004***	0.005***	0.017***
		(0.001)		(0.001)	(0.001)	(0.001)	(0.001)
Pct < 18 yrs		-0.005		-0.004	-0.009**	-0.006	0.003
		(0.003)		(0.003)	(0.004)	(0.004)	(0.004)
Pct foreign born		0.009**		0.008	0.010**	0.008	-0.002
		(0.004)		(0.005)	(0.005)	(0.005)	(0.005)
Pct non-Hisp white		0.005**		0.005**	0.003	0.005*	0.002
		(0.002)		(0.003)	(0.003)	(0.003)	(0.003)
Log(area)		0.025		0.009	0.029	0.001	0.021
		(0.019)		(0.023)	(0.020)	(0.026)	(0.028)
Less than 20% undev land		0.040		0.025	0.030	0.038	0.025
		(0.035)		(0.039)	(0.041)	(0.047)	(0.048)
Rental hsg stock, pre-1950		-0.002***		-0.003***	-0.002**	-0.004***	0.002
		(0.001)		(0.001)	(0.001)	(0.001)	(0.001)
Median rooms, rental hsg		0.179***		0.211***	0.171***	0.234***	-0.044
		(0.028)		(0.040)	(0.026)	(0.048)	(0.044)
Observations	186	186	186	186	186	186	186
R-squared	0.02	0.64		0.59	0.56	0.47	0.84

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Columns 1-2 are OLS models on the log of median contract rent in 2000, using observed values of the log of multifamily lots zoned. Columns 3-6 are OLS models on the log of median rent, using historical characteristics as instruments for multifamily zoning, as shown in Table 4. Column 7 shows an OLS model on the log of median owner-occupied housing value in 2000, using the instrumented value of SP MF lots.

Appendix A: Selected robustness checks

Table 1: OLS estimates of first stage and MF permit models

Dependent variable:	By right MF lots	MF lots by special permit	Total MF lots zoned	Log(MF permits, 2000-2005)		
Variable:	(1)	(2)	(3)	(4)	(5)	(6)
Housing density, 1940	780***		-413			
	(162)		(506)			
City Council	828*		3,352			
	(500)		(2,157)			
Worcester	41,468***	16,027***	54,923***			
	(471)	(1,819)	(2,274)			
Pct BA plus, 1970		-87*	-62			
		(45)	(48)			
Pct hsg stock in MF, 1970		77*	135**			
		(41)	(53)			
Log(MF lots)				0.386***		
				(0.113)		
Log(By-right MF lots)					0.406*	
					(0.220)	
Log(SP MF lots)						0.354***
						(0.116)
Distance to Boston, miles				-0.096***	-0.068***	-0.100***
				(0.023)	(0.025)	(0.024)
Pct BA, post-grad				-0.014	-0.023*	-0.018
				(0.012)	(0.012)	(0.013)
Pct < 18 yrs				-0.033	-0.014	-0.060
				(0.058)	(0.062)	(0.059)
Pct foreign born				0.039	0.056	0.048
				(0.078)	(0.079)	(0.080)
Pct non-Hisp white				0.025	0.065	0.017
				(0.042)	(0.052)	(0.043)
Log(area)				0.936***	1.233***	0.951***
				(0.342)	(0.321)	(0.352)
Less than 20% undev land				0.637	1.376*	0.907
				(0.716)	(0.749)	(0.751)
Observations	186	186	186	186	186	186
R-squared	0.90	0.09	0.41	0.20	0.17	0.16

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Column 1-3 are OLS models on the number of multifamily lots allowed by right; by special permit; and by either process. A comparison of the coefficients in Columns 1-3 with coefficients from the tobit models in Table 4 shows that OLS estimates are biased towards zero because of the large number observations with left-censored dependent variable. Columns 4-6 are OLS regressions on the log of multifamily permits (2000-2005), instrumenting for the number of multifamily lots zoned using the variables shown in Columns 1-3. Comparing these coefficients with tobit models in Table 5, Columns 4-6 shows that OLS would also bias the coefficients on regulations towards zero.

Table 2: Parsing multifamily regulations by zero and non-zero values

Dependent variable:	**Log(MF permits 2000-2005)**					
Variable:	(1)	(2)	(3)	(4)	(5)	(6)
Any MF zoned	7.581***					
	(2.216)					
Log(MF lots)		0.751**				
		(0.359)				
Any MF by right			12.909			
			(8.582)			
Log(By right MF lots)				0.325		
				(0.375)		
Any MF by SP					5.315***	
					(1.773)	
Log(SP MF lots)						1.587*
						(0.917)
Distance to Boston, miles	-0.127***	-0.155***	-0.023	-0.107**	-0.139***	-0.245***
	(0.039)	(0.039)	(0.105)	(0.049)	(0.038)	(0.080)
Pct BA, post-grad	-0.027	-0.015	-0.019	-0.050*	-0.034*	0.000
	(0.020)	(0.022)	(0.035)	(0.027)	(0.019)	(0.032)
Pct non-Hisp white	0.013	0.021	0.214	0.013	-0.007	0.016
	(0.034)	(0.033)	(0.165)	(0.031)	(0.033)	(0.048)
Log(area)	1.531**	1.092*	2.575**	1.861*	1.245**	1.221
	(0.602)	(0.626)	(1.057)	(1.067)	(0.609)	(0.777)
Less than 20% undev land	1.702	1.131	4.378*	2.352	2.012*	0.453
	(1.209)	(1.266)	(2.297)	(1.610)	(1.182)	(1.747)
Observations	186	152	186	59	186	126
Wald chi2 test of exog	4.44	4.59	1.84	0.03	3.52	3.56
Prob > chi2	0.04	0.03	0.17	0.85	0.06	0.06

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Column 1 is a tobit model of the number of multifamily permits, instrumenting for whether any MF lots are zoned, using the variables in Table 4. Column 2 is a tobit model on multifamily permits, instrumenting for the number of MF lots zoned, excluding observations for which zero MF lots are allowed. Columns 3 and 4 show comparable regressions, with MF lots zoned by right as the regulatory measure. Columns 5 and 6 show comparable models, using MF lots zoned by special permit as the regulatory measure.