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Inclusionary Housing Policies, Stigma Effects and Strategic Production Decisions

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Abstract Inclusionary housing policies enacted by municipal governments rely on a combination of legal mandates and economic incentives to encourage residential real estate developers to include affordable units in otherwise market-rate projects. These regulations provide a means of stimulating the production of mixed-income housing at a minimal cost to the public sector, but have been hypothesized to slow development and put upward pressure on housing prices. The results of the theoretical models presented in this paper suggest that inclusionary housing policies need not increase housing prices in all situations. However, any observed impact on housing prices may be mitigated by density effects and stigma effects that decrease demand for market-rate units. The results additionally suggest real estate developers are likely to respond to inclusionary housing policies by strategically altering production decisions.

Keywords Affordable housing · Inclusionary zoning · Residential development · Mixed-income development

Introduction

Inclusionary housing policies have been put forth as a cost effective means of stimulating the production of affordable housing in geographically dispersed areas throughout a community (Brunick 2004a, b). By encouraging or requiring the private sector to include affordable units in otherwise market-rate projects, in exchange for density bonuses or other forms of incentives, these initiatives clearly have the potential to diversify the composition of the housing stock in socially beneficial ways. However, the economic implications of the practice have been widely debated

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in the academic literature for a variety of reasons. The most longstanding concern is that these policies impose regulatory costs on developers that slow the construction of market-rate housing and put upward pressure on prices (Ellickson 1981; Clapp 1981).

The theoretical models presented in this paper address these issues using a real options framework to evaluate the potential impact of inclusionary housing policies in different economic environments. By taking this approach, housing supply and price effects can be examined after controlling for market strength, stochastically evolving demand, and any stigma effects associated with mixed-income housing. The models additionally allow for strategic phasing of development in response to an inclusionary housing policy to examine the extent to which developers can mitigate lost profits by engaging in strategic production decisions. Overall, the results indicate that developer profits, housing supply, and housing prices are all likely to respond to inclusionary housing policies when the economic incentives offered by the public sector fail to fully offset the cost of including affordable units in a project. Phasing is found to be a particularly attractive strategy for developers in response to this type of policy when housing demand is weak, as well as in situations where severe stigma effects are anticipated to exist in the market.

Development decisions in the model are presumed to occur sequentially as new information arrives. Future housing demand is uncertain and depends on two stochastic state variables, the demand level and elasticity. The developer chooses the optimal amount of housing to develop and sell each period based on current demand in order to optimize profits, knowing optimal actions will be taken in future periods. The inverse demand function is assumed to be the product of the exogenous stochastic demand level and a downward sloping function of the amount of housing developed and sold to date. Both the level and elasticity of demand are assumed to follow geometric Brownian motions and represent the uncertainty in future demand. Both of the demand state variables are allowed to change as housing units are set aside for low income families, reflecting the fact that demand for the market-rate housing may be adversely affected by the presence of low-income housing. At each time, the optimal value is a function of the demand state variables and the amount of land remaining for development. This dynamic optimization problem is solved numerically by building a binomial tree for the demand state variables and allowing the developer to build and sell in discrete units only. These procedures build upon the existing real estate literature to help explain the potential economic effects of inclusionary housing policies.

As a starting point, it is useful to consider the basic structure of inclusionary housing policies and the hypothesized economic effects. They are often found in a municipality's zoning ordinance and may be mandatory or voluntary in nature (Read 2009). Mandatory policies require real estate developers to set aside a specified percentage of the units in a residential project for individuals that satisfy defined income targets. For example, an ordinance might require 10 % of all rental or owner occupied units in a subdivision to be priced so that they are affordable to families earning no more than 80 % of the area median income. Affordability is generally defined as an amount where households spend no more than 30 % of their gross income on housing related expenditures. Density bonuses, expedited permitting, fee waivers, and other types of incentives may then be offered by a municipality to offset the financial burden imposed upon the private sector (Schuetz et al. 2009). Voluntary inclusionary housing policies operate in much the same manner, but rely solely on public sector incentives to encourage real estate developers to build mixed-income housing.

From this basic framework, inclusionary housing policies can take on a number of additional features including exemptions, fee-in-lieu options, relaxed design standards, and mandates that dictate how long affordable units must be maintained for households satisfying the income requirements (Schuetz et al. 2009). Irrespective of these differences, several common themes emerge in the academic literature regarding the potential economic implications. The primary concern is that mandatory inclusionary housing policies often fail to include economic incentives that fully compensate the private sector for building affordable units, and can therefore constrain housing supply and put upward pressure on prices (Ellickson 1981; Nirider 2008). Even sophisticated local governments may fail to adequately assess these regulatory costs because they can be direct or indirect in nature. Direct costs refer to those directly associated with the construction of affordable units, while indirect costs refer to any decrease in demand for market-rate housing brought about by the inclusion of subsidized units in residential projects (Read 2009). Both can impinge upon the profitability of real estate development, thereby influencing production decisions and ultimately housing prices.

Direct costs can be thought of not only as any cost of building affordable units above the price they can be sold for per the inclusionary housing policy, but also as lost profits resulting from the inability to sell these units at the prevailing market rate. Density bonuses allowing the construction of more housing on a given parcel of land can be used to offset these direct costs, but this form of incentive may reduce the average unit size or the amount of open space included in a project to accommodate the additional density. Numerous hedonic price models indicate that both of these types of modifications can have a detrimental effect on housing prices (Turner 2005; Anderson and West 2006; Geoghegan 2006). Assessing a density bonus's ability to offset direct costs is further complicated by the fact that this type of incentive may be more valuable in strong markets than weak ones because it relies on a developer's ability to sell the additional housing units included in a project at an attractive price (Schuetz et al. 2011).

Indirect costs may also be imposed by an inclusionary housing policy to the extent negative perceptions exist about mixed-income housing in a marketplace limiting consumer willingness to live in such projects. If this is the case, market-rate units may have to be offered at a discount to attract more affluent consumers. The magnitude of indirect costs is difficult to predict because an uncertain relationship exists between affordable housing and demand for nearby market-rate housing. Several studies completed over the last decade attempt to quantify the relationship using advanced econometric techniques intended to address endogeneity bias and other methodological issues (Funderburg and MacDonald 2010; Ellen et al. 2006, 2007). The results suggest affordable housing can have a detrimental impact on surrounding home prices in some instances, but the effects can largely be mitigated by ensuring affordable housing blends into a given neighborhood (Funderburg and MacDonald 2010). These results bode well for inclusionary housing policies because many encourage mixed-income development with affordable units that are indistinguishable from market-rate units located nearby.

On the other hand, it appears premature to conclude consumers of market-rate housing are indifferent between living in mixed-income communities and those with more homogenous socioeconomic tenancies. Some studies have found mixed-income housing struggles to attract middle-income families with children, as well as other consumer groups, unless the market is extremely competitive (Varady et al. 2005; Schwartz and Tajbakhsh 1997; Joseph and Chaskin 2010). These results indicate that inclusionary housing policies can impose indirect costs on real estate developers in some environments by making market-rate units more difficult to sell or lease. It stands to reason that the magnitude of these stigma effects could be influenced by the number of affordable units included in a project and the income groups the units are intended to serve. Nonetheless, no empirical research is currently available to the authors' knowledge quantifying these effects within mixed-income projects.

To the extent inclusionary housing policies do impose direct or indirect costs on real estate developers, tax incidence theory offers predictions regarding the outcomes, which are largely dependent upon the features of the housing market where the policies are implemented. Regulatory costs are anticipated to slow housing production and put upward pressure on market-rate housing prices (Ellickson 1981; Clapp 1981; Nirider 2008). The magnitude of these effects is contingent upon several factors. Residential developers may continue to build after the enactment of an inclusionary housing policy in markets where demand is strong and consumers are somewhat unresponsive to changes in housing prices. This may be the case in markets where housing demand is relatively inelastic. Developers may continue to build in these markets, despite the financial burden imposed by an inclusionary housing policy, if the prices consumers are willing to pay for market-rate housing are high enough to offset the cost of building affordable units and allow the developer to achieve a competitive rate of return. Thus, some portion of the cost of providing affordable housing is passed on to market rate housing consumers. This outcome would not be expected in a weak market with relatively elastic demand due to the inability to pass regulatory costs on to buyers or renters of market-rate housing. Developers would be anticipated to maintain returns in these markets by reducing bids for undeveloped land when possible or by simply building in other jurisdictions (Clapp 1981).

These basic hypotheses serve as a foundation for a series of empirical studies examining the effects of inclusionary zoning policies on market-rate housing production and prices. Das (2010) concluded that mandatory inclusionary housing policies had little impact on single-family housing development in Los Angeles and Orange County. Related research conducted by Bento et al. (2009) in California also found that inclusionary housing policies did not impact single-family housing starts, but prices increased, home sizes decreased, and development activity shifted towards multifamily construction. Schuetz et al. (2011) observed both decreased single-family housing production and modest price increases in suburban Boston and San Francisco in response to inclusionary housing policies when market housing prices were appreciating. However, inclusionary housing policies were found to decrease housing prices in the latter of these cities when the market was experiencing little or no appreciation. This unanticipated price decline in stagnant markets was attributed in part to omitted variables, correlated with the presence of an inclusionary housing program, that were not controlled for in the models.

While useful, the aforementioned empirical studies leave unanswered questions regarding the divergent effects of inclusionary housing policies in different economic environments. Limited insight is offered as to whether these policies reduce housing demand due to the increased density of development or due to negative stigma effects associated with mixed-income housing. There is also minimal attention devoted to the use of strategic production decisions by developers to mitigate any adverse effects generated by these regulations. The real estate development literature indicates that developers do in fact respond to land use regulations, competition, market conditions, and strategic opportunities when determining the appropriate timing for the conversion of raw land into housing or other usable space (Ott et al. 2012; Bulan et al. 2006; Towe et al. 2008; Cunningham 2007; Wang and Zhou 2006; Mayer and Somerville 2000; Grenadier 1996). New insights can therefore be obtained by extending these models to examine the effects of inclusionary housing policies in the presence of downward sloping demand, density effects, and any stigma surrounding mixed-income housing.

An inclusionary housing policy requiring some of the units in a project to be set-aside for low income consumers may affect a developer's optimal decision in several ways. The number of lots that can be developed and sold at the market price may be restricted. Even if the developer is compensated with a density bonus, so that the number of lots that can be developed and sold at the market price remains constant, demand may decrease due to the increase in density. Furthermore, there may be a stigma effect associated with low income housing that decreases the level of demand or increases demand elasticity for market-rate housing. All of these factors can be examined simultaneously in a theoretical setting where development is allowed to occur over multiple periods and developers respond to downward sloping demand. Such an approach allows for the incorporation of features commonly found in real options models to analyze development decisions when future demand is uncertain and developers have flexibility in the timing of new construction (Clapp et al. 2012; Ott et al. 2012; Wang and Zhou 2006; Childs et al. 2002; Capozza and Li 1994; 2002; Capozza and Helsley 1990; Majd and Pindyck 1987; Williams 1991, 1997; Grenadier 1996, 1999).

The Model

A developer is assumed to control a tract of land that can be developed into N residential units. There are T periods over which development can occur. At the beginning of period t, the developer decides how many houses x_t to build and sell at the end of the period. The price at which the houses may be sold at period's end is determined by market demand that is unknown at the beginning of the period when the developer makes his development decision.

The demand is assumed to be downward sloping as a function of the total number of houses built and sold to date and the elasticity is $-1/\lambda_t$ so that the price at which x_t houses may be sold at the end of the t^{th} period is

$$P(\theta_t, \lambda_t, x_t, X_{t-1}) = \theta_t (X_{t-1} + x_t)^{-\lambda_t},$$

where $X_{t-1} = x_1 + \ldots + x_{t-1}$ is the total number of houses built and sold as of time $t-1$ and θ_t is a state variable that determines the level of demand. There are two demand state variables, the demand level and elasticity, that account for uncertainty in future demand, and both are assumed to follow geometric Brownian motion:

$$\begin{aligned} d\theta_t &= \theta_t\left(\mu_\theta dt + \sigma_\theta dz_{\theta,t}\right) \\ d\lambda_t &= \lambda_t\left(\mu_\lambda dt + \sigma_\lambda dz_{\lambda,t}\right) \end{aligned}$$

where the two Weiner processes may be correlated with correlation coefficient ρ. At the beginning of the period, at time $t-1$ the developer observes the demand variables θ_{t-1} and λ_{t-1} and chooses x_t; his revenue $\theta_t(X_{t-1}+x_t)^{-\lambda_t}x_t$ is realized at the end of the period, at time t.

The construction costs are paid at the beginning of the period. These costs are assumed to be linearly related to the number of houses built:

$$ConstCost(x_t) = c_0 + c_1 x_t.$$

The constant c_1 represents the marginal cost of building an additional house, and c_0 is a fixed cost that represents costs of mobilizing for development. The developer also incurs an inventory cost to hold vacant lots over each period; this cost represents property taxes, insurance, property management, etc., and is assumed to be proportional to the number of vacant lots:

$$InvCost(x_t) = c_2(N - X_{t-1} - x_t).$$

The cash flow each period therefore consists of the revenue received at period's end, less the construction and inventory costs paid at the beginning of the period.

The optimal development decision is found by solving a dynamic optimization problem. At the beginning of the first period, the developer observes the current demand variables θ_0 and λ_0 and chooses the number of houses x_1 to build and sell at time $t=1$, the end of the first period, so as to maximize the discounted expected profit. At the beginning of the second period he then observes θ_1 and λ_1 and chooses x_2, etc. Note that $x_1 + \ldots + x_T \leq N$ and that the developer makes the decision each period knowing he will act optimally in all subsequent periods. This dynamic optimization problem is solved by first finding the solution over the final period and sequentially working backward through time.

A numerical solution may be obtained by approximating the geometric Brownian motion processes followed by the demand state variables with a three-dimensional binomial tree. At each of the time $T-1$ nodes, the number of houses to build is found that optimizes the discounted expected profit given the values of the demand state variables at that node, for each possible number n, $0 \leq n \leq N$, of houses already built. For each n the optimal number x_T must satisfy the constraint $x_T \leq N-n$; this gives an array of time $T-1$ optimal values. Given this array, the process is repeated for each node at time $T-2$; for each possible n, $0 \leq n \leq N$ the optimal x_{T-1} is found using the optimal x_T for the $n + x_{T-1}$ houses built at the following nodes. Continuing in this fashion, the full sequence of optimal $x_1,\ldots,x_T$ is found that maximizes all the discounted cash flows.

The rate at which the cash flows should be discounted is generally difficult to determine and depends on risk preferences. However, the profit may be viewed as a contingent claim on the stochastic demand state variables, and standard arguments imply the profit may be computed by setting the discount rate equal to the risk-free rate r and risk-adjusting the drift terms μ_θ and μ_λ. Because the demand state variables are not traded assets, the risk-adjusted drifts are found by subtracting a risk premium from the true drifts and need not be equal to r. Thus, the solution is obtained by solving the dynamic programming problem in the risk-adjusted probability measure by using the risk-neutral drift terms μ_θ^* and μ_λ^* to determine the tree for the demand state variables.

To further illustrate the solution process, at time T−1 the developer observes the demand parameters θ_{T-1} and λ_{T-1} and chooses the amount to develop x_T over the final period to maximize the expected profit

$$\max_{x_T \le I_{T-1}} e^{-r\Delta t} E_{T-1}\left[\theta_T x_T (N - I_{T-1} + x_T)^{-\lambda_T}\right] - (c_0 + c_1 x_T) - c_2(I_{T-1} - x_T)$$

where $I_{T-1} = N - X_{T-1}$ is the number of remaining undeveloped lots and the expectation is taken under the risk-neutral measure. For each possible value of I_{T-1} between 0 and N and for each of the time T−1 nodes, the optimal profit V_T^* is found and stored. Then at time T−2, the demand parameters are again observed and the solution is found to the constrained optimization problem

$$\max_{x_{T-1} \le I_{T-2}} e^{-r\Delta t} E_{T-2}\left[\theta_{T-1} x_{T-1} (N - I_{T-2} + x_{T-1})^{-\lambda_{T-1}}\right] \\ -(c_0 + c_1 x_{T-1}) - c_2(I_{T-2} - x_{T-1}) + e^{-r\Delta t} E_{T-2}\left[V_T^*\right]$$

where $I_{T-2} = N - X_{T-2}$ and V_T^* is the optimal value corresponding to $I_{T-1} = I_{T-2} - x_{T-1}$ at each of the nodes that can be reached from the observed θ_{T-2} and λ_{T-2}. This process is repeated until the optimal number x_1 of houses to develop over the first period is found. After the solution is obtained, the time zero expectation of development and price for each time period is identified by working forward through the tree, using real rather than risk-adjusted probabilities.

In the single period case, the solution process simplifies significantly. The developer determines only x_1 in order to optimize expected profit:

$$\max_{x_1 \le N} e^{-r\Delta t} E_0\left[\theta_1 x_1^{1-\lambda_1}\right] - (c_0 + c_1 x_1) - c_2(N - x_1)$$

Although this optimization problem is not easily solved analytically, a numerical solution may be found relatively quickly and easily using the binomial tree over a single time period.

The model described thus far does not yet account for any effects of inclusionary housing policies. As discussed in the Introduction, inclusionary housing policies take many forms; one of the more common economic incentives to compensate the developer for building affordable units are density bonuses that allow construction of more housing. However, this type of policy may adversely affect demand for the market-rate housing in at least two ways. First, there may be stigma effects associated with low-income housing that decrease the level of demand and increase demand elasticity as noted in the literature review. Second, demand may be reduced because of the resulting increase in density. Although there may be design features that help mitigate the negative impact of density on housing demand, the model presented in this paper is most applicable to single-family residential development where additional density may result in congestion, a reduction in the size of each residential lot, or a loss of open space in the project as a whole. Empirical studies indicate that these outcomes can have a negative impact on housing demand (Turner 2005; Anderson and West 2006; Geoghegan 2006).

These effects are easily incorporated into the model. The stigma due to the low-income housing simply reduces θ and increases λ, so the values of these variables are adjusted at each node in the tree. To capture the negative effects resulting from the increased density with a density bonus, the demand level can be presumed to decline by a constant percentage d for every additional unit included in the project. For example, if a density bonus of 10 additional units is offered to help compensate the developer for building the affordable units and d=0.1 % then the demand level declines by 0.1 % for each of these 10 available units the developer actually builds. If the developer builds only 5 additional units, the demand level decreases 0.5 %; if all 10 additional units are built, the demand level decreases 1 %; etc.

Results

The aforementioned mathematical procedures are used in conjunction with the base case parameters presented in Table 1 to estimate optimal production decisions in strong, moderate, and weak housing markets when a developer has the ability to complete a project over one, two, or five phases. Results of these estimations are presented in Table 2. In each scenario, development is presumed to take place on a parcel of land capable of accommodating N=100 units so that one “unit” represents one percent of a project of any size. No features of an inclusionary housing policy are included in the base case scenarios because they are intended to serve as a point of comparison to examine the effects of this type of policy on developer profits, number of housing units constructed, and the average price of housing in a market.

Strong (weak) markets are characterized by high (low) demand level and more negative (less negative) elasticity. In the analysis, the strong market has demand level θ=1.15 and elasticity equal to −10, i.e., λ=1/10; the moderate market has θ=1.00 and λ=1/7.5; and the weak market has θ=0.85 and λ=1/10. These elasticity parameter values are in line with the findings of Green et al. (2005) and Malpezzi and Maclennan (2001), who find elasticities for new residential construction are typically between 4 and 13.

The parameters that determine the evolution of the demand variable θ, the drifts under the two measures and the volatility, are given by μ_θ=30 %, $\mu_\theta^* = 0$, σ_λ=15 %. This corresponds to a market price of risk of 20 % for the stochastic demand level variable, in accordance with the assumption in Ott et al. (2012). The risk-neutral drift and volatility of λ are the same as for θ: $\mu_\lambda^* = 0$, σ_λ=15 % Consistent with the assumption that weak markets have low θ and high λ, while strong markets have high

Table 1 Base case parameters

Parameters and descriptions	Base case value
Parameters for the stochastic demand function:	
Θ is the initial normal demand level parameter at time zero	Weak market Θ=0.85
	Moderate market Θ=1.00
	Strong market Θ=1.15
λ is the initial normal demand elasticity parameter at time zero	Weak market λ=1/6
	Moderate market λ=1/7.5
	Strong market λ=1/10
μ_θ is the growth rate of demand level	μ_θ=3 %
μ_θ^* is the risk-neutral growth rate of demand level	$\mu_\theta^* = 0$
σ_θ is the demand level volatility rate	σ_θ=15 %
μ_λ is the growth rate of demand elasticity	μ_λ=−3 %
μ_λ^* is the risk-neutral growth rate of demand elasticity	$\mu_\lambda^* = 0$
σ_λ is the demand elasticity volatility rate	σ_λ=15 %
ρ is the correlation between demand level and demand elasticity	ρ=−1
Construction and carrying cost parameters:	
c_0 is the fixed construction cost for a housing unit	c_0=0
c_1 is the variable construction cost for a housing unit	c_1=1/3
c_2 is the inventory carrying cost for vacant lots	c_2=.01
Other parameters:	
N is the total number of lots that can be developed	N=100
Δt is the length of time to complete each phase in years	Δt=1
h is the time step length for the binomial tree in years	h=1/12
T is the total periods in years	T=1, 2, or 5
r is the risk-free rate	r=5 %

θ and low λ, it is presumed that the Brownian motions of the two demand variables are very negatively correlated. The procedure for building the tree for the demand state variables is significantly simplified when the two variables are perfectly correlated; therefore ρ is set equal to −1 in the analysis, so that in effect there is only one Brownian motion. In this case the evolution of λ is determined given the evolution of θ, and the physical drift of λ is μ_λ=−3 %. Each phase is completed in one period, i.e., Δt=1. A standard Cox-Ingersoll-Ross binomial tree is constructed to approximate the evolution of θ; for improved accuracy, a time step of length h=1/12 is used in the tree's construction. The up and down multipliers and the risk-neutral probability of an up move over each time step are given by the usual formulas $u = e^{\sigma\sqrt{h}}$, d=1/u, $q = \left(e^{\mu_\theta^* h}\right)/(u-d)$.

The fixed construction costs, c_0, are set at zero and variable construction costs are set at c_1=1/3 for each housing unit in a project. This assumption precludes the possibility of economies of scale in construction, but the model can easily be

Table 2 Base case results

	Weak market	Moderate market	Strong market
One phase			
Developer profits	4.50	18.36	35.85
Number of units constructed	87.0	100.0	100.0
Average housing price	0.43	0.57	0.76
Two phases			
Developer profits	7.42	20.09	37.02
Number of units constructed	81.6	98.2	100.0
Average housing price	0.49	0.62	0.80
Five phases			
Developer profits	8.96	20.76	37.09
Number of units constructed	82.2	95.9	99.7
Average housing price	0.55	0.65	0.81

modified to take into account scale economies when appropriate. The inventory costs are set at 3 % of variable construction costs: c_2=0.01 to account for property taxes and other holding costs associated with carrying undeveloped lots in inventory. The risk free rate of return for the project is set at r=5 %. Although the cost parameters and the risk free rate are held constant, it is straightforward to allow them to deterministically change over time.

Not surprisingly, developer profits in the base case scenarios increase with the strength of the housing market, as do the number of housing units built and the average housing price. The ability to phase production also increases profits, because of the additional flexibility in the presence of demand uncertainty and downward sloping demand. In the weak market with a single period, developers optimize profits by building fewer units than entitled because constraining supply proves to be more advantageous than delivering more units at the resulting lower price. This is not the case with the stronger demand in the moderate and strong markets when development occurs in a single period. All entitled units are constructed in these scenarios.

With multiple periods, there are some outcomes for which it is optimal to build all the entitled units and other outcomes for which it is not. The uncertainty in future demand provides an incentive to delay production until more information arrives, while carrying costs serve as a countervailing force by increasing the cost of holding back units. Downward sloping demand provides an incentive to phase production across time. Each of these have an effect on the expected number of units delivered. Since the total carrying costs increase with the number of periods, the expected number of units delivered may increase as the number of periods increases from two to five. For example, when carrying costs are 0.01 in the base case weak market scenario, it is optimal to build 87 units with a single period, an average of 81.6 units with two periods, and an average of 82.2 units with five periods. With only a single period, the developer builds the greatest number of units to limit carrying costs; with two periods, the developer can be more discriminating because the value of waiting for more information outweighs the carrying costs; with five periods the carrying costs escalate and the developer builds more than observed in the two-period model. The same logic applies in the moderate and strong market scenarios, but high carrying costs and robust market demand provide an incentive to build out the project quickly and the benefits of phasing are more modest.

Table 3 demonstrates that different results may emerge when alternative parameters are incorporated into the models. Increasing the projected carrying costs to .02 simply amplifies the patterns observed in the base case, with slightly more units constructed across the weak, moderate, and strong market scenarios in the presence of phasing. Reducing the projected carrying costs to zero also generates the same basic patterns in the moderate and strong markets, with slightly fewer units delivered in the multiple period models as compared to the base case. However, the pattern is different in a weak market with no carrying costs. Now it is optimal to build only 72 units with a single period because of the relatively high elasticity and low demand. With two periods it is optimal to build an average of 77.8 units; with no carrying costs, the

Table 3 Varying inventory carrying costs

	Weak market	Moderate market	Strong market
Inventory carrying costs=0			
One phase			
Developer profits	4.71	18.36	35.85
Number of units constructed	72.0	100.0	100.0
Average housing price	0.44	0.57	0.76
Two phases			
Developer profits	8.41	20.73	37.54
Number of units constructed	77.8	97.6	100.0
Average housing price	0.49	0.62	0.81
Five phases			
Developer profits	11.94	22.71	38.07
Number of units constructed	77.1	92.3	98.9
Average housing price	0.59	0.69	0.83
Inventory carrying costs=0.02			
One phase			
Developer profits	4.44	18.36	35.85
Number of units constructed	100.0	100.0	100.0
Average housing price	0.42	0.57	0.76
Two phases			
Developer profits	6.52	19.53	36.57
Number of units constructed	85.2	98.9	100.0
Average housing price	0.48	0.61	0.80
Five phases			
Developer profits	6.71	19.61	36.57
Number of units constructed	89.7	98.7	100.0
Average housing price	0.50	0.62	0.80

ability to sell in smaller bundles makes it more beneficial to deliver more units (in expectation) than in the single period case. However, with five periods, the developer can be even more discriminating and builds an average of only 77.1 units.

Table 4 reports developer profits, number of housing units built, and average housing price over one phase after incorporating features of an inclusionary housing policy into the model. In each instance, the developer is required to set aside 10 units for low and moderate income consumers. For simplicity, these units are presumed to be sold at cost. In the event the price of affordable housing is above or below the cost of construction, only the developer's profit will change and the analysis will not otherwise be affected. Density bonuses of 0, 10, and 20 market-rate units are incorporated into the model. This form of economic incentive is considered because it is the one most commonly found in inclusionary housing policies (Read 2009). Considering multiple density bonus levels provides an opportunity to examine the economic effects of inclusionary housing policies when the incentives provided by the public sector exceed or fall short of the developer's cost of constructing affordable housing.

Modeling three density bonus levels and three market environments simultaneously in the one phase setting allows for an evaluation of the impact of inclusionary housing policies in nine different scenarios. In each of these nine scenarios presented in Table 4, the three numbers in the upper left hand corner represent developer profits, the number of housing units built, and the average housing price when development occurs in a single phase and there are no stigma effects related to the implementation of an inclusionary housing policy. Stigma effects are considered later in the analysis and refer to any decline in the demand for market-rate housing or any increase in the elasticity of demand resulting from the inclusion of affordable units in a project. Thus, in a weak market with no density bonus, an inclusionary housing policy with a 10 unit set-aside requirement results in developer profits of 4.6 and the delivery of 87 market-rate units at an average price of 0.43. Alternatively, in a strong market with a 20 unit density bonus, an inclusionary housing policy results in developer profits of 38.72 and the delivery of 110 market-rate units at an average price of 0.75. The remaining seven scenarios included in the table can be interpreted in the same manner.

Several interesting conclusions can be drawn from the results of these basic models. In weak markets where inclusionary housing policies have no stigma effects on demand, housing production remains constant at 87 units irrespective of the size of the density bonus provided. It is not optimal to build on all of the lots available for market-rate housing because the benefits of constraining supply outweigh the benefit of constructing additional units and selling them at the resulting lower price. In comparison to the base case, developer profits are 0.10 higher and housing prices are unchanged in the weak market scenarios because the developer is not provided with a compelling incentive to alter production decisions even when additional density is allowed (the analysis assumes the developer can decline the density bonus and thereby avoid the carrying costs on these units if it is optimal to do so). These findings are noteworthy because they indicate density bonuses are often an inappropriate economic incentive in weak markets if public officials hope to encourage mixed-income development.

Table 4 Inclusionary housing policy outcomes

	Weak market			Moderate market			Strong market		
	λ: 0 %	+5 %	+10 %	λ: 0 %	+5 %	+10 %	λ: 0 %	+5 %	+10 %
Set-aside requirement=10 and density bonus=0									
θ: 0 %	4.60	3.55	2.78	17.18	15.80	14.47	32.92	31.54	30.18
	87.0	66.0	52.0	90.0	90.0	90.0	90.0	90.0	90.0
	0.43	0.43	0.44	0.58	0.56	0.55	0.77	0.75	0.74
−5 %	3.12	2.40	1.87	14.82	13.51	12.24	29.77	28.46	27.17
	63.0	49.0	39.0	90.0	90.0	90.0	90.0	90.0	90.0
	0.43	0.43	0.44	0.55	0.53	0.52	0.73	0.71	0.70
−10 %	1.99	1.51	1.16	12.46	11.22	10.02	26.63	25.38	24.16
	45.0	36.0	29.0	90.0	90.0	90.0	90.0	90.0	90.0
	0.43	0.43	0.44	0.52	0.51	0.49	0.69	0.68	0.66
Set-aside requirement=10 and density bonus=10									
θ: 0 %	4.60	3.55	2.78	18.36	16.82	15.33	35.85	34.29	32.77
	87.0	66.0	52.0	100.0	100.0	100.0	100.0	100.0	100.0
	0.43	0.43	0.44	0.57	0.55	0.54	0.76	0.74	0.73
−5 %	3.12	2.40	1.87	15.78	14.31	12.89	32.39	30.91	29.47
	63.0	49.0	39.0	100.0	100.0	100.0	100.0	100.0	100.0
	0.43	0.43	0.44	0.54	0.53	0.51	0.72	0.71	0.69
−10 %	1.99	1.51	1.16	13.19	11.81	10.46	28.93	27.53	26.16
	45.0	36.0	29.0	100.0	100.0	100.0	100.0	100.0	100.0
	0.43	0.43	0.44	0.51	0.50	0.48	0.68	0.67	0.65
Set-aside requirement=10 and density bonus=20									
θ: 0 %	4.60	3.55	2.78	19.49	17.78	16.13	38.72	36.99	35.30
	87.0	66.0	52.0	110.0	110.0	110.0	110.0	110.0	110.0
	0.43	0.43	0.44	0.56	0.55	0.53	0.75	0.74	0.72
−5 %	3.12	2.40	1.87	16.68	15.06	13.49	34.95	33.31	31.70
	63.0	49.0	39.0	110.0	110.0	110.0	110.0	110.0	110.0
	0.43	0.43	0.44	0.54	0.52	0.50	0.72	0.70	0.68
−10 %	1.99	1.51	1.16	13.88	12.34	10.85	31.19	29.63	28.10
	45.0	36.0	29.0	110.0	110.0	110.0	110.0	110.0	110.0
	0.43	0.43	0.44	0.51	0.49	0.48	0.68	0.66	0.65

In markets of moderate strength where inclusionary housing policies have no stigma effects on demand, developer profits decrease by 6.5 % and housing prices increase by 1.4 % when no density bonus is provided. Both outcomes are the result of a reduction in market-rate housing production from 100 to 90 units. An inclusionary housing policy has no impact on developer profits, housing supply, or average housing prices when a 10 unit density bonus is provided because the developer is once again able to construct 100 market-rate units on the site. A 20 unit density bonus increases developer profits by 6.1 % and reduces the average price of housing by a modest 1.2 % as production increases from 100 to 110 market-rate units. All of the outcomes are consistent with economic theory and suggest the regulatory incentives provided by a municipality influence the economic benefit or burden of an inclusionary housing policy.

Many of the economic effects observed in the moderate strength market scenarios are also found in the strong market scenarios when inclusionary zoning ordinances have no stigma effects on demand. Developer profits decline by approximately 8.1 % and housing prices increase by slightly less 1 % when no density bonus is provided as the supply of market-rate units is constrained from 100 to 90 units. These effects dissipate quickly as additional density is allowed. Developer profits, housing supply, and average housing price remain unchanged in comparison to the base case scenario when a 10 unit density bonus is provided to offset the 10 unit affordable housing set-aside. A 20 unit density bonus increases developer profits by approximately 8 % and reduces the price of market-rate units by slightly less than 1 % as housing supply increases from 100 to 110 market-rate units. These results suggest generous density bonuses may prevent inclusionary housing policies from having a detrimental impact on developer profits or on the affordability of market-rate units in strong markets.

At this point, it is important to note that the results presented in Table 4 assume increasing the density of development has no impact on the demand for housing within a project. This may or may not be the case, as noted in the literature review. Thus, three potential "density effects" are considered, including a −0.1 %, −0.2 %, and −0.4 % reduction in market-rate housing demand level associated with the inclusion of each additional market-rate unit. As discussed in the previous section, such outcomes might be expected if increasing density results in congestion, smaller lots, or a reduction in the amount of open space found throughout a subdivision comprised of single-family detached homes. The results generated after including density effects are presented in Table 5.

In the weak market scenarios, density effects do not have a detrimental impact because it is optimal for the developer to constrain housing supply below the entitled number of market-rate units irrespective of the density bonus provided. However, as demonstrated in Table 5, a different story emerges in the moderate and strong housing market scenarios. A −0.1 % density effect does not result in a reduction in supply when compared to a market with no density effect, but developer profits and housing prices both fall slightly in response to the reduction in demand brought about by the inclusion of additional units. As would be expected, the magnitude of these changes increases with the number of units constructed on site. Once the density effect reaches −0.2 %, it becomes optimal to limit housing production in markets of moderate strength to no more than 101 units even when a 20 unit density bonus is provided. Demand in the strong market scenarios is robust enough to offset the −0.2 % density effect and developers continue to build to capacity, albeit at a lower profit level. A −0.4 % density effect greatly diminishes the value of a density bonus and in no scenario is it optimal for a developer to build more than 98 units.

Although the theoretical models put forth in this paper do not explicitly allow developers or homebuyers to "relocate away from the impacted sector" in response to an inclusionary housing policy, as considered by Clapp (1981), similar results are achieved in the one-phase setting by modifying the demand elasticity parameter to reflect market conditions. Thus, inclusionary housing policies have no effect on developer profits or the average housing price when the density bonus fully offsets the cost of constructing affordable units. Alternatively, developer profits decline and housing prices increase in markets with relatively inelastic housing demand when an inclusionary housing policy imposes an economic burden that is not offset by corresponding incentives. These outcomes are respectively consistent with Clapp's (1981) "optimistic" and "pessimistic" predictions about the economic incidence of inclusionary housing policies. With this foundation in place, attention can be turned to any stigma effects generated by the inclusion of affordable units in otherwise market-rate residential development projects and the extent to which lost profits can be mitigated be engaging in strategic production decisions.

Stigma effects once again refer to any decrease in the level of demand or increase in demand elasticity for market-rate housing triggered by the requirements of inclusionary housing policies. In each of the nine scenarios presented in Table 4, stigma effects are considered by decreasing the demand level state variable θ and increasing the elasticity state variable λ in 5 % increments. Hence, the level of market rate housing demand declines moving from top to bottom across each sub-table and demand elasticity increases moving from left to right. Modifying the parameters in this way allows for a snapshot examination of the potential effects of an inclusionary housing policy in a marketplace where consumers have an aversion to living in mixed-income communities. Phasing is not yet considered in these estimations and all development occurs in a single period.

Irrespective of the strength of the market, stigma effects drive down developer profits. However, they do not always decrease housing prices or limit housing supply.

Table 5 The Impact of different density effects in the presence of a 10 unit set-aside requirement and 20 unit density bonus

Density effect	Weak market	Moderate market	Strong market
0.00 %			
Developer profits	4.60	19.49	38.72
Number of units constructed	87.0	110.0	110.0
Average housing price	0.43	0.56	0.75
−0.10 %			
Developer profits	4.60	18.37	37.22
Number of units constructed	87.0	110.0	110.0
Average housing price	0.43	0.55	0.74
−0.20 %			
Developer profits	4.60	17.33	35.71
Number of units constructed	87.0	101.0	110.0
Average housing price	0.43	0.56	0.72
−.40 %			
Developer profits	4.60	17.18	33.10
Number of units constructed	87.0	90.0	98.0
Average housing price	0.43	0.58	0.74

Severe stigma effects are actually found to put modest upward pressure on housing prices in the weak market scenarios by dramatically reducing housing supply. The opposite is found in strong market scenarios where developers continue to build to capacity despite stigma effects, thereby reducing housing prices due to the resulting decline in housing demand. Both outcomes are largely attributable to the demand elasticity parameter, which provides developers with a strong incentive to constrain supply in weak markets to preserve price levels, while correspondingly providing little incentive to pursue the same approach in markets where demand is less elastic.

The final step in the analysis involves the incorporation of phasing into the model to determine if strategic production decisions offer real estate developers a means of mitigating stigma effects of inclusionary housing policies when they are anticipated to influence the demand for market-rate units included in a project. Table 6 reports the impact of such a policy in weak, moderate, and strong markets when production is allowed to occur in one, two, or five phases. The hypothetical policy in all of these cases requires the developer to set-aside 10 affordable units in exchange for a 10 unit density bonus. Base case parameters are otherwise used to estimate developer profits, housing supply, and average housing price.

Downward sloping demand and carrying costs serve as countervailing forces in the model. Increasing production in any given phase facilitates more sales, albeit at a lower price per unit. Thus, developing in multiple phases preserves price levels by temporarily constraining supply and can be advantageous when the cost of carrying undeveloped lots is not prohibitively high. The tipping point beyond which the production of additional housing units reduces developer profits is higher in markets with stronger demand. Developer profits also tend to increase with phasing as a result of the value of real options in an uncertain economic environment, especially in the weak market. For example, profits increase by over 99 % as phasing increases from one to five periods in the weak market scenario where affordable housing has no adverse effect on the demand for market rate units. Alternatively, profits in a strong market with no adverse effects increase by only 3.5 % as the number of phases increases from one to five. This result, along with the results in Table 8, suggests that the option nature of the problem is more pronounced in weaker markets.

Table 6 also demonstrates that the expected number of units constructed, and in most cases the price, decrease with the severity of the stigma effect. As the severity of the stigma effect increases, the market strength decreases and it is therefore optimal to build fewer units. This would tend to increase the price with a downward sloping demand curve, but this effect is more than offset by the decrease in demand so that prices generally decrease. Only in the weak market where development occurs in a single period is this not the case. In this scenario, an increase in the elasticity decreases the expected number of units by a large enough margin to increase the price. The results beg further empirical analysis of inclusionary housing policies, with appropriate controls for market characteristics in place, to determine the extent to which these regulations influence housing supply and housing prices when stigma effects are anticipated to be severe.

To better illustrate the potential impact of stigma effects on production decisions, Table 7 presents the expected number of housing units constructed in each phase of the five phase scenarios described in Table 6. For brevity, only three stigma effects are

Table 6 Inclusionary housing policy outcomes in the presences of phasing

	Weak market			Moderate market			Strong market		
	λ: 0 %	+5 %	+10 %	λ: 0 %	+5 %	+10 %	λ: 0 %	+5 %	+10 %
One phase									
θ: 0 %	4.50	3.45	2.68	18.36	16.82	15.33	35.85	34.29	32.77
	87.0	66.0	52.0	100.0	100.0	100.0	100.0	100.0	100.0
	0.43	0.43	0.44	0.57	0.55	0.54	0.76	0.74	0.73
−5 %	3.02	2.30	1.77	15.78	14.31	12.89	32.39	30.91	29.47
	63.0	49.0	39.0	100.0	100.0	100.0	100.0	100.0	100.0
	0.43	0.43	0.44	0.54	0.53	0.51	0.72	0.71	0.69
−10 %	1.89	1.41	1.05	13.19	11.81	10.46	28.93	27.53	26.16
	45.0	36.0	29.0	100.0	100.0	100.0	100.0	100.0	100.0
	0.43	0.43	0.43	0.51	0.50	0.48	0.68	0.67	0.65
Two phases									
θ: 0 %	7.42	6.41	5.51	20.09	18.69	17.34	37.02	35.57	34.16
	81.6	77.5	71.5	98.2	97.7	97.3	100.0	100.0	99.9
	0.48	0.47	0.47	0.62	0.60	0.59	0.80	0.79	0.77
−5 %	5.79	4.94	4.17	17.48	16.17	14.91	33.52	32.14	30.80
	75.8	69.9	65.7	97.6	96.8	94.9	100.0	99.9	99.9
	0.47	0.46	0.45	0.59	0.57	0.56	0.76	0.75	0.73
−10 %	4.31	3.58	2.92	14.90	13.68	12.53	30.02	28.72	27.45
	68.0	64.0	59.0	96.1	94.3	92.9	99.9	99.9	99.8
	0.45	0.45	0.44	0.56	0.55	0.53	0.72	0.71	0.70
Five phases									
θ: 0 %	8.96	8.08	7.26	20.76	19.51	18.32	37.09	35.69	34.33
	82.2	79.8	77.4	95.9	94.7	93.6	99.7	99.6	99.4
	0.55	0.55	0.55	0.65	0.64	0.63	0.81	0.80	0.79
−5 %	7.32	6.52	5.79	18.22	17.06	15.96	33.61	32.28	30.99
	79.3	76.7	73.9	94.5	93.5	92.3	99.6	99.4	99.1
	0.54	0.53	0.53	0.62	0.62	0.61	0.77	0.76	0.75
−10 %	5.73	5.03	4.38	15.71	14.65	13.64	30.12	28.88	27.67
	75.7	73.0	70.4	93.2	91.8	90.1	99.3	99.1	98.9
	0.52	0.52	0.52	0.60	0.59	0.59	0.73	0.72	0.71

considered corresponding to the diagonal blocks in Table 6: θ decreases and λ increases 0 %, 5 %, and 10 %. Overall, housing supply increases with the strength of the market and decreases with the severity of the stigma effect. Furthermore, development tends to get more delayed as stigma becomes more severe; the number of units constructed in the first phase declines, while the number of units in the final phase increases with the severity of the stigma effect. This finding is consistent with the increased value of the option to postpone development as stigma effects soften the market. In weak markets, production occurs in relatively equal increments across the phases as developers constrain supply to take advantage of downward sloping demand. However, in severely weak markets, i.e., a weak market with the most severe stigma effects, production increases each period. In contrast, production occurs more quickly in both the moderate and strong markets as demand inelasticity reduces the benefits of constraining supply and greater demand diminishes the value of the option to postpone development.

Because affordable housing stigma effects serve to weaken the market, the relationship between market strength, time value, and intrinsic value suggests that phasing should be a more attractive strategy when the stigma effects are more severe or when there is more uncertainty in future demand. This can be observed in the results presented in Table 8. The first panel shows developer profits for the three market strengths (weak, moderate, strong), three total periods (one, two, and five), three levels of demand volatility (0, 15 %, 30 %), and three levels of stigma effects (θ decreases and λ increases 0 %, 5 %, 10 %, as in Table 7). Overall, the results are consistent with real options theory and demonstrate that the project value tends to increase with both demand volatility and the number of phases over which production can occur. Furthermore, greater uncertainty makes phasing more valuable and vice-versa. Roughly speaking, more phasing means more options and more uncertainty means more option value. This is especially true in weaker markets in which profits are more sensitive to both volatility and the number of periods.

The intrinsic value of the project is the value in the absence of demand uncertainty. In the weak market with five periods and no stigma, the intrinsic value is 6.46; however the value increases to 8.96 when the volatility is 15 % and is 14.80 when the volatility is 30 %. This shows that the time value, the value of being able to wait until more information to arrive about future demand, is a significant portion of the project's overall value in weak markets. In fact, in the presence of severe stigma effects the time value accounts for over 95 % of overall value when the volatility is 30 %. In contrast, in strong markets the intrinsic value dominates; with five periods and no stigma, the time value accounts for less than 1 % of overall value when the volatility is 15 % and 9 % when the volatility is 30 %.

Table 7 Housing units constructed each phase

Phase	Weak			Moderate			Strong		
	(0,0)	(5,5)	(10,10)	(0,0)	(5,5)	(10,10)	(0,0)	(5,5)	(10,10)
1	11.0	8.0	6.0	25.0	21.0	17.0	45.0	41.0	37.0
2	18.5	15.1	12.0	33.9	30.4	26.1	43.8	42.5	41.1
3	21.1	18.6	16.1	25.1	25.2	24.5	10.1	14.3	17.6
4	17.5	18.0	17.4	7.9	10.8	13.9	0.5	1.0	2.0
5	14.1	16.9	18.9	4.1	6.1	8.6	0.3	0.6	1.2
Total	82.2	76.6	70.4	96.0	93.5	90.1	99.7	99.4	98.9

If there were no carrying costs, profits should always increase with the number of periods even if there were no uncertainty because of the added flexibility afforded by additional phasing that allows the developer to take advantage of downward sloping demand. However, in a severely weak market with non-zero carrying costs, the cost of carrying undeveloped lots may outweigh the benefits of strategically limiting supply. This is observed in the weak market scenario with the most severe stigma effects.

The second panel of Table 8 lists the relative economic burden, or the percentage loss in profit, associated with inclusionary housing stigma effects. In weak markets, the burden is relatively large. For example, developer profits decline by over 76 % in response to the most severe stigma effect when development occurs over a single period in the weak market but decline by only around 27 % in the strong market. More interestingly, the results demonstrate that the economic burden generally decreases as market volatility or the number of phases increases. In response to the most severe stigma effect in the weak market with 15 % volatility, developer profits decline by 76.5 % with a single period, but decline by only 51.1 % with five periods; with 30 % volatility, profits decline by 76.6 % with a single period, but decline by only 30.4 % with five periods. Once again, this is the case because stigma effects

Table 8 The impact of inclusionary housing policies on developer profits in the presence of stigma effects, market volatility, and phasing

	Stigma	Weak market			Moderate market			Strong market		
		σ= 0 %	σ= 15 %	σ= 30 %	σ= 0 %	σ= 15 %	σ= 30 %	σ= 0 %	σ= 15 %	σ= 30 %
Developer profits										
T=1	(0,0)	4.30	4.50	5.18	18.14	18.36	19.02	35.69	35.85	36.35
	(5,5)	2.21	2.30	2.63	14.09	14.31	14.97	30.74	30.91	31.42
	(10,10)	1.01	1.05	1.21	10.24	10.46	11.13	25.99	26.16	26.68
T=2	(0,0)	5.95	7.42	10.59	19.71	20.09	22.01	36.80	37.02	37.90
	(5,5)	2.95	4.94	8.20	15.69	16.17	18.38	31.91	32.14	33.17
	(10,10)	1.11	2.92	6.20	11.85	12.53	15.07	27.21	27.45	28.62
T=5	(0,0)	6.46	8.96	14.80	19.95	20.76	25.21	36.82	37.09	39.35
	(5,5)	3.32	6.52	12.45	15.97	17.06	21.92	31.96	32.28	34.95
	(10,10)	0.47	4.38	10.30	12.19	13.64	18.85	27.28	27.67	30.77
Relative economic burden of an inclusionary housing policy in percentage loss in profits										
T=1	(0,0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(5,5)	0.49	0.49	0.49	0.22	0.22	0.21	0.14	0.14	0.14
	(10,10)	0.77	0.77	0.77	0.44	0.43	0.41	0.27	0.27	0.27
T=2	(0,0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(5,5)	0.50	0.33	0.23	0.20	0.20	0.17	0.13	0.13	0.12
	(10,10)	0.81	0.61	0.41	0.40	0.38	0.32	0.26	0.26	0.24
T=5	(0,0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(5,5)	0.49	0.27	0.16	0.20	0.18	0.13	0.13	0.13	0.11
	(10,10)	0.93	0.51	0.30	0.39	0.34	0.25	0.26	0.25	0.22

weaken a market thereby increasing the time value of a project relative to the intrinsic value in an uncertain economic environment when production can occur over multiple periods. Phasing therefore allows developers to limit lost profits after the enactment of an inclusionary housing policy when stigma effects are present. The benefits of such an approach increase with the magnitude of the stigma and with the amount of demand uncertainty. Overall housing supply generally declines in these markets with volatility and phasing, while average housing prices increase, demonstrating the impact of strategic production decisions.

The models presented in this paper are not intended to represent specific markets, but they do support existing empirical studies examining the economic effects of inclusionary housing policies. For example, it is not surprising to see that many inclusionary housing policies studied in the early to mid-2000s had little impact on housing supply and put modest upward pressure on prices. Robust demand during this period of time, and in the markets studied, presumably encouraged developers to continue building and little incentive existed to phase production. Any reduction in supply, increase in housing prices, or shift toward multifamily development in these markets indicate that density bonuses and other incentives failed to fully offset the direct or indirect costs of constructing affordable units. In the limited instances where inclusionary housing policies were found to decrease housing prices as the level of demand declined, the outcomes could be partially attributable to stigma effects.

The implications of the models including phasing are even more interesting when evaluating the prospects for housing market recovery in the future. Density bonuses included in many inclusionary housing policies may prove insufficient to offset the private sector's cost of constructing affordable housing because optimal production levels are already below the entitled number of units sites can accommodate. The resulting economic burden provides an incentive for developers to engage in strategic phasing to preserve profits levels and mitigate stigma effects associated with inclusionary housing policies. Municipalities interested in encouraging development may therefore find it necessary to provide alternative economic incentives or relax affordable housing set-asides in order to accelerate construction activity in these weak markets. Failing to do so may slow residential development in these areas and inhibit economic recovery driven by the strength of the local housing industry.

Conclusions

The theoretical models presented in this paper evaluate the potential economic implications of inclusionary housing policies after considering the impact of market characteristics, stochastically evolving demand, density concerns, phasing, and affordable housing stigma effects. Direct and indirect costs imposed upon the private sector by these regulations can reduce developer profits, decrease housing supply, and increase prices in some instances, but a number of variables mitigate these outcomes. Housing prices are most likely to increase in strong markets where density bonuses are not offered to fully offset the private sector's cost of constructing affordable units. Prices may also increase modestly in weak markets when severe affordable housing stigma effects encourage developers to dramatically reduce production in an attempt to preserve profits levels after the implementation of an inclusionary housing policy.

Density bonuses can limit the upward pressure on housing prices in strong markets, but may prove much less effective in weak markets where developers have little incentive to increase production in response to this type of economic incentive.

In relatively strong markets, robust demand provides developers with an incentive to continue building after an inclusionary housing policy is implemented. Prices may, however, fall in some of these situations when density bonuses are provided due to a combination of downward sloping demand, density effects, and affordable housing stigma effects. Density bonuses can offset the impact on developer profits once they become sufficiently large, but market-rate homebuyers and renters may still bear some of the cost of providing affordable housing by paying higher nominal prices for mixed-income housing than they would in the absence of an inclusionary housing policy. Additional research is needed to examine this outcome in the event consumers in a given market are anticipated to have an aversion to densely developed mixed-income housing.

Finally, the results indicate that phasing offers real estate developers a means of mitigating the adverse effects of inclusionary housing policies when future demand is uncertain and downward sloping. Strategic production decisions designed to temporarily constrain supply preserve developer profits by putting upward pressure on prices as market-rate housing units are delivered over multiple periods. The benefits of such an approach can be significant in both strong and weak housing markets, albeit to differing degrees. Phasing is particularly attractive in weak markets or markets with severe stigma effects where the time value of development projects is relatively large in comparison to the intrinsic value, thereby providing an incentive to postpone construction. These findings contribute to the real options literature by exploring the relationship real estate development decisions and inclusionary housing policies in different types of economic environments.

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