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ARTICLE

Do inclusionary zoning policies equitably disperse affordable housing? A comparative spatial analysis

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Abstract This article examines the impact of inclusionary zoning (IZ) policies on the production and spatial distribution of low-income housing at the neighborhood level. Using an original, geo-coded property-specific database of more than 11,000 IZ units built between 1980 and 2000 in Montgomery County, Maryland, and Suffolk County, New York, this study provides the first evidence of the locational determinants of IZ unit production and spatial clustering by census tracts. Using a comparative analytic approach, the impact of institutional framework—more specifically, the difference between jurisdictions with regional versus local housing and land use authority—is examined in relation to the effectiveness of IZ programs in promoting an equitable dispersal of low-income housing units. This analysis provides evidence of spatial concentrations of IZ units built between 1980 and 2000, although the characteristics of neighborhoods in which clustering occurs differ between the two study areas.

Keywords Spatial analytics · Low-income housing · Affordable housing · Inclusionary zoning · Social equity

1 Introduction

There is a continued concern that the siting of low-income housing through subsidized housing programs may perpetuate existing patterns of residential segregation and reinforce concentrations of poverty (Ellen et al. 2009; Freeman 2004; Oakley 2008; Rohe and Freeman 2001). Beginning in the 1980s, research has explored the connections between spatial concentrations of the poor and negative household and neighborhood outcomes (Jencks and Petersen 1991; Schill 1993; Wilson 1987). At the same time, the devolution of

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responsibility for housing provision from federal to local governments necessitated an approach that could leverage limited public funds (Khadduri and Martin 1997; Smith 2002). Federal housing programs, such as the Low-Income Housing Tax Credit Program and HOPE VI, shifted to a mixed-income model, citing the desire to break up concentrations of poverty, improve the quality of subsidized housing, and maximize low-income housing production (Popkin et al. 2004; Smith 2002).

Inclusionary zoning (IZ) policies emerged in the 1970s as a means for local governments to meet their responsibility for affordable housing provision while fostering neighborhood integration (Calavita et al. 1997; Calavita and Grimes 1998; Pendall 2009). Building on a mixed-income housing approach, IZ policies are intended to disperse affordable housing throughout a region or municipality by leveraging market-rate development to subsidize new construction (Goetz 2003; Schuetz et al. 2009). However, almost four decades after the first IZ policy was adopted, there has been no rigorous analysis of the effectiveness of these programs in equitably distributing low-income housing geographically.

Many of the justifications for a mixed-income affordable housing strategy stem from the belief that neighborhood racial and, more specifically, income integration provide positive social, economic, and political externalities (Cutler et al. 1999; Schwartz and Tajbakhsh 1997; Wilson 1987). The discussion of IZ has largely been framed in terms of class, focusing, in many cases, on the politically expedient concept of "workforce" housing.[1] The issue of race, and the potential for mixed-income affordable housing programs to perpetuate existing patterns of segregation, is often ignored by the public officials charged with advocating for and implementing IZ policies, despite the prevalence of segregation by race rather than class (Quillian 2002; White 1986). Although the appropriate role for housing policy to shape neighborhood social mix continues to be debated, the original intent of IZ policies was to both promote affordable housing development with limited subsidy and encourage residential integration through the dispersal of housing targeted for lower-income groups (Galster 2007; Sarkissian 1976; Von Hoffman 1996). However, in practice, these outcomes may not be achieved in tandem, as the structure of individual policies and external factors may constrain the simultaneous optimization of production and dispersal.

This article examines the impact of IZ policies on the production and spatial distribution of low-income housing across two distinct counties with differing forms of IZ policy. To date, there have been no rigorous, empirical studies of the spatial distribution of affordable housing built through IZ programs. Using geo-coded property-specific data for more than 11,000 IZ units built between 1980 and 2000 in Montgomery County, Maryland, and Suffolk County, New York, this article provides the first evidence of the locational determinants of IZ unit production and spatial clustering. Using a comparative analytic approach, the effect of institutional framework—more specifically, the difference between two counties, one with primarily local IZ programs and the other with a regional policy—is examined in relation to the dispersal of IZ housing units within these particular regions. First, a review of the relevant literature on factors affecting the siting of subsidized housing and recent work on IZ programs is presented. Next, using two robust new databases, estimates of affordable housing built through IZ programs in Suffolk and Montgomery Counties, together with an analysis of the spatial distribution of those units, are developed. Finally, the locational determinants of IZ units are analyzed using logistic regression

[1] "Workforce" housing typically refers to housing for working individuals and families (e.g., police officers, nurses, firefighters, and teachers) whose incomes are between 80 and 120 % of area median income.

propensity score techniques and fractional logit models. The article concludes with a discussion of the results and their implications for policy and planning.

2 The effects of inclusionary zoning and factors affecting production and siting of inclusionary units

Since the 1970s, a number of towns, cities, and counties throughout the USA have implemented some form of IZ, whether mandatory of voluntary programs, including municipalities in California, Massachusetts, New Jersey, New York, Colorado, Vermont, and New Mexico (Brunick 2004; Porter 2004). In the past 10 years, the number of municipalities adopting or considering IZ has grown exponentially. Research by Pendall et al. (2006) indicates that 16.5 % of 6,584 jurisdictions surveyed from across the USA have some form of mixed-income affordable housing program. Interest in IZ has also spread to larger cities, with Boston adopting it in 2000, San Francisco in 2001, San Diego in 2003, and, more recently, Washington, DC, in 2009.

While there has been extensive discussion of the economic impacts of land use regulations (see, for example, Fischel 1985; Glaeser et al. 2005; Katz and Rosen 1987; Quigley and Rosenthal 2005), there has been relatively limited empirical analysis on the effects of IZ programs on local and regional housing markets and housing affordability. Two recent empirical studies suggest that price increases occur in jurisdictions with IZ as compared to those without, as IZ policies are modeled as tax on new residential development. In an analysis of cities in California, jurisdictions with IZ saw house prices increase, on average, 2.2 % more than in non-IZ jurisdictions (Knapp et al. 2008). More recently, research on municipalities in suburban Boston and the San Francisco metropolitan area produced mixed results (Schuetz et al. 2011). In the Boston area, there is evidence that IZ policies increased prices and decreased housing production, although the effect is marginally significant and relatively small and occurred only during periods of economic growth. On the other hand, the analysis of municipalities in the San Francisco area revealed no statistically significant effects. Production is found to be modest and dependent on the length of time the particular policy was in place (Schuetz et al. 2011).

In the only empirical analysis of the diffusion of IZ policies to date, Meltzer and Schuetz (2010) use a hazard rate model to examine the economic and political factors affecting policy adoption in the San Francisco Bay Area. The authors find that housing costs, the strength of local nonprofit housing advocacy organizations, and political ideology are significant determinants of adoption. Although the study is limited by a sample size of only 100 municipalities, the results indicate that IZ policies are adopted by municipalities looking for flexible policy tools to address housing needs. However, there is no evidence to suggest that decision makers at the local level are evaluating the effectiveness of IZ programs in other municipalities prior to adopting their own policy.

Research on the spatial distribution of subsidized housing provides a useful starting place for the analysis of the dispersion of low-income housing built through IZ programs. In a study of the siting of LIHTC units, Freeman (2004) finds that low-income units built in the 1990s tended to be disproportionately located in poor, minority neighborhoods with fewer homeowners and less valuable housing. However, Freeman points out that, during the 1990s, neighborhoods receiving LIHTC units experienced improvements in income, poverty levels, and housing values relative to other neighborhoods in the metropolitan area. A spatial analysis of LIHTC units built between 1987 and 2000 by Oakley (2008) reveals somewhat contrary evidence. The study finds no empirical evidence to suggest that LIHTC

units are more likely to be placed in disadvantaged neighborhoods. In a more robust study of LIHTC units built between the start of the program and 2003 across all US Metropolitan Statistical Areas, Ellen et al. (2009) find support for Oakley's results and conclude that criticisms of negative spatial effects of the LIHTC program are misplaced. Another study of the dispersal of LIHTC units in the Dallas/Fort Worth metropolitan area finds some evidence of distribution of units in suburban areas, although the neighborhoods in which units are typically built are highly disadvantaged in terms of economic conditions (Van Zandt and Mhatre 2009). Ryan and Enderle (2012) examine the effects of incentive zoning in California and find spatial concentrations of affordable housing in certain neighborhoods characterized by high proportions of Hispanics, Blacks, and multi-family housing.

2.1 Theoretical expectations and hypotheses

Following the adoption of an IZ program, its effectiveness in implementation is dependent on a range of factors, including program structure (e.g., project threshold, proportion of units required to be low-income, and in-lieu-of fee options); the political will to enforce the policy and the extent of supporting land use policies, the strength of the local housing market, and the outcome of localized conflicts between housing advocates and community opposition to new development (Dear 1992; Gaber 1996, Mukhija et al. 2010; Pendall 2009; Schively 2007; Schuetz et al. 2011). These factors, in turn, affect project-level decisions to provide affordable units as part of a mixed-income development, which can influence the amount and location of affordable housing produced through an IZ program. Four propositions emerge as the focus of the empirical analysis that follows:

Proposition 1 *IZ programs implemented by regional governments are more likely to be coordinated with complementary land use policies (e.g., higher-density zoning, allowing rental units, and multi-unit structures) and overcome local opposition to the specific siting of IZ projects.*

The need for political will and complementary land use policies for IZ policy implementation suggests a role for regional government to help overcome local politics and community land use debates (Basolo and Hastings 2003; Basolo and Scally 2008). In a study of state planning and IZ in Oregon, Knaap (1990) finds that coordinated state land use planning contributed to IZ policies and practices by ensuring sufficient land was available for development at higher densities to support mixed-income housing. This is accomplished by periodic state-level review of local land use plans in relation to established state-wide planning goals. Knaap also suggests that state governments may remove barriers to IZ implementation by allowing, and encouraging, advocacy groups and pro-housing coalitions to form across jurisdictions. This finding is supported by Porter (2004) in a cursory survey of IZ ordinances across the USA. Conversely, Calavita and Grimes (1997) identify the lack of political will, particularly at the local level, as the primary cause of the ineffectiveness of IZ programs in New Jersey.[2]

[2] The introduction of IZ policies in New Jersey was the result of the *Mount Laurel I* and *II* rulings by the New Jersey Supreme Court in the mid-1970s and early 1980s. The court-imposed low-income housing "fair share" requirements initiated a state-wide mandate, but the local governments retained some control over how and when the requirements would be met. Despite the mandate, New Jersey continues to struggle to produce equitable housing options for low-income households (Wish and Eisdorfer 1997).

Proposition 2 *An IZ program implemented by a regional government will have a consistent, unified program structure and thus avoid locality-specific IZ program variations that may influence the spatial distribution of IZ units.*

The spatial distribution of IZ units may be significantly affected by program structure, including project size thresholds and the presence of an in-lieu-of payment option. In the latter scenario, the housing developer, at their option or by mutual agreement with the municipality, agrees to pay a fee (or dedicate another property for the affordable units) rather than build required affordable units on site. There has been a significant debate on the implications of in-lieu-of fees for neighborhood integration and the potential to exacerbate spatial concentrations of low-income households (Porter and Davison 2009). In general, in-lieu-of fees dis-incentivize income integration at the project level and often result in the suboptimal production and distribution of affordable units. It is less expensive, on average, to build affordable units as part of an ongoing project than to have a municipality use the fees to find a site and construct such units itself. On the other hand, in-lieu-of fees allow for greater flexibility in meeting IZ requirements. This is dependent, in large measure, on the amount of the per unit fee. There are numerous ways to calculate the in-lieu-of payment option—using a fixed fee or a fee equal to the per unit cost of construction, for example—that can dramatically influence the attractiveness and feasibility of exercising the option by a developer.

Proposition 3 *IZ units will be built in some proportion to the total number of residential units constructed in a particular neighborhood and a higher proportion of IZ units will be built in areas where more multi-family housing is built.*

It can be expected that affordable housing built through IZ programs would be geographically dispersed across a jurisdiction with an IZ policy in some proportion to new (market-rate) housing development in that jurisdiction, assuming that no other factors differentially affect the siting of mixed-income projects in relation to market-rate housing projects. For mandatory IZ policies, new residential development projects that meet certain thresholds (typically above a certain number of units) are required to include a certain percentage of affordable units; therefore, it would follow that affordable housing should be spatially distributed with market-rate development projects that trigger such mandatory IZ requirements. There are a number of exceptions to this, including in-lieu-of payment options and the avoidance of IZ requirements through the reduction in project size. This type of mixed-income housing approach utilized by IZ programs raises a concern with respect to both the production of low-income units and their dispersal: affordable housing is produced when market-rate housing is produced, but market-rate housing is only developed in areas with sufficient demand at a (market) price level to offset the costs associated with providing the affordable units, less any incentives or density bonus benefits. In addition, zoning and other land use regulations may limit the type and scale of housing development in certain areas, thus precluding affordable housing development even in areas with IZ. Furthermore, it is possible that local sentiment against the development of affordable housing may affect the siting of mixed-income IZ housing projects and thus shift the spatial distribution of IZ units away from certain neighborhoods.

Proposition 4 *If effective Smart Growth policies are in place, it can be expected that new development will be directed to areas with existing infrastructure capacity and/or to areas of existing development, thus creating an observed spatial clustering of newly constructed units. A regional IZ program is more likely to be coordinated with regional Smart Growth policies than local IZ programs.*

It has been argued that spatial concentrations of affordable housing units can reinforce patterns of residential segregation and exacerbate the negative effects of concentrations of poverty (Cutler et al. 1999; Massey and Denton 1993; Schwartz and Tajbakhsh 1997; Wilson 1987). However, spatial clustering may not necessarily reflect a failure of an area's affordable housing policy to adequately disperse units. From a planning perspective, Smart Growth principles support new development in areas where infrastructure is in place to accommodate additional growth (Knaap and Talen 2005). These areas typically are located around public transit hubs and in previously urbanized neighborhoods. Zoning may be changed to reflect the desire by a municipality to direct growth to specific nodes, thereby increasing development opportunities in certain areas while restricting them in others. The growing acceptance of Smart Growth land use policies and transit-oriented development models reflect an emerging awareness of the connection between development patterns, transportation, employment opportunities, and housing (Danielson et al. 1999; Downs 2005).

3 Study area overview and descriptive statistics

This study compares the spatial distribution and siting of IZ units in Suffolk County, New York, and Montgomery County, Maryland. These two areas allow for the analysis of contrasting institutional frameworks relating to housing provision and land use decision making. In Suffolk County, IZ policies are adopted by local governments (the 43 towns and villages) and structures vary across these municipalities, although all IZ policies in place during the study period for this analysis were voluntary in nature (Kontokosta 2014). The Suffolk County regional government, through the Suffolk County Planning Commission, maintains non-binding review authority over certain land use decisions, but county-level decisions can be overturned at the local level. As part of this oversight, since the early 1970s, the Suffolk County Planning Commission has stipulated that residential projects should provide at least 20 % of total units proposed as affordable. These requirements, however, remained loosely defined until a re-articulation of Planning Commission guidelines in 2009. Montgomery County, on the other hand, retains regional control over land use and zoning decision and the county's IZ polices—known as the MPDU (Moderately Priced Dwelling Unit) ordinance. Decision authority over the approval of residential development, as well as the standards for the MPDU ordinance and its implementation, is held by the county planning agency (Kontokosta 2014). Although there are numerous variations and differences in policy structure and history, these two counties provide a reasonable comparative environment to understand how affordable housing is dispersed in areas with regional land use and housing policies and in those where local "home-rule" authority exists.

While Suffolk is larger than Montgomery in population and land mass (911 square miles to 496 square miles), the two counties shared a similar population density and proportions of Blacks and Hispanics in 1980 (see Table 1). Although Suffolk has a considerably larger percentage of single-family homes, ownership rates were roughly similar in the two counties and have converged over time. Most relevant to this comparative analysis is the virtually identical change in the number of housing units in Montgomery and Suffolk. Between 1980 and 2000, Montgomery County added 116,675 net new housing units and Suffolk County added 117,000, which represents just a 325 unit difference over the 20-year study period. Median household income in 1980 was approximately 30 % higher in Montgomery County than Suffolk County, with a correspondingly lower poverty rate. In

Table 1 Descriptive statistics, 1980–2000, by County

	1980	1990	2000	% Chg, 1980–2000
Montgomery County				
Population	583,806	761,666	873,341	49.6 %
% Bachelors degree	41.9	49.6	54.8	12.9
% Employed—prof/tech	29.5	31.5	36.3	6.8
Population density	3,933	4,694	5,244	33.4
% Black	8.7	11.8	15.3	6.6
% Hispanic	3.7	7.2	11.4	7.8
% Non-Hispanic White	83.2	73.4	61.6	−21.6
Housing units	217,957	297,620	334,632	53.5
% Single-family	62.5	58.7	58.2	−4.3
% Built before 1939	8.3	6.5	6.2	−2.0
% Owner-occupied	67.7	67.8	69.4	1.7
Vacant units	8,901	13,581	10,067	13.1
% Vacant	4.1	4.6	3.0	−1.1
Suffolk County				
Population	1,282,852	1,320,547	1,419,356	10.6
% Bachelors degree	17.8	23.3	28.0	10.2
% Employed—prof/tech.	17.7	19.1	22.3	4.6
Population density	3,086	3,106	3,288	6.5
% Black	6.1	6.6	7.7	1.6
% Hispanic	4.6	6.3	10.2	5.6
% Non-Hispanic White	88.5	85.5	79.5	−9.0
Housing units	405,306	480,879	522,306	28.9
% Single-family	82.0	81.7	82.7	0.8
% Built before 1939	13.3	11.1	9.6	−3.8
% Owner-occupied	76.8	74.3	75.7	−1.1
Vacant units	19,940	56,583	53,014	165.9
% Vacant	4.9	11.8	10.1	5.2

both Counties, the percentage of persons with incomes below the poverty line was less than half of the figure for the respective States in the aggregate. The similarities in demographic characteristics in 1980 and the essentially equal number of net housing units between 1980 and 2000 make the two areas suitable for a comparative analysis of IZ housing production and spatial distribution in differing institutional contexts. However, the differences in income levels and ownership rates discussed here must be acknowledged as potential limitations to the generalizability of the results presented below.

3.1 Data sources

The primary data for this analysis consist of counts for all affordable housing units constructed in Suffolk County and Montgomery County between 1980 and 2000. This includes units built through IZ programs, HUD subsidy programs, and the Low-Income Housing Tax Credit (LIHTC) program. The focus of this analysis, however, is IZ units; other low-

Table 2 Data sources

Data source	Description
Suffolk County Department of Planning	Housing policies, housing data; regional and local land use data
Suffolk County Department of Affordable Housing	Affordable housing data
Long Island Housing Partnership	Affordable housing data
Village and town officials	Affordable housing data; IZ policy structure
Montgomery County Planning Department	Local and regional land use and housing data
Montgomery County Department of Housing and Community Affairs	MPDU program data
Housing Opportunities Commission	MPDU program data
Maryland State Department of Assessments and Taxation	Property characteristics and locations
Maryland State Department of Planning	State and regional land use data
US Department of Housing and Urban Development Low-Income Housing Tax Credit database	LIHTC unit data
Picture of Subsidized Housing	HUD subsidized unit data
New York State GIS Clearinghouse	GIS layers
Montgomery County Department of Technology	GIS layers

income units are used to study spatial relationships of units constructed through different subsidy programs. Unit-level geo-location and property type data are supplemented and merged with tract-level socioeconomic, demographic, and housing characteristics from the GeoLytics Neighborhood Change Database, which includes decennial Census data for 1970, 1980, 1990, and 2000.[3] Census data are collected for all tracts in the study area. Specific data sources for affordable housing units, property characteristics, and geographic information system (GIS) spatial information are outlined in Table 2.

This analysis incorporates two original databases of affordable units built in Suffolk County, New York, and Montgomery County, Maryland between 1980 and 2000.[4] Descriptive statistics of unit counts and locations are provided in Figs. 1, 2, 3, and 4. These databases, compiled from numerous sources described in Table 2, contain information on the address of the unit, unit type, project type, year built, and price control period. In addition, the Montgomery County database includes the racial characteristics of first occupants. By collecting geographic information for more than 18,000 low-income units, of which 11,043 are classified as being constructed through IZ programs, these data allow for the first comprehensive study of the locational determinants of IZ units.

At the time of the data collection for this study, Suffolk County had no central repository of affordable housing data. Local municipalities, as well, had limited data available on affordable housing units built specifically through IZ programs. These data limitations were overcome by working with the Suffolk County Planning Department to review and compile IZ unit data extracted from individual project files. First, units

[3] Data from the 1970 Decennial Census are included to provide certain lagging indicators in the regression models.

[4] The original databases include all housing units built between 1971 and 2008, although this study is limited to the time period between 1980 and 2000.

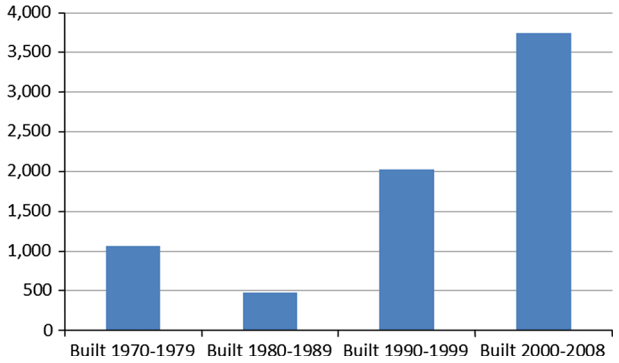

Fig. 1 Total affordable units built by decade in Suffolk County, 1970–2008

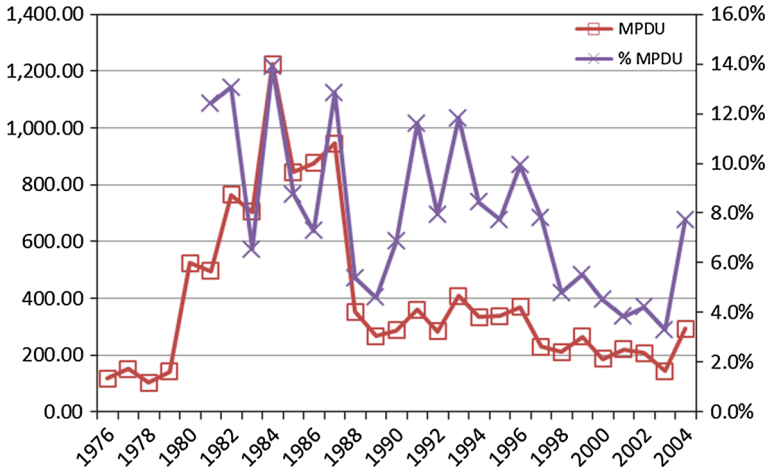

Fig. 2 MPDU units built by year (Total MPDU units and percent of all units built) in Montgomery County, 1976–2004

identified by the local planning officials as IZ units are totaled. Then, units included in mixed-income residential developments, and not funded by HUD or LIHTC programs, are added. In total, we find 2,393 IZ units built between 1980 and 2000 that can be attributed to IZ programs. As such, this paper presents the first comprehensive database of affordable housing built in Suffolk, as well as the first database of units built through IZ and mixed-income housing programs. Also, it should be noted that none of the local municipalities reported having information on the extent or location of affordable units built through in-lieu-of payment options.

For Montgomery County, the Department of Housing and Community Affairs maintains a database of all units built through the MPDU program. From the database, individual addresses and affordability control periods were extracted for all available MPDU units (rental and ownership) built between 1980 and 2000. In total, data were retrieved for 8,650 units.

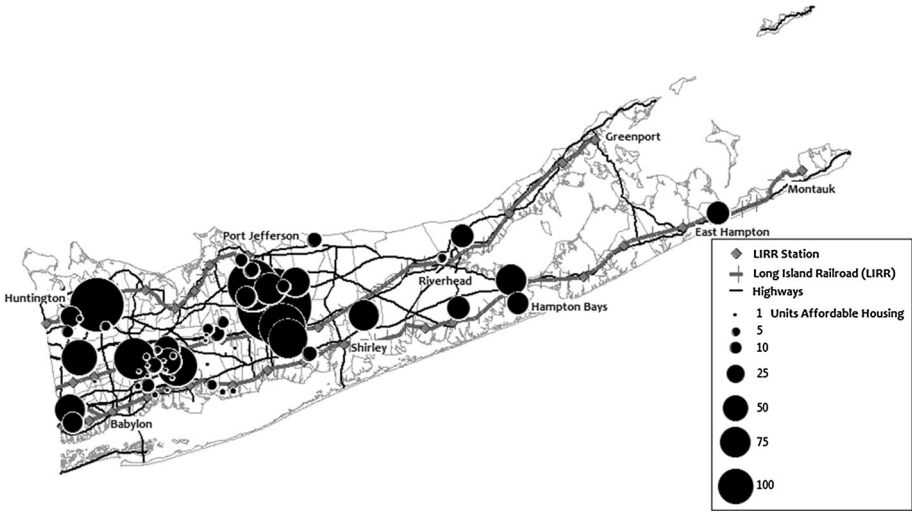

Fig. 3 Proportional dot map of IZ units built between 1980 and 2000, Suffolk County, New York

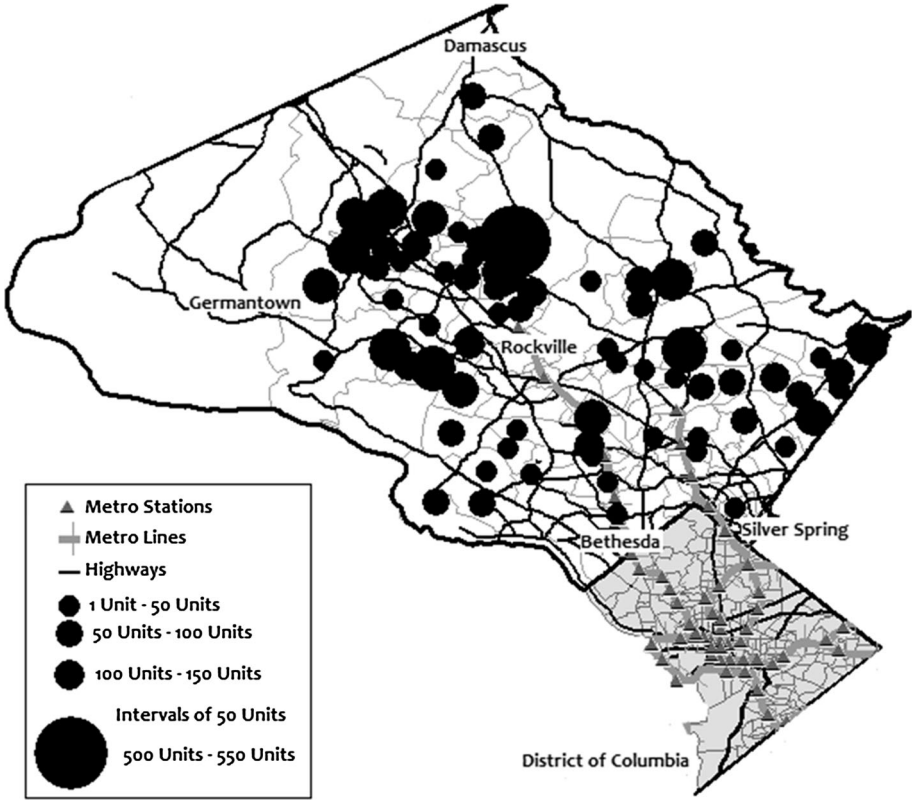

Fig. 4 Proportional dot map of MPDU units built between 1980 and 2000, Montgomery County, Maryland

3.2 Total production of IZ housing units

The total production of affordable housing through IZ programs in the USA has been relatively modest. Estimates for the total production of IZ units built between 1980 and 2000 range from 30,000 to 50,000 units (based on author's estimates from data collected for this paper and from the review unit counts in Mukhija et al. 2010; Porter 2004; Schuetz et al. 2011). Many of these units, however, are no longer subject to price controls, so the current stock of affordable units built through IZ programs is considerably less.[5] By comparison, the Low-Income Housing Tax Credit program, enacted in 1986, produced over 800,000 low-income units through 2000 (Freeman 2004). As these data indicate, while there has been a growing interest in IZ programs since 2000, the amount of low-income housing created has been relatively limited (Meltzer and Schuetz 2010).

Suffolk County experienced in largest gains in affordable housing units in the 1990s and 2000s. Figure 1 shows production of affordable housing from all subsidy programs for which data were collected as part of this study.

Figure 2 shows data for MPDU production per year and as a percent of total building permits in Montgomery County. With the exception of the mid-1980s and mid-1990s (both periods of expansion in the housing market), MPDU production has remained between five and 10 % of the total units built. The periods of higher production were most likely the result of greater demand for housing during the mid-1980s and mid-1990s, prompting developers to provide additional MPDU units to capture the greater density bonuses available through Montgomery County's sliding scale density incentive. The relatively low production of MPDU units (both as a percent of total and in absolute numbers—see Fig. 3) during this period highlights another potential concern with IZ programs. Although the housing affordability gap was widening, as real wages remained relatively constant while prices escalated rapidly, affordable housing production was decreasing.

4 Methodology and results

The impact of IZ policies on the production and spatial distribution of low-income housing is analyzed here using two approaches. First, logistic regression is used to estimate the likelihood of a neighborhood (defined by census tract boundaries) receiving *any* IZ units, assuming that an IZ policy is in place. Second, the factors affecting the proportion of IZ units built in relation to total housing units is analyzed using a fractional logit model, which is described in more detail below.

4.1 Probability of a neighborhood receiving inclusionary zoning units

Here, logistic regression is used to estimate the influence of a range of variables on the likelihood of having *any* IZ units built in a particular neighborhood. This technique for quantitatively identifying comparable groups, known as propensity score matching, uses a predicted probability of group membership based on observed predictors obtained by logistic regression. Formally,

[5] For example, IZ units built in the 1970s in Montgomery County were only subject to 5-year price controls (Trombka et al. 2004).

$$P(X_i) = \Pr(T_i = 1|X_i)$$

where *P(X)* is the propensity score, the conditional probability of participating in the treatment (*T*) given a vector of observed characteristics (*X*).

The binary dependent variable in this case is equal to one if the jurisdiction had any IZ units built between 1980 and 2000, and 0 otherwise. The independent or explanatory variables are the same as those used in the fractional logit model described below and divided into five categories: socioeconomic status, demographics, housing market conditions, measures of integration, and previously built affordable housing units. The propensity score is then predicted from the coefficients of the logistic regression model, allowing tracts to be grouped according to the expected likelihood of having IZ units built over the study time frame. Matching propensity scores can be accomplished using a number of methods, including nearest neighbor, caliper, Mahalanobis metric, and stratification (Rosenbaum and Rubin 1985; Rubin and Thomas 1996). Given the number of covariates in the model, matching in this study is accomplished using the caliper technique with replacement where comparison units are selected from a pre-determined propensity score range (Gu and Rosenbaum 1993).

Based on the propensity scores derived from the logistic regression analysis, neighborhoods are classified into four quartiles, from "least likely" to "most likely" to receive IZ units. This provides the basis for comparison of racial and socioeconomic characteristics in neighborhoods receiving IZ units and those that did not.

From Table 3, several differences between neighborhoods least likely and most likely to receive IZ units become apparent. First, more racially diverse neighborhoods are more likely to receive IZ units. This is evidenced by the proportions of Hispanic and Black populations in 1980, both of which are considerably higher (more than double from "least likely" to "most likely" categories) in areas most likely to have had IZ units built over the study period, and in the integration entropy index values.[6] Neighborhoods more likely to have IZ units built have a more diverse housing stock, with more rental and multi-family housing. This is expected, as the financial feasibility of homeownership becomes constrained at lower-income levels. Furthermore, higher proportions of multi-family housing indicate two important factors for IZ production. First, multi-family housing is, holding land values and housing amenities constant, less costly to build and own, on a per unit basis, than single-family housing. Mixed-income residential development in multi-family structures is more economically viable than in mixed-income single-family subdivisions, as the per unit subsidy (difference between market price and controlled price) for multi-

[6] The entropy index is given by:

$$H_i = \Sigma \sum_{m=1}^{M} Q_{im} / \ln(m)$$

where

$$Q_{im} = -\pi_{im} \ln(\pi_{im}) \quad \text{if } \pi_{im} > 0$$
$$= 0 \quad \text{otherwise}$$

π_{im}= the proportion of the population of tract *i* consisting of persons in group *m*

M= number of groups(four for race,five for income)

Consistent with Galster et al. (2008) and HUD income guidelines, five income categories are defined: very low income (households earning less than 50 % of AMI); low-income (households earning between 51 and 80 % of AMI); moderate-income (households earning between 81 and 100 % of AMI); high moderate Inc (households earning between 101 and 120 % of AMI); and high-income (households earning more than 121 % of AMI).

Table 3 Census tract characteristics in 1980 (grouped by probability of receiving IZ units between 1980 and 2000)

	Racial Int			Inc Int			% Ownership			% SF		
	Both counties	MC	SC	Both counties	MC	SC	Both counties	MC	SC	Both counties	MC	SC
Least likely	0.23	0.41	0.16	0.81	0.86	0.79	75.3	63.1	80.2	81.0	66.5	86.8
Less likely	0.24	0.46	0.19	0.78	0.87	0.76	77.3	68.2	79.3	83.0	74.4	84.8
More likely	0.31	0.42	0.27	0.76	0.87	0.71	73.2	67.7	75.1	74.2	64.6	77.6
Most likely	0.41	0.39	0.48	0.79	0.85	0.64	68.0	69.2	65.0	61.6	57.0	72.9

	% HSP			% BLK			% NHW			Average HH income		
	Both counties	MC	SC	Both counties	MC	SC	Both counties	MC	SC	Both counties	SC	MC
Least likely	2.9	4.3	2.3	4.1	9.5	2.0	91.2	82.1	94.8	$ 28,139	$ 31,395	$ 26,828
Less likely	3.5	5.0	3.2	4.7	10.3	3.5	90.3	80.1	92.5	$ 26,901	$ 33,990	$ 25,341
More likely	4.6	4.1	4.8	8.6	8.0	8.8	84.8	82.8	85.5	$ 27,348	$ 35,581	$ 24,421
Most likely	6.1	3.0	13.9	10.7	8.3	16.5	80.1	84.6	68.9	$ 30,549	$ 33,967	$ 22,052

	% Poverty			Average IZ units in adjacent		Median gross rent (diff from county)			Sum IZ units in adjacent	
	Both counties	SC	MC	MC	SC	Both counties	MC	SC	MC	SC
Least likely	4.5	4.4	4.5	5.25	7.08	$ 61	$ 100	$ 45	36.00	43.32
Less likely	5.8	4.5	6.0	7.16	6.95	$ 16	$ 80	$ 2	55.86	39.76
More likely	6.8	4.6	7.6	20.69	13.41 S	$ (5)	$ 81	$ (36)	153.28	79.48
Most likely	6.7	4.5	12.0	58.99	11.50	$ (70)	$ (88)	$ (25)	434.67	68.43

family housing should be lower than for comparable single-family homes. Second, the presence of multi-family housing indicates both a willingness to accommodate a range of housing types and zoning that allows for such housing. Housing cost measures show a negative relationship between median gross rent and the likelihood of having IZ units, while average household income does not vary considerably.

Table 3 above also shows 1980 tract characteristics by county based on probability of receiving IZ units. In terms of this comparative analysis between regional and local land use frameworks, the data reveal a sharp contrast between the two counties in the types of neighborhoods that receive IZ units. Looking at differences between tracts least likely and most likely to receive IZ units, neighborhoods in Montgomery County exhibit only small variations along the spectrum, while Suffolk County neighborhoods have statistically significant differences (at the 99 % confidence level) based on a two-sample *t* test of significance.

Of particular interest are differences in the measures of integration, given by the entropy index values. In Montgomery County, racial and income integration remains relatively constant across the four probability categories. In Suffolk County, racial integration varies from 0.1599 in least likely neighborhoods to 0.4789 in most likely neighborhoods, almost three times greater. This suggests that neighborhoods receiving IZ units are much more racially diverse, evidenced by the percentages of Hispanic and Black populations (13.9 and 16.5 %, respectively) in tracts most likely to receive units. Conversely, neighborhoods receiving IZ units in Suffolk are far less income integrated than others. Given that poverty rates are considerably higher for neighborhoods likely to receive IZ units, the income integration value is not surprising and indicates spatial clustering of low-income units in low-income communities in Suffolk.

In addition to spatial clustering within tracts, the evidence supports IZ housing concentrations across larger geographies of multiple tracts, as well. The average and total number of IZ units built in adjacent tracts, grouped by likelihood of a particular tract receiving any IZ units, are shown in Table 3. In both study areas, there is a clear difference between tracts less and most likely to receive IZ units. Tracts most likely to receive IZ units are surrounded by tracts with relatively large number of IZ units, reinforcing, again, the strong spatial clustering indicated by the visual analysis of spatial data and calculations in Table 3.

4.2 Locational determinants of IZ unit production

The following analysis examines the factors that affect the quantity of IZ units built in a given neighborhood, building conceptually on previous studies of locational determinants of low-income housing (Ellen et al. 2009; Freeman 2004; Oakley 2008; Rohe and Freeman 2001). In this case, the dependent variable is the *proportion of IZ units to total housing units* built between 1980 and 2000 and explanatory variables include neighborhood characteristics, housing conditions, and spatial and geographic controls. The proportion of IZ units is used as the dependent variable for two reasons. First, many "fair share" housing allocations rely on a benchmark of percent of total housing units to evaluate the sufficiency of a given community's affordable housing stock. For example, in Massachusetts, the Chapter 40B statute is predicated on each municipality maintaining at least 10 % of its housing inventory as affordable units (Cowan 2006; Dain 2006). Second, it has been argued that IZ programs may constrain supply in the aggregate, thus lowering the number of units built in a given neighborhood (Schuetz et al. 2011). Using the absolute number of IZ units built as the dependent variable, even after controlling for total units built, would

Table 4 Distribution of affordable housing units in 5 and 10 % of tracts, 1980–2000

	5 % of Census tracts (%)	10 % of Census tracts (%)
Montgomery—IZ units	36.9	56.1
Montgomery—total LI units	34.6	52.5
Suffolk—IZ units	85.1	97.7
Suffolk—total LI units	83.2	97.3

therefore result in biased estimates due to this problem of endogeneity and thus not properly account for neighborhood-level differences in housing production. A quasi-MLE method with a logistic mean function, otherwise known as a fractional logit model, is used here to estimate the effect of the factors above on the dependent variable, y, where values of y are bounded by 0 and 1. This method has been shown to produce more precise estimates than linear regression techniques in cases where the dependent variable can equal 0, and thus, no adjustments are needed to the dependent variable to account for the fact that some neighborhoods had no IZ units built during the study time frame (Fuerst, Kontokosta, and McAllister 2014; Papke and Wooldridge 1996; Wooldridge 2002).[7]

4.3 Spatial distribution of inclusionary zoning units

Between 1980 and 2000, the data reveal spatial concentrations in IZ unit distribution, to varying degrees, in both Montgomery County and Suffolk County. Table 4 summarizes the percentage of affordable units built before 2000 by percentage of census tracts.

The data for Suffolk County reveal a significant concentration of affordable units in a small number of tracts (shown in Fig. 3). More concretely, almost all IZ units (97.7 % of the total) are located in just 31 census tracts, representing 10 % of the total. In 2000, these tracts accounted for 11.8 % of the total housing units in the County and approximately 13.7 % of the total land area. When including LIHTC units, the percentage of affordable units in the top 10 % of tracts remains extremely high (97.7–97.3 %). This suggests that certain tracts are more likely to have both LIHTC units and IZ units. A Pearson correlation confirms this with a positive coefficient value of 0.138 and significance at the 95 % confidence level. This correlation is explored more fully in the fractional logit regression results presented below.

Inclusionary zoning units in Montgomery County are more geographically dispersed than in Suffolk, but still reflect some spatial clustering (see Fig. 4). Fully 56.1 % of all IZ units are located in just 17 tracts (10 % of the total). Including LIHTC units in the analysis reduces this percentage slightly, to 52.5 %, indicating a marginally higher dispersion for LIHTC units. Interestingly, unlike Suffolk, although the correlation between tracts with LIHTC units and tracts with IZ units is positive, it is not statistically significant (p value = 0.168). Another important difference between Montgomery and Suffolk relates

[7] Another econometric approach is to use a Tobit model and to account for the relatively large number of neighborhoods in the sample with no IZ units built during the study period. However, Sigelman and Zeng (1999) shows that Tobit models are not appropriate for data when censoring has not occurred. Since there cannot be a negative number of IZ units, while there is clustering at zero, the data are not censored at zero. In this case, they state, a two-step approach that first looks at the yes/no binary decision and then secondarily looks at estimates of the actual number of units produced. This is also the empirical approach used by Larson (2004). As a robustness check, the regression was run using a Tobit model and resulted in similar estimates to those presented in Table 6.

Table 5 Percent IZ units and total housing units built by tract poverty level, 1980–2000

Bin	% Poverty	Cumulative % IZ units	Cumulative % total housing units	LQ
Montgomery County, Maryland				
1	8.1–11.7	16.0	14.5	1.12
2	4.5–8.1	20.2	28.8	0.72
3	0.9–4.5	57.2	52.4	1.10
4	0–0.9	5.9	4.8	1.23
	($\mu = 4.5$ %)			
Suffolk County, New York				
1	11.2–15.7	18.0	15.4	1.21
2	6.7–11.2	35.5	35.5	1.02
3	2.2–6.7	46.2	46.2	0.98
4	0–2.2	0.2	2.8	0.09
	($\mu = 6.7$ %)			

Bin 1: $\mu + 1\sigma$ through $\mu + 2\sigma$

Bin 2: μ through $\mu + 1\sigma$

Bin 3: μ through $\mu - 1\sigma$

Bin 4: $\mu - 1\sigma$ through $\mu - 2\sigma$

to the characteristics of the top 10 % of tracts by number of IZ units. In Montgomery, these tracts account for over 45 % of the total housing units in the County and approximately 38 % of the total land area. The results suggest that affordable units are distributed in a more equal proportion to both housing stock and population.

Turning to the distribution of units by neighborhood poverty level, we begin to see patterns emerge across the two study areas. Table 5 shows the percentage of IZ units and total housing units built by tract, divided according to poverty level. Tracts are grouped in four bins based on standard deviations from the mean percentage of persons below the poverty level.

The IZ unit 'location quotient' (LQ) was calculated for each poverty group based on the following equation:

$$\mathrm{LQ} = \frac{(IZ_i/HU_i)}{(IZ_c/HU_c)} \tag{1}$$

where IZ_i is the number of IZ units built in tract *i* between 1980 and 2000, HU_i is the total number of housing units built in tract i between 1980 and 2000, IZ_c is the total number of IZ units built in county c, and HU_c is the total number of housing units built in county c.

In Montgomery County, 36.2 % of IZ units were built in tracts with above average levels of poverty, whereas 43.3 % of the total housing units were built in those same tracts. Therefore, the location quotient value of 0.72 for Montgomery County reveals an under-allocation of IZ units in areas with above average poverty levels, compared to 1.12 for the tracts with the highest poverty levels. The data for Suffolk County, on the other hand, show a sharp distinction between the lowest and highest poverty categories, with an over-allocation, when compared to total units built, of IZ units in the highest poverty areas and an under-allocation in neighborhoods with the lowest percentage of households living in poverty (those in the bin with less than a 2.0 % rate of poverty).

Table 6 Regression results: IZ units built between 1980 and 2000 as a proportion of all housing units built

Variable	Model 1- Full sample	Model 2- Suffolk County	Model 3- Montgomery County
Constant	−5.311***	−5.885**	−2.719*
Housing characteristics			
Tract population (000 s)	0.0003	0.001**	0.00004
Population density	−0.029***	−0.041**	−0.038***
% Single-family homes	−0.921	−1.169	−0.08
% Ownership	0.497	2.991	−2.436**
Median gross rent (000 s)	−0.003**	−0.009**	0.0008
Total housing units built, 1980–2000	−0.0002	−0.002*	0.0004**
LIHTC units, any built 1980–2000 (yes = 1)	0.226	−0.203	0.157
Socioeconomic characteristics			
% Bachelor's degree or higher	0.234	−4.205	−1.578
% Over the age of 65	−2.17	1.396	−1.472
% In poverty	9.603	12.968*	−18.839*
Income integration, entropy index	1.777	3.992	1.011
Racial characteristics			
% Black	3.846	5.632	1.727
% Black (squared)	−3.608	−4.712	11.749
% Hispanic	14.92***	18.048*	36.27**
% Hispanic (squared)	−18.103	−21.002	−35.81
% Foreign born	−0.172	−16.637	0.424
Spatial controls			
Total IZ units Built in adjacent tracts, 1980–2000	−0.0003	0.003	−0.001
Average IZ units built in adjacent tracts, 1980–2000	0.009	−0.020	0.019**
Municipality with IZ policy (Suffolk only)		−0.379	
N	486	312	174
Log pseudolikelihood	−48.403	−26.758	−17.695

All 1980 values unless otherwise indicated

*** Significant at the 99 % level

** Significant at the 95 % level

* Significant at the 90 % level

5 Discussion of results: fractional logit model

Three models are specified, one for each county and one for the full sample. The results of the fractional logit model are provided in Table 6.

The results presented above reveal important differences between the two counties in the direction and significance of the coefficient estimates. In Suffolk County, higher proportions of IZ units are correlated with larger tract populations, lower rents, less building activity, and higher proportions of Black, Hispanic, and poor households. Tracts in Suffolk County that received a greater proportion of IZ units have higher rates of poverty and greater percentages of Black and Hispanic residents. These findings strongly support the preliminary findings presented earlier, which reveal a pattern of spatial

concentration of IZ units in poor neighborhoods with high proportions of minorities. Neighborhoods with higher median rents experienced lower proportions of IZ units built over the study period. This finding is consistent with the hypothesis that local residents, motivated by a desire to protect and preserve their property values, may be opposed to the development of new IZ units. Even after controlling for the number of *total housing units built* in a particular tract, a pattern indicative of racial and income segregation emerges.

The coefficient estimates for Montgomery County (presented as Model 3) indicate significantly different correlates of IZ unit spatial distribution at the neighborhood level than those for Suffolk County. The coefficient for the total number of housing units built in a tract is positive and significant, indicating that neighborhoods with more building activity are also receiving larger percentages of IZ units. This may reflect the lower per unit subsidy for IZ units as the scale of building projects increases. Conversely, tracts with higher rates of homeownership were less likely to receive IZ units between 1980 and 2000. This supports findings by Freeman (2004) and may occur in the case of IZ for two reasons. First, the financial costs associated with homeownership are often too great for low-income households, making rental options more feasible for households with lower disposable income and less savings. Second, it is possible that homeowners may try to protect the value of their properties by limiting new supply in the submarket (Fischel 1985, 2001). These households may also be concerned about the economic and social spillover effects of lower-income households entering their neighborhood (Pendall 1999, 2000).

The coefficients of interest for percent Black and percent Hispanic populations reveal mixed evidence of spatial clustering in minority areas. The positive and statistically significant coefficient for Hispanic population indicates that neighborhood in Montgomery County with higher proportions of Hispanics received higher proportions of IZ units as a percent of total units built. The poverty rate variable is negative and significant at the 90 % confidence level, which indicates, albeit weakly, that neighborhoods with lower rates of poverty received higher proportions of IZ units.

The two spatial variables included in the model are used to identify spatial clustering of IZ units at a scale beyond the individual tract and to control for spatial autocorrelation across neighborhoods. Although commonly used as a proxy for neighborhoods in empirical studies, it has been argued that Census tracts may be inadequate for fully capturing and defining appropriate spatial and social interactions that define a neighborhood (Clapp and Wang 2006). Here, variables for the total and average number of IZ units built in adjacent tracts are included to examine possible spatial correlation across, and not just within, tracts. Only in the case of Montgomery County is one of these variables found to be significant; in this instance, a positive coefficient for the variable of the average number of IZ units built in the adjacent tracts. This suggests evidence of spatial clustering across tracts and neighborhoods. On the one hand, this clustering could represent areas of concentration of IZ units in low-income or racially segregated communities that cross tract boundaries. On the other hand, Smart Growth planning practices would suggest that plans are coordinated for contiguous areas determined to be appropriate locations for development, e.g., near public transportation hubs, away from environmentally sensitive land, and in previously built-up areas, which would result in clustering of IZ units across larger geographic areas. Given the coefficients of the other statistically significant variables in the model, the results support the latter as the driver of spatial clustering in Montgomery County, although further exploration is necessary.

6 Conclusions and policy implications

This analysis provides evidence of spatial concentrations of IZ units built between 1980 and 2000, although the characteristics of neighborhoods in which clustering occurs differ between the two study areas. Overall, we find evidence to support the four propositions discussed and tested in this paper. In Suffolk County, fully 97.7 % of IZ units were built in just 10 % of the census tracts. This is compared to 56.1 % of IZ units in 10 % of tracts in Montgomery County. In Montgomery County, where the results indicate little variation in characteristics of neighborhoods least and most likely to receive IZ units, it is possible that IZ has been an effective policy in producing affordable housing as certain areas deemed appropriate for development have grown over time. This is supported by the positive relationship between the number of units constructed in Montgomery County over the study period and the proportion of IZ units built in a particular census tract.

For Suffolk County, the findings for the siting of IZ units reveal a troubling pattern of low-income units being sited predominantly in low-income and minority neighborhoods. The siting of almost all IZ units in the lowest-income neighborhoods, consistently over the 20-year study period, indicates that IZ policies in Suffolk County have not effectively dispersed low-income units throughout the region. This conclusion is reinforced by the relatively small total number of low-income units produced between 1980 and 2000. There are several possible explanations. First, IZ programs may not be sufficient to overcome community opposition to new development and, more specifically, NIMBY attitudes toward low-income housing, thus directing low-income housing production to neighborhoods least likely to resist new development (on NIMBY, see Dear 1992; Fischel 2005; Schively 2007). Second, in areas where policy requirements are more restrictive or little land is available for development, substitution effects may limit the production of low-income housing through IZ programs. Local governments reluctant to alter land use plans and zoning, therefore, can constrain the effectiveness of IZ programs adopted by those municipalities. When compared to the results for Montgomery County, the outcomes in Suffolk County suggest that local control over housing policy, without regional coordination or oversight, fails to account for inter-municipality distributions of low-income housing.

In both Counties, the results of the fractional logit model demonstrate that the proportion of IZ units built is negatively correlated with population density and positively correlated with the percentage of Hispanic population in the census tract. These findings control for the total number of housing units built between 1980 and 2000, among other explanatory variables. In Montgomery County, where regional government controls both land use decisions and the IZ (MPDU) program, there were no statistically significant differences in levels of pre-IZ integration in those neighborhoods least likely and those most likely to receive IZ units. In addition, we find that the *percentage* of IZ units (rather than just the absolute number) increases with the total number of housing units built in the neighborhood. Thus, as more housing is produced in a neighborhood, the share of those units that are classified as IZ increases, irrespective of the actual number of IZ units built. This is in sharp contrast to Suffolk County, where the neighborhoods most likely to receive IZ units had entropy index values more than three times greater than their least likely counterparts for racial integration, but approximately 25 % lower for income integration. Neighborhoods most likely to receive IZ units in Suffolk County have much larger proportions of Black and Hispanic populations and far greater concentrations of lower-income households.

The results presented here demonstrate significant variation in the outcomes of IZ programs with respect to both the production and spatial distribution of IZ units across the two study areas. The Counties included in this study represent two approaches to housing policy: Suffolk County has local government control over IZ program design and implementation with little oversight at the regional level, while Montgomery County maintains regional authority over housing and land use policies. In the two Counties, almost an identical number of total housing units were built between 1980 and 2000; however, approximately 75 % fewer IZ units were constructed in Suffolk than were built in Montgomery County during this time period. Furthermore, IZ units constructed in Suffolk were predominantly sited in poor neighborhoods with high proportions of Black and Hispanic populations. Therefore, while the debate on the role of housing policy in shaping neighborhood social mix continues, this research has shown that IZ programs can have outcomes counter to their stated policy intent and to prevailing expectations. From the perspective of both affordable housing production and the equitable spatial distribution of units, the effectiveness of IZ is contextual and must be considered in light of the institutional framework in which these policies are adopted. The potential for IZ policies to exacerbate existing patterns of residential segregation and isolation by continuing to locate low-income housing units in poor, minority neighborhoods is a finding that must be considered in the adoption and evaluation of future IZ policies.

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