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Urban Sprawl: Policies for Containment and Cost Recoupment*

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INTRODUCTION

Urban sprawl, it has been argued, results in a distortion both in the allocation of resources and in the effects on real income redistribution. The explanation of these effects is relatively straightforward—a sprawling pattern of subdivision growth induces higher public and private sector costs than does a compact pattern of growth, and neither developers nor residents of the sprawl subdivision nor land speculators are required to pay the incremental costs; that is, there tends to be average rather than marginal cost pricing. As a consequence, the public budget dollar and private expenditures are distorted toward services entailing higher transportation costs, and all users of a given service subsidize sprawl residents. To avoid these allocative and distributive effects, either sprawl would have to be eliminated or recoupment schemes would have to be developed along the lines of marginal cost prices for each service. Neither alternative is apt to become public policy, for neither is politically feasible: measurement problems would be substantial, and the problems of allocating the cost of a public good among individuals would remain.

In practice, public policy toward urban sprawl has been piecemeal: that is, there have been a number of different approaches taken by a number of different levels of government. Some of these actions are designed expressly to constrain urban sprawl, others, to recoup the costs of urban sprawl. In any case, these actions are rarely coordinated, and their joint results—either in terms of recoupment or constraint—have not been adequately evaluated.

The purpose of this paper is to offer, in a very preliminary form, a general framework for the evaluation and identification of the effects of alternative land use controls, tax measures, and user charges on the set of decisions which lead to sprawl. In particular, we attempt to explore two points: that only distance related charges can both recoup costs and constrain sprawl, and that existing tax programmes may do little to

* The authors are indebted to Dean Misczynski for a number of helpful comments.

constrain sprawl. We consider the alternative forms of sprawl, and, to illustrate the nature and magnitude of the costs involved, we present the results of a case study of the incremental public costs associated with a particular form of urban sprawl. We then construct and use a crude model to suggest how alternative public policies might play on the decisions of the potential homebuyer, the developer, and the land speculator.

THE FORMS OF URBAN SPRAWL

At least three physical patterns of urban sprawl are discernible. First, there is the low-density, continuous development which is merely the "gluttonous use of land in opposition to a value judgment about a higher density which would have been more appropriate" (Harvey & Clark, 1965). Second, there is the ribbon development which is an axial extension from previous development, such as that which occurs along a highway. Finally, there is the leapfrog development, a development which is separated from the urban area by some amount of idle, or unused, land. New towns, if they are in fact "new suburbs," are a special case of the leapfrog variety.

One's views of urban sprawl—its costs, its aesthetic harm, and the like—depend on the time span considered. Some have argued that these forms of sprawl are a part of the urban growth process and tend to disappear over time. The sprawl of the 1950's is frequently the admired, compact urban area of the early 1960's. Harvey and Clark (1965) illustrate with the example of a 160-acre plot of land, on the periphery of a city, that may be subdivided and built upon at a rate of forty acres per year. If the tract is in the form of a square, to be developed in fourths, and if the segments most distant from the established areas are developed first, there is sprawl. If the segments next to the established areas are settled first, growth is presumably orderly and compact. Given the short period of total development, they argue, the net results to society are probably not significantly different. Such a conclusion is impressionistic. In fact, little is known about the costs of sprawl; hence, it is difficult to assess their significance. The little work which has been done suggests that such costs, when combined with the number of instances of urban sprawl in a metropolitan area, may exert a significant effect on community resources.

Whether the net effects of urban sprawl are harmful to society has been debated in the literature. The more common criticisms are that it is costly, it is aesthetically unattractive, it wastes land since the intervening lands are typically not used for any purpose, and it encourages land speculation. Other writers have argued the opposite, that from an *a priori* point of view, the argument for scatter appears at least as compelling as the argument for compact development. Focusing on the dynamic aspect of society, Lessinger finds that scatter suits an economy where technological, social, and economic change predominates because it leads to a beneficial residential mixing of middle-class and poor people (Lessinger, 1962). This, in turn, minimizes the impact of slum housing and makes the rebuilding of old neighbourhoods more feasible.

Nevertheless, there are incremental costs associated with sprawl which give rise to distributive and allocative effects. Whether these are offset by other considerations is not directly relevant to the purpose here, which is to study the relationship between alternative remedial policies and these effects.

THE COSTS OF URBAN SPRAWL

There is a considerable and growing literature on the public sector costs attributable to urban sprawl. Casual observation suggests that for any given population, government expenditures will be higher if the land area within the jurisdiction is greater. Empirical analysis shows that, in fact, higher densities tend for some services to be associated with lower per capita urban government expenditures (Weicher, 1970). Such aggregate analyses, while they do give some hint about the costs of low-density development, do not permit one to deal directly with the question of the costs of sprawl, their magnitude, and ultimately their recoupment. The recourse is painstaking measurement in a context of specific case studies.

Before using the results of one such study for illustrative purposes, it would seem worth exploring the nature of the incremental costs of urban sprawl. Simply put, such incremental costs are those which could have been avoided by planned, compact urban development. Given planned open space and parklands, the incremental costs of a leapfrog subdivision are those costs which could have been avoided had the subdivision been built adjacent to the urbanized area. It should be noted that contiguous development may also constitute sprawl, if lot sizes are "too" large. In such a case, the incremental costs would be those which could have been avoided had lot sizes been equal to some norm for the urban area. The major problem with measuring the costs of the low-density development form of sprawl is the determination of what constitutes a "normal" or "average" lot size.

Such an approach was taken in a case study of a Lexington, Kentucky suburb (Bahl, 1963); the results of that study are summarized here to suggest the nature and magnitude of the costs of urban sprawl. This study is of a single family subdivision, developed two miles from the urbanized area, and seems typical of leapfrog developments. The approach taken to estimating incremental costs in this case is straightforward. A hypothetical location for the subdivision was posited adjacent to the urbanized area, and since the characteristics of the subdivision are identical whether assumed on the hypothetical or the actual site, any cost differential must be uniquely a function of location.

Archer's recent and more generalizable adaptation of the incremental costs as estimated in this case study are presented in Table 1 (see Archer, 1973). As noted in the table, these costs are presented as annual amounts; that is, they are the costs attributable to the idle intervening land for each year during which this land remains undeveloped. An annual statement is necessary because many of these costs, for example, that of installing public utility lines, reflect the creation of excess capacity which will be utilized when the intervening land is developed.

By way of summary, the total annual cost generated by the two-mile leapfrog subdivision was $272,534 in 1962. This represents a cost of about $220 per year per resident, or about $810 per year for each house, or about $1,360 per acre per year for the two hundred acres being developed. Of the incremental cost of $220 per person per year, about 65 per cent is borne directly by the leapfrog subdivision resident in the form of increased private costs. Therefore, about 35 per cent or $77 per resident is paid by all local consumers of public and private services.

From the far right column of Table 1, it may be seen that over half of this amount is incremental cost due to commercial delivery services. To the extent that the delivering firms make use of marginal cost pricing, the entire burden would tend to be borne by residents of the leapfrog subdivision. At least in this case, there was no indication of a general use of a differentially higher delivery charge for residents of this subdivision. Hence, there is potentially an overall increase in delivery service charges which affects the entire community (see Table 1).

With respect to public services and public utilities, only in the case of the bus company was there any indication of a differentially higher rate being imposed on residents of the leapfrog area. All other costs were imposed at a going rate, that is, the general practice was one of average cost pricing.

Total public utilities and general public service costs amount to $126 per house in the leapfrog subdivision. Local government services (sewage, refuse collection, fire, police, and school bus services) amount to $14.56 per resident, as compared to total per capita expenditures of $52.09 per capita for all local governments in the metropolitan area. These comparisons are shown on a function-by-function basis in Table 2 below. These results suggest that the incremental costs, and the subsidy provided to sprawl

TABLE 1

INCREMENTAL COSTS OF A 200-ACRE LEAPFROG RESIDENTIAL DEVELOPMENT

Item	Additional Costs							
	Capital Works	Interest and Depreciation, per annum[a]	+	Operating Costs, per annum	=	Total Additional Costs per annum	Who paid these Additional Costs	Per cent of Total Cost
	$	$		$		$		
Water[b]	45,079	3,155		5,611		8,766	Consumers, Lexington area	3.2
Gas	10,609	1,013		–		1,013	Consumers, Lexington area	0.4
Telephone	44,960	4,046		9,885		13,931	Consumers, statewide	5.1
Electricity	11,250	937		–		937	Consumers, statewide	0.3
Sanitary sewage[c]	122,783	8,596		420		9,016	City taxpayers	3.3
Refuse collection	–	–		638		638	City taxpayers	0.2
Fire protection[d]	–	–		208		208	City taxpayers	0.1
Police protection	–	–		7,425		7,425	City taxpayers	2.7
Mail service	–	–		374		374	Federal taxpayers	0.1
School bus service	–	–		737		737	County taxpayers	0.3
Commercial delivery services[e]	–	–		54,677		54,677	Consumers, Lexington area	20.1
Automobile commuting[e]	–	–		172,207		172,207	"Gainesway" residents	63.2
Bus commuting	–	–		2,483		2,483	60% by consumers, Lexington area	0.6
							40% by "Gainesway" residents exclusively.	0.3
Road and street maintenance	–	–		122		122	County taxpayers	0.0
Total	234,681	17,747		254,787		272,534		100.0

As adjusted by Archer (1973) based on Bahl (1963).

[a] Interest calculated at 5 per cent p.a.;
[b] Water costs calculated on a 10,560 feet mains extension;
[c] Sanitary sewage calculated on the full cost of the treatment plant (at less than the cost of a mains extension);
[d] Fire protection calculated as $4.00 per week; and
[e] Vehicle running costs calculated at 7.0 cents per mile on 2,140 miles of additional commercial vehicle travel per day and 6,740 miles of additional car travel per day.

residents, are substantial. Recoupment of this cost would require an effective property tax rate of \$4.22 per \$1,000 of property value on a \$30,000 home.

USER CHARGE SCHEMES

A first class of policies of urban sprawl constraint is related to the user charge. In order to evaluate its effect on urban sprawl, it is necessary to view the potential homebuyer in the context of a choice model. Earlier work on the evaluation of alternative approaches to constraining urban sprawl has centred on how locating closer in might be induced, or coerced. Bahl (1968) and Shoup (1970) have studied the economics of the land speculator's decision. Weiss et al. (1967) has studied the developer's process of decision making, but little has been done with the motives of potential homebuyers. The intent here is to consider the latter in evaluating the effects of policies aimed at the potential homebuyer. The model presented is crude and is merely preliminary. Let us assume that the potential homebuyer faces a situation where he must decide between a house adjacent to the urbanized area and one located some distance away. Further, let us assume that he attempts to maximize a utility function

$$U = U[D, Q_o, G, Q_g] \tag{1}$$

where:

D = units of distance, i.e., a house on land located some distance (i) from the urbanized area,

Q_o = quantity of all other private goods and services,

G = quantity of public services provided specifically to residents outside the urbanized area, and

Q_g = quantity of public goods and services provided by governments operating in the urbanized area.

The inclusion of D directly in the utility function means that land suitable for housing some distance from the urbanized area is treated as good; that is, consumers may choose a distant or a near house location. We will assume that the price he can pay for his housing package, however, is fixed (that is, he can only afford to spend a given amount) and we will assume that he will not spend less. By buying a distant house then, he buys "more house": a bigger house, a larger lot, privacy, and so forth. We could have entered the quantity of housing directly in the utility function, but by constraining the price he may pay for a unit of housing to be constant, this would be the same as assuming that quantity could be increased only by moving farther out—by buying distance. Another

TABLE 2

PER CAPITA LOCAL GOVERNMENT EXPENDITURES AND PER RESIDENT INCREMENTAL COSTS

Function	Incremental cost per resident of leapfrog subdivision	Total Metropolitan area expenditures	Per cent
Sanitary sewage	$ 7.27	$16.43[1]	44.25
Refuse collection	0.52	4.83[2]	10.76
Fire protection	0.17	8.31	2.04
Police protection	5.99	7.99	74.97
School bus service	0.59	58.55[3]	1.00
TOTAL:	$14.56	$52.09[4]	27.95

1 Including capital outlay.
2 Sanitation other than sewerage.
3 Total education.
4 Other than capital outlay.

argument in the utility function is G, which represents public services that are not ordinarily supplied through the regular general budgetary process because of remote locations of sprawl subdivisions. These services must be purchased at prices in addition to the normal government tax prices. If all services are provided by existing governments with no differential pricing—the situation we assume already exists within the urbanized area—the G term drops from the utility function; that is, it becomes a part of Q_g. In any case, the division of total public services provided (Q_t) outside the urbanized area into amount G and Q_g is assumed to be strictly a government decision. Hence, the consumer may not choose between G and Q_g as substitutes: he must accept Q_g as given (he pays the total tax bill in any case), but he may choose to consume varying amounts of G at its offered price.

Potential homeowners then maximize equation 1 subject to a budget constraint

$$Y = P_o Q_o + P_g Q_g + P_x G + P_d D. \tag{2}$$

The term $P_x G$ requires further explanation. It is the price of a unit of public services provided to a house at any given distance from the urbanized area, over and above the tax price P_g paid for public services which are provided through the regular budgetary process. Now consider the nature of the consumer choice between total public services ($Q_t = Q_g + G$) and D. The homebuyer is indifferent among the various combinations of public service packages and distance from the urbanized area since the utility of both public services and the "amenities of distance" is assumed to diminish at the margin. He reaches an equilibrium when the ratio of the marginal utility gained by moving an additional distance unit from the city, to the marginal utility of the public services lost because of that move, is exactly equal to the price ratio.

Consider a graphical example, where potential homeowner preferences may be presented by I_1, in Figure 1. Assume, for the moment, that the potential homebuyer's utility function is separable, and that he follows a two-stage process where in the first stage he selects expenditure levels for the aggregate of Q_g, G and D, and for all other goods. Assume first that the government provides no general services to the subdivision. In this case, all public services provided to resident locations at $D>0$ cost P_x per unit; hence the slope of the budget line is P_d/P_x, and the consumer chooses a distance D_1 and a level of services G_1.

Lump Sum Charge

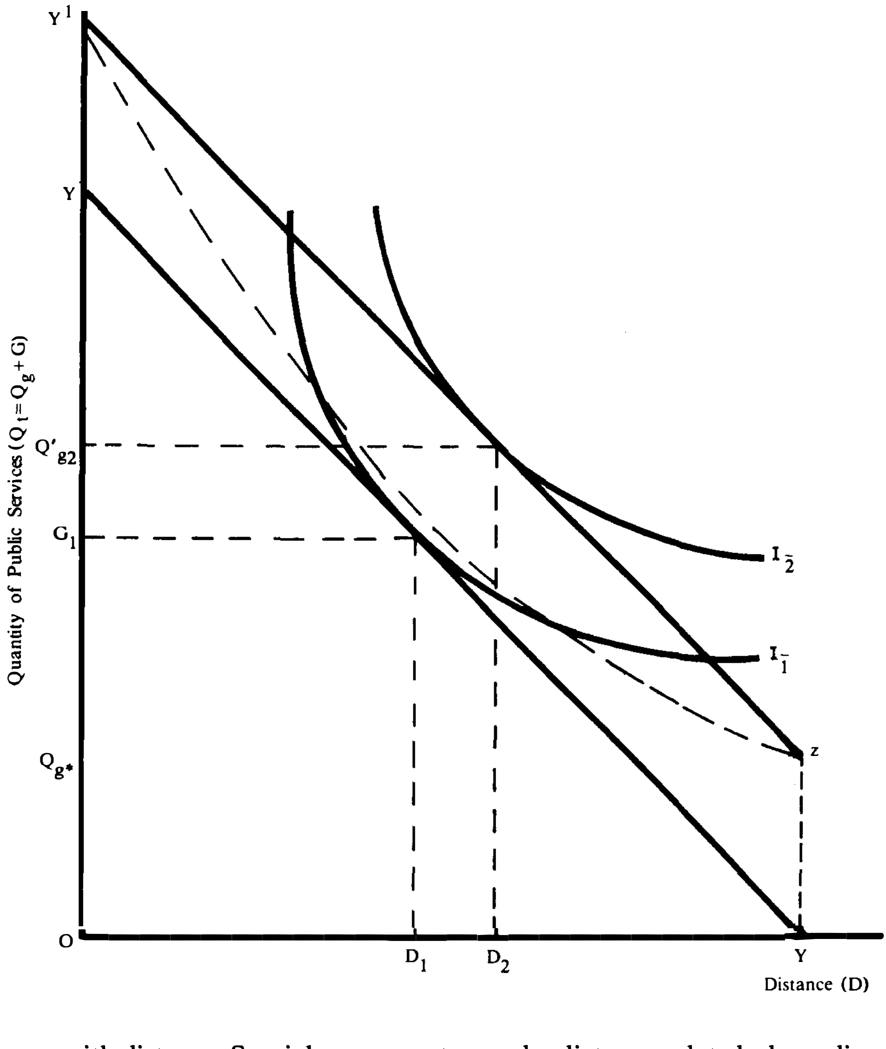
Within this framework, consider a charge for each resident living outside the urban service area, but let the charge be invariant with respect to distance. Let us assume that Q_g* units of public goods are general revenue financed (that is, $P_x = 0$ for the first Q_g* units). The budget line becomes Y^1ZY (since $Y^1Y = OQ_g$*), and the resident consumer is able to reach a higher level of welfare. Hence, the consumer may obtain more public services at any given distance from the urbanized area than he could before, but because both public services and distance are normal goods, he chooses to live even farther out (that is, at D_2). This result occurs whether the charge to the individual is based on front footage, family size, or any other factor except distance from the urbanized area.

Variable Distance Charge

Now let the price of public services received outside the urban service area be a function of distance, such that the budget line becomes the dotted line ZY^1 in Figure 1; that is, it is convex from below. Now the relative cost of distance rises as we move further from the urbanized area. Thus, in order to obtain any given level of public services, for example, Q_{g2}, the homeowner would choose a location closer to the urban area. The greater the charge per distance unit, the closer the location chosen.

The important point, here, is that the appropriate policy is one of special assessment where the full incremental costs may be recovered. Current institutional practices suggest an increasing use of special assessments that

FIGURE 1



vary with distance. Special assessments may be distance-related, depending on the method of cost allocation used. The three most frequently used methods of allocating costs of special assessment projects are frontage, zone, and area. In the frontage method, the computation for each lot is the ratio of that lot frontage to the total frontage abutting the public improvement multiplied by the assessable cost. Under the zone method, the land adjacent to the improvement is divided into zones, and the property within each zone is then assessed a percentage of the costs in proportion to its area. Typically, there are two or more zones, with the rates of assessment diminishing with the distance from the improvement. Finally, under the area method, each parcel served by the facility is assessed that proportion of the cost which its area bears to the total area of the district benefited by the improvement. The frontage method is not distance related and therefore would not discourage the choice of a location farther from the improvement. The area method would introduce a bias against larger lot sizes, but would not necessarily induce the choice of a location closer to the improvement. The zone method, however, can be used to provide a marginal inducement to choose a location closer to the improvement if public costs to homeowners are distance related.

TAX POLICIES

A second set of constraint and recoupment policies are aimed directly at developers and at the owners of land considered ripe for development. These include various taxation and assessment schemes. Analysis of the effects of these schemes requires a model which predicts the effects of such interventions on the decisions made by developers and land speculators.

There is not a large body of literature on the issue. Available studies indicate that the typical case is one in which a tract of land is sold several times before it is developed into a residential area (Clawson, 1971). The process typically begins with a farmer selling a tract of land to a land speculator. He, in turn, may sell it to other intermediaries until it is finally sold to the developer. Speculators admit to using two major approaches in valuing land: a comparison method in which current sales of comparable land are used as the basis for determining the value, or an income capitalization method in which land values are determined by discounting an expected flow of future returns. In fact, these amount to the same approach. Selling prices are decided on by considering estimated value increases in the light of the costs of holding land. The most important costs which the speculator must consider are interest, the opportunity cost of having his money tied up in the ownership of the land, taxes, and maintenance.

Developers seem to use a different approach for evaluating land. Weiss et al. (1967) have concluded after a number of studies that developers who purchase suburban land act in a much less orderly fashion:

> Land development is obviously much more of an *ad hoc* process than we had previously supposed. The unsystematic manner in which developers approach the production of residential lots indicates that most of the decisions made at this stage of the development process are

probably made on the basis of their own experience and a general awareness of what is going on in the local development industry rather than on the basis of what new techniques and ideas are available.

What appears to happen is something like the following. The developer's ultimate interest is in making a profit from selling a total housing package to a consumer. In order to do this, he must first forecast the short-run demand for housing. His estimate of this demand may be sophisticated, or it may be impressionistic. He might base his estimate, for example, on the current rate of household formation or on conditions in the national money market; or he might simply base his estimate on a rough judgment, for example, that ten to twenty houses of a certain type and price can be sold over the next year or so. Given his forecast of the demand for housing, the developer might imagine a tract of land ideal as to size, location, physical characteristics, availability of services, and price. With this ideal in mind, he approaches the land speculator to bargain for the sale of a tract of land. Whether a particular tract is developed depends on whether the assessments of the speculator and developer happen to match. All of the variables at work in the conversion process can interfere with orderly, compact development and can generate urban sprawl.

If this description is correct, the speculator acts in a more rational way than the developer, and therefore it should be possible to formulate a model from which the speculator's reactions to tax policy changes can be predicted.

A Land Speculation Model

In this section we draw from Bahl (1968). The problem of developing a model to explain the actions of a land speculator is analogous to the classic problems of how long a tree should be permitted to grow before it is harvested and how many years wine should be permitted to age before it is drunk. An early statement of marginal conditions for the optimal length of investment (attributed to W.S. Jevons) is that a "ripening" asset should be held until the discounted rate of increase in value is equated with the opportunity cost (per cent return) (Baumol 1965). If one identifies the costs and returns associated with speculating in urban land, he should be able to develop a similar set of optimality conditions.

The model is presented in a discrete form here primarily for the sake of simplicity (see also Bahl 1968). The optimality conditions are developed in terms of the ratio of the difference between the rate of return on the land and an opportunity cost for the current period, to the discounted difference between these rates for the aggregate of all future periods. These conditions can be much more easily explained when discrete time periods are considered.

In formulating the model this way, it is implied that the landowner faces the sell or hold decision at the beginning of each period and makes his decision on the basis of what he expects in terms of net benefits for the coming period and on his evaluation of aggregated, discounted net benefits in all future periods.

In order to develop a model to explain the optimum length of time to hold a parcel of land, assume the value of the land to be increasing at a decreasing rate; that is $dV/dt>0$ and $d^2V/dt^2<0$, where dV/dt represents the rate of increase in market value. The traditional incremental reasoning of economic theory suggests that, with perfect knowledge, the speculator will hold the land an additional period only if the increase in market value is great enough to compensate him for the additional cost incurred during that period. If one abstracts from risk considerations, these costs include the property tax and the opportunity cost, that is, the amount which could have been earned by investing an amount equivalent to the current market value of the land in the best alternative investment.

Symbolically, this condition may be expressed as

$$R_t = P_t + iV_{t-1} \tag{3}$$

where:

R_t = expected increase in the value of the land during the t^{th} year,
P_t = amount of the property tax for the t^{th} year,
i = rate of return which could be earned on the best possible alternative investment, and
V_{t-1} = market value of the land at the beginning of the t^{th} year.

However, since property taxes are fully deductible for federal income tax purposes, the landowner does not consider the entire amount P_t an incremental cost. Specifically only an amount $(1\text{-}s)P_t$ is borne by the speculator, where s represents his marginal personal income tax rate. Thus, from equation 3 it may be seen that the optimal time for selling land occurs when:

$$[R_t - (1-s)P_t]/V_{t-1} = i. \tag{3a}$$

Note that we view the property tax as a cost which must be absorbed by the speculator. The left side of the equation 3a (hereafter referred to as r) is the net rate of return to the landowner, or alternatively, may be thought of as his indifferent rate of interest, that is, that market rate of return at which he will be indifferent between holding the land for an additional period or selling now and reinvesting the return. Conversely, if i is expected to exceed r in the t^{th} period, the landowner will be acting rationally if he sells.

This relatively simple statement of optimality conditions from the viewpoint of the speculator is based on two assumptions. First, the landowner must be certain that he may reevaluate his position at the beginning of each time period. Thus, his expectations for future growth in the value of the land beyond the first year are disregarded. Second, the value of the parameters of the system are estimated with certainty (though it would be possible to assign probabilities to both sides of the equation).

A second, and more realistic case, may be developed in which the landholder feels that he must consider not only his position in the next period, but also his expected returns and costs for the following periods. Under these conditions, the optimality condition in equation 3a must be amended to reflect: (a) the expectations of the landowner for future increases in the value of the land; (b) the estimate of the landowner of the expected future return from an alternative investment; and (c) the marginal cost of time. If these modifications are applied, the equilibrium statement† becomes:

$$R_t + \sum_{j=t+1}^{n} \frac{R_j - (1-s)\,P_j}{(1+\hat{i})^j} = (1-s)P_t + iV_{t-1} + \sum_{j=t+1}^{n} \frac{I_j}{(1+i)^j} \qquad (4)$$

where††

R_j = the dollar increment in the value of the land in the j^{th} year, and

I_j = the dollar return which could be earned in the j^{th} year by selling the land and reinvesting the proceeds in the best alternative investment.

Rearranging the terms in equation 4 and dividing through by V_{t-1} yields:

$$\frac{R_t - (1-s)P_t}{V_{t-1}} - i = \frac{\sum_{j=t+1}^{n} I_j/(1+i)^j - \sum_{j=t+1}^{n} [R_j - (1-s)P_j]/(1+\hat{i})^j}{V_{t-1}} \qquad (4a)$$

or,

$$r - i = i^* - r^* \qquad (4b)$$

where:

r-i = difference between the net rate of return on the land and the landowner's interest rate (in year t), and

†However, if $d^2I/dt^2 < d^2R/dt^2$: (where dI/dt is the average rate of return associated with the alternative investment) an equilibrium will not exist. For purposes of this paper, it will be assumed that second order conditions are satisfied.

††In equations 4 and 4a we adopt the convention of denoting the discount factor of the land as $\hat{i}$ and that of an alternative investment as i. For convenience it will be assumed that the alternative investment involves no risk. Thus, i is purely a cost of capital while $\hat{i}$ also includes a risk factor.

i^*-r^* = difference between the discounted expected per cent return on an alternative investment and on the land (over n years).

(It should be emphasized that r^* and i^* are not annual rates of return, but ratios of discounted expected flows to original outlay and that they are calculated from period $(t+1)$ forward to some period n. For example, $r^* = R_{t+1} + R_{t+2} + \cdots + R_n / V_{t-1}$. The number of periods, n, is defined as the speculator's time horizon.) Therefore, if the equilibrium condition is stated in terms of actual and expected per cent returns, one concludes that the speculator will hold the land for the marginal period only if the difference between present net rates of return exceeds the difference between discounted expected per cent returns.

To use a numerical example, assume that a speculator is certain of a return of 10 per cent (net of property taxes) if he holds a parcel of land for the coming period, and further, that he is aware that if he holds the land he must forego a return in that period of 6 per cent (i) on an alternative investment. After choosing an appropriate time horizon (n periods), the speculator estimates a discounted net return on the land of 25 per cent (r^*) and a comparable rate for the alternative of 27 per cent (i^*). Since $(r-i)/(i^*-r^*) > 1$, the land should be held for the t^{th} period. The landholder may then reevaluate his position at the beginning of each succeeding period, whether to sell now or to hold the land until time period n (the number of years in his time horizon).

Tax Controls

There are a number of tax adjustments which have been used in an attempt to induce speculators to sell earlier. These include market value assessments, property tax rollback schemes, and various forms of development value taxes. In a context of the land speculator's decision parameters, four factors about such tax policy are worth note: the size of the tax amount, the effect of the tax on the timing of development, the effect of the tax on the price of land, and the extent to which the tax compensates society for the incremental costs. In this context, consider the effects of market value assessments, tax rollback schemes, and development value or betterment taxes.

Deferred or rollback taxes exist in fourteen states: Alaska, Arkansas, Hawaii, Kentucky, Maryland, Minnesota, New Jersey, Oregon, Pennsylvania, Rhode Island, Texas, Utah, Virginia, and Washington. Under this arrangement, two assessed values are determined annually for each qualified property. The value at which the property is assessed on the tax roll corresponds to its use value assessment in its current agricultural or open space classification. A second value assigned to the property is current market value in highest and best use. As long as the property is utilized for purposes consistent with its classification under law, it is assessed for property taxation on the basis of the values associated with that use. Should the property be sold or developed for purposes not consistent with those covered by the law, all or part of the taxes due on the difference between the two levels of assessment become due. Deferred payments are ordinarily limited to given percentages of the deferred taxes or to rollbacks for a limited number of years of deferred taxes (Barlowe, 1973).

Since the potential tax amount is known before the time of development under this scheme, and since the tax amount is theoretically a function of selling price, it may affect the timing of development and the price of land, depending on conditions in the land market. In that it increases the perceived cost of withholding the land from the market (relative to a situation where there is no rollback), the effect of the rollback may be to hasten the timing of the development. To the extent this is true, the effectiveness in hastening development is related to the magnitude of the tax. It seems a reasonable argument that the possibilities here are not cause for optimism. Assessed property values—even in the best of cases—do not generally keep pace with market prices, effective property tax rates may be quite low and effectively lowered even more by their being deductible. Consider an example: let value in use be $50,000, and fifty per cent lower than development value, allow for a rollback provision of three years, assume the national metropolitan average tax rate of approximately 2.5 per cent of full market value, and let the speculator's marginal income tax bracket be 52 per cent. In this case, between the time of rezoning and the time of development (if within the next three years) the speculator recognizes that his new taxes will be $600 higher per year than he is presently paying. Substitution in equation 4, and reasonable assumptions about r and i, suggests that this amount would probably not have a marked effect on the development decision.

There is also renewed interest in development value taxes. In an interesting demonstration, Rose shows that if the tax is levied at the time of rezoning for urban use, the tax has no effect on when development will begin. Neutze agrees that most of the taxes Rose examines have no effect on the timing of development. He adds, however, that a lump sum "tax" payable at time of development, such as the requirement that developers provide a range of services, and a land market characterized by generally rising values may cause development to be delayed. There is proposed legislation in Hawaii which would enact such a tax.

The other form of development value tax is one levied at the time of sale, such as the British betterment levy. The British betterment levy, a shortlived tax (1967-1971), was designed to recover only a limited part of unearned increments in land value. The tax was applied at a rate of 40 per cent to increments in land value which resulted from government permission to change the use of land. By reducing the return from land speculation, the betterment levy would act to reduce sprawl, though the effectiveness would depend on the magnitude of the tax and the nature of the value assessment.

Another form of development value tax which potentially could recoup cost and affect the timing of development is Colombia's "valorization" tax. This is a tax on increases in property value which are due directly to public investments. The uniqueness of this tax is its emphasis on securing payment before the investment is really made—an attempt made necessary in developing countries by the lack of a capital market which can be tapped to finance badly needed public investments. The procedure for imposing the tax in Medellin, Colombia, where it is most successfully used, is as follows. An independent valorization department selects a project, determines an area of benefit, and, after carefully estimating expected costs and land value increases, seeks to impose taxes sufficient to cover costs in a way "that will seem fair to the taxpayers."

In general, development value taxes of all types will have a similar effect on the variables of the model presented here: the cost of holding land is increased, thereby prompting the speculator to sell earlier. The cost, however, may vary widely as among types of development value tax. Taxes such as the valorization tax which are paid off over a longer time period may create less incentive to sell than would a special assessment where advance payment is required.

LAND USE CONTROL POLICIES

Another class of urban sprawl constraints is direct land use controls. Using the framework of equation 3 above, local planners may shorten the optimal time for sale by increasing the risk associated with holding the land. The speculator must of necessity attach a higher risk premium in a city where planners have a history of employing subdivision control measures and where there is a substantial pressure from local residents for the preservation of open space within the metropolitan area. In general, it has been noted that the drastic shortening of the suburban planning horizon and the ensuing irregularity of the intensity of demand for urban land has increased the uncertainty for any land user.

At any rate, all of these effects of r^* could be felt as moral suasion and are a function of interactions between market forces and the degree to which the local authorities have supported a responsible planning programme in the past. Given the limitations of existing data, it is not possible to construct a quantitative estimate of the relative dampening effect of a higher risk factor. However, one might hypothesize, on the basis of the relatively small effect of changes in the property tax on the optimal time for selling lands, that a 1 per cent increase in the subjective risk factor may be more effective in reducing the optimum speculation time than a 1 per cent increment in the property tax.

In a more general sense, the effects of increasing landholding risks as a constraint to urban sprawl are difficult to evaluate. For example, some land use control measures may increase such risks differentially at varying distances from the urbanized area. In such a case, sprawl may well be encouraged rather than constrained. One's overall view about using such a "risk" effect to promote orderly development has to reflect one's confidence in land use planning and regulation as effective control devices. Certainly there is reason to be suspicious of their effectiveness.

An example of direct land use controls which seems worth brief description here, because they do provide a framework for planned urban expansion, is the French system of ZUP (*zone à urbaniser de priorité*), areas needed immediately for urban development, and ZAD (*zone d'aménagement différé*) areas where development is not likely to occur for several years. For descriptions, see Kinsey (1969) and Grimes (1974).

Once an area is officially designated for development as either ZUP or ZAD, land prices and transactions in the area are frozen until the government decides whether or not to exercise its option to purchase the parcel. In the case of ZUP lands, the government has four years to exercise its option with the right to extend this period for an additional two, while in the case of ZAD lands, the government has a total of fourteen years. If the government does exercise its right to purchase the land, the purchase price is the assessed market price of the parcel one year prior to ZUP designation or, in the case of ZAD lands, is the market value at the time of ZAD designation adjusted for inflation.

CONCLUSIONS

In addition to pointing out that the costs of urban sprawl are substantial, this paper highlights four points about containment and recoupment policies and about the allocative and distributive effects of urban sprawl.

The first is that even with marginal cost pricing of the incremental costs of urban sprawl in the short run, allocative efficiency will suffer in the long run. The annual costs may be recovered through a system of distance related charges, but the sprawl pattern of growth may affect the location of public facilities (for example, fire stations, schools, parks). When the suburban area fills in, this location may be suboptimal and therefore impose a long-term and irreversible cost on society. Such a cost will not be recouped in marginal cost pricing of incremental current expenditures.

Moreover, annual user charges will not ordinarily reflect all social costs imposed on the community; for example, the new school bus route inconveniences existing passengers in addition to raising operating costs. Finally, if recoupment is not made for each service on an incremental cost basis, allocative efficiency will still suffer. For example, if a special assessment were paid which compensated society for the incremental costs in total, there would be distributional neutrality, but the allocation of the budget dollar would still be distorted in favour of services with higher transportation costs. This conclusion results because incremental costs vary across functions and therefore distort relative prices.

A second point here is that the goals of both sprawl constraint and cost recoupment might be served simultaneously by developing user charges in terms of distance; for example, the special assessment for sewage may be distributed among residents of the sprawl subdivision on a basis of front footage, but the total amount of the cost to be assessed should be based on distance from the urbanized area.

Third, we argue that tax control measures at foreseeable levels are likely to do little to constrain urban sprawl. Moreover, resulting tax burdens on speculators are heavily offset by the federal tax deductibility provisions. In any case, we feel intuitively that increasing the riskiness of holding land would have a more significant effect, though there are serious problems with implementing such an approach with existing land use control and regulation mechanisms.

Finally, the question of from whom to recoup expenses underlies any evaluation of public policies. While certain programmes (user charges) are aimed at homeowners, others (various tax schemes) are aimed at land speculators. A host of questions which surround this issue remain to be studied.

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