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On the Theory of Growth Controls

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I. INTRODUCTION

Numerous empirical studies have examined the effect of growth controls on housing prices.[1] These studies have used many different techniques ranging from hedonic price model estimation to paired comparisons but have all come to the same conclusion: growth controls raise the price of housing.

In theory, there are both demand and supply side explanations (which need not be mutually exclusive) for these observed price differences. On the supply side, housing caps, zoning restrictions, limitations on the amount of developable land, and other forms of growth control may reduce the supply of housing over time. This, in turn, may produce scarcity effects which manifest as shifts (or other changes) in the housing supply curve and attendant price increases.

On the demand side, to the extent that growth controls may reduce or internalize expected negative externalities and/or congestion costs associated with growth, controls may also produce amenity effects. Such amenity effects manifest as changes in the demand curve and likewise may be capitalized in land values (and wages), e.g., the price of a house rises as commute time falls.

[1]This list is long and includes Frech and Lafferty [7], Gleeson [8], Hansen and Green [9], Katz and Rosen [11], Knaap [12], Schwartz *et al.* [13], and Zorn *et al.* [16]. For a literature review, see Fischel [6].

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Given these two alternative explanations of observed housing price differences, it is perhaps curious that the bulk of the existing empirical literature has settled on the scarcity effect view of the world. That is, the reported housing price changes are typically attributed primarily to supply side effects. Amenity effects are either ignored, assumed away, or regarded as negligibly small.

The question of which view of the world is correct—scarcity versus amenity effects—does, however, have profound and indeed polar policy implications. In the scarcity effect view of the world, there is an underlying presumption that growth controls likely result in a classic dead weight loss due to the supply side restriction. The logical implication is that growth controls therefore must reduce social welfare and must be bad. On the other hand, to the extent that housing price increases reflect improved amenity levels through the internalization of externalities or the reduction of congestion costs, there is at least a prima facie case that growth controls can, in some cases, be welfare-improving.[2]

The purpose of this paper is to reevaluate the prevailing scarcity effect view of the growth control world. We argue that this view is the product of an inadequate partial equilibrium approach to growth controls. We show that when controls are viewed in a more general equilibrium context, most if not all of the observed housing price differences can be seen to have their roots in amenity effects.

Section II introduces a very simple model of spatial structure to examine the impact of growth controls on land prices, land uses, and the distribution of income among segments of the population.[3] Section III enriches the model by incorporating congestion costs, externalities, local public goods, and labor demand elasticity. Section IV briefly discusses possible welfare effects. The paper concludes with a summary and discussion of policy implications.

II. THE BASIC MODEL

Consider land use in the very simple circular city of Paradise. Paradise has identical households, all of whom commute to the central business district (CBD) and face transport costs that are linear in the distance of the commute. Each household rents exactly one housing unit and the land in the city is owned by landlords (who, as homeowners, may coincide with the renters in some cases). Assume further that there exists a class of developers who rent land from the landlords and rent capital at a fixed

[2] See Carson and Navarro [2] for a discussion of, and appropriate estimation techniques for, amenity effects.

[3] The results in this paper are similar to that of a paper by Brueckner [1]. This paper was written prior to reading the Brueckner paper.

nonspatial price. These developers construct housing using a technology that requires one unit of land and one unit of capital to produce one unit of housing and then rent this housing to the households.

In equilibrium, the perfectly competitive developers must make zero profits, and the households must be indifferent between housing at all distances from Paradise's CBD. The developed land will be just equal to the number of households, and land rent on the undeveloped land will be taken to be a constant normalized to zero. The slope of the land bid rent schedule in equilibrium is simply the negative of the per mile cost of transportation.

A. The Uncontrolled Growth Case

Letting $R[s]$ be the land rent at distance s in miles and k be the transport cost per mile, the equilibrium bid rent is simply

$$R[s] = R[0] - ks \tag{1}$$

and the edge of the city is where the land rent falls to the agricultural reservation price, which is taken here to be zero. The distance to the edge of the city is therefore given by

$$s_e = R[0]/k. \tag{2}$$

If there are $Q[s]$ units of land within distance s of the CBD, then the equilibrium population is given by

$$N = Q[s_e], \tag{3}$$

Let Y be the income of the households, $C[s]$ the rental price of housing, and $X[s]$ the quantity of other goods purchased, where X is taken to be the numeraire so that the price of X is one. Then the budget constraint becomes

$$Y = C[s] + X[s] + ks, \tag{4}$$

where the rental price of housing must be related to the rental price of capital, P, by

$$C[s] = R[s] + P \tag{5}$$

from the zero profit condition of developers using the fixed coefficient technology.

If the households' utility function is $U(H, X)$, where H is housing and X is all other goods, then in equilibrium each household can achieve a level of utility U_0 given by

$$U_0 = U(1, Y - R[0] - P), \tag{6}$$

In this model, there is no role for growth controls because the economy is in a static equilibrium in which there is no internal population growth. To incorporate growth into the model, it is necessary to introduce new migrants into Paradise and compare the situations with and without growth controls.

Assume, then, that there is a perfectly elastic supply of potential migrants from a region called Purgatory. Purgatorians have utility functions identical to those of Paradisians. As in Paradise, all households are renters.

In an open economy (and in the absence of migration costs), households in Purgatory must achieve the same level of utility as households in Paradise.[4] Assume, then, in the initial equilibrium, that household utility in Paradise, U_0, equals household utility in Purgatory.

Now suppose that an external shock is introduced into Purgatory which lowers the utility of Purgatorians to U_1. For example, income in Purgatory may be generated by an industry which goes into a decline because of foreign competition.[5] This shock, in turn, triggers migration from Purgatory to Paradise because the first Purgatorian who migrates to Paradise can achieve a level of utility $U_0 > U_1$.

For simplicity, assume that Purgatory is very large relative to Paradise so that, at the margin, migration has large effects on utility in Paradise and virtually no effects on utility in Purgatory. Under this assumption, in the new postmigratory equilibrium, there will be more residents in Paradise and fewer residents in Purgatory. The small fraction of Purgatorians who move to Paradise will drive the utility level in Paradise down to U_1. Utility in Purgatory will remain approximately at U_1.

In the absence of growth controls, rents must rise until all new migrants are indifferent between living in Paradise versus Purgatory. Formally, this

[4]Migration costs include both the obvious economic costs of moving from one city to another and the sociological costs of factors such as "roots" and "family ties" that might be reflected in an individual's utility function. The existence of such migration costs, together with barriers to exit in some employment markets, helps to explain why there may be variation in the standard of living in different cities, even in a relatively open economy such as that of the United States.

[5]There are many different kinds of shocks that could produce such a change in relative utility between the two locations. For example, suppose Paradise is economically dependent on the aerospace industry and Purgatory is dependent on the auto industry. An increase in defense expenditures for "high-tech" weapons systems and/or a decline in the market share of American automobile manufacturers would improve the utility of Paradisians over that of Purgatorians and spark migration.

solution expressed with a subscript n for no growth controls is

$$\begin{aligned} U_1 &= U(1, Y - R_n[0] - P) < U_0 \\ R_n[s] &= R_n[0] - ks > R[s] \\ s_{ne} &= R_n[0]/k > s_e \\ N_n &= Q[s_e] > N. \end{aligned} \tag{7}$$

Thus, in the absence of growth controls, Paradise is larger, rents are everywhere higher, household utility is lower, and landlords realize more rent. Given these distribution consequences, it would appear that growth creates a conflict between households and landlords. However, the case either for or against growth controls should not be made by comparing the solution in Eq. (7) with the static setup of Eqs. (1)–(6). Rather, the appropriate analysis is to compare Eq. (7) with the solution given the same external source of migrants when growth controls are imposed.

B. The Growth Control Case

Suppose, then, that the City Council of Paradise implements growth controls in the form of a complete prohibition on new construction. New migrants from Purgatory still seek to enter Paradise. However, since there is no housing available, Purgatorians can only find accommodation by outbidding existing residents of Paradise. Rents are bid up and, quite possibly, some current Paradise residents emigrate. As no new construction is allowed (and any increase in the number of residents per household is initially ruled out), population N in the new equilibrium must be the same as that before immigration, but the new utility is U_1. With subscript g denoting elements of the new growth control equilibrium, this solution is simply given as

$$\begin{aligned} U_1 &= U(1, Y - R_g[0] - P) \\ R_n[0] &= R_g[0] \\ R_g[s] &= R_g[0] - ks, \qquad \text{for } s < s_e. \end{aligned} \tag{8}$$

As illustrated in Fig. 1, rents are the same as those without growth controls except for the area between s_e and s_{ne} (where the downward-sloping lines are the relevant bid rent schedules).

Comparing the outcomes with and without growth controls, it is clear that the majority of the economic sectors are indifferent between the two outcomes. Except for the area between s_e and s_{ne}, households are indifferent because they pay the same rent and achieve the same level of utility,

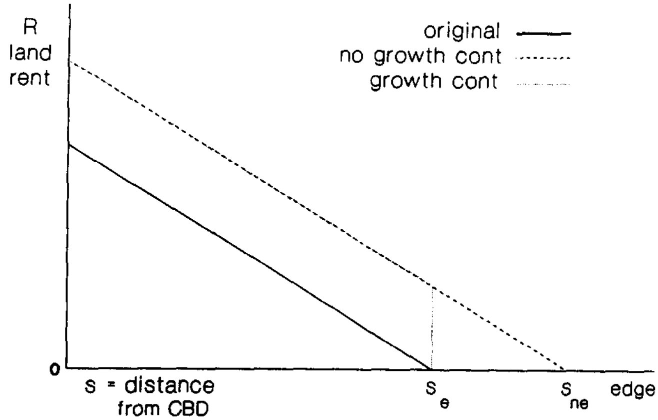

FIG. 1. Growth controls in the absence of externalities or congestion costs.

and landlords of developed property are indifferent because they receive the same rent. Even the potential migrants from Purgatory are indifferent because they conclude that moving to Paradise is not as attractive as it initially seemed. Thus, the argument that growth controls hurt potential migrants is not valid here. In fact, the only ones hurt by growth controls are the owners of undeveloped land. Since no one is helped by the controls, there is consequently a mild presumption that they are not useful in this setting.

A similar allocation of activities can be achieved by various tax- or user-fee policies. For example, a tax on all firms sufficient to reduce wages to the point $Y_1 < Y$ would equilibrate utility between Paradise and Purgatory if $U_1 = [1, Y_1 - P - R[0]]$. The city edge would again be S_e, but land and housing rents would be the same as those at the beginning. In effect, the inflow of migrants from Purgatory has been stemmed by a lump sum tax. In this alternative setting to the supply restriction form of growth controls, renters are again indifferent, but all landlords are worse off unless the tax revenue is rebated to them.

A similar outcome can be achieved by taxing capital. If capital for new construction is taxed so that the after tax price becomes $P_1 > P$, the price of new housing will rise. Hence, new migrants will raise the bids for existing housing until housing prices reach the solution from Eq. (7) with $C_1[0] = P_1 + R_1[0]$. In this case, the population will not grow, there will be no new construction, and land rents will not change, but housing rents will. Landlords will again have a capital gain (this time due to the capital rather than the land) and only the owners of undeveloped land will be unhappy. The new tax will raise no revenue for distribution as no new housing will actually be constructed. Thus, a variety of policies which may be considered either quantity constraints or taxes or supply and demand policies can lead to the same allocation of resources.

III. EXTENDING THE BASIC MODEL

Thus far, the model is inadequate for examining the possible merits and demerits of growth controls because it does not reflect the underlying economic and political forces that give rise to controls. As Cooley and LaCivita [4] have shown, growth controls are most likely to result when city governments fail to internalize negative externalities and mitigate congestion costs and when government tax structures force existing residents of a community to subsidize growth. Nor does this setting acknowledge possible agglomeration economies or diseconomies associated with population growth or the relative mobility or immobility of labor. To confront these issues, we thus must further enrich the model.

The most common negative externalities associated with population growth are congestion and pollution. In the typical urban environment, both traffic congestion and air and noise pollution as well as crime tend to increase with population, often at an increasing rate.[6] At the same time, population growth often results in additional congestion at public facilities such as parks, libraries, and schools and at public places such as museums and beaches.

As a potential at least partially offsetting benefit, agglomeration economies associated with population growth may be available, at least up to a certain city size. These agglomeration economies can take several forms, including higher productivity firms and better job opportunities as well as a broader consumption opportunity set.[7]

Suppose, then, that both k, the cost of transportation as a function of distance, and Y, the income of the typical resident, are functions of total population. As N increases, $k[N]$ will increase due to congestion, and $Y[N]$ will decrease if negative externalities outweigh the agglomeration economies.

A. Congestion Costs

Consider first the case in which only transportation costs depend upon N. With growth controls, neither population nor transport costs per mile increase in Paradise so the solution is identical to that in the basic growth

[6]The statistical relationship between crime and population growth has been examined extensively and seems to indicate that population growth per se does not lead to an increase in the crime rate. However, population growth which leads to increases in density in lower income neighborhoods appears to lead to an increase in the crime rate. See Hoch [10].

[7]There is a substantial literature on the optimal city size comparing the negative and positive effects of growth. See, for example, Tolley and Crihfield [14] and Tolley *et al.* [15].

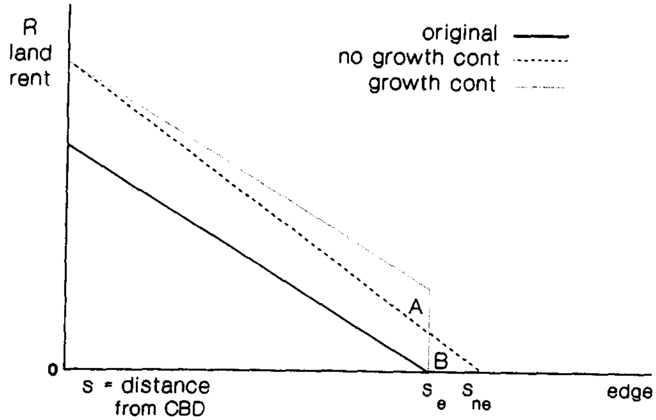

FIG. 2. Growth controls in the presence of congestion costs.

control solution in the absence of congestion costs. That is, population N is the same as that before immigration, rents are bid up, and the new utility is U_1.

Without growth controls, however, population in Paradise increases. This leads to increased transportation costs and a steeper bid rent function. To calculate this new bid schedule, consider the rent in the center of the city. Since utility must be equal to U_1 and since there is no transport cost when $s = 0$, the bid rents must meet there. Consequently, the edge of the Paradise is less far out than in absence of congestion costs and the population increase is less. The new solutions are illustrated in Fig. 2.

Note that the rents within the old city limits of Paradise are everywhere at least as high or higher under growth controls than they are without growth controls. Nevertheless, households can achieve the same level of utility under either scenario and are therefore indifferent because, in the absence of growth controls, they must pay higher commuting costs. At the same time, the potential migrants are by definition indifferent.

Note further that the landlords of developed property, including homeowners, prefer the higher rents and therefore prefer growth controls. (Homeowners benefit through an implicit wealth effect.) The only opponents to growth controls in the presence of congestion costs will be the landlords of undeveloped property.[8] Since the congestion costs represent a dead weight loss, there must at least be a presumption that growth controls can provide a possible solution toward minimizing this loss.

[8]It is useful to note that developers would be indifferent if there were perfectly elastic supply of developable land in Purgatory since they would make zero economic profits in either case.

As an aside, it is worth noting that this case sheds considerable light on the politics of growth control. Since landlords of developed property in the form of homeowners are likely to be a much larger numerical voting class than landlords of undeveloped land, growth controls are likely to emerge in the presence of congestion costs if renters *remain* indifferent. Note, however, the emphasis on the word "remain."

In their political campaigns against growth control ballot measures, landlords of undeveloped property have typically targeted renters as the important swing vote. The thrust of such campaigns is that rents will rise with controls, but there is no mention of any possible offsetting benefits due to lower transportation costs (or, as we see below, higher amenity levels). When renters have been persuaded that they will be worse off under controls, growth controls often have gone down to electoral defeat.

B. Pollution Externalities

Turning to the externalities case, suppose there are negative income effects associated with pollution that make $Y[N]$ a decreasing function of population, N.[9] As with the traffic congestion case, the growth control solution is unaffected by pollution since N does not change. However, the non-growth control solution *does* change: The rise in N leads to a decrease in Y and therefore a smaller rise in R is needed to reduce utility to U_1. In particular, the rent in Paradise's CBD is given by

$$R_n[0] = R_g[0] - \{Y - Y[N_n]\}, \tag{9}$$

which is represented by Fig. 3, assuming both congestion and pollution externalities.

As with the congestion case, landlords of developed land (including homeowners) will favor growth controls, landlords of undeveloped land will oppose controls, and renters will be indifferent. The net effect of the externalities is to discourage immigration in lieu of actual increases in the rental cost of housing.

The same analysis can be used to examine the case in which agglomeration economies dominate the negative externalities. In such a setting $Y[N]$ is an increasing function of N, and the solution in (9) implies that the rent in the center without growth controls will exceed the rent with growth controls. The congestion externality will still increase the slope of the rent gradient so that the net effect would be as in Fig. 4. The city still expands because N increases.

[9] While this case is designed to capture the implications of externalities, it clearly relates to congestion and many more settings.

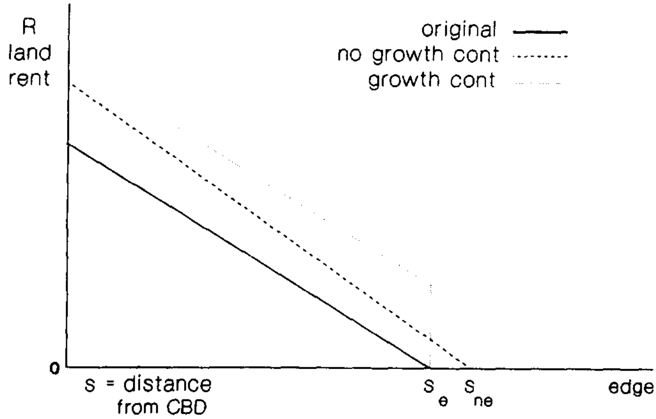

FIG. 3. Growth controls in the presence of congestion and pollution externalities.

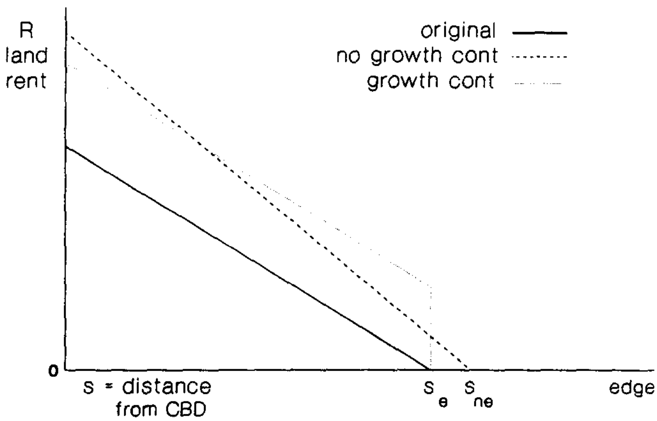

FIG. 4. Externalities vs agglomeration effects.

Note now that a coalition of inner city landlords and landholders of undeveloped land would be opposed to controls. Depending on the strength of the congestion externality, this coalition could defeat the measure. If Paradise is allowed to grow rapidly, then center city locations will gain disproportionately due to their low transport cost exposure. The agglomeration economy effects mean that greater rent increases are needed to achieve equilibrium between Paradise and Purgatory.

C. Local Public Goods

As Cooley and LaCivita [4] have argued, political pressures for growth controls are likely to emerge when the marginal cost of public goods provision is higher than the average cost. In such a case, under the typical municipal practice of average cost pricing, existing residents are forced to subsidize growth, and this subsidy almost inevitably leads to political backlash.

Much has been written about the cost functions for the provision of police and fire protection; waste disposal, water, and sewer services; education; and transportation. From the literature, it is clear that as population increases, the total cost of providing these services surely increases. However, the cost per household may increase or decrease depending on whether there are increasing or decreasing returns to scale.

In this regard, it is generally assumed that there are increasing returns to scale for small areas. These economies, in turn, are an explanation for the unification of municipal districts into cities or even larger areas. However, as city size increases, these returns eventually may be exhausted and decreasing returns to scale observed.[10]

Besides the issue of scale associated with city size, a second consideration that bears on the relationship of average to marginal cost is the rate of inflation. In the presence of inflation, new public facilities capacity, which is required to service growth, will, by definition, be more expensive than old, even identical capacity. These higher costs may occur not only because "bricks and mortar" are more expensive but also because the cost of financing the facilities may be higher due to higher interest rates. In such a case, marginal cost will exceed average cost, holding scale effects constant. This is because implicit capital gains to the local authority are not paid out.

Both the exhaustion of economies of scale and inflation are prominent features of today's growth control landscape. Suppose, then, that the marginal cost of providing services to an additional household exceeds average cost. If these services are paid for by a tax on income or by an average cost user fee, we can interpret Y as disposable income after paying user service charges, and $Y[N]$ will again decline with population growth as it did when negative externalities dominated agglomeration effects.[11]

D. Labor Demand Elasticity

Critics of growth controls often argue that controls will result in unemployment and recession in the local economy. However, it is axiomatic that

[10] For a discussion within the context of solid waste disposal, see Dubin and Navarro [5].

[11] Although much of the local tax revenue is raised by property taxes on real property, it is better to model this as an income tax: A property tax in this model cannot be shifted by the landlords and therefore will have no effect on rents or allocations. (It might be that landlords would object to population increases if their taxes were increasing in N).

growth controls can have no impact on the long-run rate of unemployment in a local economy when labor is mobile. Moreover, statistical studies have shown no clear relationship between population growth and the unemployment rate: it may rise, fall, or remain the same with growth. Instead, the rate of unemployment is driven by broader macroeconomic factors such as the level of interest rates and the rate of inflation.

Critics of growth controls also argue that growth is a prerequisite for economic prosperity. Such an argument confuses, of course, population growth with economic growth. Depending on factors such as the types of jobs being generated and the relationship between labor supply and demand, population growth can lead to an increase, decrease, or no change in per capita income.

It follows from these two popular misconceptions that the relevant theoretical issue regarding the labor market is *not* predicting the impact of growth controls on the unemployment rate. Rather, it is predicting how growth controls in one city or region might affect both the geographical distribution of jobs between cities or regions and the wage rate. A key issue is the elasticity of labor demand.

In particular, in this discussion, we have not made clear where income is generated. As a first pass, we might assume for simplicity that firms in Paradise have a perfectly elastic demand for labor at a wage Y. If, however, this demand function is *less* than perfectly elastic, then again $Y = Y[N]$ is decreasing in N, and we have the same results as above for the growth control versus no growth control case under externalities, congestion, and public goods provision.

Thus, the picture presented in Fig. 3 corresponds not only to the cases in which there are negative externalities and in which the marginal cost of public goods exceeds the average cost. It also corresponds to the case in which the demand for labor is less than perfectly elastic. In each case, renter households are indifferent between growth controls and no growth controls, homeowner households and landlords of developed land prefer growth controls because it leads to higher rents (or home appreciation), while only landlords of undeveloped property lose. In such cases, it is highly likely that growth controls will be welfare-improving in the sense that landlords of developed property and homeowner households will be made better off while renter households will remain indifferent.

It is also useful to note that the inelasticity of the labor demand functions of Purgatory and Paradise will tend to act as an equilibrating device for migratory flows. In particular, an outmigration from Purgatory to Paradise caused by an external shock will cause income to decline in Paradise and rise in Purgatory. Since Y is a declining function of N in both cities, utility eventually once again will be equalized in the postshock environment, and migration will cease.

IV. WELFARE IMPLICATIONS

A policy will be considered to be potentially welfare-improving if the beneficiaries can at least potentially compensate the losers. Since renters have been shown to be indifferent in all cases, it remains only to determine whether landlords of developed property can potentially compensate the owners of undeveloped land.

In the basic model in the absence of externalities, owners of developed land were shown to be indifferent about growth controls while landlords of undeveloped land were shown to be worse off. Hence, growth controls in this case unambiguously reduce welfare.

However, in the presence of externalities, the results can go either way. Referring once again to Fig. 2, the area A represents the gain to landlords of developed property from imposing growth controls while area B represents the loss to owners of developable land. If $A > B$, then growth controls are welfare-enhancing, and conversely. This conclusion is consistent with the observation that internalizing an externality has the potential to improve welfare by eliminating a dead weight loss.

V. SUMMARY AND POLICY IMPLICATIONS

This paper has presented a simple model of growth controls in a two-city framework in which migration between cities occurs. Acknowledging the existence of potentially significant "amenity effects," we have shown that in the presence of congestion costs, pollution externalities, local public goods problems, or inelastic labor demand, that growth controls may reduce or eliminate dead weight loss and therefore be welfare-improving. These theoretical results have important implications for empirical research.

First, empirical research on growth controls has hitherto observed that where growth controls are imposed, prices of land and housing appear to increase. Since it is likely that growth controls will be imposed only where there is excess demand for land and housing, studies which have relied on a growth control dummy variable to measure the effects of control have used a variable which is not exogenous to the estimation.[12]

A perhaps even more important implication is that rather than simply measuring scarcity effects due to a relative shift in housing supply, price increases estimated in the wake of growth controls also provide evidence that there are negative externalities, congestion costs, and/or underfunded public facilities in the absence of controls. Without these features,

[12]See, for example, Center for Real Estate and Urban Economics [3] for use of such a dummy variable procedure.

there would be *no* difference in housing prices between growth control and no growth control cities.

Thus, previous empirical studies of the effects of growth controls on housing prices are most likely biased. But even if these studies could be taken at face value, the interpretation is misleading. These price increases represent evidence of exactly the features which make growth controls sensible. It follows that future empirical studies should take great pains to sort out the scarcity versus amenity effects due to growth controls and evaluate these effects only within the context of a broad measure of welfare.

As a final observation, we have also seen in our model that the primary beneficiaries of growth controls are owners of developed land, e.g., homeowners, while the primary losers are owners of undeveloped land. Since the benefits of growth controls to typically numerically superior owners of developed land are likely to be diffuse relative to the costs imposed on developers, developers are likely to have much more incentive to organize politically and thwart growth controls. Indeed, only when the costs of *not* having controls rises to a sufficient level will the owners of developed land effectively organize. This explains why growth controls in the 1980s and early 1990s have tended to emerge in cities and regions only after the problems associated with growth have become severe.

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