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WORKING PAPER NO. 99-22

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 Alex Anas, Jan Brueckner, Theodore Crone, William Gale, Joseph Gyourko, Douglas Holtz-Eaken, and Janet Pack provided helpful comments on an earlier draft.

Abstract

The purpose of this paper is to provide a new framework to analyze the potential role of the federal tax treatment of housing in the patterns of metropolitan development. The framework we use to address the issue has a very different focus from that of the basic urban model. Following the work of Voith and Gyourko (1998), we develop an equilibrium model of two communities, one of which has fixed boundaries while the other community does not. We call the fixed boundary community the city and the unbounded community the suburb. Individuals in these communities are assumed to have similar systematic tastes over housing and community amenities, but they also have an idiosyncratic preference for either the city or the suburb. For a given individual, the relative attractiveness of the city and the suburbs depends on his or her idiosyncratic taste, the relative amenities of the city and suburbs, and the relative price. Community amenities are endogenously determined and are assumed to depend on the distribution of high and low income individuals. High concentrations of low income residents in a community potentially can adversely affect the attractiveness of the community. Within this framework, we examine the residential choices of high and low income individuals with and without zoning constraints. Given these outcomes, we evaluate the relative profitability of communities choosing exclusionary zoning or not by comparing the aggregate land values under both regimes.

In this framework, we show that housing-related tax incentives are likely to create incentives for suburban communities to enact exclusionary zoning. To the extent that these incentives actually result in more exclusionary zoning, it reinforces the marginal effects on decentralization and sorting that result from the tax code's effects on individuals' choices regarding land consumption and residential location. This is an important result because it suggests that the spatial and sorting impacts of the tax treatment of housing may be larger than its effects on individuals' choices of residential location and housing consumption alone. In fact, under reasonable parameterizations, the tax incentives can result in large changes in equilibrium land prices, community choices, and community characteristics.

I. Introduction

Decentralization is probably the single most important fact of recent urban development. Mieszkowski and Mills (1993) have convincingly argued that suburbanization has been occurring in most developed countries throughout most of the twentieth century. Decentralization in the United States has been particularly rapid, and perhaps more important, it has been associated with considerable geographic sorting by income. Lower income households have become increasingly concentrated in American central cities while more wealthy households have opted for suburban communities. The rapid pace of U.S. decentralization is often seen as the reflection of the intrinsic tastes of the American public and, hence, some argue, should not be an issue for public policy. Persistent concerns about central city decline and suburban sprawl, however, suggest some dissatisfaction with current patterns of metropolitan development.

Observed patterns of decentralization are broadly consistent with the implications of the basic urban model developed by Mills (1967), Muth (1969), and Alonzo (1964) over 30 years ago. In the basic model, and the generalizations that followed, land prices adjust to compensate for differential commuting costs across residential locations. This model implies that, as rising incomes increase the demand for residential land and as improved transportation systems lower the cost to commute to distant locations, cities should become more decentralized and have lower population densities. The model further suggests that higher income households will outbid lower income households for the most desirable locations, leading to communities that are stratified by income. If high income households strongly prefer large residential lots, they will tend to locate in more distant suburban locations where land is relatively less expensive, while

lower income households reside in more central locations.

To the extent that decentralization is driven by the basic forces described in the basic urban model, the process of decentralization is efficient and there should be few public policy concerns regarding the trend toward less dense residential patterns or the geographic sorting by income. There are at least three reasons, however, to reexamine the role of public policy in the process of decentralization. First, the pace of decentralization appears to be more rapid in the United States than in other developed countries, and it has frequently been associated with severe central city decline. Severe decline in urban centers is not necessarily an implication of the urban model. Second, there is little evidence on the relative importance of preferences versus prices in the process of decentralization. Both commuting costs and house prices are significantly affected by public policies, which makes it less clear whether the observed pattern is solely a result of preferences, or whether the outcome is altered by policy-related effects on the prices of land and transportation. Third, the basic urban model does not address the actions of local jurisdictions, such as those related to zoning, that may affect patterns of development. Although more sophisticated Tiebout-type models suggest that efficient sorting by income across communities can occur without zoning, large-lot zoning, which has the effect of making some suburban communities inaccessible to lower income households, remains common.

One national policy that can potentially affect both individuals' choices regarding residence and land consumption and communities' choices regarding zoning rules is the federal tax treatment of housing. Two aspects of the tax treatment of housing may affect patterns of metropolitan development. First, the U.S. tax code effectively reduces the price of housing,

including residential land, relative to other goods.[1] This increases the demand for housing and residential land. Because land is often a fixed factor in cities, the suburbs have a productive advantage in housing. Thus, the tax treatment of housing favors suburban communities with elastic supplies of land. Second, the value of the tax-related housing subsidy is greater for higher income individuals. In an earlier paper, Voith and Gyourko (1998) show that in the presence of exclusionary zoning this results in a concentration of higher income people in suburban communities and a corresponding concentration of lower income people in the city.

The purpose of this paper is to provide a new framework to analyze the potential role of the federal tax treatment of housing in the patterns of metropolitan development. In contrast to our earlier paper in which we examined only the marginal responses of individuals to the tax treatment of housing given a set of institutional rules regarding zoning, here we also seek to examine how the tax treatment of housing may provide incentives that could affect the choice of institutional rules, such as zoning, that constrain individual choices. In particular, we analyze how the tax treatment of housing affects the profitability of suburban residential development with and without exclusionary zoning.

Following the work of Voith and Gyourko (1998), we develop an equilibrium model of two communities, one of which has fixed boundaries while the other community does not. We call the fixed boundary community the city and the unbounded community the suburbs. Individuals in these communities are assumed to have similar systematic tastes over housing and

[1]The actual subsidy to owner-occupied housing is the nontaxation of imputed rent. It is the mortgage and property tax deduction, however, that changes the price of housing relative to other goods differentially across households of different income levels. This differential will result in diverging choices of high and low income households in our analysis.

community amenities, but they also have an idiosyncratic preference for either the city or the suburbs. For a given individual, the relative attractiveness of the city and the suburbs depends on his or her idiosyncratic taste, the relative amenities of the city and suburbs, and the relative price. Community amenities are endogenously determined and are assumed to depend on the distribution of high and low income individuals. High concentrations of low income residents in a community potentially can adversely affect the attractiveness of the community. Within this framework, we examine the residential choices of high and low income individuals with and without zoning constraints. Given these outcomes, we evaluate the relative profitability of communities choosing exclusionary zoning or not by comparing the aggregate land values under both regimes.

In this framework, we show that housing-related tax incentives are likely to increase the relative profitability of development under exclusionary zoning, creating an incentive for the adoption of such regulation. To the extent that these incentives actually result in more exclusionary zoning, it reinforces the marginal effects on decentralization and sorting that result from the tax code's effects on individuals' choices regarding land consumption and residential location. This is an important result because it suggests that the spatial and sorting impacts of the tax treatment of housing may be larger than its effects on individuals' choices of residential location and housing consumption alone. In fact, under reasonable parameterizations, the tax incentives can result in large changes in equilibrium land prices, community choices, and community characteristics. For example, if changing tax law makes exclusionary zoning unprofitable, the changes in spatial patterns of development may be larger than the changes associated only with individuals' marginal responses to the change in tax treatment of housing.

The plan of this paper is as follows. In the next section, we briefly place our work in the context of recent literature on the spatial consequences of housing taxation as well as the literature on zoning and its motivation. In section three, we present our model. In section four, we discuss some caveats and extensions regarding the model. Section five presents the baseline simulation used to evaluate the role of the tax treatment of housing on the incentive to engage in exclusionary zoning. Section six presents alternative simulations and section seven concludes with suggestions for future research.

II. The Tax Treatment of Housing, Residential Choices, and Exclusionary Zoning

It has long been recognized that the U.S. tax code favors housing consumption and this favored treatment has increased the level of investment and consumption of housing above that which would occur in the absence of the tax subsidy (Mills (1987), Feldstein (1982), Hendershott (1982) and Poterba, (1984)). To the extent that land is an input to housing, the tax advantages of housing likely increase the consumption of land, potentially resulting in less dense patterns of development, although in a strict monocentric framework, this outcome is not necessary. Blackley and Follain (1983), for example, suggest that the housing subsidy has two offsetting effects on rent gradients: they become flatter, which increases land consumption but also increases the equilibrium rent in the center. They argue that it is not implausible that the housing subsidy results in more dense development in a monocentric city.

When there are high and low income residents, it is well known that the monocentric model will result in the segregation of the two groups. The group with the steepest bid rent function will locate nearest to the center (DiPasquale and Wheaton (1996)). In the U.S., it is

generally presumed that preferences are such that higher income groups locate in more distant locations and consume more land. Mieszkowsi and Mills (1993) note that there is a natural progression whereby as income grows, wealthier residents purchase new, larger houses on the perimeter and lower income residents live in older, smaller houses nearer to the center. It is possible, however, for the housing subsidies to affect the equilibrium location choices of the two groups. If the demand for residential land is elastic, the tax subsidies have the effect of flattening the bid rent functions of the rich (but not the poor). [2] Thus, it is possible within the framework of the monocentric model that the choice of more distant locations by wealthier residents is, in part, the result of housing subsidies rather than preferences.

Voith and Gyourko (1998) develop a series of equilibrium models to evaluate the effects of tax subsidies on residential community choice for high and low income individuals in an essentially nonspatial context. They consider residential community choice (and housing consumption) when there are two communities: one with fixed land area (the city) and another with elastic borders (the suburbs). In this context Voith and Gyourko show that in the absence of other constraints on the housing market, housing tax subsidies unambiguously result in larger numbers of high and low income residents choosing suburban locations and less dense patterns of metropolitan development. They further show that with exclusionary zoning in the suburbs, high income residents depart the city in higher numbers. Finally, in the case in which community amenities are assumed to depend positively on the number of high income individuals in the community, they show that the housing subsidies for the high income group can lead to

[2]Jan Brueckner has pointed out that if demand for residential land is inelastic, the impact goes in the opposite direction.

decentralization, income sorting, and potentially to land value declines in the central city. Models that generate income sorting across communities are complementary to, rather than competing with, the sorting process that occurs in the monocentric framework. In addition, the fact that the tax treatment of housing essentially finances individuals' choices of homogeneous communities is also complementary to the sorting associated with Tiebout and exclusionary zoning.

From an empirical point of view, the extent to which housing subsidies encourage lower density communities and income sorting depends on individual and community choices. On the margin, the effect of the tax subsidy on individuals' land consumption depends, in part, on the price elasticity of demand for residential land.[3] Muth (1964) estimates the price elasticity of demand for residential land to be -0.8 while Gyourko and Voith (1999) estimate this price elasticity to be about -1.6. Given an average subsidy of 15 percent, the effect of the tax treatment of housing is to reduce density 12 percent using Muth's elasticity estimate or 24 percent using Gyourko and Voith's estimate.[4]

The average price elasticity of residential land does not, however, yield any insight into the process of geographic sorting by income associated with housing subsidies when there are

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[3]Of course, the elasticity of supply plays an important role as well. If supply is perfectly inelastic, the subsidy is fully capitalized into land prices and there is no change in residential land consumption. We believe, however, that suburban residential land is relatively elastically supplied.

[4]We use Poterba's (1991) estimate that tax subsidies reduce the cost of housing 15 percent. Poterba's estimate focused only on the impacts of taxes on the cost of structures; we are implicitly assuming that the reduction in the after-tax use of land is the same. Of course, the actual impact of the tax treatment of housing on the cost of residential land will depend on both the elasticity of demand of residential land as an input to the production of housing services as well as on the elasticity of supply of residential land.

zoning constraints in the suburbs. More important, those estimated marginal responses do not capture the potential equilibrium shifts associated with the effects of housing subsidies on communities' decisions concerning exclusionary zoning. These changes are shifts in equilibrium outcomes that could potentially be larger than marginal movements along the demand schedule. In this paper, we develop a framework to evaluate the effects of the tax code on the economic incentives to adopt exclusionary zoning.[5]

III. The Model

The basic strategy to evaluate the role of the tax treatment of housing in the decision to pursue exclusionary zoning is to set up an equilibrium model of residential location choice and housing consumption for high and low income residents. The framework developed below is an extension and specialization of that analyzed in Voith and Gyourko. The framework presented here departs from the Voith-Gyourko model in two important ways. First, we assume that the suburban community is created by a developer that chooses suburban prices to maximize its profits.[6] Second, we evaluate a specific functional form of the model so that we can

[5]There is a growing literature that examines endogenous zoning choices and motivations. Epple, Romer and Filimon (1988) examine equilibrium zoning outcomes and show that communities may adopt inefficient exclusionary zoning choices when the zoning process is controlled by existing owners. Pogodzinski and Sass (1994) attempt to estimate the determinants of zoning in a Tiebout-type setting and find evidence for fiscal, externality, and exclusionary zoning. Bogart (1993), however, cautions that it is hard to identify empirically the underlying motivations for zoning. The analysis in this paper focuses on how the tax code changes the underlying financial incentives to zone but is not intended to supplant other motivations for zoning.

[6]While the model formally examines a profit-maximizing developer, the suburban community decision-maker can also be viewed as a property value maximizing local government that chooses the zoning regime to maximize total land value.

quantitatively compare equilibria with and without zoning constraints.

In this economy, there are two communities. The city is a bounded community with a fixed stock of land suitable for development. The suburb is an unbounded community, having a potentially infinite supply of land. There are two types of worker households (high skill (h) and low skill (l)) whose distribution across the metropolitan area depends on preferences, equilibrium prices, local amenities, and housing subsidies. The subsidy for land is characterized as the fraction of the price of housing services paid by the government. If r_j is the market price of land in community j, the effective price individuals pay for land is $\tau^i r_j$ where τ is one minus the subsidy. For simplicity, we assume that the standard deduction and progressivity of the tax code combine so the subsidy is available only to high skill workers.[7] Thus, $0<\tau^h<1$, with $\tau^l=1$.

Individual households (indexed by k) maximize utility by choosing residential location and the optimal quantities of housing (h) and the numeraire good (x) given rents (r), the housing subsidy ($1-\tau^i$), local amenities (A), and wages (w^h earned by high skill workers and w^l earned by low skill workers). Individuals of a given type have identical preferences over x, h, and A, so their systematic preferences over the composite good and land, given amenities, can be expressed by the indirect utility function: $V^i(\tau r_j, w^i; A_j)$. Individual households also have idiosyncratic preferences, ε^{ik}, over city or suburban locations. Thus, total utility is given by $V^i + \varepsilon^{ik}$.

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[7]One might expect that with progressivity there could be a way for high income homeowners to transfer the tax benefits to low income households through renting. The tax treatment of housing is essentially symmetric across owners and renters in that mortgage interest and property taxes are deductible for homeowners and landlords, so that this tax advantage is available to both high and low income if they rent. With respect to ownership, deductibility increases in attractiveness with increasing income (ignoring the recent 'phase-out' provisions in the tax code), but it is difficult for high income households to transfer this advantage to low income households because it involves losing the benefit of nontaxed imputed rents.

Normalizing ε^{ik} to represent preference for a suburban location, we can define the marginal consumer who is indifferent between city and suburb as $V^i(\tau r_s, w^i; A_s) - V^i(\tau r_c, w^i; A_c) = \varepsilon^{i*}$.

Community Choice

There are N^h high income consumers and N^l low income consumers choosing their residential community and level of housing consumption. By choosing a community, the consumer also chooses the amenity package associated with that community. By specifying a distribution function for the idiosyncratic location preference, we can define a function that determines the fraction of people choosing each community:[8]

(1) $$N_c^h = \Phi(r_c, r_s, A) = \alpha_0 r_s^{\alpha_1} r_c^{\alpha_2} A^{\alpha_3}$$

where: N_c^h is the number of high income people choosing a city residence;

r_c is the rent in the city;

r_s is the rent in the suburb;

A is the amenity in the suburb relative to the city;

α_i are the parameters of the function.

Given the functional form, α_1, α_2, and α_3 are the elasticities of the number choosing the city with respect to changes in suburban rent, city rent, and relative amenities. A similar equation holds for low income individuals:

[8]Equation (1) is best thought of as an approximation incorporating the implicit indirect utility functions and distribution function for idiosyncratic preferences.

(2) $$N_c^l = \phi(r_c, r_s, A) = \beta_0 r_s^{\beta_1} r_c^{\beta_2} A^{\beta_3}$$

where: N_c^l is the number of low income people choosing a city residence.

The number of high and low income individuals choosing suburban communities is:

(3) $$N_s^h = N^h - N_c^h$$

and

(4) $$N_s^l = N^l - N_c^l$$

In addition to choosing communities, individuals also choose their consumption of residential land. For simplicity, we assume that land consumption is proportional to housing consumption and ignore the tradeoff between capital and land in housing.[9] Abstracting from income effects, the demand for housing depends on the after tax price of housing so that for high income individuals demand is given by[10]:

(5) $$g_c^h = g^h(r_c, \tau) = \gamma_0(\tau r_c)^{\gamma_1}$$

(6) $$g_s^h = g^h(r_s, \tau) = \gamma_0(\tau r_s)^{\gamma_1}$$

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[9]This assumption is discussed further in Section 4.

[10]Amenities do not enter the housing demand functions; people get the full value of a community's amenities by choosing that community, regardless of the quantity of housing they purchase.

where: g_i^h is the demand for housing in the city and suburb;

τ is one minus the tax-related subsidy to housing for the wealthy;

γ_i are the parameters of the demand function.

The demand functions for low income individuals differ from those of high income residents because they are assumed to have sufficiently low incomes to make itemization on tax returns, and hence deductibility, irrelevant. Demand functions for low income residents are:

(7) $$g_c^l = g^l(r_c) = \delta_0(r_c)^{\delta_1}$$

(8) $$g_s^l = g^l(r_s) = \delta_0(r_s)^{\delta_1}$$

where: g_i^l is the demand for housing in the city and suburb;

δ_i are the parameters of the demand function.

Note that γ_1 and δ_1 are the price elasticities of demand for high and low income individuals, respectively.

Land, Amenities, and Developer Behavior

Total land in the city community is assumed to be fixed so that:

(9) $$\bar{L}_c = N_c^h g_c^h + N_c^l g_c^l$$

where: $\bar{L}_c$ is the fixed amount of land in the city.

Land in the suburb, on the other hand, is determined endogenously and is given by:

(10) $$L_s = N_s^h g_s^h + N_s^l g_s^l$$

The relative attractiveness of the suburban community and the city community depends on the communities' amenities. Amenities, in turn, are assumed to depend on the number of each type of consumer opting for a suburban residence:

(11) $$A = A(N_s^h, N_s^l) = \theta_0 + \theta_1 N_s^h + \theta_2 N_s^l$$

If θ_1 is positive, more high income people choosing suburban locations increases the relative attractiveness of suburban locations. If θ_2 is less than θ_1, but greater than zero, an additional low income resident increases the attractiveness of the suburb, but less than would a higher income person. If $\theta_2 < 0$, an additional low income person choosing a suburban residence will lower the relative attractiveness of the suburban community.

The developer plays an important role in this framework in that he is assumed to have a monopoly over suburban land. The developer seeks to choose its price for suburban land to maximize its profits. The developer maximizes profits conditional on the costs of supplying land

and on individuals choosing their communities and land consumption optimally in response to the developer's choice of r_s and the endogenously determined values for r_c and A. The developer's profits, Π, are:

(12) $$\Pi = r_s(N_s^h g_s^h + N_s^l g_s^l)$$

The developer's unit land cost (its only cost) is assumed to be flat or to increase with L^s:

(13) $$C = C(L_s) = \rho_0 L_s^{\rho_1}$$

As developers increase r_s, both the number of people choosing suburban locations and the amount of housing they consume decreases. The tradeoff is more complicated than just the total price elasticity of suburban land (including the effects on amount of land to consume and effects on community choice) because the suburban community's attractiveness depends on the number of rich and poor choosing to live there. Thus, if low income individuals reduce the amenities of the community, an increase in low income individuals reduces the number of people that would willingly choose a suburban location for any given rent. In this context, we can compare the incentives to pursue exclusionary zoning policies: Is it more profitable for the developer to sell suburban housing to the largest market, including both high and low income individuals, or is it more profitable to exclude low income residents? How is the developer's decision about whether or not to exclude low income residents affected by the tax treatment of housing? And, finally, does the developer's decision have significant effects on the equilibrium locations of the rich and poor as well as the relative prices of each community?

IV. Caveats and Extensions

Before turning to simulation of the model, a number of simplifications in the model warrant further comment. First, the assumption that residential land demand is proportional to housing demand is not realistic. In general, as land prices increase, households substitute capital for land in the production of housing services. In our model, we are ignoring this potential margin for substitution. Generalizing the model to include this margin would not affect the qualitative implications of the model as long as capital has a diminishing marginal product in the production of housing services. The key is that land is a fixed factor in the city, and while one can expand housing services in the city by substituting capital for land, at some point, the productivity of capital in housing production will fall enough to make additional housing production in the city prohibitively expensive, relative to the suburban alternative. Thus, while the substitution of capital for land can loosen the constraint imposed by having a fixed amount of land in the city, it cannot eliminate its ultimate impact.

Another simplification of the model is the assumption of a single monopoly developer setting suburban land prices to maximize developer profits. Once again, this is not realistic, as there are typically many developers active in a metropolitan area's suburban housing market. The key issue is, what would be the consequence of having additional developers that essentially reduce the ability of individual developers to set prices above marginal costs? In the limit, perfectly competitive developers would drive profits to zero, with or without zoning, so that comparing the relative profitability of the two regimes would not be informative. Even in this case, the tax treatment of housing may have implications for the aggregate value of land under constrained and unconstrained regimes, but our framework would have to be recast somewhat to

explicitly examine the aggregate land values with and without zoning under a zero profit constraint.

If we reinterpret the developer as a property-value-maximizing local government, however, the idea of competing communities, each supplying different local bundles of attributes, is consistent with the commonly held Tiebout view of local jurisdictions. Since these communities are providing a differentiated product, it is likely they would retain some pricing power, and in theory, we should be able to evaluate how the tax treatment of housing affects zoning choices in the context of many suburban communities, each with some power to affect land prices. While it is our conjecture that the tax treatment of housing would have similar implications in that context, verification of that conjecture is left to future research.

Another area in which the framework could be extended is the developer's choice set. In our model, the developer is limited to either selling to both high and low income households or to high income households alone.[11] In a richer framework, the developer (or community) may optimally set rules that allow some fraction of the total low income households seeking housing in their market to gain access rather than simply accepting or excluding all low income households. Along these lines the model might be recast in terms of a land-value-maximizing community that chooses minimum lot sizes, rather than zoning that fully constrains low income households. In this context, we could reevaluate how changes in housing taxation affects the choice of minimum lot size, which is a common type of suburban zoning. Again, this topic is left for future research.

[11]Comments by Alex Anas provided the idea of expanding the developer's choice set.

V. Model Simulation: Are There Tax Incentives for Exclusionary Zoning?

In models similar to the one described in section three, but without a developer setting suburban rents, Voith and Gyourko (1998) derive several analytic comparative statics results regarding the effects of housing tax subsidies on equilibrium location choices, land consumption, and rental rates.[12] Conditional on a given level of suburban rents, the comparative statics of the Voith-Gyourko model would obtain in this framework as well. In the framework presented in section three, comparative statics analysis is more complex because the optimizing developer's choice of suburban rents depends on the price elasticity of demand for suburban housing, the elasticity of location choice with respect to the developer's choice of suburban rents, and the endogenously determined city rent levels and amenity levels, as well as the developer's cost function.

Comparative statics, however, play a less important role for the question addressed in this paper: We wish to compare alternative equilibria for economies with and without zoning constraints to see how the tax treatment of housing affects not only the developer's choice of suburban rent, but also whether it is more profitable for a developer to adopt exclusionary strategies. And if housing subsidies result in exclusionary strategies that are profit maximizing, what are the effects on location choice and housing consumption?

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[12]The models analyzed by Voith and Gyourko are more general in that they do not assume a specific functional form. However, in those models, suburban rents are assumed to be an arbitrary function only of amenity levels. Essentially, rents are assumed to increase with amenities but not so much that they offset the location incentives of the amenities--that is, amenities are not fully capitalized. In the framework here, suburban rents are determined by an optimizing developer and, therefore, require no ad hoc assumptions about the relationship between amenities and suburban rents.

Simulation Strategy

To examine the role of the tax treatment of housing on the decision to zone, we start by examining the model with a baseline set of parameters under two regimes: 1) unconstrained, in which both low and high income individuals can choose either city or suburban locations, and 2) constrained, in which low income individuals are prevented from choosing a residence in the suburban community.[13] Choosing values for many of the parameters of the model is essentially arbitrary, since there is little empirical evidence on the effects of rents on choice between city or suburban communities, nor is there evidence on the effects of amenities on location choice.[14] Indeed, we have not precisely defined amenities, and in our model, amenities simply reflect differences in relative attractiveness in the systematic component of utility across communities.[15] We therefore cannot bring empirical evidence to bear on the magnitude of the relative effects of high and low income people on the attractiveness of city and suburban communities. Thus, we examine a range of parameters for the location choice functions and the amenity production function.

With respect to the four equations for price elasticity of demand for housing, we center on

[13]We do not specify the mechanism for exclusion here, but minimum lot size zoning would be entirely consistent with this framework.

[14]A potentially interesting exercise in this regard would be to examine how alternative specifications of the distribution of idiosyncratic preferences affect the equilibrium outcomes. In this paper, we simply assert a functional form and parameter values for the location choice function rather than parameterize a utility function and probability distribution function over idiosyncratic preferences.

[15]If amenities were more precisely defined, one could use existing hedonic studies to infer monetary values for these amenities and perhaps realistically calibrate the community choice function.

elasticity of demand of -1. As will be evident in the simulations, housing price elasticity plays an important role in how the housing tax code affects the incentive to adopt exclusionary zoning. We examine a range of elasticities from -.7 to -1.3. The last parameters we must select are in the residential land supply function. Here we examine a range from perfectly elastic supply to steeply upward sloping. Note that, although we must choose values for the multiplicative (or additive in the case of the amenity production function) parameters, we do not consider a range for these parameters. These parameters are essentially scale parameters, but scale in this model–such as rent per square foot or square mile, or number of people in the community–is essentially arbitrary and so we do not focus on these parameters.[16]

Reference Simulation

The reference simulation is characterized by a price elasticity of housing demand of -1 ($\gamma_o = \delta_0 = -1$); modestly upward sloping supply of housing ($\rho_1 = 1.2$); identical community choice parameters for rich and poor, with symmetrical responses to city and suburban rents ($\alpha_1 = \beta_1 = .5$, $\alpha_2 = \beta_2 = -.5$); moderate location response to amenities ($\alpha_3 = \beta_3 = -.5$); low income residents adversely affect community amenities ($\theta_2 = -.5$); and high income residents do not affect amenities ($\theta_1 = 0$). Figures 1 through 4 show the effects of increasing subsidies on suburban and

[16]These parameters can, however, affect the magnitude of movements along the demand curve in a given community in response to a change in rents relative to the magnitude of the effect of a change in rents on land consumption resulting from shifting across communities. That is, when rents change, people in a community adjust their land consumption. Changing rents also may induce moving from one community to another, in which case there will be discrete changes in land consumption as the rents in the new community could be considerably different from rents in the original community. These scale parameters can affect the relative importance of the shifts along the margin within a community when compared to the shifts in consumption associated with changing communities.

city rents, the number of high and low income people choosing city residences, and relative amenities for the unconstrained and constrained simulations. Figures 5 through 8 show the household land consumption for high and low income residents in the city and the suburb for the constrained and unconstrained simulations.

As one would expect, an increase in housing subsidies for high income individuals results in increasing rents in both the city and the suburbs because demand for housing shifts up. Figure 1 shows the path of suburban rents as subsidies increase. In both the constrained and unconstrained case, suburban rents rise, but the suburban rent level is much higher in the unconstrained case. The constrained case has lower rents because, in the absence of demand from low income people, it is more profitable to attract additional residents to the suburbs by lowering rent. Recall that, because the price elasticity of residential demand is -1, changing the rent will not affect revenue for any given resident, but it will have an effect on the total number of residents through the location function.

City rents increase in both the constrained and unconstrained simulation as well (Figure 2). Note that initially, city rents are higher in the constrained case, but rents rise faster in the unconstrained case, because the number of high income people choosing city residences is much higher in the unconstrained case. Consistent with the comparative statics derived in Voith and Gyourko (1998) the number of high and low income individuals choosing city locations declines as subsidies increase under both regimes, but the number of high income people choosing city residences is much higher for all levels of subsidy in the unconstrained case (Figure 3).[17] The

[17]Note that the reduction in the number of low income people choosing the city is the same as the reduction for the high income residents, even though the low income residents do not receive the subsidy. This result obtains because the community choice function depends only on

decline in number of people choosing city residences as subsidies increase results from the fact that the supply of land can expand in the suburban community in response to the increased demand for housing for the rich. The number of high income people choosing city residences is much lower in the constrained case for two reasons: 1) suburban rents are much lower relative to city rents; and 2) suburban amenities are higher.

Figure 4 shows relative city-suburban amenities. In the unconstrained case, suburban amenities are lower and declining with increases in subsidy. This occurs for two reasons: (1) subsidy increases provide an incentive for both high and low income individuals to choose suburban locations; and (2) since low income residents adversely affect amenities, amenities decline with subsidies in the unconstrained case. In the constrained case, amenities are constant because the location choices of high income individuals are assumed to have no effect on amenities.[18]

Land consumption by high income consumers depends on the after-subsidy price of housing while land consumption by low income consumers depends only on the market price. Figure 5 shows land consumption in the city by high income people increasing moderately with housing subsidies in both the unconstrained and constrained case. In contrast to city land consumption, suburban land consumption differs sharply between the unconstrained and constrained regimes (Figure 6). In the unconstrained case, suburban land consumption by high income residents increases somewhat faster than in the city, reflecting the more elastic supply of

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rents and amenities and not on subsidies.

[18]This view is consistent with that of Pack (1995), who argues that low income residents impose higher costs on communities than do high income residents.

suburban land. In the constrained case, however, land consumption by high income residents is high at low subsidy levels and increases dramatically as subsidies increase. This occurs because suburban rents are very low and rise only modestly with subsidies so that the after-subsidy cost of suburban land is extremely low when subsidies are high.

As the subsidy for high income residents rises, low income individuals are generally confronted with higher rents but receive no subsidy, so their housing consumption falls. Figure 7 shows the falling land consumption in the city, which is similar in both the unconstrained and constrained cases. Finally, Figure 8 shows suburban land consumption by low income residents, which falls modestly as rents rise with subsidies in the unconstrained case. Of course, suburban land consumption is zero for low income people in the constrained case.

Developer profits, which depend on suburban rents and the aggregate suburban land consumed by high and low income individuals, increase with subsidies. The monopolist developer captures part (the magnitude of which depends on the elasticity of supply and demand, as well as the amenity production function) of the value of the subsidy. The key questions for this paper are: Which regime would maximize the developer's profits--the unconstrained or constrained model? How is that choice affected by the rate of subsidy? What are the consequences for development patterns?

Figure 9 shows profit for the developer under the two regimes as housing subsidies increase. Given this parameterization, the developer reaps higher profits from the unconstrained regime if subsidies are less than 17 percent of housing costs, but if subsidies increase beyond that, the constrained regime is more profitable. Thus, from the developer's point of view, when housing subsidies for high income people increase, he prefers to exclude low income residents.

The forces making the constrained regime more profitable are threefold. First, as subsidies increase, developers are making more revenue from each high income resident as their land consumption increases with the subsidy. Second, constraining low income residents in the city results in a much higher city to suburban relative rent so that more high income people choose suburban locations than in the unconstrained cases. Third, the concentration of high income residents in the suburb results in a higher amenity level in the suburb than that prevailing in the unconstrained case.

Under the reference parameterization, the incentives to choose constrained communities inherent in the tax treatment of housing have dramatic consequences for the patterns of metropolitan development. For discussion purposes, we refer to the effects of housing subsidies within a regime as the "marginal effects" and the effects associated with shifting regimes when the constrained regime becomes more profitable as "equilibrium effects." In many cases, the equilibrium responses are much greater than the marginal responses.

To show the effects of shifting from unconstrained to constrained equilibria, we show the path of rents, city residents, housing consumption, amenities, and profits, given that the developer is choosing the profit-maximizing regime for each rate of subsidy. Figure 10 shows the path of city and suburban rents as subsidies increase. City rents rise relatively smoothly, but suburban rents fall to one-third of their unconstrained level and rise only slightly as subsidies increase. While at first blush this result may appear surprising, it is consistent with the modestly upward sloping supply of land in the suburbs.[19]

[19]One might ask what the role of capitalization is in this model. Because the developer is a monopolist, subsidies are capitalized into rents in both the constrained and unconstrained case, and hence, rents increase with subsidies. Rents can fall, however, when an increase in subsidies

The number of high income residents living in the city declines dramatically with a shift from unconstrained to constrained (Figure 11). The marginal response of high income residents to an increase in subsidies is for fewer people to choose city residences, but the decline with subsidy increase within a regime is far less important than the decline resulting from a shift in regimes. The shift of high income residents to the suburbs is further accentuated by the positive amenity effect associated with excluding low income people (Figure 12). With respect to housing consumption, high income residents' housing consumption in the suburb rises dramatically when the developer shifts to a constrained regime and the rate of increase of housing consumption with subsidy rises as well (Figure 13). On the other hand, suburban housing consumption of low income residents falls to zero, and as city rents rise, city housing consumption falls as well (Figure 14). Finally, developer profits, by definition, shift up when there is a regime shift as is evident in Figure 9.

The reference simulation indicates that the tax treatment of housing has both marginal effects and equilibrium effects on the patterns of metropolitan development. While marginal impacts are, by definition, incremental changes and do not imply dramatic changes in the basic patterns of metropolitan development, the equilibrium shifts imply potentially dramatic shifts in patterns of development. The reference simulation suggests that the tax treatment of housing provides financial incentives for exclusionary policies that result in fundamental shifts in the structure of land prices, location choice, and community characteristics. In the next section, we investigate alternative parameterizations of the model to get a fuller understanding of the

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causes a shift from an unconstrained regime to a constrained regime because the entire equilibrium structure of prices changes.

conditions under which the tax treatment of housing yields incentives to pursue exclusionary policies.

VI. Sensitivity Analysis

While the reference simulation indicated that an increase in housing subsidies for high income individuals can provide incentives for shifts from unconstrained to constrained regimes, these incentives do not exist for all parameterizations of the model. We believe that these incentives are likely to exist for empirically plausible parameterizations. To more closely examine these issues, we simulate the model with alternative assumptions regarding the production of amenities and their parameters in the location choice function, the elasticity of supply, the price elasticity of demand, and finally the effects of rents on location choice. The key focus of our discussion in all cases will be the relationship between subsidies and the difference in profitability of the unconstrained and constrained regimes. In particular, if unconstrained profits rise more slowly than constrained profits as subsidies increase, we view the tax treatment of housing as providing an incentive for exclusionary policies.

Amenities

Although amenities can play an important role in affecting whether the tax treatment of housing provides an incentive to exclude low income residents, it is not necessary for low income residents to have adverse impacts on community amenities to obtain this result. This can be seen by simplifying the reference simulation such that amenities play no role in the location choice function (and hence no role in any of the variables of interest). Setting $\alpha_3 = \beta_3 = 0$ in the

location choice functions for high and low income individuals still results in increasing relative profitability of the constrained regime as subsidies increase. Amenities do, however, play a potentially important role in the relationship between subsidies and the desirability of excluding low income residents. As we show in the next section, there are combinations of parameters--in particular, either perfectly elastic supply or inelastic demand for housing–that yield a negative relationship between subsidies and the relative profitability of the constrained regime, but this relationship can be reversed if there are sufficiently negative effects of low income residents on community amenities.

Developer Costs

The nature of the developer's costs in suppling residential land can affect the relationship between subsidies and the desirability of the constrained regime. In general, the more unit costs increase with quantity supplied, the greater the likelihood that the increased subsidies will favor excluding low income residents. Figure 15 shows simulations identical to the reference simulation except that the developer's unit costs vary from flat to relatively strongly upward sloping.[20] Flat costs correspond to the curve marked $\rho_1 = 1.0$ while the other two curves correspond to the reference case, $\rho_1 = 1.2$, and a more strongly upward sloping case, $\rho_1 = 1.4$. In each case, increases in subsidies make the constrained option more attractive, but the more upward sloping the costs, the more subsidies favor the constrained case. It is important to note, however, that for perfectly elastic supply, $\rho_1 = 1.0$, it is easy to generate the reverse relationship. In particular, if there are no amenity effects, perfectly elastic supply results in subsidies favoring

[20]Full descriptions of the simulation results are available on request.

the unconstrained case, given the remaining parameter values of the reference simulation.

Price Elasticity of Demand for Land

Another key parameter affecting the relationship between housing subsidies and the relative profitability of excluding low income residents is the price elasticity of demand. Figure 16 shows simulations using the same parameters as the reference simulation, but with the demand elasticity parameter, δ_1 taking on the values of -.7, -1, and -1.3. These simulations show that, given the parameters of the reference simulation, the more elastic residential land demand is, the more subsidies favor the constrained regime. Although not shown in Figure 16, if the demand for residential land is inelastic, it is much easier to reverse the relationship between subsidies and the attractiveness of the constrained regime. For example, if supply is perfectly elastic but demand is inelastic, increased subsidies favor the unconstrained regime. Similarly, if low income residents do not adversely affect the amenities of suburban communities, increased subsidies again favor the unconstrained regime.

VII. Conclusion

It is well known that tax-related subsidies increase the consumption of housing and, indirectly, residential land, which results in less dense development patterns. Voith and Gyourko (1998) have argued that in the presence of exclusionary zoning, these subsidies induce additional geographic sorting by income. In this paper, we have shown that under plausible parameters, the tax treatment of housing may also provide an incentive to adopt exclusionary zoning policies to maximize the return to suburban developers. The consequences of this incentive are potentially

far reaching. Rather than the incremental shifts in housing demand and location choice suggested in the analysis conducted by Gyourko and Voith, this work suggests that there may be large shifts in rents, location choice, and community characteristics associated with unconstrained and zoning constrained equilibria. Because the tax code may provide incentives for communities to adopt policies that exclude low income residents, these policies may cause significant shifts in the overall pattern of development even with no change in preferences.

Further research is required to see if the current equilibrium pattern of very dispersed, income segregated development really is a reflection of unique American preferences or policy-related incentives that affect not only individuals' choices on the margin, but communities' choices of institutional rules that shape the equilibrium outcomes. To accomplish this objective, additional research is needed to make the basic modeling framework more realistic, including allowing for the substitution of capital for land in the production of housing services, allowing for competitive developers or competitive suburban communities, and broadening the developer's choice set. To develop credible simulations of the magnitude of the empirical impact, research must be done on the parameterization of the function describing community choices, valuation and production of amenities, and the elasticity of residential land demand.

Bibliography

Alonzo, William, *Location and Land Use*, Cambridge: Harvard University Press (1964).

Blackley, Dixie and James R. Follain, "Inflation, Tax Advantages to Homeownership and the Locational Choices of Households," *Regional Science and Urban Economics*, Vol. 13 (1983), pp. 505-16.

Bogart, William T., "'What Big Teeth You Have': Identifying the Motivations for Exclusionary Zoning," *Urban Studies*, Vol. 30 No. 10 (1993), pp. 1669-81.

DiPasquale, Denise and William C. Wheaton, *Urban Economics and Real Estate Markets*, New Jersey: Prentice-Hall Inc. (1996).

Epple, Dennis, Thomas Romer, and Radu Filimon, "Community Development With Endogenous Land Use Controls," *Journal of Public Economics*, Vol. 34 (1988), pp. 133-62.

Gyourko, Joseph and Richard Voith, "The Price Elasticity of the Demand for Residential Land," University of Pennsylvania: Wharton Real Estate Center, mimeo (1999).

Feldstein, Martin, "Inflation, Tax Rules and the Accumulation of Residential and Non-Residential Capital," *Scandinavian Journal of Economics*, vol. 84, No. 2 (1982) pp. 293-311.

Hendershott, Patric H., "Government Policies and the Allocation of Capital Between Residential and Industrial Uses," National Bureau of Economic Research, Working Paper No. 1036, December 1982.

Mieszkowski, Peter and Edwin Mills, "The Causes of Metropolitan Suburbanization," *Journal of Economic Perspectives*, Vol. 7, no. 3 (Summer 1993), pp. 135-47.

Mills, Edwin, "An Aggregative Model of Resource Allocation in a Metropolitan Economy," *American Economic Review*, 47 (1967) pp. 197-210.

Mills, Edwin, "Dividing Up the Investment Pie: Have We Overinvested in Housing?" *Business Review*, Federal Reserve Bank of Philadelphia, March-April, 1987.

Muth, Richard F., "The Derived Demand Curve for a Productive Factor and the Industry Supply Curve," *Oxford Economic Papers*, pp. 221-34 (July 1964).

Muth, Richard F., *Cities and Housing: The Spatial Pattern of Urban Residential Land Use* (University of Chicago Press, 1969).

Pack, Janet Rothenberg, "Poverty and Urban Public Expenditures," Zell/Lurie Real Estate Center at Wharton Working Paper 197, University of Pennsylvania (1995).

Poterba, James M., "Tax Subsidies to Owner-Occupied Housing: An Asset-Market Approach," *Quarterly Journal of Economics*, 99 (1984) pp. 729-52.

Poterba, James. "House Price Dynamics: The Role of Tax Policy and Demography," *Brookings Papers on Economic Activity*, 1991, 2, pp. 143-203.

Pogodzinski, J.M. and Tim R. Sass, "The Theory and Estimation of Endogenous Zoning," *Regional Science and Urban Economics*, Vol 24 (1994), pp. 601-30.

Voith, Richard and Joseph Gyourko, "The Tax Treatment of Housing: Its Effects on Bounded and Unbounded Communities," Federal Reserve Bank of Philadelphia Working Paper No. 98-23, December (1998).

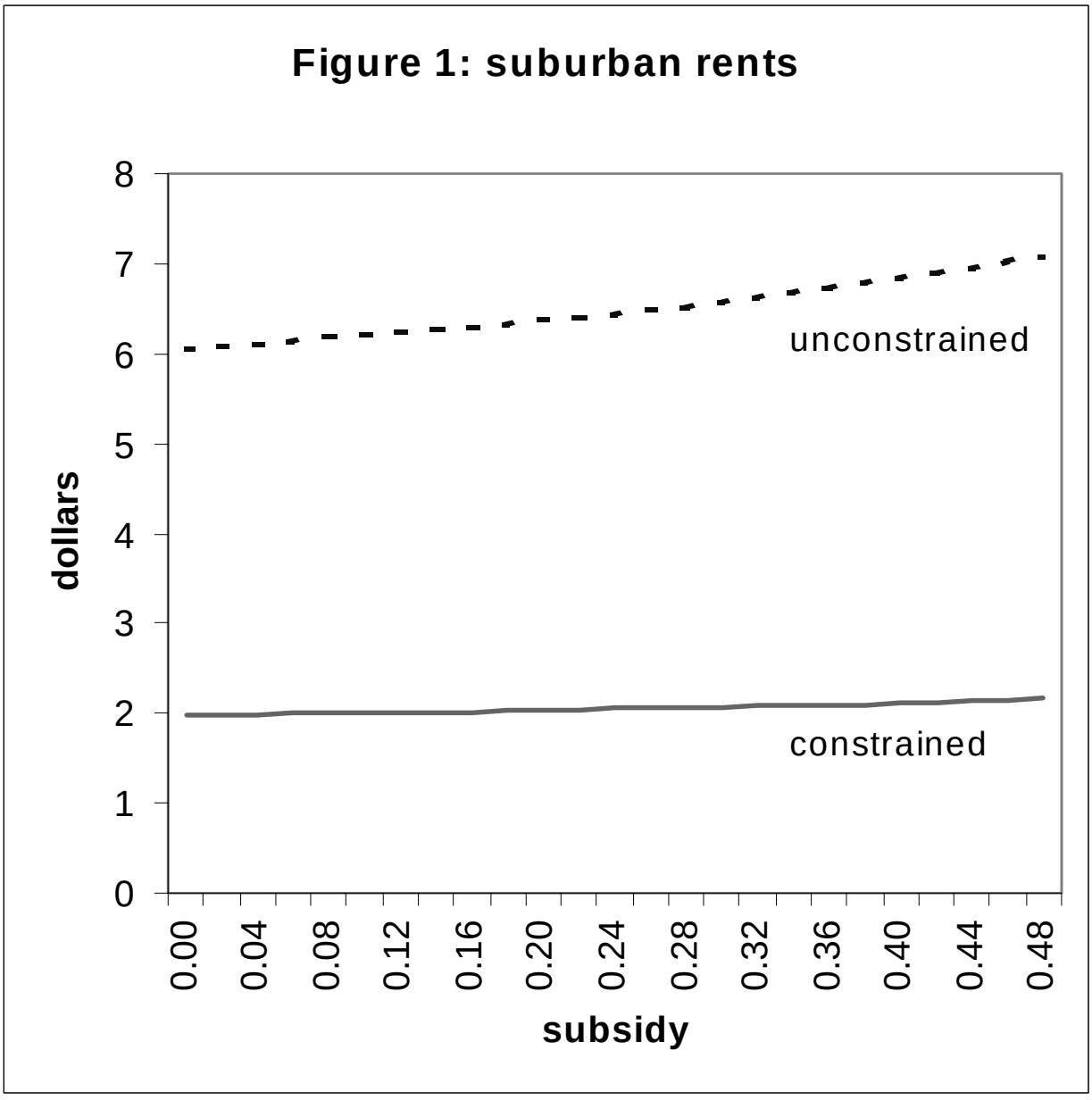


Figure 1: suburban rents
8
7
6
5
4
3
2
1
0
dollars
unconstrained
constrained
0.00
0.04
0.08
0.12
0.16
0.20
0.24
0.28
0.32
0.36
0.40
0.44
0.48
subsidy

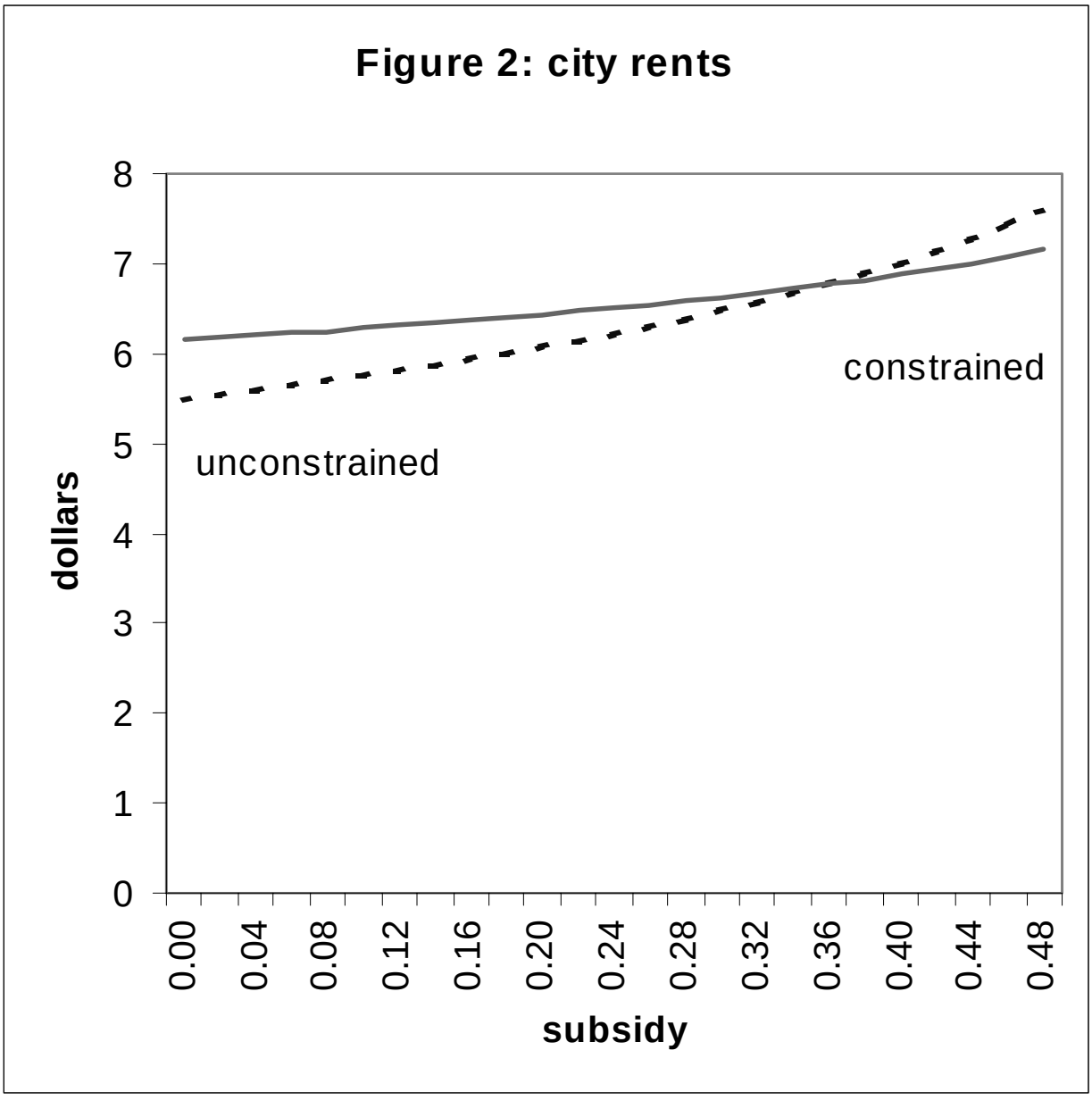


Figure 2: city rents
8
7
6
5
4
3
2
1
0
dollars
constrained
unconstrained
0.00
0.04
0.08
0.12
0.16
0.20
0.24
0.28
0.32
0.36
0.40
0.44
0.48
subsidy

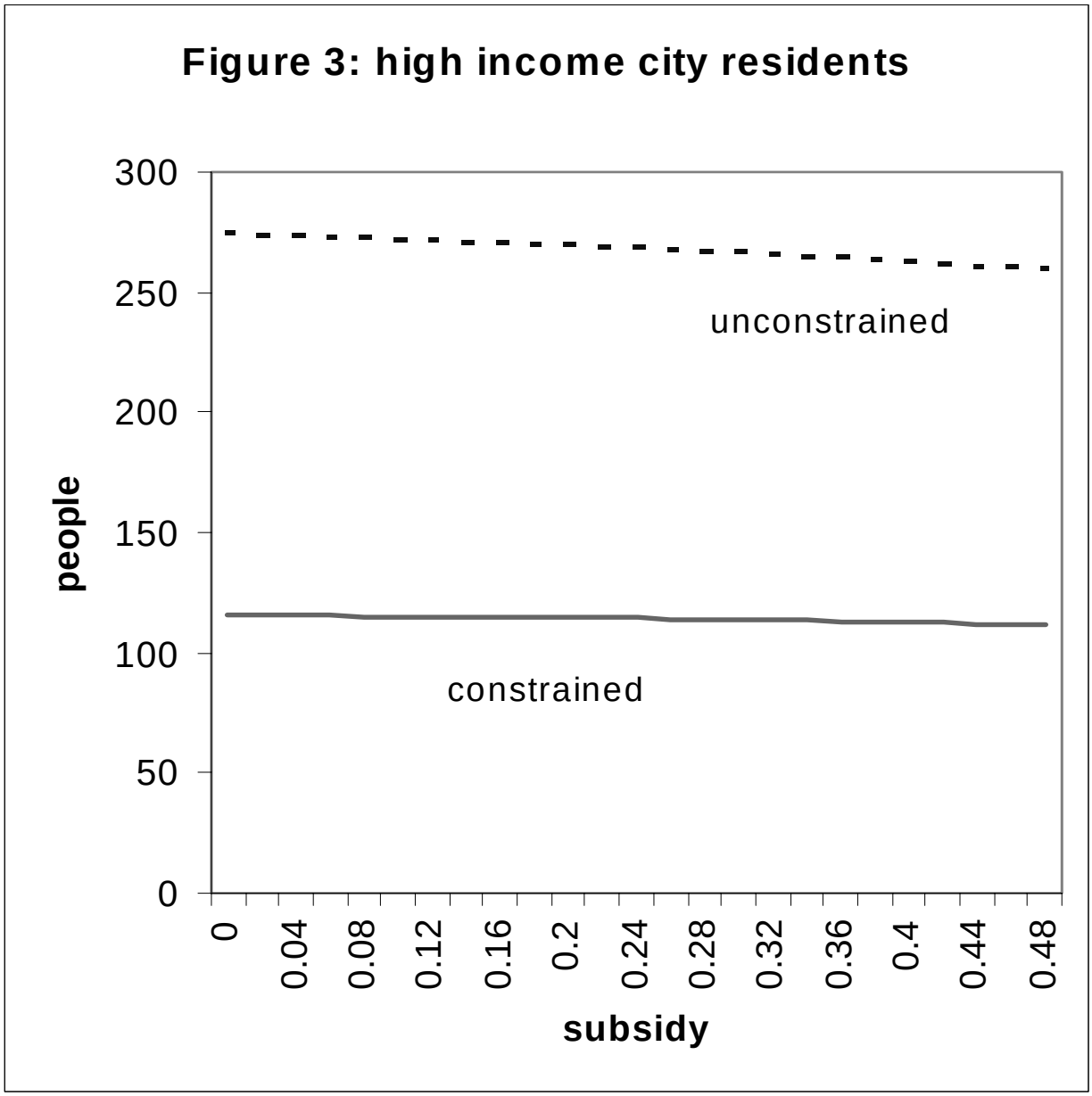


Figure 3: high income city residents
300
250
200
150
100
50
0
people
unconstrained
constrained
0
0.04
0.08
0.12
0.16
0.2
0.24
0.28
0.32
0.36
0.4
0.44
0.48
subsidy

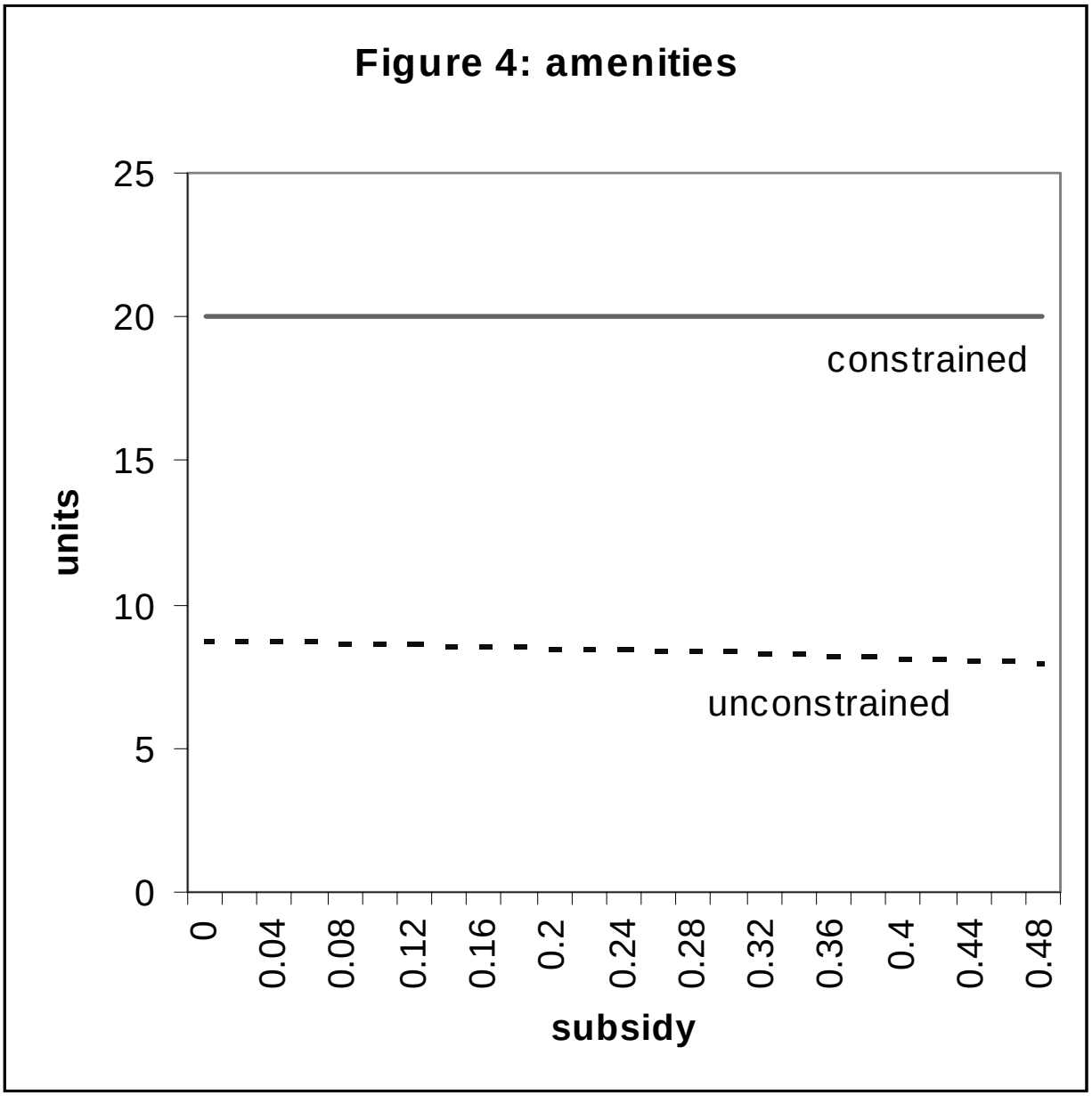


Figure 4: amenities
25
20
15
10
5
0
units
constrained
unconstrained
0
0.04
0.08
0.12
0.16
0.2
0.24
0.28
0.32
0.36
0.4
0.44
0.48
subsidy

Figure 5: city land consumption, high income

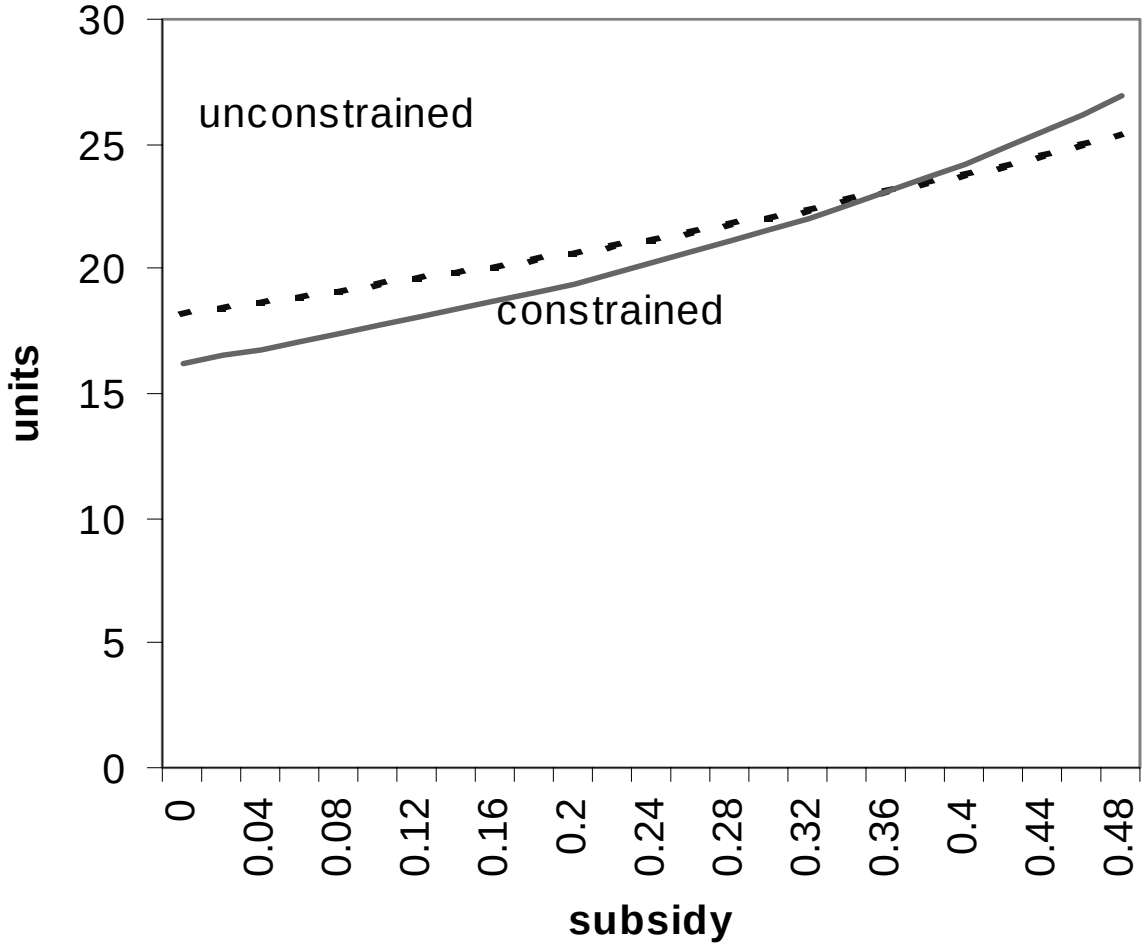


Figure 6: suburban land consumption, high income

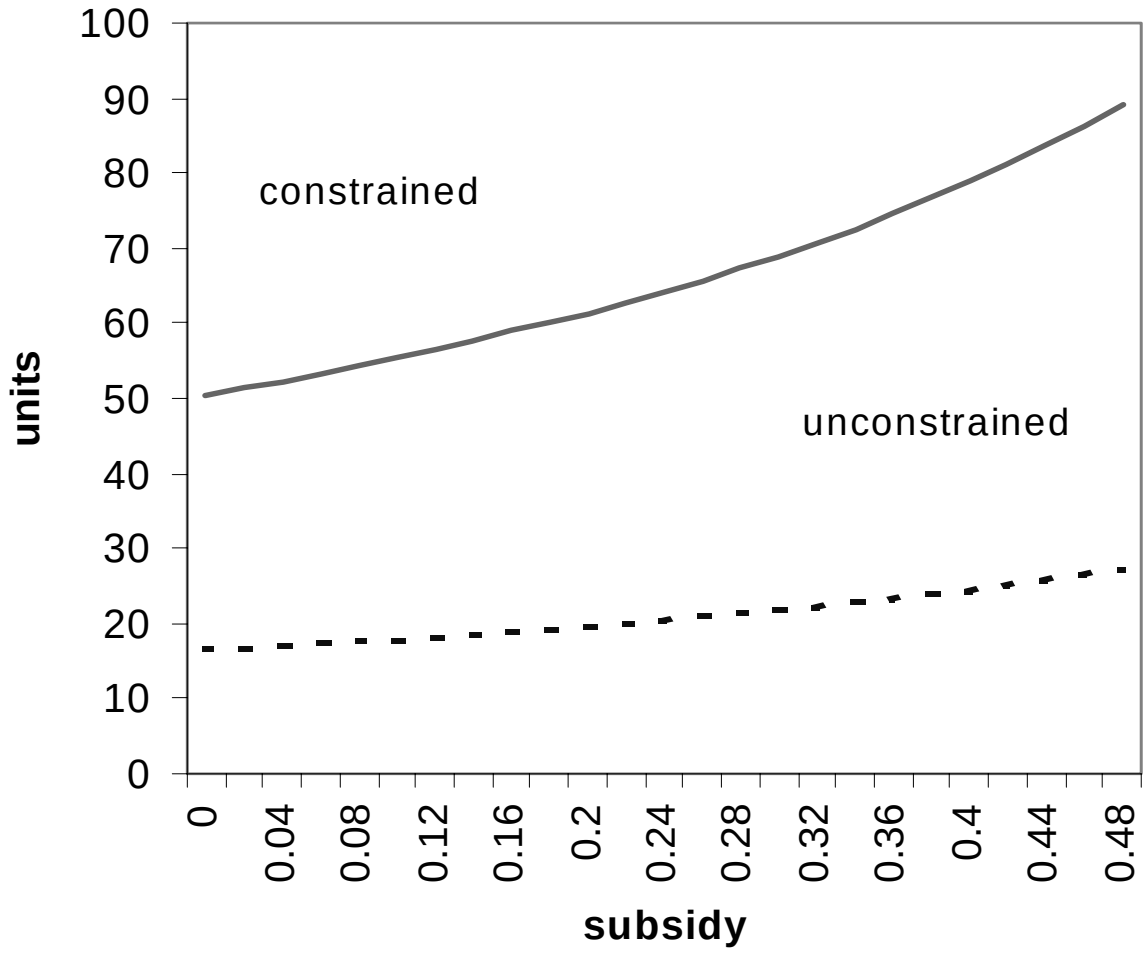


Figure 7: city land consumption, low income

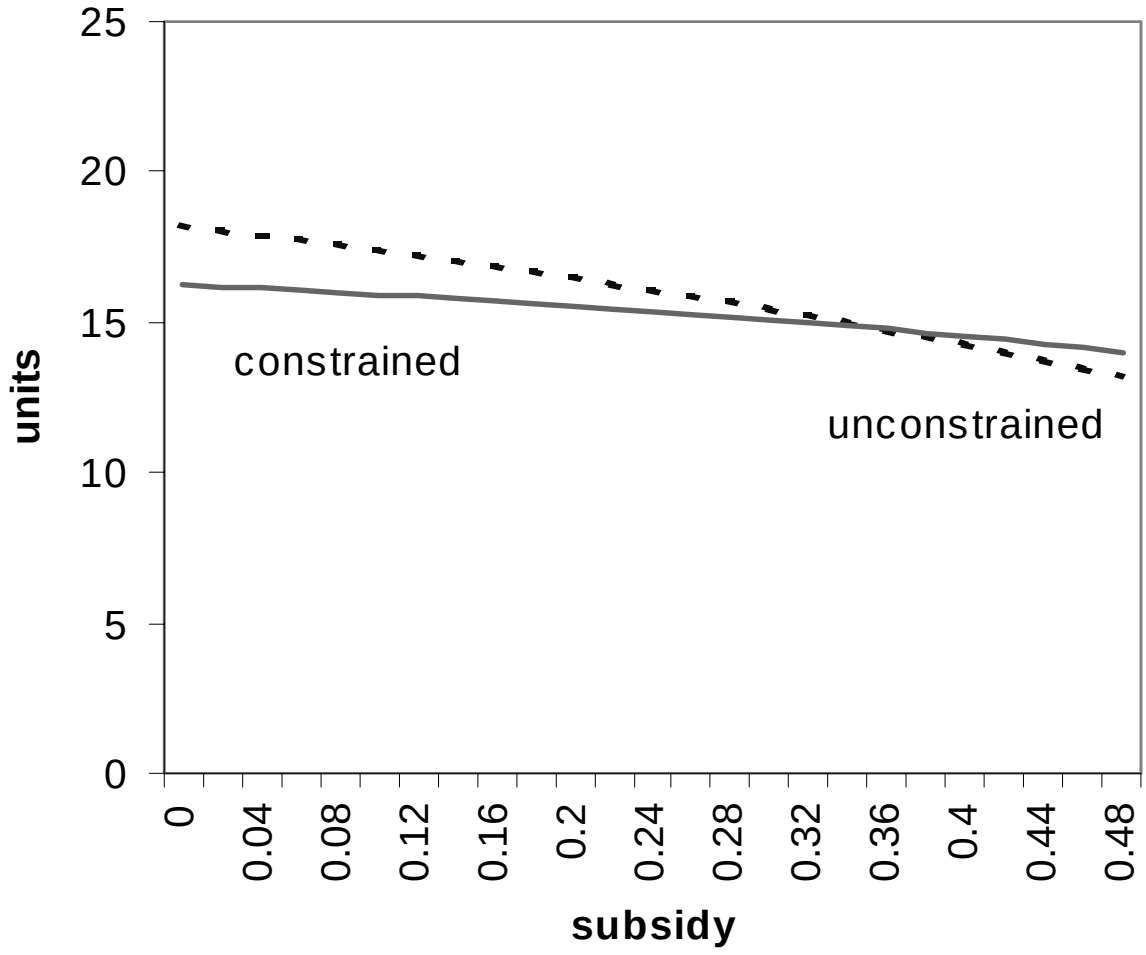


Figure 8: suburban land consumption, low income

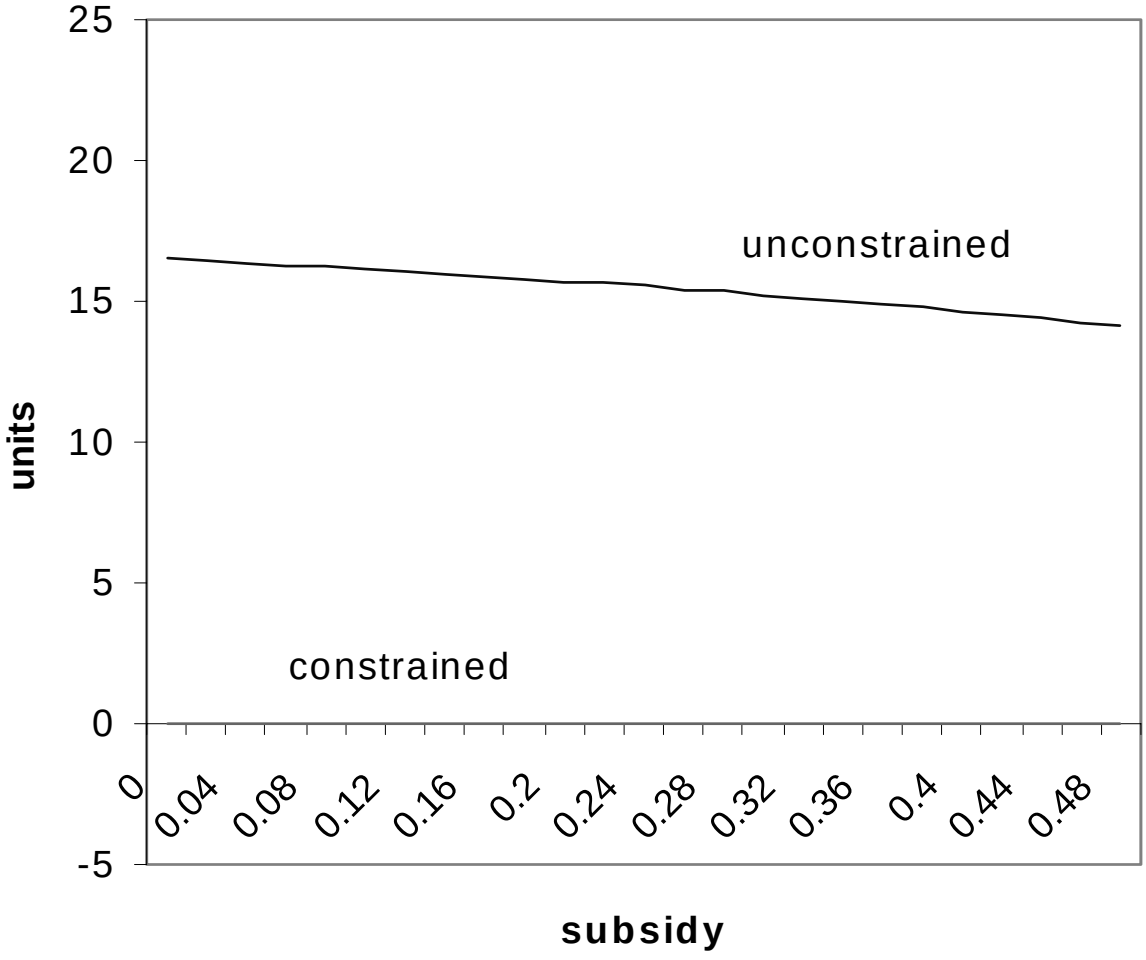
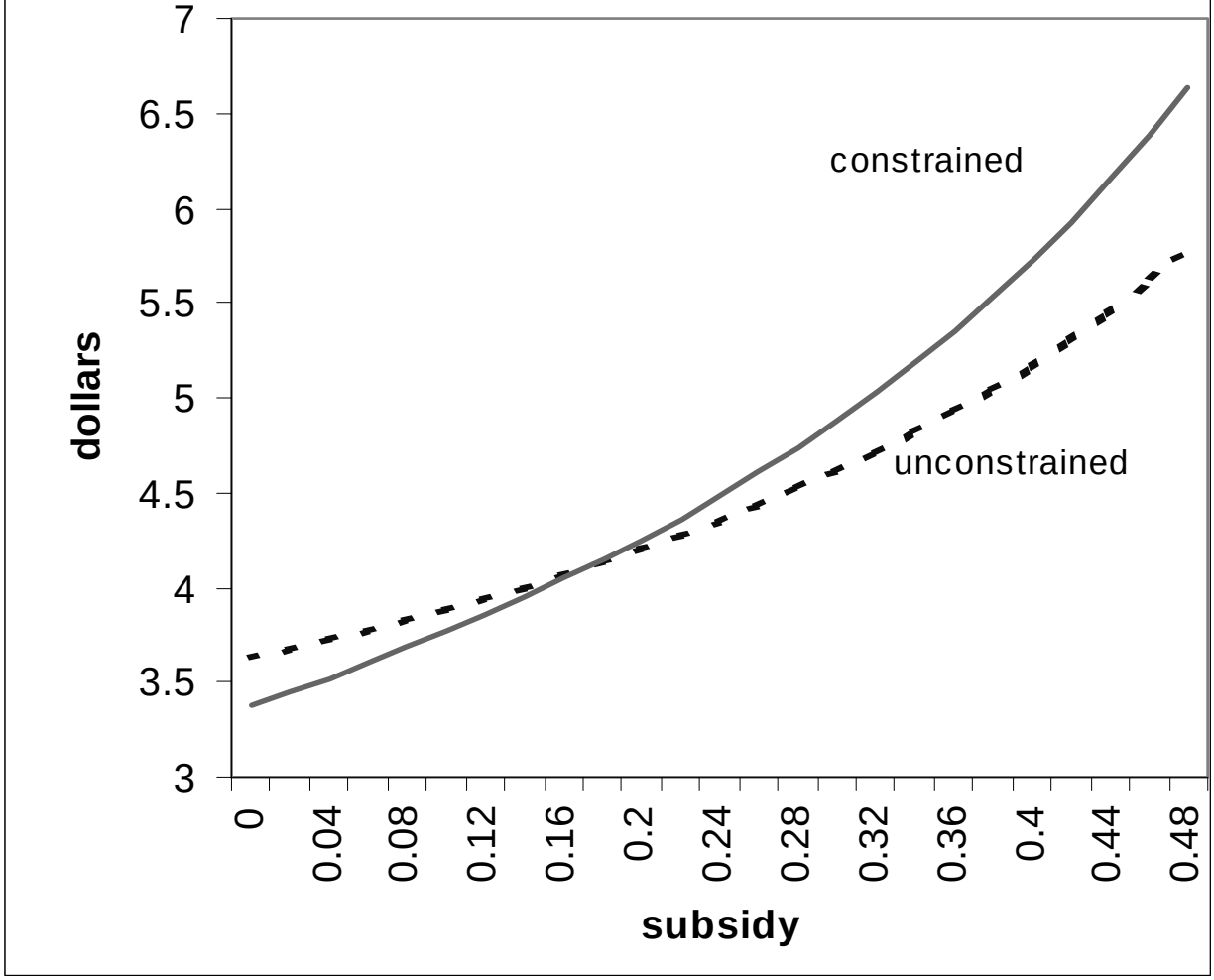


Figure 9: profits: unconstrained and constrained



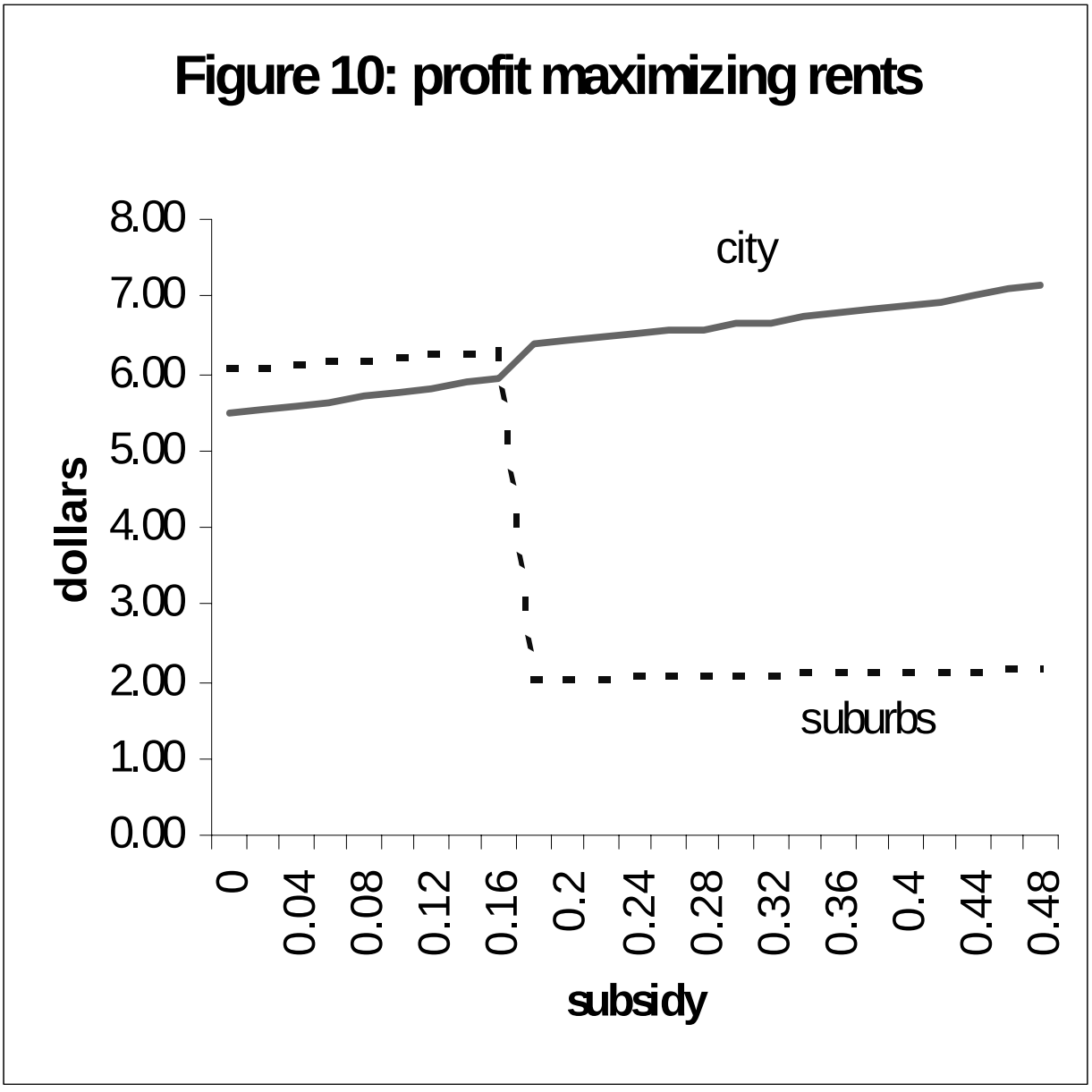


Figure 10: profit maximizing rents
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
dollars
city
suburbs
0
0.04
0.08
0.12
0.16
0.2
0.24
0.28
0.32
0.36
0.4
0.44
0.48
subsidy

Figure 11: profit maximizing high income people in city

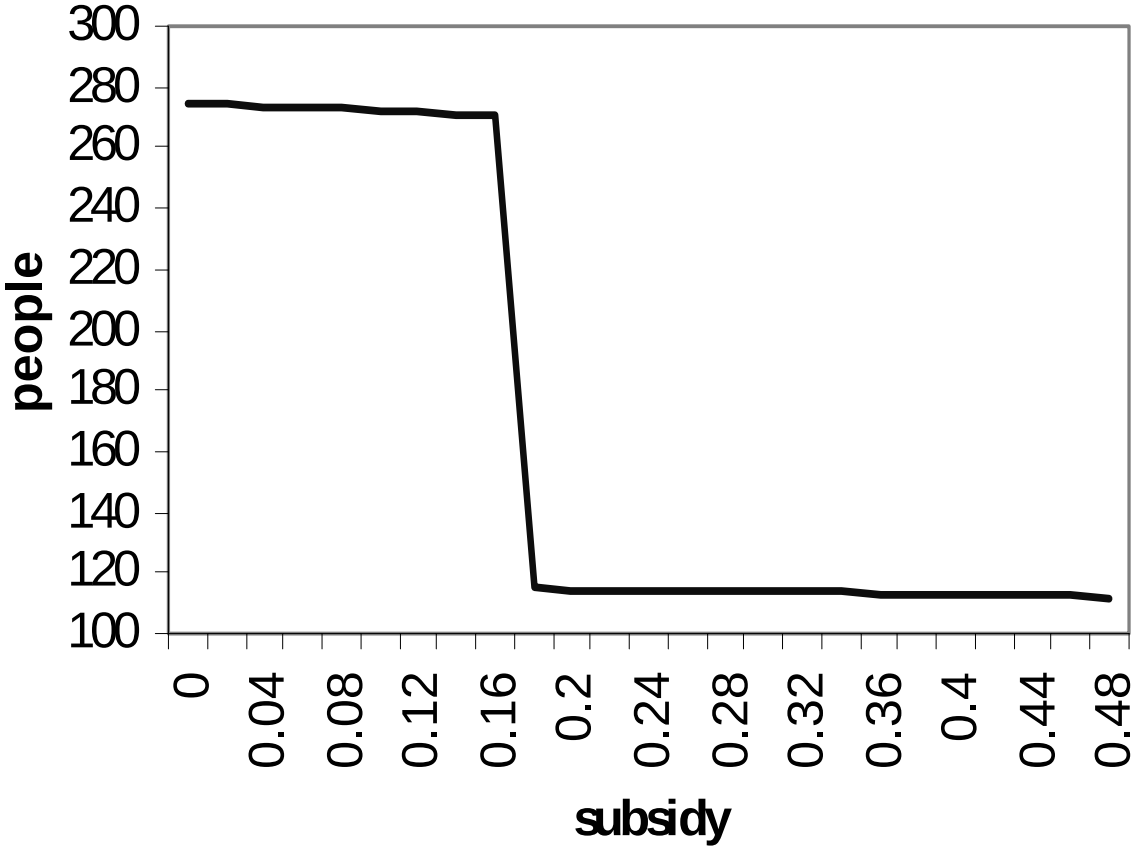


Figure 12: profit maximizing amenities

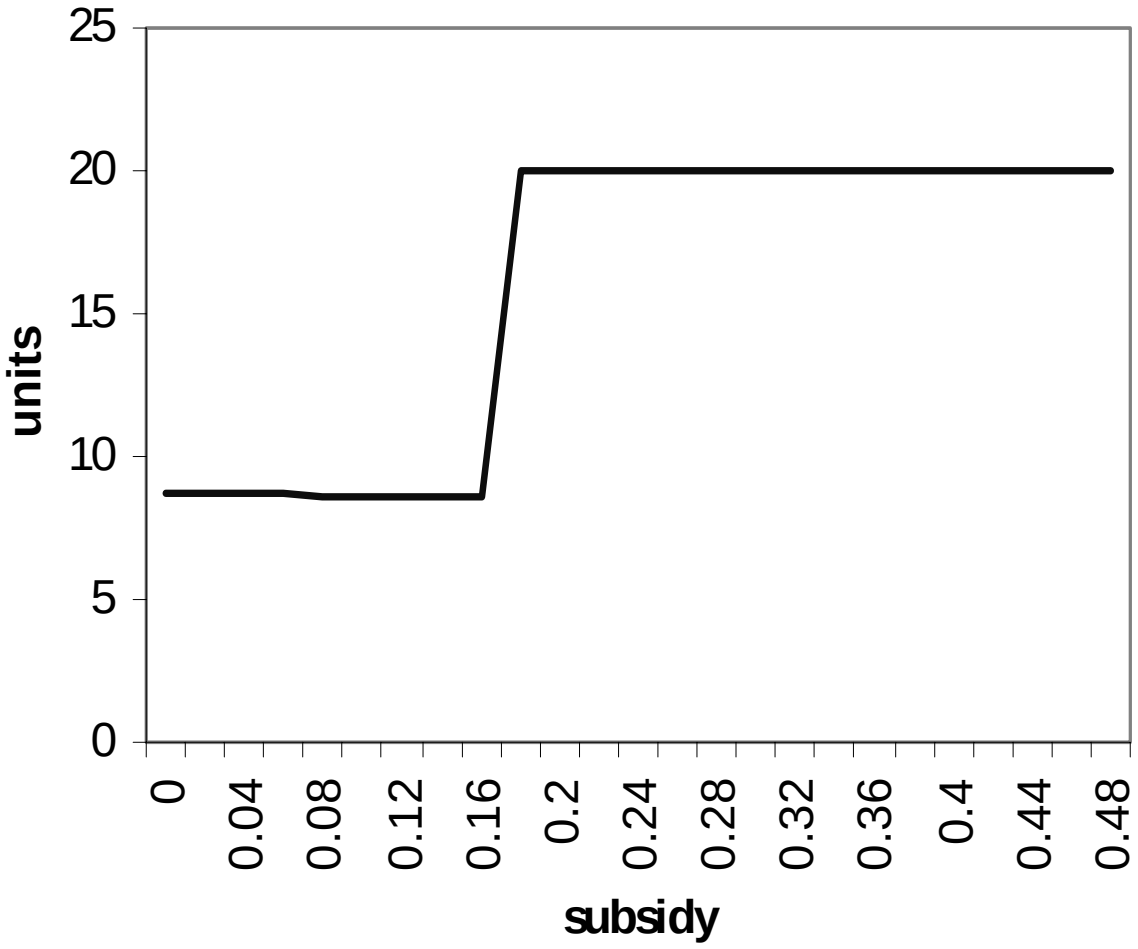
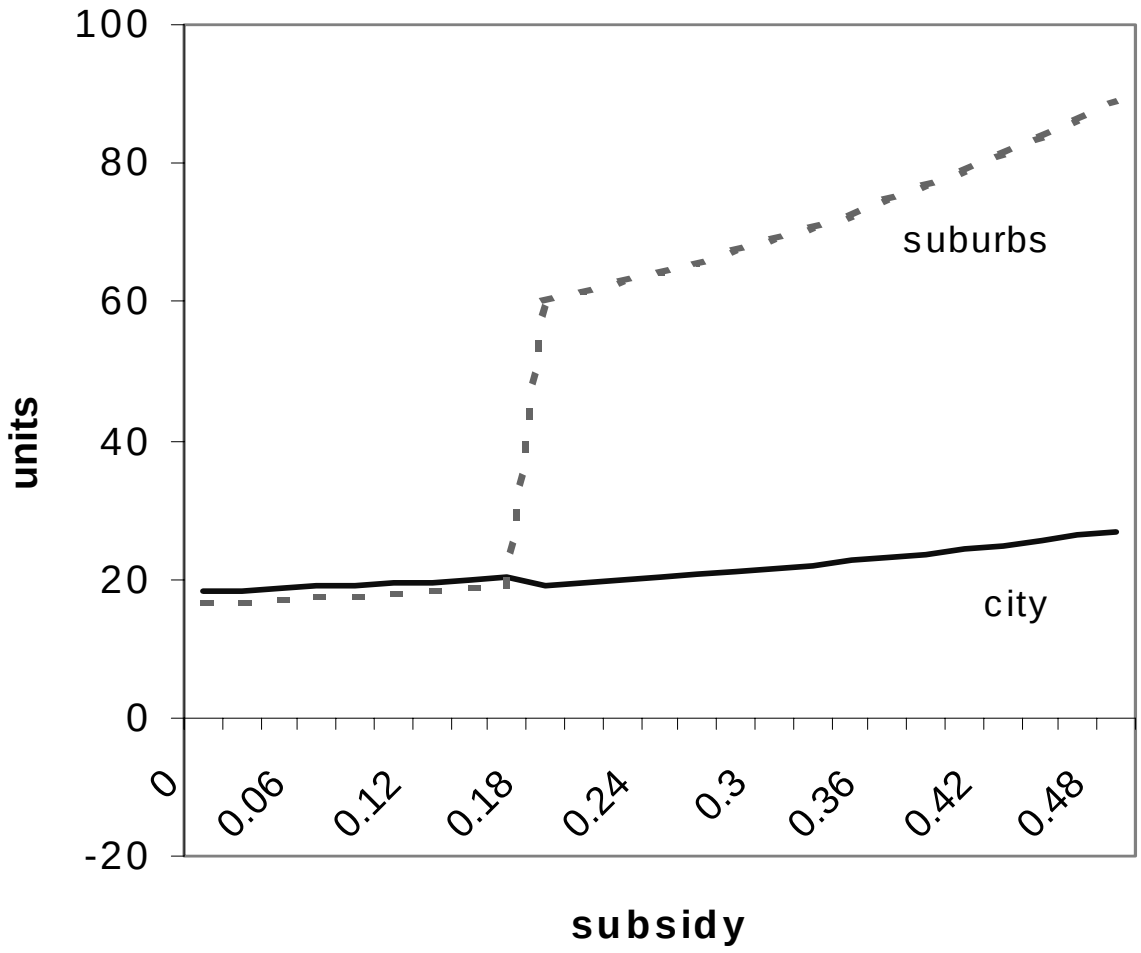
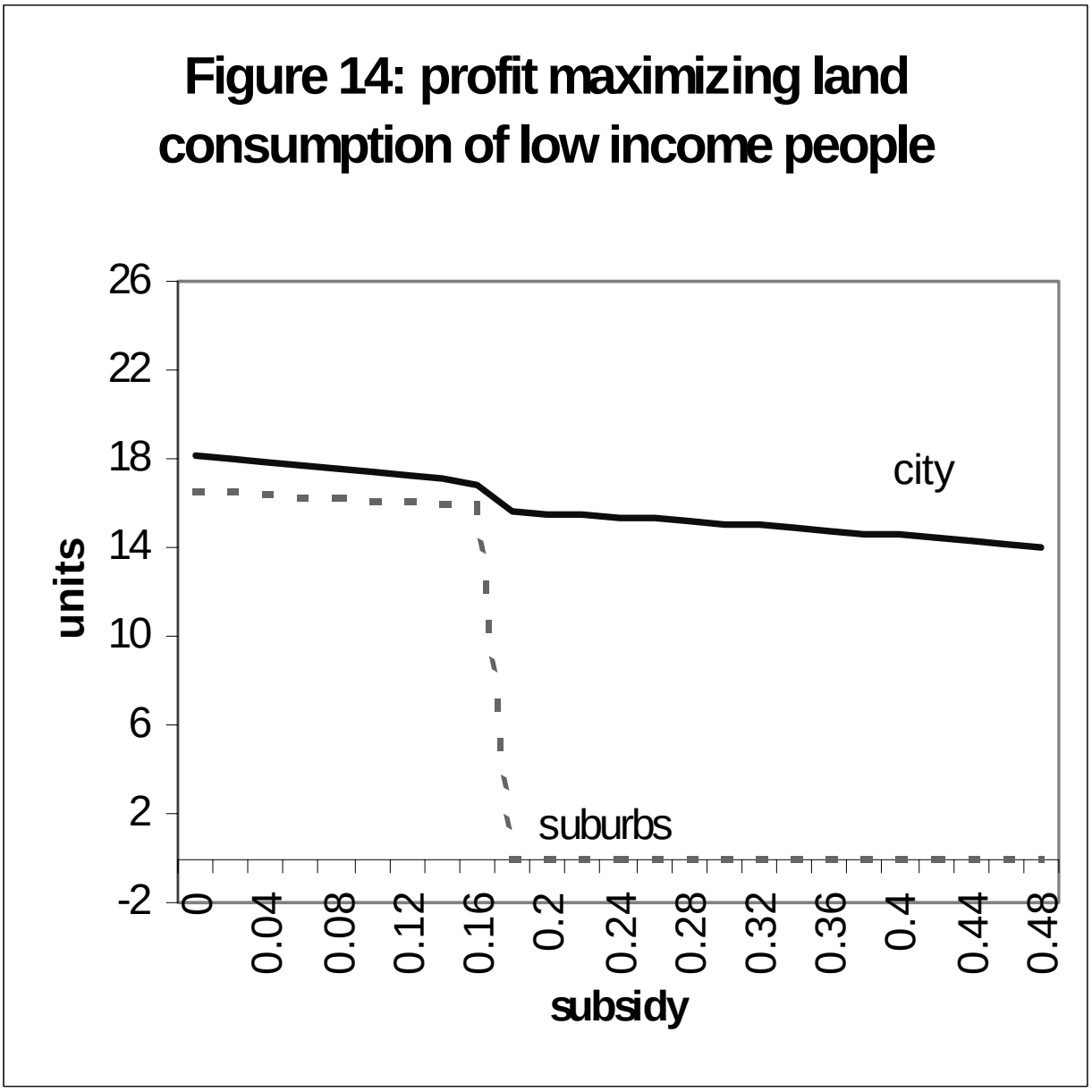


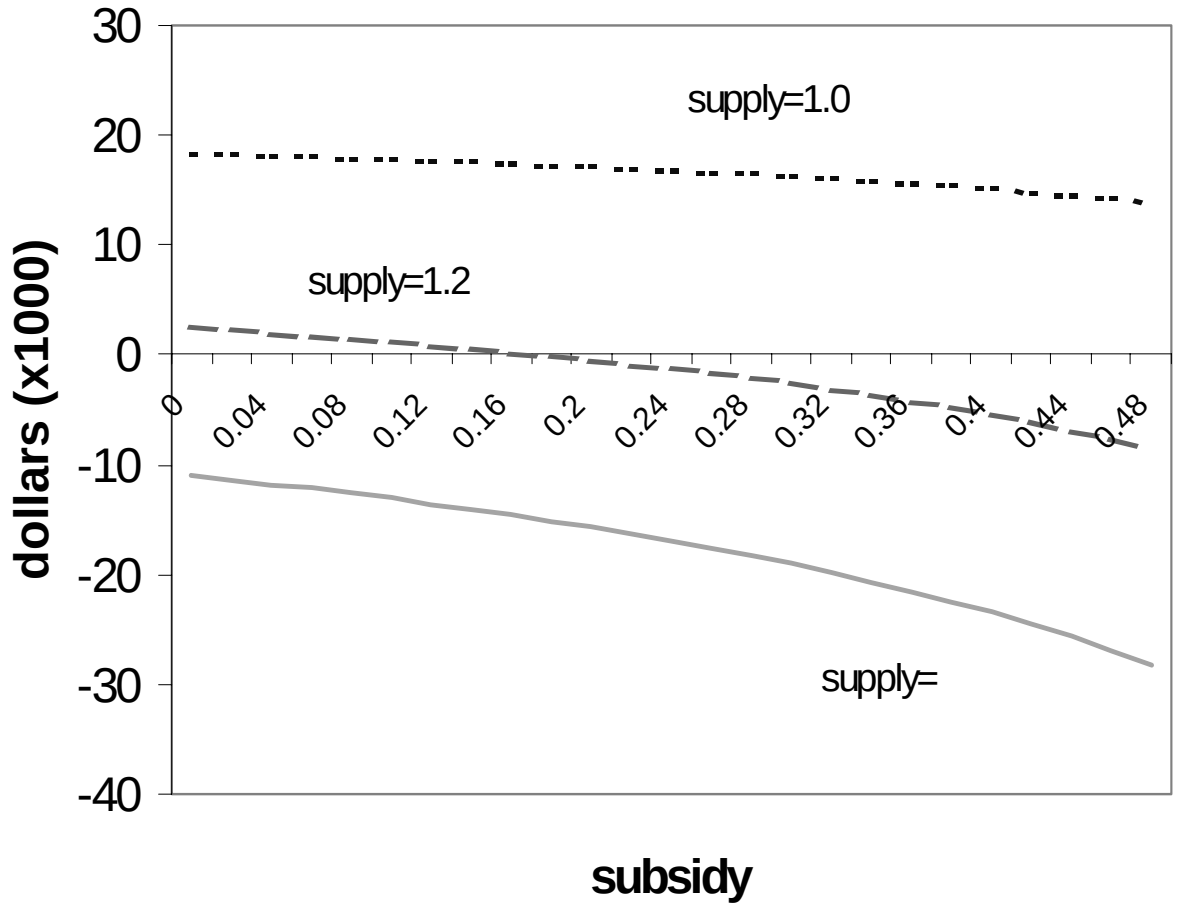
Figure 13: profit maximizing land consumption of high income people





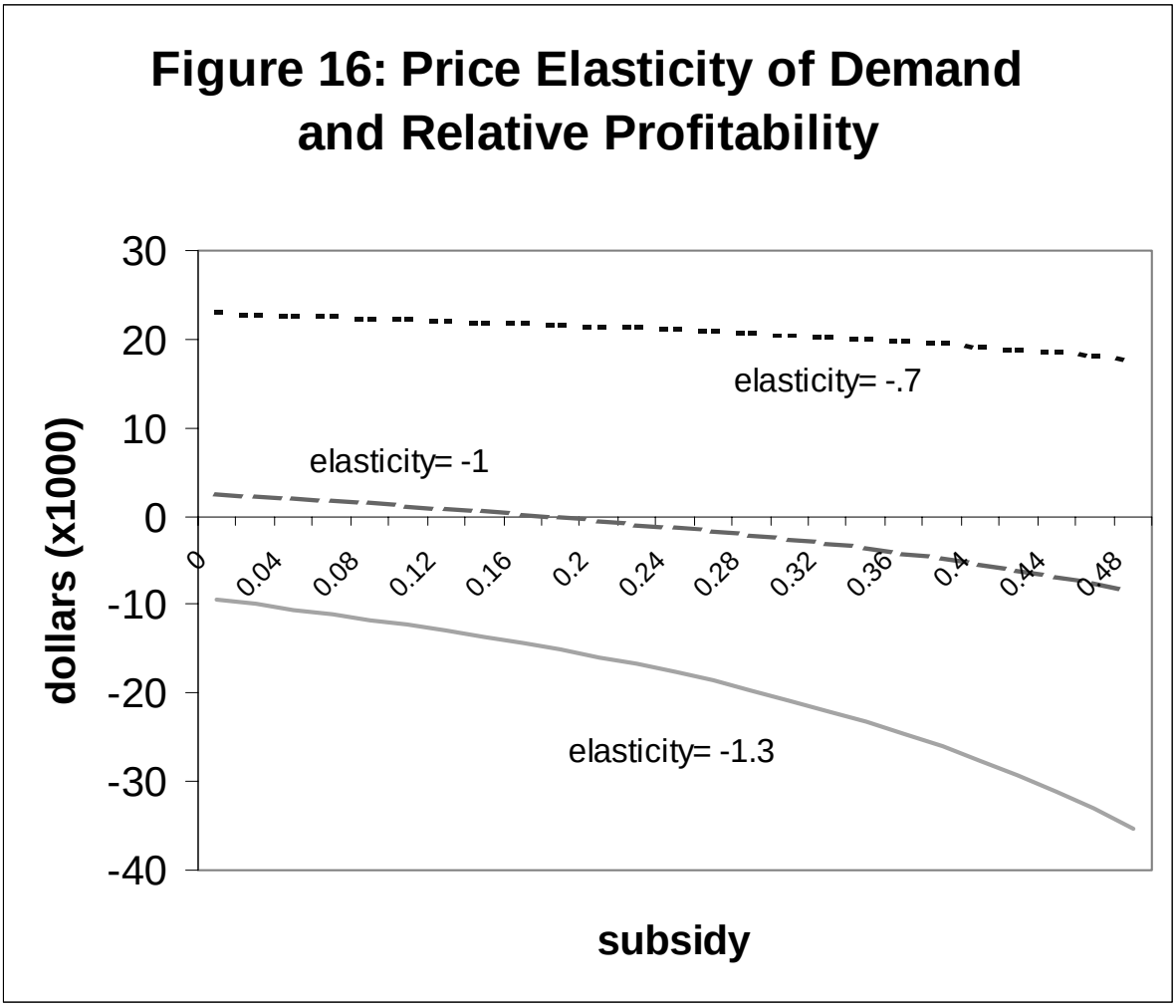
Note: Relative profitability is defined as unconstrained profits minus constrained profits, so that negatively sloped lines imply that increased subsidy makes the constrained regime relatively more attractive.

Figure 15: Elasticity of Supply and Relative Profitability



Note: Relative profitability is defined as unconstrained profits minus constrained profits, so that negatively sloped lines imply that increased subsidy makes the constrained regime relatively more attractive.

Figure 16: Price Elasticity of Demand and Relative Profitability



Note: Relative profitability is defined as unconstrained profits minus constrained profits, so that negatively sloped lines imply that increased subsidy makes the constrained regime relatively more attractive.