

A Theory of Growth Controls¹

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A microeconomic model of individual decision-making that illustrates how growth controls might arise is developed. The emergence of growth controls is analyzed under a variety of assumptions about the local-governmental environment, including congestion effects, different cost conditions and pricing schemes for public services, and property-tax limitations. Some welfare consequences of growth controls are also presented.

I. INTRODUCTION

One of the troublesome passions of local governments that has emerged in recent years is hostility toward growth. No-growth politics, whether manifested through rigid development controls, explicit population targets, or the refusal to finance expansions of public services (schools, water supplies, or sewage treatment facilities) have spread rapidly and now find support in many areas that have previously encouraged rapid growth. The rhetoric of no-growth politics often invokes the neo-Malthusian concerns with the limited availability of resources and the limited ability of country or planet to support population. Such arguments make little sense, since antigrowth measures are exclusionary and are not directed at resource use of birthrates.

Growth controls are not a new phenomenon. Local governments have long had the power to regulate new developments through zoning and land-use controls. The evolution of the legal rights of communities to limit private property rights is discussed by White [16] and Ellickson [2].² In

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²Governmental restrictions on the exercise of property rights are deemed justified by the regulatory (police) powers of government when external diseconomies exist. Governmental rearrangement of ownership of property rights is justified under the doctrine of eminent domain and is deemed justified when there is a bilateral monopoly. Only in the latter case is compensation usually paid.

virtually all discussions of zoning and land-use controls the antidevelopment sentiments of residents are assumed to stem from the self-interest of existing homeowners. There have been many attempts in the economics literature to explain why the early residents of a community may wish to keep others out. Tiebout [13] was the first to view the regulatory and fiscal powers of local governments as providing residents with freedom to organize local governments according to their parochial tastes.³ Given a sufficient number of communities, individuals choose to live in the community that provides the level of public services they desire with the result that communities are composed of individuals who demand the same level of public goods.

Hamilton [6] has recast the Tiebout hypothesis as a theory of neutral zoning in which new residents pay the marginal cost of public services they consume. Zoning, therefore, is seen as a device to establish a price for the public service. An alternative view is that existing residents have a form of monopoly power that they exert over potential residents. White [16], for example, argues that the primary motive for zoning is fiscal and that existing residents use their monopoly power to ensure that new residents pay as much or more in property taxes as the cost of providing them with public services. Under "fiscal-squeeze" zoning the regulations are established to maximize the contributions of new residents to the fisc. In explaining the desire to curb growth altogether White [17] argues that although environmental awareness may have increased, the demographic and institutional facts may have changed sufficiently to make no-growth the optimal fiscal zoning strategy. An alternative version of the monopoly-power argument proposed by Hamilton [7] is that communities face a downward-sloping demand curve for labor so that the derived demand for housing is also downward sloping and they act to exploit this.⁴

That restrictive zoning is a form of market failure that arises because of the exercise of monopoly power by current residents is a view that has been challenged in a recent paper by Frankena and Scheffman [5]. They argue that market failure, when it occurs, is the result of distortions introduced by the property-tax system. Their analysis, however, depends crucially on the absence of externalities or congestion effects and on what they term the "small"-city assumption. This assumption holds that the actions of the community in question will have no effect on the inhabitants of other communities. This is not only unrealistic, but sidesteps the main issue. When the small-city assumption is relaxed interurban transfers are necessary for allocative efficiency. Nevertheless, the reliance on partial equi-

³Mills and Oates [9] point out that Tiebout's central idea is not new, but rather has many antecedents in the literature of economics and politics.

⁴Sonstelie and Portney [11] raise an important objection to this basic premise that both Hamilton and White adopt. They argue that collectively run communities will not in general act as profit maximizers.

librium analysis in much of the literature on local public decision-making is a result of the extreme difficulty of doing general equilibrium analysis.⁵

A common conclusion of all of the preceding literature is that it is not necessary for there to be externalities or congestion effects associated with growth for exclusionary zoning to arise. Thus, it is tempting to view the contemporary preoccupation with growth limits as simply old wine in new bottles. When there are perceived congestion effects that decrease individual utility, however, growth controls are likely to arise.

The objective of this paper is to develop a microeconomic model of individual decision-making that illustrates how growth controls might arise and relates their appearance to other characteristics of the local-government environment. The model incorporates a number of important features that are missing from previous analyses. First, we allow specifically for congestion effects and analyze how these influence the optimal population size. Second, our model takes into account the effect of the tax "subsidy" to owner-occupied housing. This is an important consideration since growth controls have a strong direct effect on the housing market. In addition we introduce a variety of assumptions concerning the cost and pricing of public services. Most previous analyses have assumed that services are priced at average cost equal to marginal cost. The issue is important because many discussions of growth controls are motivated by reference to the limited capacity of the local public-service systems such as schools, water supply, or sewage systems. A related issue is the impact of property-tax limitations on the optimal population size. The trend toward Proposition 13-type tax limitations places constraints on the ability of local governments to practice fiscal-squeeze zoning and thus makes growth control a more attractive alternative.

The impact of inflation on the optimal population is analyzed in Section III. Since inflation is nonneutral in its impact on individual decision-making because of distortions introduced through the tax system, the ultimate effect on optimal population is complex, although some effects are clear.

In Section IV we analyze some of the welfare consequences of growth controls although a complete general equilibrium analysis is not possible within the current context. The results are summarized in the final section.

II. A MICROECONOMIC MODEL OF GROWTH CONTROLS

2.1. *Optimal Population*

Any theory that attempts to explain growth controls is ultimately concerned with the optimal allocation of population. The model developed here

⁵Stiglitz [12], McGuire [8], Wheaton [15], Westhoff [14], and Brueckner [1] have all emphasized this problem. In general, even if Tiebout assumptions are met there are manifold possibilities for stable equilibria that are inefficient.

is thus in the spirit of optimal-population models that have been developed by Flatters, *et al.* [3] and others. To determine why a region (community) might impose growth controls, consider a region A that is one of $K + 1$ regions. Assume all residents of A are homeowners with differing tastes and preferences. The government of A provides its residents with public services. Some public services, such as education and police protection, are financed solely by taxes, while others, particularly utilities such as water and sewer, are financed both by taxes and a marginal fee for each unit consumed. For the moment, let us assume that the good s is a utility-like service that is financed by both a property tax levied on homeowners to cover fixed costs and a fee for each unit consumed to cover variable costs. We assume initially that s is priced at average variable cost (not equal to marginal cost) and operates in an area of increasing average costs. The property tax is levied to pay off bonds issued to finance capital construction and improvements for the public service. For simplicity assume the total amount of the bonds outstanding is fixed; therefore, the total amount of the property tax is also fixed. This assumption is subsequently relaxed.⁶ There are residents of regions other than A who wish to migrate to A due to some exogenous shock, for example, an increase in population. These new residents can enter A only by purchasing a home.

Since the residents of A are not identical, growth controls will be enacted in A when a majority of A's population votes for them. Thus, we must examine individual attitudes toward these controls to determine the factors that would lead an individual to vote for them. Begin with the direct utility function of the i th individual of region A, $U_i^A(x, h, e, s)$, where x is a composite bundle of consumption goods, h represents housing quantity and quality, e is environmental quality, and s is the public service. U_i^A obeys the usual assumptions about utility and is concave and twice differentiable. Prices of x , h , and s are P , R , and Q , respectively. Thus, R is the implicit rental fee on i 's house, and Q is the marginal price for each unit of public service consumed. The individual must pay property tax of T_i , and his wage income W_i is subject to an income tax. The tax rate α is an increasing function of W_i ,⁷ and property tax may be deducted from W_i before the income tax is computed. In a model with renters the deduction allowance for property taxes (as well as the deduction allowance for interest payments) acts as a subsidy to owner occupied housing (Rosen and Rosen [10], and White and White [18]). In an inflationary environment it also introduces

⁶Fixing the total amount of bonds outstanding is not unrealistic in a short-run model. For example, the bonds may have been issued recently or bonds that are due may be replaced with new bonds.

⁷This is obviously a simplified version of the actual tax system since we don't distinguish between marginal and average rates. It is sufficient for the purpose at hand because all of the effects are in the same direction.

some important nonneutralities which are discussed in Section III. Individual i has implicit rental income of $R\bar{h}_i$ on his house, where \bar{h}_i is his current house. i 's budget constraint is thus

$$Px + Rh + Qs + T_i = W_i - \alpha(W_i - T_i) + R\bar{h}_i.$$

Moving T_i to the right-hand side and normalizing on P , this becomes

$$x + rh + qs = w_i(1 - \alpha) + (\alpha - 1)t_i + r\bar{h}_i = y_i$$

where $r = (R/P)$, $q = (Q/P)$, $w_i = (W_i/P)$, and $t_i = (T_i/P)$ are the prices and taxes normalized on the price of goods while y_i is the real disposable income of i .

Solving the first-order conditions of this maximization problem for its demand functions and substituting these demand functions back into the utility function yields the indirect utility function for i :

$$V_i^A(r, q, y_i, e). \quad (1)$$

The optimal population is determined by maximizing (1) with respect to N , but we must first specify which variables are functions of N . We assume that environmental quality e is a decreasing function of N due to congestion and/or pollution effects. We assume that x is supplied more elastically than s or h so that changes in R , W , and Q lead to real changes in r and q . We assume that each new resident places additional demands on the public service. This, with the increasing costs assumption, makes q an increasing function of N . Assuming that the supply curve for housing is upward sloping, r is also an increasing function of N .⁸ t_i is a decreasing function of N since the total amount of the property tax to be raised is fixed, as assumed above. Finally, assume that additional workers decrease the marginal productivity of labor, although this assumption is not crucial to our results. Thus, w_i is a decreasing function of N .⁹

Maximizing (1) with respect to N yields the first-order condition

$$\begin{aligned} & \left(\frac{\partial V_i^A}{\partial y_i} \frac{\partial y_i}{\partial r} + \frac{\partial V_i^A}{\partial r} \right) r' + \frac{\partial V_i^A}{\partial q} q' \\ & + \frac{\partial V_i^A}{\partial y_i} \left[\frac{\partial y_i}{\partial w_i} w_i' + \frac{\partial y_i}{\partial t_i} t_i' + \frac{\partial y_i}{\partial \alpha} \frac{\partial \alpha}{\partial W_i} W_i' \right] + \frac{\partial V_i^A}{\partial e} e' = 0 \end{aligned} \quad (2)$$

⁸For arguments that this is the case even in local communities see White and White [18].

⁹While this is a reasonable assumption, it is not necessary for the model. As we will see later, if w is an increasing function of N , growth controls will occur at a higher population than if it is a decreasing function.

or

$$\left(\frac{\partial V_i^A}{\partial y_i} \bar{h}_i + \frac{\partial V_i^A}{\partial r} \right) r' + \frac{\partial V_i^A}{\partial q} q' + \frac{\partial V_i^A}{\partial y_i} \left[(1 - \alpha)w_i' + (\alpha - 1)t_i' + (t_i - w_i) \frac{\partial \alpha}{\partial W_i} W_i' \right] + \frac{\partial V_i^A}{\partial e} e' = 0 \quad (3)$$

where the prime denotes $d(\cdot)/dN$. Due to the assumptions on U_i^A , $\partial V_i^A/\partial r$, $\partial V_i^A/\partial q$, and $\partial V_i^A/\partial t_i$ are negative, while $\partial V_i^A/\partial e$ and $\partial V_i^A/\partial y_i$ are positive. As discussed above, w_i' , W_i' , t_i' , and e' are negative, and q' is positive. Finally, by assumption, $\partial y_i/\partial w_i$, $\partial y_i/\partial r$, $\partial \alpha/\partial W_i$, and \bar{h}_i are positive while $(\alpha - 1)$ and $(t_i - w_i)$ are negative. Using these assumptions we see that the first term in the parentheses and the last two terms in the brackets are positive, while the others are negative. The first term in the parentheses represents the increase in i 's utility due to the increase in the implicit rental income on his house; the second term is the decrease in utility due to the increase in i 's implicit rent. If i chooses to remain in his current house, these two terms cancel and can be dropped from the equation. If i chooses to use his increased equity to "trade up" to a larger house or move to another region, then

$$\frac{\partial V_i^A}{\partial y_i} \bar{h}_i > \frac{\partial V_i^A}{\partial e}.$$

For the remainder of this section, we assume that i chooses to remain in his present house. The second expression in (3) is the decrease in i 's utility because of the increase in q caused by adding one more resident. The third expression in (3) is the total change in i 's utility because of changes in income due to changes in wages, property taxes, and the tax rate. The first term in the brackets is the decrease in y_i due to the decrease in w_i , and the second term is the increase due to the decrease in the property-tax deduction. The third term in the brackets is the combination of the two opposing effects of the lower tax rate α caused by the reduction in W_i . The term $t_i(\partial \alpha/\partial W_i)W_i'$ is the amount by which the tax subsidy to owner occupancy is decreased when the tax rate is decreased while $w_i(\partial \alpha/\partial W_i)W_i'$ is the amount of income tax saved as a result of the lower tax rate. Since $w_i > t_i$, the latter effect is larger, and $(t_i - w_i)(\partial \alpha/\partial W_i)W_i'$ is positive. Finally, the fourth expression in (3) is the decrease in utility because of the decline in environmental quality. Rewriting (3) as

$$\frac{\partial V_i^A}{\partial q} q' + \frac{\partial V_i^A}{\partial y_i} (1 - \alpha)w_i' + \frac{\partial V_i^A}{\partial e} e' = \frac{\partial V_i^A}{\partial y_i} \left[(1 - \alpha)t_i' + (w_i - t_i) \frac{\partial \alpha}{\partial W_i} W_i' \right] \quad (4)$$

the left-hand side (LHS) of (4) represents the loss in utility to individual i if one additional resident moves into the community, while the right-hand side (RHS) represents the gain in utility from adding one additional resident to the community. If the absolute value of the left-hand side of (4) is less than the absolute value of the right-hand side, adding an additional resident to the community increases individual i 's utility, and vice versa if the LHS is greater than or equal to the RHS. Before growth controls are passed, the RHS of (4) is greater than the LHS for a majority of the population of region A. As N increases, the LHS becomes greater than the RHS for more and more of the residents of region A. When the LHS of (4) is greater than the RHS for a majority of A's population, growth controls will be enacted, halting growth. We assume this is accomplished by prohibiting new construction. Since all residents are homeowners, fixing the housing stock also fixes population.¹⁰ This then is the mechanism that establishes the optimal population N^* for the region.

2.2. Fiscal-squeeze Zoning

It is interesting to note the relationship between (4) and the literature on fiscal-squeeze zoning. We see in (4) that it is in the interest of each individual in A to maximize the RHS of (4) while minimizing the LHS. That is, each resident would like to maximize the utility gained by adding a new resident while minimizing the utility lost. This is simply fiscal-squeeze zoning expressed in terms of marginal utilities rather than money. In fact, (4) is the utility analog of White's [16] fiscal-squeeze transfer equation.¹¹ Maximizing the utility gained from adding a new resident requires that the new resident's contribution to the fisc be maximized. This is accomplished by maximizing the value of new housing. Both White [16] and Frankena and Scheffman [5] have shown that the value of new housing is maximized by lot- and house-size zoning. Thus, we see the underlying motivation for fiscal-squeeze zoning. It maximizes the utility gained from adding a new resident.

2.3. Property Tax Limitations

One issue of interest is how optimal population N^* varies when a limit on local property taxation is imposed. The passage of Proposition 13 in California has inspired consideration of similar measures elsewhere, and they are becoming widespread.

The immediate effect of a property-tax limitation depends on the extent to which property taxes were being levied to pay off voter-approved

¹⁰ Fixing the housing stock does not necessarily fix population; however, we will assume that it does in what follows.

¹¹ Compare our Eq. (5) with her Eq. [3.1].

measures and the manner in which these voter-approved taxes are treated by the limitation. For example, Proposition 13 allows for the levying of property taxes to cover the expenses associated with all voter-approved general obligation bonds even if the taxes collected exceed the limitation. On the other hand, any taxes collected on non-voter-approved measures in excess of the specified rate were immediately lost when Proposition 13 became law, resulting in a reduction in the property taxes paid by existing residents.

Not all property taxes are levied in connection with voter-approved measures, and taxes collected before a tax limitation is passed may exceed the rate specified in the limitation. The immediate effect of a property-tax limitation, therefore, is usually a rollback in the property taxes a resident pays. This implies an increase in disposable income. However, since we have assumed that the total amount of the property taxes collected prior to the passage of the tax limitation was just equal to the amount necessary to finance the bonds, the marginal charge q would have to be increased to cover the shortfall resulting from the tax rollback. Moreover, the shortfall in taxes collected implies that the addition of a new resident is not likely to reduce taxes. The addition of a new resident will, however, require a further increase in the marginal charge q and decreases in environmental quality and wages. Consequently, new residents will not appear as attractive after the tax limitation is implemented. It seems likely, then, that the imposition of a property-tax limitation will hasten the imposition of growth controls.

This is consistent with the fiscal-squeeze transfer view of zoning discussed above. Since local governments are viewed as maximizing the contribution to the fisc of marginal residents, a limitation on the amount of that contribution is likely to make additional residents less attractive.

2.4. Cost and Pricing of Public Services

Many analyses of zoning and the provision of public services make assumptions about the costs and pricing of services that do not fit the facts. Consequently, it is of interest to compare the population attained under different cost conditions and pricing schemes for the public service s . If s is priced at marginal cost rather than at average cost, the first term in (4) is larger, *ceteris paribus*, since under average-cost pricing the marginal cost of a new resident is averaged over all residents while under marginal-cost pricing each resident pays a price equal to the marginal cost of the new resident. Thus, under marginal-cost pricing the optimal population N^* is lower than under average-cost pricing.

If s is in the range of decreasing costs and priced at average cost, each new resident causes a decrease in the marginal price q , and there are two positive effects of adding another resident—the decreases in q and t_i —and two negative effects—the decreases in e and w_i . Therefore, (4) can be

rewritten

$$\begin{aligned} & \frac{\partial V_i^A}{\partial y_i} (1 - \alpha) w_i' + \frac{\partial V_i^A}{\partial e} e' \\ & = - \left[\frac{\partial V_i^A}{\partial q} q' + \frac{\partial V_i^A}{\partial y_i} \left[(\alpha - 1) t_i' + (t_i - w_i) \frac{\partial \alpha}{\partial W_i} W_i' \right] \right] \end{aligned} \quad (5)$$

where the LHS is still the marginal cost of adding a new resident, and the RHS the marginal benefit. Under these conditions N^* is greater than under either pricing scheme in the increasing-cost case since the effect of an additional resident on the marginal price of the public service is beneficial to existing residents. Thus, N^* varies, *ceteris paribus*, with pricing and cost conditions. Moreover, N^* is always higher under average-cost pricing than under marginal-cost pricing for given cost conditions, as long as marginal cost is increasing, that is, as long as communities using marginal-cost pricing for public services will impose growth controls at lower population levels, *ceteris paribus*, than communities using average-cost pricing. Under increasing average costs, however, communities using marginal-cost pricing are less likely to impose growth controls than those using average-cost pricing because, *ceteris paribus*, the higher price for s in communities that price at marginal cost makes them less attractive to potential residents. The implication is that growth controls may in part be a reaction to inefficiencies caused by the pricing of public services. As is well known, average-cost pricing leads to an overallocation of resources if average costs are increasing and an underallocation of resources if average costs are decreasing. In this instance average-cost pricing leads to a misallocation of population. As a consequence, growth controls are more likely to be imposed in rising average-cost-pricing communities as a way of correcting this misallocation. They may be efficiency improving to the extent that they correct this distortion.

2.5. Alternative Methods of Financing Public Services

Let us now examine the model under different assumptions concerning the financing of public services. Suppose the public service is financed only by property taxes with no user fees. This is typical of public services such as education and police protection. Under these conditions, the analysis depends on whether the whole community shares the financing of increased services or new residents alone must bear the burden. If the entire region shares the increased costs of new residents, the result is similar to the average-cost case discussed above, and the marginal cost of an additional resident is financed either by increasing the total amount of the property tax to be levied or by accepting a lower level of public services. In either case,

these effects can be separated into a positive effect, which is the additional contribution to the property tax by new residents, and a negative effect, which is either the increase in the total amount of the property tax or the decline in quality of the services. If q now represents either of the two negative effects rather than the user's fee and we assume the costs of providing the public service are increasing, then we can still use (4) to evaluate the attitude of i toward the addition of a new resident. The first term of (4) has the same sign as before, the LHS of (4) is the marginal costs of adding one more resident; the RHS is the marginal benefit. If the cost of providing the public service is decreasing, then (5) is appropriate and, *ceteris paribus*, communities experiencing increasing costs for their public services impose growth controls at a lower population than those experiencing decreasing costs.

If new residents alone pay for the increased services, then the term involving q in (4) drops out. Also, since the new resident usually pays for his public services through a special assessment added to his property tax, the term involving t in (4) represents his property tax contribution to the community. Thus, (4) becomes

$$\frac{\partial V_i^\wedge}{\partial y_i} (1 - \alpha) w_i' + \frac{\partial V_i^\wedge}{\partial e} e' = - \frac{\partial V_i^\wedge}{\partial y_i} \left[(\alpha - 1) t_i' + (t_i - w_i) \frac{\partial \alpha}{\partial W_i} W_i' \right]. \quad (6)$$

Comparing (4) and (6), we see that if s is in the range of increasing cost, a community that shares the burden of financing the public services of a new resident imposes growth controls at a lower level than a community that does not. If s is in the range of decreasing cost, however, the results are reversed. Thus, it is not only the cost characteristics of the public service that determine the level of population at which growth controls are imposed but also the method of financing those services.

Moreover, we see once again the role of inefficiencies caused by average-cost pricing. In those communities with increasing average cost, the price of s is higher, *ceteris paribus*, for potential residents who pay the marginal cost for services than for potential residents who pay the average cost. Therefore, potential residents will find communities charging new residents the marginal cost of services less attractive making explicit growth controls less likely.

2.6. The Demand for Environmental Quality

An interesting result is obtained if the demand for environmental quality is income elastic. Since we have already assumed exclusionary fiscal zoning, new residents tend to be individuals in higher income brackets. On average, then, new residents have a higher demand for e . In view of (4), this implies that, *ceteris paribus*, a region that practices exclusionary fiscal zoning will impose growth controls at a lower population than a community that does

not. Thus, income distribution and zoning policies may be prime determinants of the timing for the imposition of growth controls among various communities. It is not accidental that growth controls appear to have the greatest appeal in communities that are considered well heeled.

2.7. *The Impact of Growth Controls on the Housing Market*

Although there are different methods of controlling or stopping growth, the impact of these measures is always felt in the housing market. If residents of other regions wish to migrate to A, the demand for housing in A will exceed the supply, and housing prices will be bid up. More formally, assume that the housing market in each region is in equilibrium, and that there is an exogenous shock, for example, an increase in population, in all regions except A. Thus, there are K regions that experience the shock. Let individual j be a potential resident of region A who now resides in region k , where k is any one of the K regions. Then the utility that individual j derives from residing in k is $V_j^k(r^k, q^k, y_j^k, e^k)$. Similarly, the utility j can derive by migrating to A is $V_j^A(r^A, q^A, y_j^A, e^A)$. If $V_j^A > V_j^k$, j will desire to migrate to A. To see how this affects the housing market in A, we introduce two more simplifying assumptions: before growth controls are imposed, no resident of A wishes to migrate to another region, that is, $V_i^A > V_i^k$, for all i and k . Furthermore, A is the only region that is imposing growth controls. The total demand for housing, H^A , in A is the sum of the individual demands of existing residents determined from the first-order conditions, that is, $H^A = \sum_i h_i^A(r^A, q^A, y_i^A, e^A)$, plus the demands of residents of other regions who wish to migrate to A, $\sum_k \sum_j h_{j,k}^A$. Once growth controls are enacted, the housing supply is fixed at the current level, $\bar{H} = \sum_i h_i^A$. Thus,

$$\sum_i h_i^A(r^A, q^A, y_i^A, e^A) + \sum_k \sum_j h_{j,k}^A(r^A, q^A, y_j^A, e^A) > \bar{H}. \quad (7)$$

Fixing the housing supply also fixes N , which fixes y and e and leaves r^A as the only variable that can change. Assuming that $\partial h / \partial r < 0$, the only way the housing market can be brought into equilibrium is for r , the implicit rental on housing, to rise. Moreover, the only way for an individual to migrate to A is to persuade an existing resident to leave by bidding up the price of his house so that with his increased wealth he will gain utility by emigrating from A. Equilibrium will be restored in the housing market of region A only when r rises enough so that $V_i^A \geq V_i^k$ for all i residing in A and $V_j^A \leq V_j^k$ for all j residing in $k \neq A$.

2.8. *Wealth Effects*

Thus far, we have assumed that individuals choose to remain in their current houses. This allowed us to ignore wealth effects since increases in

rental income are offset by like increases in imputed rent. As noted earlier, however, if i borrows on his increased equity, "trades up" to a larger house in A, or plans to move to another region, then the income (wealth) effect is larger than the price effect and $(\partial V_i^A / \partial y_i) \bar{h}_i > (\partial V_i^A / \partial r)$ in (3). Rewriting (3) as

$$\begin{aligned} & \frac{\partial V_i^A}{\partial q} q' + \frac{\partial V_i^A}{\partial y_i} (1 - \alpha) w_i' + \frac{\partial V_i^A}{\partial e} e' \\ & = - \frac{\partial V_i^A}{\partial y_i} \left[(\alpha - 1) t_i' + (t_i - w_i) \frac{\partial \alpha}{\partial W_i} W_i' \right] - \left[\frac{\partial V_i^A}{\partial W_i} \bar{h}_i + \frac{\partial V_i^A}{\partial r} \right] r' \end{aligned} \quad (8)$$

we see that N^* will be higher, *ceteris paribus*. Paradoxically, however, if i realizes that the new equilibrium r will be higher under growth controls, he may in fact desire to impose them sooner. That is, if i believes that the utility he derives from the increased wealth he receives under growth controls is greater than the net benefits of adding more residents, he will vote to impose growth controls at a lower N . The obvious implication is that there is a transfer of wealth from individuals migrating to region A to those migrating from A. If the demand for environmental quality is indeed income elastic, this may be egalitarian redistribution.

III. INFLATION

In the absence of a redistributive tax system, there is no change in real variables or consumer welfare when all nominal variables change at the same rate. In this section, however, we show that the combined effects of the progressive-tax system, the tax subsidy to owner-occupied housing, and inflation cause an increase in the real implicit rental rate r even if all nominal variables increase at the same rate so that inflation changes the attractiveness of growth controls. To show this result, we drop the assumption that there are no renters. We assume that there are renters in regions other than A who are indifferent about whether to remain in their present region or to purchase a house in A.

Consider again the budget constraint of individual i :

$$x + qs + rh = w_i(1 - \alpha) + (\alpha - 1)t_i + r\bar{h}_i = y_i.$$

Suppose there is a one-time price increase such that P , Q , R , W_i , and T all increase by $\theta\%$. Initially, there is no change in q , r , w_i , or t_i , but y_i will decrease due to the increase in α caused by the increase in W_i . The increase in α , however, increases the subsidy to owner-occupied housing αt_i . Consequently, some of the renters who were indifferent about renting or owning a

house in A have an incentive to purchase a house. Inflation increases the value of the subsidy to owner-occupied housing. The increased demand for owner-occupied houses puts upward pressure on r , and in the post-price-change equilibrium r will be higher than before the increase in nominal prices. As noted previously, the increase in r implies an increase in i 's income and implicit rent, and if he remains in his present house, these two effects are offsetting. If, however, i moves to another region, "trades up" to a bigger house or uses his increased equity to purchase other goods, it is clear that the income effect dominates the price effect. Whether this increase in income is larger than the original decrease caused by the higher tax bracket is an empirical question, but in either case these real changes are caused by the progressive income tax and the special treatment given property tax and interest payments.

Since the optimal population N^* determined by (4) is a function of both r and y_i , it is likely that the changes in these two variables lead to a change in N^* . Furthermore, since r and y_i are functions of the tax rate α , the change in N^* attributable to the changes in r and y_i can be determined by examining the partial derivative of (4) with respect to α . The LHS of (4) is utility lost if one more resident is added and is written $L(r, q, y_i, e)$. The RHS of (4) is the gain from adding another resident and is written $G(r, q, y_i, e)$. Thus, (4) becomes

$$L(r, q, y_i, e) = -G(r, q, y_i, e) \quad (9)$$

and the change in N^* due to inflation is determined by examining the changes in L and G due to the change in α . Taking the derivatives of L and G with respect to α , we have

$$\begin{aligned} \frac{\partial L}{\partial \alpha} &= \left[\frac{\partial L}{\partial y_i} \frac{\partial y_i}{\partial \alpha} + \frac{\partial L}{\partial \alpha} \right] + \left(\frac{\partial L}{\partial y_i} \frac{\partial y_i}{\partial r} + \frac{\partial L}{\partial r} \right) \frac{\partial r}{\partial \alpha} \\ \frac{\partial G}{\partial \alpha} &= \left[\frac{\partial G}{\partial y_i} \frac{\partial y_i}{\partial \alpha} + \frac{\partial G}{\partial \alpha} \right] + \left(\frac{\partial G}{\partial y_i} \frac{\partial y_i}{\partial r} + \frac{\partial G}{\partial r} \right) \frac{\partial r}{\partial \alpha} \end{aligned} \quad (10)$$

where the bracketed expression in each equation is the effect of the progressive income tax and the remainder is the effect of the tax subsidy to owner-occupied housing. Since we are interested in determining the effects of each separately, we examine each expression individually. Expanding $(\partial L/\partial y_i)(\partial y_i/\partial \alpha) + (\partial L/\partial \alpha)$, we have

$$V_{qy}(t_i - w_i)q' + V_{yy}(t_i - w_i)(1 - \alpha)w_i' - V_y w_i' + V_{ey}(t_i - w_i)e' \quad (11)$$

where $V_{jk} = \partial^2 V_i^A / \partial j \partial k$, $j, k = q, y_i, e$, and $V_y = \partial V_i^A / \partial y_i$. The assumption that income is subject to diminishing returns and that the public good

and environmental quality are normal goods implies that V_{qy} and V_{yy} are negative while V_{ey} is positive. The second expression in (11) is negative while the others are positive. Thus, the utility lost due to the increase in q and the decrease in e is greater after the price rise, but the direction of change in utility lost due to the decrease in w_i is ambiguous. Consequently, the effect of the progressive income tax on L and N^* is ambiguous.

The expression for $(\partial G/\partial y_i)(\partial y_i/\partial \alpha) + (\partial G/\partial \alpha)$ is

$$V_{yy}(t_i - w_i) \left[(\alpha - 1)t'_i + (t_i - w_i) \frac{\partial \alpha}{\partial W_i} W'_i \right] + V_y t'_i. \quad (12)$$

Since the first expression is positive and the second is negative, the change in G due to the progressive-tax system is also ambiguous. Combining the changes in L and G , it is likely that N^* has been changed, but the direction of change is not clear.

The change in N^* due to the tax subsidy to owner-occupied housing is found by examining

$$\left(\frac{\partial L}{\partial Y_i} \frac{\partial y_i}{\partial r} + \frac{\partial L}{\partial r} \right) \frac{\partial r}{\partial \alpha} \quad \text{and} \quad \left(\frac{\partial G}{\partial y_i} \frac{\partial y_i}{\partial r} + \frac{\partial G}{\partial r} \right) \frac{\partial r}{\partial \alpha}.$$

These derivatives are

$$\begin{aligned} \left(\frac{\partial L}{\partial y_i} \frac{\partial y_i}{\partial r} + \frac{\partial L}{\partial r} \right) \frac{\partial r}{\partial \alpha} &= (V_{qy} \bar{h}_i + V_{qr}) q' \frac{\partial r}{\partial \alpha} + (V_{yy} \bar{h}_i + V_{yr}) (1 - \alpha) w'_i \frac{\partial r}{\partial \alpha} \\ &\quad + (V_{ey} \bar{h}_i + V_{er}) e' \frac{\partial r}{\partial \alpha} \end{aligned} \quad (13)$$

and

$$\left(\frac{\partial G}{\partial y_i} \frac{\partial y_i}{\partial r} + \frac{\partial G}{\partial r} \right) \frac{\partial r}{\partial \alpha} = (V_{yy} \bar{h}_i + V_{yr}) \left[(\alpha - 1)t'_i + (t_i - w_i) \frac{\partial \alpha}{\partial W_i} W'_i \right] \frac{\partial r}{\partial \alpha} \quad (14)$$

where the terms involving \bar{h}_i show the changes in the income effects due to changes in r , and the remaining terms show the changes in the price effects due to changes in r . As before, if i remains in his present house, these income and price effects are changing at the same rate. If individuals move then the income effect must be greater than the price effect. This implies that L is smaller and G is larger after the price rise. If it is anticipated that imposing growth controls will increase wealth, however, individuals may vote for them at a lower N . The fact that inflation and the tax system have already increased r implies that they make growth controls more attractive.

IV. A PARTIAL WELFARE ANALYSIS

Although we have used a utilitarian model to show the circumstances under which individuals in A maximize utility by imposing growth controls, we did not consider the impact of these actions on the inhabitants of other regions. Since average-cost pricing leads to an inefficient allocation of both population and resources, and since average-cost pricing is the predominant method for pricing public services in this country, it is not likely that population will be distributed efficiently even in the absence of growth controls. Another source of inefficiency is in the use of the property tax to finance all or part of the public service. Since it is in the interest of existing residents to maximize the amount of the property tax paid by new residents, the payments extracted from new residents might easily be more than sufficient to finance the increase in public services and compensate existing residents for pollution and congestion effects. Efficiency requires transfers to equate marginal rates of substitution when externalities are present, and there is no reason to believe that the property-tax payments extracted from new residents will just equal the necessary transfer payment. Thus, an efficient solution requires marginal-cost pricing and lump-sum transfers to compensate for pollution and congestion effects.

While a complete general equilibrium analysis of the model is difficult, some implications of the model are clear. Since the equilibrium population of A after the imposition of the growth controls is less than without them, the equilibrium populations of the other regions are higher. Thus, the final allocation of the increase in population under growth controls is different from the allocation in a competitive solution. Of course, the most interesting question is whether the population of A under growth controls is at an efficient level. Given the property-tax system for financing public services and the prevalence of average-cost pricing, it would be a coincidence if it were.

Those individuals who emigrate from A attain a higher level of utility than if they remain after growth controls are enacted. The only reason an individual would emigrate from A is to achieve a higher level of utility elsewhere by realizing his increased wealth from the higher housing prices. The majority who voted for the growth controls obviously experience an increase in utility. For the minority who were against growth controls, utility is fixed at a level that is lower than could have been attained without them. If they emigrate from A, they may increase their utility, but there is no way to determine whether the increase is as great as they would have experienced without controls.

Individuals who immigrate to region A increase their utility by doing so, but it may be lower than it would have been in the absence of growth controls. Because of the higher housing prices that they must pay to immigrate, there are residents of other regions who could have increased

their utility by moving to region A before growth controls were imposed, but find that once controls force up housing prices, they will suffer a loss of utility by immigrating to A. Thus, growth controls eliminate a potential increase in utility for these individuals.

Finally, although we have not explicitly included renters and owners of undeveloped land in A in our model, both groups will be affected by growth controls. Renters suffer because of increased rents caused by the higher housing prices. Moreover, even if they move to another region after growth controls are passed, they still suffer a utility loss. If a renter is residing in A at the time growth controls are passed, it must be the case that he is achieving more utility by residing in A than elsewhere. Therefore, if a renter emigrates from A, he does so because increased rents have decreased his utility in A enough that it is optimal to live in another region.

The effect of growth controls on the welfare of owners of underdeveloped land depends on the nature of the controls. If the controls completely prohibit the building of new housing, then the effective demand for new housing will be zero, and the demand for underdeveloped land will decrease. Consequently, the price of land will fall with a resulting loss of utility to landowners. However, if property rights are not completely usurped by the controls, that is, if some new housing is permitted, there will be both losers and gainers. Since there are fewer property rights than parcels, those who manage to obtain the property rights will benefit (assuming they do not have to pay the market price for the right), while those who do not obtain them will lose.

This partial taxonomy of welfare gains and losses due to growth controls is not intended as a general analysis. It does, however, demonstrate that there are both gains and losses in efficiency and welfare that are associated with growth controls.

V. CONCLUDING COMMENTS

In this paper we have developed a microeconomic description of the factors that would lead a community or region to adopt growth controls. We then analyzed how the likelihood of their appearance varies with different characteristics of municipal finance. We have shown that controls are more likely when public services such as water and sewer facilities are operating under increasing costs than under decreasing costs. When municipal services are priced at marginal cost, the optimal population will be lower than when they are priced at average cost. Property-tax limitations make growth controls more likely, and they are more likely to appear in high-income communities and those that practice exclusionary fiscal zoning. Finally, growth controls transfer wealth from new residents to original homeowners.

All of the conclusions of this paper are thus consistent with the standard portrait of an exclusionary city or suburb—a well-to-do, heavily zoned, environmentally attractive place to live.

Nevertheless, there are certain aspects of these results that suggest that growth controls may not be as thoroughly malignant as some would believe. Because of the prevalence of inefficient pricing and financing policies for public services, there may be misallocations of population, and growth controls may be a crude way of promoting a more efficient allocation of population. In addition, if the demand for environmental quality is income elastic, then growth controls may promote a relative redistribution of wealth to those who choose to emigrate (although we would not care to press this argument too far because of the assumption that all such people own homes). A complete welfare and efficiency analysis has not been attempted here because of the general difficulty of such an undertaking.

REFERENCES

1. J. K. Brueckner, Equilibrium in a system of communities with local public goods: A diagrammatic exposition, *Econ. Lett.*, **2**, 387–393 (1979).
2. R. C. Ellickson, Suburban growth controls: An economic and legal analysis, *The Yale Law Journal*, **86**, 385–511 (1977).
3. F. Flatters, V. Henderson, and P. Mieszkowski, Public goods, efficiency and regional fiscal equalization, *J. Pub. Econ.*, **3**, 99–112 (1974).
4. M. Frankena, "The Economic Theory of Local Development Controls," forthcoming.
5. M. Frankena and D. Scheffman, "A Theory of Development Controls in a 'Small' City," *J. Pub. Econ.*, **15**, 203–234 (1981).
6. B. W. Hamilton, Property taxes and the Tiebout hypothesis: Some empirical evidence, in "Fiscal Zoning and Land Use Controls" (E. S. Mills and W. E. Oates, Eds.), Heath, Lexington, Mass. (1975).
7. B. W. Hamilton, Zoning and the exercise of monopoly power, *J. Urban Econ.*, **5**, 116–130 (1978).
8. M. McGuire, Group segregation and optimal jurisdictions, *J. Polit. Econ.*, **82**, 112–132 (1974).
9. E. S. Mills and W. E. Oates, The theory of local public finance: Its relevance to urban fiscal and zoning behavior, in "Fiscal Zoning and Land Use Controls" (E. S. Mills and W. E. Oates, Eds.), Heath, Lexington, Mass. (1975).
10. H. S. Rosen and K. T. Rosen, Federal taxes and homeownership: Evidence from time series, *Journal of Polit. Econ.*, **88**, 59–75 (1980).
11. J. C. Sonstelie and P. R. Portney, Profit maximizing communities and the theory of local public expenditure, *J. of Urban Econ.*, **5**, 263–277 (1978).
12. J. Stiglitz, The theory of local public goods, in "Economics of Public Services" (Feldstein and Inman, Eds.), Macmillan Co., New York (1977).
13. C. Tiebout, A pure theory of local public expenditure, *J. Polit. Econ.*, **64**, 416–424 (1956).
14. F. Westhoff, The existence of equilibria in an economy with a local public good, *J. Econom. Theor.*, **14**, 84–112 (1977).
15. W. Wheaton, Consumer mobility and community tax bases, *J. Public Econ.*, **4**, 377–384 (1975).
16. M. J. White, Fiscal zoning in fragmented metropolitan areas, in *Fiscal Zoning and Land Use Controls* (E. S. Mills and W. E. Oates, Eds.), Heath, Lexington, Mass. (1975).
17. M. J. White, Self-interest in the suburbs: The trend toward no-growth zoning, *Policy Analysis*, **4**, 185–204 (1978).
18. M. J. White and L. White, The subsidy to owner-occupied housing: Who benefits? *J. of Public Econ.*, **7**, 111–28 (1977).