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LOCAL DECENTRALIZATION AND THE THEORY OF OPTIMAL GOVERNMENT

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Introduction

Many of the key issues involved in today's problems about cities focus on local government. Government is a form of group decision making just as is the market and can be analyzed with much the same tools. Structural imperfections in the one can lead to inefficient resource allocation just as in the other. Moreover, much the same criteria of efficiency can be used in both, although evaluation of income distribution is more intrinsic to public sector activities.

In the present paper we concentrate on a welfare evaluation of local government in the typical metropolitan area. We study chiefly the influences on efficient local decision making of (1) population migration into the metropolitan area from outside, (2) suburbanization of a given metropolitan area population, and (3) the fragmentation of local government in the metropolitan area into various nonhierarchical jurisdictions.

Our study suggests that the pattern of local government in modern decentralized urban areas leads to suboptimal resource use in the public sector, and helps thereby to contribute to the severity of problems more popularly blamed on other phenomena.

Some Issues in the Theory of Optimal Government

To discover whether a particular government is inefficient, one must first determine what constitutes efficiency. It is beyond the scope of the present paper to conduct a systematic study of the theory of optimal government. But some important issues involved in specifying optimality for the public sector must be mentioned.

Suppose we have a given population extending over a substantial geographic area. The population establishes a system of markets for private transactions. It wishes to establish a collective decision making system to complement the market system. How shall the apparatus of collective choice be fashioned? In particular, what principles shall guide the distribution of collective powers among political jurisdictions? How much centralization, delegation under hierarchy, and decentralization are desirable? This differs from the comparable problem for a business firm or for the economy as a whole because we assume that collective decisions are to be made by majority rule. In any given choosing situation a majority will outvote a minority, thereby imposing a special form of external diseconomy upon the latter. Different patterns of jurisdictional delegation of power will affect who are included among the majority and the minority on different issues, and therefore what public sector decisions will be made, thus determining the distribution of real well-being among the population.

Assume individualistic welfare criteria apply to the public sector. Then movement from a Pareto-inferior to Pareto-superior position is a sufficient condition for welfare improvement; and Pareto-optimality is a necessary condition for over-all welfare maximization. In this context, the presence of substantial private sector externalities suggests inefficient resource allocation. Indeed, one key rationale for the public sector is to preclude, control or internalize these externalities.

For this purpose, the delegation of power to political jurisdictions should be done in a way that minimizes the redistributional effects of majority rule. The goal is to shape government to be able to carry out efficiently resource decisions which a strong consensus desires collectivized. Given the convention—which could be shown to have efficiency properties—that political jurisdictions be geographically connected spaces, and that political hierarchy be represented as spatial inclusion, the actual U.S. distribution of characteristics and activities over space suggests that majority rule will generate the least "political externalities" in highly homogeneous communities, and that such homogeneity is most nearly approximated at the extreme local level ("home rule").[1] Maximal practical political consensus will call for very small political jurisdictions indeed.

[1] Even the most local level will not have perfect homogeneity, but differences within the community will be substantially smaller than differences between communities of this size.

What size unit would most effectively achieve "home rule" consensus is significant in assaying governmental performance, for consensus, while important, is not the only consideration bearing on efficiency, and the size of the jurisdictional unit affects the achievement of the others.

Economies and diseconomies of scale is one. If public output is produced under substantial scale economies, then a system of many very small jurisdictional units will incur considerably higher costs of producing public output than will a system of a few large units. Savings under the second could adequately compensate individuals who would have preferred the first. Other things being equal, the greater the net scale economies the larger is the size of the optimal political jurisdiction.

Other things are not equal. While the exact magnitudes depend on real world facts, it seems reasonable to surmise that the degree of political decentralization which maximizes consensus generates units considerably smaller than what is efficient for public output production. Some moderate scale economies do very likely exist for particular public functions, and these probably more than offset scale diseconomies in a few other functions so that, aided by constant costs in the bulk of public services, minimum average costs are achieved in the moderate sized jurisdiction, a scale which much exceeds the unit of maximal consensus (probably the neighborhood).[2]

[2] We refer to jurisdictions for *clusters* of public functions, not for single functions. Functions will generally differ in their consensual and scale economy characteristics. Optimal size for consensus and scale will both necessitate compromise among the component function profiles—but a different compromise generally for the two, as the text asserts.

Jurisdictions could be set up for individual functions. Since consensus is more broadly attainable for certain functions, government units for some functions might be formed which were optimal on both home rule and scale economy grounds. The special district represents an accommodation of this sort. But while the existence of a few types of special district in an environment of multifunction jurisdictions may prevent important scale economies from being neglected, a system where all public functions are divided into single-function jurisdictions is quite different, and can be shown to be highly inefficient. First, it would substantially increase total resource costs of public decision making, since such decision making involves important overhead components which would be seriously underutilized. Legislative, executive and judicial bodies set up to perform one function could inexpensively perform related functions as well. Second, it would hamper the rationality of public decision making by preventing the same electorate from considering complementary and substitutive relations among different functions. Compromises (log-rolling) across different functional categories would be unavailable to accommodate intergroup differences in policy preferences.

A further mechanism for minimizing scale economy–home rule discrepancies is claimed to be in the ability of a given multifunction jurisdiction to purchase

Another efficiency consideration arises out of externalities not within, but among, political jurisdictions. If the population affected by the policy of any jurisdiction is larger than that jurisdiction's constituency the jurisdiction will generate externalities beyond its borders. Similarly, if the actions of nonconstituents of a jurisdiction can influence the operation of policies within the jurisdiction, then externalities will be imposed on the jurisdiction from outside. In both instances the externalities are not of the usual economic sort: here the behavior of at least one of the participants involves political action, not economic. What is involved is that the jurisdiction is too small to enable the entire affected population to take the totality of their interaction into account in formulating public policy. Public decision making is faulty insofar as important interactions either cannot be coordinated or must be disregarded.

All other things being equal, the jurisdictional unit should be large enough to include the total population affected by all policies within its purview and all whose behavior affects the character of its policies. Even more than scale economies, this desirability of internalizing all sources of interjurisdictional externality prescribes a local jurisdictional unit considerably larger than what is called for on home rule grounds.

Both scale economies and diseconomies, and interjurisdictional externalities affect the real cost and real output possibilities with existing resources. Changes in unit size toward greater efficiency will result in output gains available to serve as bribes (compensation) to induce general agreement to the direction taken—i.e., they result in Pareto improvements. A third efficiency consideration refers to income distribution alone. Collective choice is not resorted to only to fulfill allocative goals; it is conventionally employed to achieve income distributional goals as well. Indeed, political scientists often devote preeminent attention to the redistributive functions of government, largely ignoring the allocative.

Suppose the population of the system as a whole decides that it wishes the political apparatus to make possible a certain range of redistributional functions. We suppose this is arrived at within the

services from public or private organizations which can more efficiently produce those services. This is possible for some functions, but by no means all. It is likely to be difficult where large, durable, specialized capital installations are associated with provision of the services; where the services are difficult to price on a market; where sensitive direct relations with the electorate as clients are integral; or where the chief production issue is not so much to provide inputs cheaply as to coordinate the planning of a complex service system.

highest governmental jurisdiction of the system, supposing this to be anterior to the various decentralized jurisdictions. The broad principles and direction of desirable redistribution are assumed to be decided here; however, it is desired that they be worked out concretely in ongoing situations close to jurisdictional levels possessing strong consensus. This goal requires forming jurisdictional units which contain both the appropriate donors and beneficiaries and in which majorities and minorities are present that will make the appropriate everyday decisions likely to come to pass. Whereas maximal consensus requires optimal homogeneity, "socially desired" redistributions require optimal heterogeneity. At whatever level of government the redistributive function is desired to be incorporated, jurisdictional units at that level must include the desired constituent mix, whether by spatial extension or by inducements on the locational incentives of private parties. Since the latter device depends on the everyday incentives of existing—and sometimes inappropriate—constituencies, the former is more dependable. Thus, insofar as there may be "socially approved" redistributional goals, and insofar as some of them may be delegated to the local level of government to be fulfilled, the desirable unit is likely to be larger and more heterogeneous than what would be designated on home rule consensus grounds alone.

In sum, we denote four types of criteria with which to evaluate the optimality of local political jurisdictions: (1) minimization of political externalities within each jurisdiction, (2) minimization of political externalities across jurisdictions, (3) minimization of the resource cost of providing public output, (4) maximization of the achievement of social redistributive goals. Of these, the first and fourth rest upon social value judgments about real income redistributions, the second and third rest upon narrower definitions of efficiency in terms of aggregate output levels. Broadly, (1) calls for the greatest degree of political decentralization, (2) and (4) for the least. In general no distribution of political powers is likely to rank uniformly on all criteria. Relative evaluation of alternative distributions will depend on trade-offs across these criteria, whose a priori character is difficult to discern, except in principle for the common aggregate output dimension of (2) and (3)—although the actual empirical magnitudes of these trade-offs are not less difficult to discern.

In the remainder of the paper, we shall examine to what extent the distribution of political powers within a typical metropolitan area meets the various criteria specified here. We shall be most concerned with tensions between home rule and interjurisdictional externalities within this institutional setting, but an examination of a potential conflict between home rule and the redistributive function will precede this. Finally, the strategic opportunities for ameliorating these conflicts inherent in scale economies will be briefly noted.

Constituent Composition and the Collective Redistributive Function

Assume we begin at time t_0 with a metropolitan area in which the "entire" urban population is concentrated in the central city: the "suburbs" are still rural. The population N at t_0, N^0, has a certain total income Y^0 and a certain distribution of that income, of which $\bar{Y}^0 = \frac{Y^0}{N^0}$ is the mean, σ^0 the standard deviation, m_3 the third moment, etc.

Given these characteristics of income, in a socio-economic institutional context which we shall assume to remain essentially unchanged throughout the analysis, the collective decision making process—the municipal government—generates a tax system from which we can predict a real-income redistributive flow—a tax-expenditure program providing services which help the poor: a "welfare" program[3]—for each specified tax rate. This productivity of the tax system can be expressed as a percentage of the community's income (k). Further, we may measure each actual flow in a normalized form as the per capita income improvement to the poor. A simple model will be presented to indicate the relationships involved.

(1) $$k^i = k(\bar{Y}^i, \sigma^i \mid T_1 = T_2)$$
$$\frac{\partial k^i}{\partial \bar{Y}^i} > 0, \frac{\partial k^i}{\partial \sigma^i} > 0,$$

where Y^i is the SMSA total income at t^i; $\bar{Y}^i$ is the SMSA per capita income at t^i; σ^i is the dispersion of the income distribution at t^i; T_1 is the central city tax rate for welfare purposes; T_2 is the suburban tax rate for welfare purposes; and k^i is the productivity of the tax system, measured at the city tax rate $T^i = T_2$.

(2) $$W^i \equiv \frac{T_1{}^i Y^i}{N_w{}^i},$$

[3] It is a "welfare" program in a broad sense. It includes public goods enjoyed by the nonpoor as well as the poor.

where N_w^i is the number of poor people—beneficiaries of the welfare program—in the central city at t^i, and W^i is the size of the welfare budget per welfare recipient at t^i.

The tax rates in 1 and 2 express only the levies for welfare purposes, interpreted broadly. For simplification we assume that other dimensions of the city and suburban budgets are unaffected by the population shifts involved in the model.

Now we introduce an opportunity for greater home rule. Income recipients above the mean are paying taxes to support welfare services for low-income households. If they moved to a new political jurisdiction in the suburbs where the population was homogeneously concentrated above the poverty line the total redistributive flow necessary to raise through government would be considerably lower—i.e., the suburban welfare tax rate T_2 would be less than T_1. This attraction has to be balanced against a comparison between suburban and city land prices, the greater transportation costs necessitated by a suburban location, and the general tastes for or against the amenities of suburban relative to urban life. Symbolically, the decision to relocate in a suburban political jurisdiction is given in the suburb location function, as follows:

$$N_2^i = \Pi\left(N^0, A, \frac{T_2^i}{T_1^i}, \frac{q_2^i}{q_1^i}\right) \tag{3}$$

where q_2 is the price per acre in the suburbs at t_i; q_1 is the price per acre in the city at t_i; A refers to relative amenities in city and suburb and is a general index of tastes for urban vs. suburban life; and N_2^i is the number of persons locating in the suburbs at t^i.

We have assumed that at t_0 $N_2 = 0$. Let tastes for suburban life improve among a small group, so that at $\frac{T_{20}}{T_{10}}, \frac{q_{20}}{q_{10}}$ they are now willing to move to the suburbs. This establishes an initial emigration source. There is also an immigration source. Whenever someone leaves the city an "empty place" is created, and this place is filled by an immigrant from outside the metropolitan area. The latter belongs to a population which is attracted to the higher average income opportunities available in the SMSA than in its place of origin. The immigrant population has a lower per capita income and a higher incidence of poor people. The mean out-migrant income is $(1 + r)\bar{Y}^0$, that of in-migrants, $(1 - r)\bar{Y}^0$; so the mean difference between them is $2r\bar{Y}^0$. The mean difference in incidence of the poor in the two streams is w.[4] Thus:

[4] As the two streams proceed, the mean city income drops, so the differential between them decreases. We assume immigrant incomes to be unchanged, a reflection

$$\frac{\partial EY_1}{\partial N_2} = -2r\bar{Y}_1^0 \qquad 0 < r < 1 \tag{4}$$

$$\frac{\partial EN_W}{\partial N_2} = w \qquad 0 < w < 1 \tag{5}$$

where EY_1 and EN_W are expected values of Y_1 and N_W and $\bar{Y}_1^0$ is the original per capita income in the city.

Since immigration into the metropolitan area is assumed to depend on per capita income differences, similar differences between central city and suburb must be assumed to evoke similar desires to suburbanize by lower-income city dwellers, or to prevent the suburbanites from escaping the city's tax jurisdiction. In the present model we assume these desires are frustrated by the incentive and ability of the suburbanizing well-to-do to prevent either of these from occurring. Zoning regulations, high travel costs, and sometimes outright discrimination hamper low-income suburbanization, and home rule sovereignty vetoes political annexation. On the other hand, the central city cannot, or does not, similarly "protect" itself against the flow of low-income migrants. These assumptions are not far from real-world circumstances.

This outflow together with its inflow replacement have the effect of decreasing the city's mean income and income dispersion, and thereby of decreasing the productivity of the tax system, while at the same time increasing the welfare case load (equation 5). The response to this by the municipal government with respect to its welfare tax rate is of real importance. We assume that the tax rate is negatively influenced by the productivity of the tax system, positively by the tax welfare case load, and negatively by the fear of losing high income population to the suburbs. I.e.,

$$T_1 = T_1(k, N_W, N^0 - N_2) \tag{6}$$

$$\frac{\partial T_1}{\partial k} < 0, \frac{\partial T_1}{\partial N_W} > 0, \frac{\partial T_1}{\partial N_2} < 0$$

$\partial T_1/\partial k < 0$ because, for a given case load, a greater tax productivity suggests the need for a smaller tax rate to furnish adequate welfare services.

$\partial T_1/\partial N_W > 0$ because, all else being equal, a larger case load induces the production of greater welfare revenues through tax rate increases.

of a very large pool of potential immigrants relative to the specific SMSA being discussed. Thus, when mean city income has fallen to this level, immigration will cease even though suburbanization continues.

$\partial T_1/\partial N_2 < 0$ because, all else being equal, an increase in T_1 without a comparable increase in T_2 will induce further out-migration of higher-income households with consequent further replacement that lowers $\bar{Y}$, σ, and the productivity of the tax system, while increasing the welfare case load. The intensity of the constraint against tax rate increases from this source is approximated by the size of N_2 (actually $N^0 - N_2$) since this indicates how much migration loss has already occurred, and therefore how important (scarce) the remaining upper income population in the city is. In addition, it suggests roughly the existing extensiveness of the T_2/T_1 discrepancy in terms of its effect on locational incentives. The larger is N_2 (relative to N^0) the more reluctant will the city be to risk "chasing" more of its inhabitants out by even further tax rate increases.

What then is the effect of the first migration round on the tax rate? From (6) taking into account (1), (4), and (5), and rearranging, we may write:

$$\frac{dT_1}{dN_2} = \frac{\partial T_1}{\partial k}\left[-\frac{2r\bar{Y}^0}{N_1}\frac{\partial k}{\partial \bar{Y}} + \frac{\partial Ek}{\partial E\sigma}\frac{\partial E\sigma}{\partial N_2}\right] + w\frac{\partial T_1}{\partial EN_W} + \frac{\partial T_1}{\partial N_2} \tag{7}$$

Since $\partial T_1/\partial k < 0$, $2r\bar{Y}/N_1 > 0$, $\partial k/\partial \bar{Y} > 0$, $\partial Ek/\partial E\sigma > 0$, $\partial E\sigma/\partial N_2 < 0$, $w\partial T_1/\partial EN_W > 0$, and $\partial T_1/\partial N_2 > 0$, the first two terms are positive and the third is negative. Migration tends to increase the city tax rate insofar as it decreases the tax's productivity while increasing the welfare case load. It tends to decrease the tax rate insofar as it enhances the desirability of the remaining upper-income persons and thereby leads to efforts to forestall further out-migration. The net effect depends on the relative size of the opposing forces.

In the situation at hand with trivial N_2, the increasing forces are likely to prevail and the tax rate will rise. The rise in T_1 will now make location in the suburbs seem more attractive to persons hitherto just willing to stay in the city, persons whose antipathy to suburban living is slight relative to the rest of the population, or whose positive attraction for the suburbs is relatively strong and has been just barely offset by suburban disadvantages like high transportation expenses. Some of these will now therefore move to the suburbs; their places will be taken by others from the same lower-income outside population as before. This will have the same effect on tax productivity, welfare load and very likely, on the tax rate again. So a third and successive round will proceed via this mechanism, until greater and greater personal antipathy to suburban living has to be overcome to induce further migration, and the growing desperation in the city about the loss of higher-income groups prevents the tax rate from rising despite unfinanced growing public service needs. Moreover, in-migration will be shut off when the falling per capita city income reaches the level of the in-migrants.

It is instructive to ask what happens to the level of redistributive aid during this migration process. The analysis is given in (8):

$$\text{(8)}\qquad \frac{\partial W}{\partial N_2} = \frac{\partial\left(\frac{T_1Y_1}{N_W}\right)}{\partial N_2} = \frac{N_W\left[T_1\frac{\partial Y_1}{\partial N_2} + Y_1\frac{\partial T_1}{\partial N_2}\right] - T_1Y_1\frac{\partial N_W}{\partial N_2}}{(N_W)^2}$$

Since the out- and in-migration processes have a stochastic element, we convert to expected values in the appropriate places.

$$\text{(9)}\qquad \frac{\partial EW}{\partial N_2} = \frac{N_W\left[T_1\frac{\partial EY_1}{\partial N_2} + Y_1\frac{\partial ET_1}{\partial N_2}\right] - T_1Y_1\frac{\partial EN_W}{\partial N_2}}{(N_W)^2}$$

$$= -\frac{2rT_1\bar{Y}^0}{N_W} + \frac{Y_1}{N_W}\ \frac{\partial ET_1}{\partial N_2} - \frac{wT_1Y_1}{(N_W)^2}$$

The first term represents the tax loss per welfare client due to the changed income composition of the city population; the second is the revenue change per welfare client due to a tax rate change; the third is the result of spreading the original welfare revenues over a larger case load [especially when written as $(T_1Y_1/N_W)(w/N_W)$]. The first and third terms are negative; the second depends on the direction of response of the municipal tax rate.

From this formulation we can see what constitutes a dilemma for the city. If the city keeps its tax rate unchanged (its constraint against losing further well-to-do population just offsetting the opposite pressures of tax erosion and heightened expenditure needs), then its per-client welfare benefits will decline, possibly substantially. If it attempts to forestall this by raising its tax rate, then welfare standards will decline anyway unless the tax increase is large enough to offset the other factors. A rate increase large enough to maintain welfare standards $\left[\frac{\partial ET_1}{\partial N_2} = \frac{2rT_1\bar{Y}^0}{Y_1} + \frac{wT_1}{N_W} > T_1\left(\frac{2r}{N_1} + \frac{w}{N_W}\right)\right]$ will induce additional out-migration with its attendant replacement by a population that erodes its taxable capacity and expands its needed welfare services: in other words, it simply buys a small amount of time before induced suburbanization brings about the same dilemma, but in even worse degree (because of the further population compositional change). A tax rate decline intended to attract suburbanites back to the city results in a significant worsening of welfare services.

Insofar as the present simplified model (especially with respect to the endogeneity of the in-migration stream[5]) resembles the real world, the option most likely to be chosen is to raise tax rates somewhat, to allow welfare standards to fall somewhat, and to allow some further suburbanization to be pushed—a compromise of sorts.

How is this phenomenon to be appraised in welfare terms? It is sometimes described as a distortion of resource allocation: basic needs hitherto met by the public sector are now going unmet. The public sector, because of shifts in fiscal capacity, becomes less responsive to the needs of its own constituents. A less responsive public sector is a distortion of the purpose of collectivization. So a straightforward welfare loss is encountered as a result of less efficient decision making.

This argument is faulty. The critical error is in carrying out the analysis as though a given population were experiencing an inadvertent loss of control over their own collective instrumentality. In fact, the constituency of the city government changes throughout the process. It becomes, from the welfare point of view, a different decision-making unit. The cut in per-client benefits, the raising of the tax rate, are well understood in these terms: a new group with lower per capita income than the earlier one, faced with a rising cost of welfare per capita of population, *chooses rationally* to purchase a smaller bundle of such services. The higher tax rate expresses the higher cost to the new community, the lower welfare standards express the rational output response by the new decision makers. So long as the new city population differs from the old we cannot conduct a straightforward welfare analysis. No direct normative comparison can be made between the two populations or the relative over-all fulfillment of their respective needs.

An indirect analysis can, however, be made. What has happened must be viewed against the whole of the population affected. The critical, indeed active, agency is the group that migrated to the suburbs to take advantage of the tax benefits inhering in a closer approximation to home rule with selective entry. Their move has resulted in the formation of a community for themselves more nearly homogeneous than they had before, and the transformation of the community they came from into one also more nearly homogeneous than before. In the latter community, this homogenizing has raised the cost of redistributing income

[5] The typical real-world phenomenon is an immigrant stream largely exogenous. It has many of the characteristics we posit here, but its largely uncontrollable magnitude has an active augmenting role, not merely a passive one, in the forces leading to suburbanization.

to any desired recipient level through the collective mode of decision making, as witnessed by the increased tax rate (or perhaps more clearly, by the erosion of tax productivity k). That less recipient redistribution will be purchased when its price rises is to be expected.

Thus, if the population of the over-all system has decided on a certain desirable degree of income redistribution to be achieved at the local level, closer approximation to home rule can induce too little a degree of population mix in each community to bring it about. This decrease in average redistribution might be accompanied by an increase in over-all redistribution if—as is likely—immigrants came from areas in which redistribution was less than the newer lower level at their destinations. Regardless of this, however, even the average degree of redistribution would be greater if, despite physical suburbanization, suburbanites *remained within the same political jurisdiction.* It is not physical but jurisdictional mobility that affects redistributional ease. The home rule option of forming separate, more homogeneous jurisdictions through controlled political entry conflicts with the possibility of maintaining jurisdictions with desirable population mix for redistributional purposes. The unrestricted right to maximize home rule consensus could transform the local community system into a set of homogeneous special privilege preserves established by active segregating groups on the one hand, and a set of residual homogeneous "problem" dumping grounds, passively formed in their wake, on the other. The use of local government for significant redistributional purposes would be significantly compromised.

The welfare evaluation of our model is therefore based on the efficiency of the public sector to produce not income but income redistribution. It depends on the existence of social value judgments concerning the desirable degree and locus of income redistribution. While such decisions are, of course, highly controversial, the structure of the normative analysis that results is the same in the two cases. If we agree on the goals for public decision making we can examine the efficiency with which the particular institutions achieve the redistributional as well as the income level goals. Since ideal resource utilization includes establishment of decision-making instruments that can meet society's broad goals, redistributional inefficiency is a symptom of resource misallocation just as is income level inefficiency.

Analysis of the use of resources to produce decision-making apparatus has been largely neglected, but it represents an extremely important type of production. Collective decision making especially merits new attention, since it has often been accorded an ideological sanctuary akin to that of individual decision making. This paper joins other recent work in attempting to rectify this omission.

A final matter. We see that the goal of unrestricted home rule consensus can conflict with income redistributional goals. One compromise is to restrict the former somewhat in the interest of the latter. Another is to shift the locus of redistributional responsibility to a higher level of government, where adequate population mix is achieved despite local homogeneity. Since the real-world counterpart of our model's inmigration is heavy interregional flows, largely uncontrollable on even a state level, this suggests that the appropriate site of such responsibility is the federal level.

Home Rule, Suburbanization and Interjurisdictional Externalities: A Family of Location-Resource Allocation Models

So far we have dealt with misallocations concerning the income redistributive goal. For the rest of the paper we shall be concerned with the more usual aggregate income level goal. We find public sector transactions that appear to produce resource misallocations in this more usual sense.

The crux is that the ability of economic agents—households and business firms—to proliferate nonhierarchical political jurisdictions within the metropolitan area, and their freedom to relocate among them at will, creates a set of asymmetrical interjurisdictional externalities, especially between the central city and the several suburban jurisdictions taken as a whole. These externalities affect the revenue and expenditure policies of the several jurisdictions and by so doing, have an impact on the decisions taken by the economic units as to where they should locate within the metropolitan area. Each stage of location decisions creates a new balance of interjurisdictional externalities in the system and thereby influences a new stage of impacts on public sector experience and then new location decisions. The allocation of resources to the several units in the public sector, as reflected in the ultimate pattern of intrametropolitan location, can thus be explained in part by the presence of these externalities. As such, they bear the usual stamp of inefficiency stemming from imperfect coordination between wants and opportunities.

Many issues are involved in formulating a complete system. The author has been examining a family of models to incorporate the several factors. We present here only the two simplest ones, in order to throw into boldest relief the kind of impact interjurisdictional externalities have on resource allocation. But it is instructive to summarize the character of other members of the family.

1. A model of residential location. The same homogeneous public good is produced in all political jurisdictions, and the total public output is invariant over different locational configurations. Taxes are levied on income, but all individuals have the same income.
2. The same, but total public output varies with different locational configurations.
3. The same as no. 1, but a separate tax on land and improvements is levied, relative land prices explicitly influence location decisions and are endogenous, and individual income levels differ.
4. A model of residential and business location. An invariant homogeneous public good, a separate tax on land and improvements.
5. The same, but with relative land prices influencing location.
6. A model of residential location. Heterogeneous public output. Differential spillovers as interjurisdictional consumption.
7. The same for residential and business location.
8. The same as no. 6, but differential spillovers are costs of accessibility to the SMSA center.
9. The same as no. 6, but the specialized differentiated public outputs in different jurisdictions are endogenous (functions of locational configurations).

We shall concentrate on models number 1 and 4.

A Model of Residential Location with Interjurisdictional Externalities

Specification of the Model

This first model is notably oversimplified, excluding some important facts of both private and public sector mechanisms and somewhat misrepresenting others. But it illustrates sharply the kind of impact that interjurisdictional externalities have on resource allocation, and the role that home rule distribution of political power—local political fragmentation—plays in generating these externalities.

Assume the SMSA contains N individuals, N_1 in the central city and N_2 in the suburbs—with separate political jurisdictions.

$$N = N_1 + N_2 \tag{10}$$

In the present model we hold total SMSA population constant in order to isolate the effects of intrametropolitan locational distribution alone. The over-all character of the population remains unchanged, and we assume that every individual has the same per capita income. This makes plausible our assumption about the homogeneity and invariance of public sector output.

The public sector produces either a single type of output or—more realistically—a bundle of commodities with constant proportions among them. Only the scale of the bundle may change, not its internal composition. The population has an identical per capita effective demand for public output, and this is invariant over different locational distributions.[6] Each individual has an effective demand for public output—i.e., at the political deliberative, not the consumption, stage—only in the jurisdiction where he is a legal resident, regardless of where else he may actually consume public output. Thus:

$$G^D = G^D(N), \tag{11}$$

where G is the size of the public output.

We assume that political decision making is such that whatever output is demanded is exactly supplied, so that actual budgeting is demand determined: government is "perfectly" responsive.

$$G^S = G^D \tag{12}$$

An important aspect of the whole family of models being considered is that a distinction is made between the *output* of public goods and the productive *inputs* necessary to produce them. This distinction is rarely maintained elsewhere, partly because of the tradition of measuring value of public output by the total cost of the inputs used. This has stemmed largely from the difficulty in measuring output units and the absence of markets within which buying and selling transactions could provide market valuations for the several public commodities. Despite these conceptual and practical difficulties, we do distinguish here between the level of the ultimately wanted services and things that emerge from public production and the variety of productive resources that go to bring them about. We even distinguish between this "final" output and the intermediate input complexes that are proximate productive factors.

[6] The significance of this assumption, and a different interpretation, will be examined more closely after the nature of the interjurisdictional externalities is introduced.

As an example of this distinction, in police services we assume that individuals seek a particular level of security of property and person, of convenient traffic flows, rather than any particular number of policemen on the force, or numbers of detection laboratory chemicals, or even intermediate goods like number of patrolmen beat-hours, or suspects questioned, etc. Arrests or convictions, or crime rates, while they possess notable deficiencies, are closer indices of the output dimension. In the field of transportation, the citizenry seeks particular levels of convenience, speed, safety and accessibility—not tonnage of highway construction materials used, or man-hours worked, or even intermediate goods like numbers of rapid transit vehicles, width of streets, etc.

We now specify the resource cost functions corresponding to the production of public output. The central city and suburban jurisdictions have separate cost functions. We shall present two alternative functions, depending on whether or not there exist interjurisdictional externalities. Consider first the nonexternality case (Case I).

$$S_2 = S_2(N_2) = P_2N_2 \tag{13a}$$

$$S_1 = S_1(N_1) = P_1N_1 = P_2N_1, \tag{14a}$$

where P is constant; S_1 is the resource cost of the public sector in the central city; S_2 is the resource cost of the public sector in the suburbs; P_1 is the per capita cost (price) of the public output produced in the central city; and P_2 is the per capita cost (price) of the public output produced in the suburbs.

We assume that public output is produced at constant per capita cost in the suburbs, and this is equal to cost conditions in the city when no externalities occur.[7] The significant content of 13a and 14a is that resource costs for both jurisdictions depend solely on the resident population of each. The presence of either makes no difference to the other.

The presence of interjurisdictional externalities changes this.

$$S_2 = S_2(N_2) = P_2N_2 \tag{13b}$$

$$S_1 = S_1(N_1, N_2) = P_2N_1 + E(P_2, N_2) = P_1(N_1, N_2)N_1 \tag{14b}$$

$$= P_1N_1 \geq P_2N_1$$

$$E(P_2, 0) = 0 \qquad \frac{\partial E}{\partial N_2} > 0,$$

where $E(P_2, N_2)$ is the externality cost function.

[7] The externalities we shall adduce are a qualification to this linearity assumption, since they establish cost nonlinearity with respect to variables associated with average population density and spatial extensivity, which are related to population scale.

Externalities arise in the following way. When individuals move out of the city into the suburbs they do not thereby sever their relations with the central city. They are likely to continue many of their former city activities—employment, shopping, recreational, cultural. Thus, for a significant proportion of their time, they are still present in the city. They use many of the same public facilities as city dwellers—streets, police, museums, ball parks, etc. Their presence and use of city facilities mean that the municipal government must make larger resource expenditures per remaining resident in order to provide the same level of public output (with unchanged quality—e.g., congestion—level) as before the move: i.e., the denominator of the fraction expressing per resident expenses declines by one for every resident who moves away, while the numerator declines by less than the preceding per resident expenses because of his continued partial use of city public output. While it is true that many public services or facilities, once in existence, offer roughly similar benefits to a variable number of possible beneficiaries, the quality of those benefits does depend on the expected level of use, especially past some minimum congestion level. A municipality, having to plan for the expected total user population, will have to tailor its scale of output to the expected amount of suburban presence within the city. Thus, equation 14b shows the resource cost of public output in the central city influenced by the size of N_2 as well as N_1. The size and presence of the suburban population does make a difference. It is expressed in the externality cost function $E(P_2, N_2)$ where, broadly speaking, N_2 influences the real externality cost and P_2 normalizes this to dollar values in terms of the per capita cost of government output.

While reverse externalities may exist, where city residents use suburban public facilities (e.g., in connection with recreation or, increasingly, employment), we assume here that these are distinctly smaller in magnitude. The externality cost function represents in reality the *net* externality relationship between the two directions and can be tolerably used with its present arguments because of the postulated strong asymmetry between the two directions. As a result, P_1 no longer equals P_2 and exceeds it for any positive N_2.[8]

[8] We may interpret this less simply. The spatial distribution of business firms is exogenous in the present model. It is often believed that sizable business concentrations in a city decrease the residents' tax cost, since the taxes which firms pay or their activities induce others to pay exceed the expenses they add to the public budget. It is quite possible that so much of the SMSA business activity is located in the central city that the tax rate on residents there is *less* than that for suburbanites, despite the presence of substantial externalities. Since we shall be interested in following how an initial relationship between P_1 and P_2 is changed by migration, it does not change

This raises a problem. If suburbanites consume their "normal" amount of public output in the suburbs as well as additional amounts in the city, is not total G larger? Or, alternatively, if they consume only the same total public output regardless of where they reside, why do they not decrease the amount they demand in the suburbs to offset what they consume in the city? Given the assumption of homogeneous government output bundles, consumption in the city would seem to be a close substitute for consumption in the suburb.

Our model is oversimplified on this ground, but the simplification is convenient and the results not very sensitive to the issue. With respect to the constancy of G, G is taken to be the *effective* demand for government output. City residents continue to demand their same per capita public *output:* suburbanites' consumption of city public goods is not an *effective* demand by them for such goods, since they are disenfranchised in the city. Their consumption raises the *resource cost* of meeting the city dweller's effective demand, so it is as a cost rather than as a component of G that we treat it.

The second question is more important. Insofar as they are substitutes, suburbanites' consumption of public goods in the city should decrease their demand for public goods in the suburbs. This might be a significant effect with heterogeneous public goods. Then density or scale, or population heterogeneity requirements might lead to certain public goods being provided only by central cities and not by suburbs, while suburbanites continued to enjoy them by traveling to the central city. Locational specialization of this sort could be substantial.[9] In a homogeneous public goods world this is less important. Overhead and peak load considerations make it difficult for suburbanites to save much on streets, water and sanitation, police and fire, schools, and other standard functions of local government just because some members of the community—typically some member or members of some of the households—conduct some of their activities out of the jurisdiction. Something can be saved, but not much.

Our assumption of G invariant with spatial distribution thus has the effect of misclassifying part of the discrepancy between ideal and actual public cost as waste instead of as payment for productive input, thus overstating waste. But allowance for these substitutions increases the

the analysis to suppose that the initial ratio between them is 1 : 1.5 instead of 1 : 1. The initial distribution of population between N_1 and N_2 will of course be affected, since this is influenced by the distribution of business and the relative real cost of government in the two jurisdictions. But the succeeding analysis simply examines how this initial distribution will be changed by the presence of externalities.

[9] Consider the specialized provision of zoos, museums, major league ball parks, or opera houses in the real world of public good heterogeneity.

size of the discrepancy by making suburban location even more "artificially" attractive, thus understating waste. The net effect on measruement of waste is therefore uncertain. In any case, this issue does not affect the impact of externalities on location decisions.

Our discussion bears on our assumption of constant per capita costs, since this implies an absence of scale effects (for constant E). Yet the effect of the model's jurisdictional externalities is to establish a population density effect on cost (with thresholds): lower density through suburbanization increases total costs (partly in extra transportation).

We now specify how public costs are borne through taxes. We assume simply that tax liabilities are proportional to income. Since all individual incomes are equal, this is tantamount to a per capita tax. By suitable supporting assumptions relating real estate improvements to income, we may also interpret it as a tax on such improvements. Since the tax is associated with the individual and his income, when the individual shifts from one jurisdiction to another his tax liability moves with him. For a property tax interpretation we would have to assume that the assets upon which the tax is levied must also move with him. This is an appropriate long-run assumption for real estate improvements. What is precluded by this is a tax on land, since land remains in one place, along with its tax liability, regardless of the domicile of its owner.

We omit direct reference to business taxes, even though business firms exist and are presumably subject to taxation. The proper interpretation of this exclusion is that we assume that firms as a whole are subject to a total tax liability just equal to the portion of total costs for which they are responsible: they exactly pay their way. This means that the resource costs (S_1, S_2), per capita output prices (P_1, P_2), and tax rates (T_1, T_2) refer only to those for which services to households are responsible.[10] This is unsatisfactory for the interpretation of some real world phenomena, but does little analytic harm in the absence of a treatment of business location as endogenous.

The tax functions in the respective jurisdictions are:

$$T_1 = P_2 + \frac{aE(P_2, N_2)}{N_1} \tag{15}$$

$$T_2 = P_2 + \frac{(1 - a)E(P_2, N_2)}{N_2}, \tag{16}$$

[10] This does not refer to any discrimination of public goods to different beneficiaries but only to the incremental effect on the size of total resource costs of the presence of a household population in addition to business firms. This treatment of business taxes bears on footnote 8 above. It implies that tax rates on households *are* similar in city and suburb except for externalities.

where T_1 is the central city tax rate on individuals (i.e., net of business influences); T_2 is the suburban tax rate on individuals (i.e., net of business influences); $(1 - a)$ is the percentage of expenses due to suburban-caused interjurisdictional externalities which is financed by suburbanites (a marginal tax rate); and a is the percentage of these expenses which, as a residual, is borne by city dwellers.

The tax rate for each jurisdiction is the sum of the per capita cost of the basic public output bundle P_2 and that portion of the total externality cost which is borne by inhabitants of that jurisdiction. We suppose that the decision is first made by the municipal government as to how much of the total externality cost can be placed on those on whose account it was incurred $(1 - a)$, and the residual (a) must be borne by the city population.

The last element in the model is the residential location function, expressing the factors which influence the decision of residents in selecting the jurisdiction in the metropolitan area within which they wish to reside.

$$N_1 = L\left(N, A, C, \frac{T_2}{T_1}\right) \tag{17}$$

$$\frac{\partial L}{\partial\left(\frac{T_2}{T_1}\right)} > 0,$$

where L is the residential location function, showing determinants of jurisdictional mobility; A is the distribution of community amenities between city and suburb; and C is the city-suburb distribution of jobs and commerce (aggregate relative accessibility).

The decision to locate in one jurisdiction or another depends on the distribution of community amenities between jurisdictions (a composite index of tastes for city versus suburban way of life), the distribution of job and shopping locations (an aggregate relative accessibility variable), and the relative tax rates between the two jurisdictions. The presence of N is to normalize the size of N_1 to the given total SMSA population. The determination of N_1 automatically determines N_2. The relative price of land in city and suburb is included indirectly, because since it is assumed that the patterns of relative amenity and relative accessibility have determinable effects on location, this implies, given a set of transportation costs assumed to be unaffected by the changes of the present model (and therefore omitted as an explicit functional argument), that a land rent gradient can be inferred whose influence on location, along with the others mentioned, is consistent with observed choices.[11]

The Optimal Distribution of Population

Since total G is constant, but S varies, for different distributions of N between N_1 and N_2, we define the optimal population distribution as that which minimizes total resource cost. Thus, the goal is:

$$\min S = S_1 + S_2 = P_1N_1 + P_2N_2 \tag{18}$$

subject to the constraint that individuals choose their locations freely, i.e.,

$$N_1 = L\left(N, A, C, \frac{T_2}{T_1}\right)$$

We have two cases, one without externalities, the other with.

CASE I: EXTERNALITIES ABSENT. Form the Lagrangean expression

$$Y_I = P_2(N - N_2) + P_2N_2 + \lambda(N - N_2 - L) \tag{19}$$

from 13a and 14a. Then:

(20) a. $$\frac{\partial Y}{\partial N_2} = \frac{\partial}{\partial N_2}[P_2(N - N_2) + P_2N_2 + \lambda(N - N_2 - L)] = 0$$

b. $$\frac{\partial Y}{\partial \lambda} = \frac{\partial Y}{\partial \lambda} = 0$$

From a: $-P_2 + P_2 - \lambda - \lambda\left(\frac{\partial L}{\partial N_2}\right) = 0$ or $\lambda\left(1 + \frac{\partial L}{\partial N_2}\right) = 0$; but with no externalities $T_1 = P_2 = T_2$, so $\partial L/\partial N_2 = 0$, and therefore $\lambda = 0$, i.e., the social cost of a move by any individual is zero.

From b: $N - N_2 - L = 0$, or $N_1 = L$. Together this means that any distribution along L is optimal: redistributions do not affect total costs.

CASE II: EXTERNALITIES PRESENT.

$$Y_{II} = P_2(N - N_2) + E(P_2, N_2) + P_2N_2 + \lambda(N - N_2 - L) \tag{21}$$

Setting partial derivatives equal to zero for first order conditions:

[11] Our exclusion of land taxes means that tax changes do not necessarily become capitalized in land prices.

(22a) $$\lambda = \frac{E_{N_2}}{1 + \dfrac{\partial L}{\partial N_2}} \qquad \left(\frac{\partial L}{\partial N_2} \neq 0 \text{ generally, since } \frac{\partial\left(\dfrac{T_2}{T_1}\right)}{\partial N_2} \neq 0\right)$$

Similarly, $N - N_2 - L = 0$, so

(22b) $$N_1 = L$$

Equation 22a is the crux. The right side represents the marginal social cost of an additional unit move to the suburbs, the left side the marginal social value. The marginal social cost comprises a direct and an indirect component. The numerator represents the marginal externality cost of a single unit's move to the suburbs; the denominator represents the number of units who make the move, both by direct initiation (i.e., 1) and as induced through the influence of such moves on $\dfrac{T_2}{T_1}$ $\left(\text{i.e., } \dfrac{\partial L}{\partial N_2}\right)$. $\dfrac{\partial L}{\partial N_2} = \dfrac{\partial L}{\partial(T_2/T_1)} \dfrac{\partial(T_2/T_1)}{\partial N_2} < 0$ (since $\dfrac{\partial L}{\partial(T_2/T_1)} > 0$ and $\dfrac{\partial(T_2/T_1)}{\partial N_2} < 0$); moreover, for stability purposes assume $-1 < \partial L/\partial N_2 < 0$. So

(23) $$\lambda > E_{N_2},$$

i.e., the social value of an additional move to the suburbs must exceed the mere marginal externality cost because the first move will induce others (interpreting "unit" as more than one person, so that $1 + L_{N_2}$ may represent at least one person), each of which incurs additional social costs.

An interpretation of marginal social value and of the equation as a whole in individualistic terms is that each move to the suburbs must be worth at least $E_{N_2}/(1 + L_{N_2})$ to the individual contemplating the move (and therefore, on the basis of individualistic value judgments, to the society) in order to be justified. Unjustified moves add more to social cost than to social benefits. A possible procedural rule for empirically determining the optimum distribution is for government to impose a charge equal to $E_{N_2}/(1 + L_{N_2})$ for the right to move to the suburbs, and then to allow anyone to move who is willing to pay the charge. We assume that individuals differ in their tastes in the matter of city versus suburb, so there will be an array of maximum charges that the members of N_1 will be willing to pay for the privilege of moving (some will be negative). The marginal mover will be the individual whose maximum charge just equals the official charge. Thus, $\lambda_j = E_{N_2}/(1 + L_{N_2}) = \lambda$, where individual j is this marginal mover.

Equilibrium Population Distribution

From here on, we consider only the situation with externalities present. In order to examine the discrepancy between optimal and realized population distributions we define the "neutral tax" case as one in which the relative tax rates of the two jurisdictions—the relative price facing each individual—just equals the marginal rate of substitution of a location move between them. Each individual would face market signals which gave the true marginal social cost of moving in either direction: the externalities would in an important sense be internalized.

(24) $$\text{Define } N_{1I} \equiv L_I\left(\frac{T_2}{T_1} = \frac{MSC_2}{MSC_1} \,\bigg|\, N, A, C\right),$$

where N_{1I} is the "neutral tax" distribution (subscript I signifies "externalities internalized"), i.e., that N_1 population which comes about by free choice under given N, A, C, and T_2/T_1 equal to the marginal rate of substitution between city and suburb relocation—the ratio of the marginal social costs of a move in either direction ($MSC_2/MSC_1 = dN_1/dN_2 \mid S$ constant). In the present case $\frac{MSC_2}{MSC_1} = \frac{P_2 + E_{N_2}/(1 + L_{N_2})}{P_2} = 1 + \frac{E_{N_2}}{P(1 + L_{N_2})}$. So

(25) $$N_{1I} = L_I\left(1 + \frac{E_N}{P(1 + L_{N_2})} \,\bigg|\, N, A, C\right)$$

Now we shall express choice of city location (equation 17) as a function of N_{1I}, as follows:

(26) $$N_1 = L\left(N, A, C, \frac{T_2}{T_1}\right) = N_{1I}[1 - M(d, A, C)],$$

where $d = MSC_2/MSC_1 \div T_2/T_1$, i.e., the ratio of the marginal rate of substitution between location move and the relative tax rate. $M(d, A, C)$ is a function for which the following hold:

(1) $M(1, A, C) = 0$;

(2) $0 \leq M(d > 1, A, C) \leq 1$;

(3) $(1 - N/N_{1I}) \geq M(d < 1, A, C) \leq 0$;

(4) $0 \leq \partial M/\partial d \leq 1$.

Thus: (1) if externalities are completely internalized, $N_1 = N_{1I}$; (2) if the private cost of moving to the suburbs is less than the social cost, $N_1 < N_{1I}$; (3) if the private cost of moving to the suburbs is greater than the social cost, $N_{1I} \leq N_1 \leq N$; (4) an increase in the social cost relative to the private cost of moving to the suburbs decreases N_1, but with an upper limit on the magnitude of the effect.

Let us now bring in the tax system. Assume for simplification that E_{N_2} is constant over the domain of N_2 (i.e., $\partial E^2/\partial N_2^2 = 0$). Then $E_{N_2} = E/N_2$. We recall from equations 15 and 16 that $T_1 = P_2 + aE(P_2, N_2)/N_1$ and $T_2 = P_2 + (1 - a)E(P_2, N_2)/N_2$. If the tax system is to internalize the externalities, then each suburbanite must be faced with a charge that reflects the social cost which he incurs by his own use of city public output. Administratively, this may be approximated by imposing an appropriate charge on each and every occasion of use; or by imposing an annual charge on estimates of year-long costs incurred, based on certain characteristics of the individual's over-all situation. In either case the attempt is to pair each individual with the annual marginal cost of *his* being a suburbanite—i.e., a charge equal to E_{N_2}.

But the user-charges to approximate marginal costs are generally not available, not at least for many of the public goods involved. So charges on the suburbanites are likely to fall short of E_{N_2} for each, and fall short of E for all N_2. We assume $(1 - a)$ is the percentage of *total* external costs which falls on the suburbanites. Then a is the residual percentage which must be borne by the city dwellers, and the actual amount must be expressed as an *average* cost, because these are not met by user charges on city residents, since the residual depends on the amount of use by N_2, not N_1. Under our assumption of constant E_{N_2}, $E_{N_2} = E/N_2$, so we may rewrite equation 16 as $T_2 = P_2 + (1 - a)E_{N_2}$. (Any $1 - a$, $a(0 < 1 - a < 1)$ applied respectively to suburbanites on marginal or average cost basis, and to city dwellers on average cost basis, will exactly meet total E.[12])

We first examine two extreme tax cases and then the general case.

EXTREME CASE 1: $1 - a = 1$. Here the suburbanite pays the full private marginal externality cost. So no tax burden falls on the city dweller ($a = 0$). Then:

[12] This is not true for variable E_{N_2}, a matter which affects the complexity of the mathematics but not the basic issues examined here, exhaustion of E not being one of them.

(27)
$$d = \left(1 + \frac{E_{N_2}}{P_2(1 + L_{N_2})}\right) \div \left(\frac{P_2 + E_{N_2}}{P_2}\right)$$
$$= \left(1 + \frac{E_{N_2}}{P_2(1 + L_{N_2})}\right) \div \left(1 + \frac{E_{N_2}}{P_2}\right)$$

But $L_{N_2} = 0$ in this case, because $\frac{\partial L}{\partial N_2} = \frac{\partial L}{\partial(T_2/T_1)} \cdot \frac{\partial(T_2/T_1)}{\partial N_2}$ and:

(1) $\partial T_2/\partial N_2 = 0$ because E_{N_2} is constant and therefore does not affect the user charge for the rest of N_2;

(2) $\partial T_1/\partial N_1 = 0$ because, under constant E_{N_2}, the full marginal cost tax on all members of N_2 totals exactly E, so the shift to N_2 does not change the size of the over-all residual of E (which is zero) to be financed by N_1.

Thus, $d = 1$, and so $\bar{N}_1 = N_{1I}$ (where $\bar{N}_1$ is equilibrium N_1). In a perfectly responsive system of user charges such that each suburbanite pays his full personal E_{N_2}, all externalities are internalized, and the distribution of population is optimal.

EXTREME CASE 2: $1 - a = 0$. Here the suburbanite pays no part of the externalities. The total is borne by an average cost tax on the city dweller ($a = 1$). Then:

(28)
$$d = \left(1 + \frac{E_{N_2}}{P(1 + L_{N_2})}\right) \div \left(\frac{P_2}{P_2 + E/N_1}\right)$$
$$= \left(1 + \frac{E_{N_2}}{P(1 + L_{N_2})}\right)\left(1 + \frac{E/N_1}{P_2}\right) > 1$$

The inequality holds because both multiplier expressions >1 since E_{N_2}, P_2, E and N_1 are positive, while $-1 < L_{N_2} < 0$ (so that $0 < 1 + L_{N_2} < 1$). L_{N_2} here *is* affected by changes in N_2, since any increase in N_2 increases the tax burden on N_1 by E_{N_2}. So (1) $\partial T_2/\partial N_2 = 0$ (no part of E_{N_2} is borne by N_2), (2) $\frac{T_1}{N_2} > 0$, so together $\frac{\partial(T_2/T_1)}{\partial N_2} < 0$, and therefore $\frac{\partial L}{\partial N_2} = \frac{\partial L}{\partial(T_2/T_1)} \cdot \frac{\partial(T_2/T_1)}{\partial N_2} < 0$.

The results are: (1) $d > 1$, (2) $\bar{N}_1 < N_{1I}$, (3) $\bar{N}_1$ is less the greater E_{N_2}, E/N_1 and $|L_{N_2}|$ are, and the smaller P_2, i.e., the larger are external costs relative to direct costs.

In this case there is a problem of the existence of equilibrium. Given an initial shift from the city to the suburb, this induces additional shifts through the relative tax rate effect which, in turn, induces further shifts via the same mechanism. Is there any convergence so that the shifting stops before $N_2 = N$? To answer this rigorously would require recasting the problem into dynamic terms. The scope of the paper precludes this. Instead we shall give an informal exposition of the issues involved.

Form the total differential of L.

$$(29) \qquad dL = \frac{\partial L}{\partial N}\,dN + \frac{\partial L}{\partial A}\,dA + \frac{\partial L}{\partial C}\,dC + \frac{\partial L}{\partial (T_2/T_1)}\,d\left(\frac{T_2}{T_1}\right)$$

The condition for equilibrium is that at N_2,

$$(30) \qquad \frac{\partial L}{\partial N_2} = \frac{\partial L}{\partial (T_2/T_1)} \; \frac{\partial (T_2/T_1)}{\partial N_2} = 0.$$

Our model essentially assumes $\dfrac{\partial (T_2/T_1)}{\partial N_2}$ = constant, so equation 30 requires $\dfrac{\partial L}{\partial (T_2/T_1)} = 0$. A reasonable specification for the partial relationship between T_2/T_1 and L is an exponential or growth curve, characterized critically for our purposes by increasing flatness at lower and lower values of L (i.e., N_1). This reflects the cost differentials that will induce different members of the population to shift from city to suburb. Since we assume a whole spectrum of tastes for city versus suburban living, at low values of L only intense city lovers are left as city dwellers and it takes larger and larger increments of the cost differential to induce more of these individuals to move.

In the continuous form specified there will be no convergence short of $N_2 = N$ so long as both partial derivatives are even slightly positive. An equilibrium is more reasonable if we recognize the discreteness of the population. Then the relationships of equation 30 become step functions. As N_2 increases, each new household shift causes a jump in T_2/T_1 (which we continue to assume is constant over the relevant range).[13] This jump induces a new jump in N_2. But these induced moves become smaller and smaller as N_2 gets larger. Finally, there comes a point where the constant jump in T_2/T_1 induced by the previous unit jump in N_2 is no longer as large as the T_2/T_1 jump that is necessary to induce the next least suburb-aversive person to make the shift (the growing cost differentials necessary to induce shifts are retained from the con-

[13] More realistically, this effect should vary over N_2. But this stems from a varying E_{N_2}.

tinuous case above). The shift process stops, and equilibrium is achieved, with an inequality rather than an equality in this discrete case. The equilibrium condition is:

$$(31) \qquad \left|\frac{1}{\dfrac{\Delta L}{\Delta(T_2/T_1)}}\right|_{\bar{L}} > \left|\frac{\Delta(T_2/T_1)}{\Delta N_2}\right| > \left|\frac{1}{\dfrac{\Delta L}{\Delta(T_2/T_1)}}\right|_{\bar{L}+1}$$

where $\bar{L}$ (or $\bar{N}_1$) is the equilibrium size of N_1.

Thus, equilibrium short of $N_2 = N$ exists only if these relative slope relationships exist in some range of N_2 short of $N_2 = N$—and this depends upon the empirical characteristics of the particular situation involved. Equilibrium is more likely to exist the wider the variety of tastes concerning city-suburban location among the population. If it exists, it will occur with smaller N_2 the larger the percentage of N that has intense tastes favoring city location.

Assume $0 < 1 - a < 1$. So both N_1 and N_2 must share in financing E. The general expression for d in this case is:

$$(32) \qquad d = \left(1 + \frac{E_{N_2}}{P_2(1 + L_{N_2})}\right) \div \left(\frac{P_2 + (1 - a)E_{N_2}}{P_2 + aE/N_1}\right)$$

$$= \left(1 + \frac{E_{N_2}}{P_2(1 + L_{N_2})}\right)\left(\frac{P_2 + aE/N_1}{P_2 + (1 - a)E_{N_2}}\right).$$

Without explicitly solving we can state sufficient conditions for $d > 1$. Since the first term exceeds 1, it is sufficient for $d > 1$ that:

(33)

$$P_2 + \frac{aE}{N_1} \geq P_2 + (1 - a)E_{N_2}; \text{ or } \frac{aE}{N_1} > (1 - a)E_{N_2}; \text{ or } \frac{a}{1 - a} \geq \frac{N_1 E_{N_2}}{E}.$$

Under our assumption of constant E_{N_2}, this can be interpreted as follows. $\bar{N}_1$ is less than optimal N_{1I} if the percentage of the marginal externality falling on N_1 (i.e., $a/(1 - a)$) exceeds the percentage of total E which N_1 would pay if *they* were subject to the marginal cost taxation imposed on N_2. With E_{N_2} constant this is a function of $a/(1 - a)$ and N_1 only: the larger is a or the smaller is N_1. If N_1 begins very large relative to N it takes a large relative a to oversuburbanize. If the appropriate L_{N_2} function is a growth curve, this is augmented by the smallness of L_{N_2} with large N_1, since the effect on T_2/T_1 of a small shift to N_2 is very small.[14]

[14] A growth curve implies that the absence of a critical mass of other people is a repelling force in location decisions. When population density is especially sparse in the suburbs, it takes a larger T_2/T_1 change to induce suburbanizing shifts.

Exact conditions for $d > 1$ bearing intuitive force are not easy to derive from equation 32. An intermediate form of manipulation helps some. The condition that $d > 1$ is:

(34)

$$1 > \frac{P_2^2(1 + L_{N_2}) + P_2(1 - a)(1 + L_{N_2})E_{N_2} - P_2 E_{N_2} - (aEE_{N_2}/N_1)}{[P_2 + (aE/N_1)][P_2(1 + L_{N_2})]}.$$

We may draw some presumptive inferences. $d > 1$ (and therefore oversuburbanization) is favored by: (1) high E, (2) high L_{N_2} (in absolute value), (3) low N_1, (4) high E_{N_2}, and (5) high a.

In the typical metropolitan area E_{N_2} is probably not much above zero. So the first term is probably not much above 1. But in some municipal tax systems a may exceed $1 - a$ considerably (especially since we deal only with the nonbusiness portion of taxes and expenses). For these systems, since $N_2E_{N_2} = E$ by our assumption of constant E_{N_2}, so long as N_2 is at all comparable in size to N_1, d will considerably exceed 1. Thus, where tax systems fail to charge suburbanites a substantial part of their externality-generated costs, the distortion effect on allocation stemming from oversuburbanization will be noteworthy in those metropolitan areas where the suburban population is a sizable part of the total, the effect will be all the more the greater the influence of T_2/T_1 on the location decision.

The Character of Resource Misallocation

Suppose $N_1 < N_{1I}$. In what way is this suboptimal? Three aspects of resource misallocation are involved. First, suburbanization is carried inadvertently too far, because private incentives reflect social interests in a systematically distorted way. As a result, the whole pattern of consumption (e.g., transportation and housing combinations), and the pairing of individuals with jobs, differ systematically from what they would have been in the absence of uninternalized externalities, diverge from the best over-all accommodation of means to ends. So there are net productivity losses for households and businesses. Their magnitude depends on the specifics of the situation.

Second, excess suburbanization leads to excess resource costs of conducting local government in the metropolitan area. In our simple model the size of this excess is measured by the difference between actual externality costs at equilibrium $\bar{N}_2[E(P_2, \bar{N}_2)]$ and the optimal level of costs that compromises population tastes for city versus suburb with the social cost of buying different amounts of dispersed living

$[E(P_2, \hat{N}_2)]$. The public is willing to pay for this much enhanced resource cost for the privilege of $\hat{N}_2$ leading suburban lives.

It may be objected that $E(P_2, \bar{N}_2) - E(P_2, \hat{N}_2)$ overstates the true amount of wasted resources in the public sector because suburban consumption of city public goods does render social gain: part of the discrepancy is a resource payment for the production (and consumption) of extra public goods (G actually varies over different population distributions). This is controversial. Nonetheless, the public good decision is taken on the basis of monetary incentives that distort the true social costs of the decision. So some government waste *is* involved, and the differential $E(P_2, \bar{N}_2) - E(P_2, \hat{N}_2)$ is at least an *index*—if not a direct measure—of the extent of the distortion.

Third, distorting price effects, although so far omitted, will probably vary. If relative prices are admitted in the demand for public goods, excess suburbanization increases the real price of public goods for the city, thereby leading to a decreased combination of quality-quantity in their production. Introducing public output production as an argument in the location function may then show substantial locational impact. Some empirical results suggest that differences in tastes for city versus suburban living are much more sensitive to the public output dimension than to the public costs dimension. Thus locational resource misallocation may be more serious when the endogeneity of public goods output is considered. Even further types of effects may be approached, since this suggests an explicit treatment of heterogeneous public goods.

Addendum: Residential Location with Explicit Land Prices

In the model just presented equilibrium depended on the discreteness of certain relations ostensibly corresponding to the discreteness of the population. This is not satisfactory, since the relevant populations are large enough to be well approximated by continuous models. Additional mechanisms for equilibrating convergence are therefore desirable. An attractive candidate is the introduction of relative land prices into the residential location function, as follows:

$$N_1 = L\left(N, A, C, \frac{r_2(N_2)}{r_1(N_1)}, \frac{T_2}{T_1}\right), \tag{35}$$

where r_1 and r_2 are the per acre price of land in the city and suburbs, respectively. This may be enriched further by making land values and developed acreage separately variable, as follows:

$$(36) \qquad N_1 = L\left[N, A, C, \frac{R_2(N_2)/M_2}{R_1(N_1)/M_1}, \frac{T_2}{T_1}\right],$$

where R_1 and R_2 are respective total land values, and M_1 and M_2 respective total developed acres, in city and suburb.

These steps permit introduction of an explicit property tax system, but we must distinguish between a tax on real estate improvements having the same interjurisdictional mobility in the long run as economic decision-making units, and which therefore influences location decisions; and a tax on land having no such mobility, regardless of its owner's residence, and so does not influence location decisions. We do this by recasting the definition of T_1 and T_2 thus:

$$(37) \qquad \text{a. } T_1 = P_2 + \frac{aE(P_2, N_2)}{N_1} - \frac{bR_1(N_1)}{N_1}$$

$$\text{b. } T_2 = P_2 + (1 - a)E_{N_2}(P_2, N_2) - \frac{bR_2(N_2)}{N_2},$$

where R_1 and R_2 are functions expressing total land values in city and suburb respectively and b is the land tax rate. (P_2 is now interpreted as a cost per unit of taxable real property.)

These modifications help build a self-balancing distributional mechanism. As persons move from city to suburb they set in motion forces tending to augment further moves through a worsening tax rate situation in the city, but also tending some to *restrain* further moves. Their greater density in the suburbs tends to bid up land prices there, while the now-lower density in the city tends to make land prices fall there. These effects need not be linear over the domain of N_2, and their presence augments the increasing friction of inducing shifts through differences in tastes, thereby making stable equilibrium positions highly likely even in the continuous function case. Comparison of the effect of land prices and tax rates in influencing location decisions depends on relative values of land versus improvements (but the equilibrating power of land prices is lessened by inclusion of land tax revenues as a subtraction from the tax liabilities that influence location decisions).

Nonetheless inclusion of endogenous relative land prices does somewhat moderate, but not eliminate, the misallocative effects of externalities. To see the latter, suppose externalities did not exist, and population distribution was accomplished through equation 35. Now let externalities appear. The new effect on T_2/T_1 would change that distribution, and the endogenous change in land prices would then occur as an offset *only to the extent that some locational effect had already occurred.* Moreover, the braking effect could not logically reverse all traces of such an effect. It merely serves to moderate the net effect. Misallocation will continue to occur, but it will be smaller.

Sketch of a Model of Residential and Business Location

Space will not permit more than a brief look at how the location of business firms can be made endogenous in a model of the sort we have been developing. We present the basic equations:

(38) $$N = N_1 + N_2$$

(39) $$C = C_1 + C_2$$

(40) $$G = G(N, C)$$

(41) $$G_C = \alpha G_N \qquad 0 \leq \alpha \leq 1$$

(42a) $$S_2 = S_2(N_2, C_2) = N_2 \frac{\partial S_2}{\partial N_2} + C_2\alpha \frac{\partial S_2}{\partial N_2} = N_2P_2 + \alpha C_2P_2$$

no externalities:

$$S_1 = S_1(N_1, C_1) = N_1 \frac{\partial S_1}{\partial N_1} + C_1\alpha \frac{\partial S_1}{\partial N_1} = N_1P_2 + \alpha C_1P_2 \quad (P_1 = P_2)$$

(42b) $$S_2 = S_2(N_2, C_2) = N_2P_2 + \alpha C_2P_2$$

externalities:

$$S_1 = S_1(N_1, N_2, C_1, C_2) = P_1(N_1, N_2, C_1, C_2)N_1$$
$$= N_1P_2 + \alpha C_1P_2 + E(P_2, N_2, C_2)$$
$$E(P_2, 0, 0) = 0; E_{C_2} = \beta E_{N_2}$$
$$0 \leq \beta \leq 1 \qquad \alpha \gtreqless \beta$$

(43) Residential location:

$$N_1 = L\left(N, A, C_1, C_2, \frac{T_2}{T_1}\right) = N_{1I}[1 - M(d, A, C_1, C_2)]$$

(44) Business location:

$$C_1 = K\left(N_1, N_2, A, \frac{T_2}{T_1}\right) = C_{1I}[1 - Q(f, A, N_1, N_2)]$$

(45) $$T_1 = \frac{N_1P_2 + \alpha C_1P_2 + aE(P_2, N_2, C_2) - R_1(N_1, C_1)}{V_N(N_1 + \gamma C_1)}$$

(46) $$T_2 = \frac{N_2P_2 + \alpha C_2P_2}{V_N(N_2 + \gamma C_2)} + (1 - a)E_{N_2}(P_2, N_2, C_2) - \frac{R_2(N_2, C_2)}{V_N(N_2 + \gamma C_2)}$$

where C, C_1, and C_2 are business units in total, city and suburb respectively (expressed in acres of occupancy); f is the ratio of marginal social cost of business in the suburb to that in the city divided by the ratio of the business tax rate in the suburb to that in the city; Q is a function with properties analogous to those of M in equations 26 and 43; γ is the coefficient showing a combination of lower per acre generation of public good cost and higher average taxable value of real improvements per acre than resident unit; N, N_1, N_2 have the usual meaning and are expressed in per person units, each bearing constant average taxable real improvements; V_N is assessable capital value per resident unit (person); and γV_N is assessable capital value per business unit (acre).

In this model a shift of one resident unit from city to suburb first affects relative tax rates in the usual fashion and induces further residential shifts in the usual fashion. But it also affects business location in two ways: first, through the same relative tax rate change and second, because businesses are attracted to residents for the same locational reasons (access to customers and labor supply) that attract residents to businesses (access to jobs and retail trade)—but with larger lags, larger thresholds and smaller impact. These induced business shifts then augment the second round resident shifts because of the new distribution of business in the SMSA, and thus the patterns of accessibility are changed. These in turn induce further business shifts and the interactive process continues.

Thus, locational interactions between households and businesses operate at every stage through both a direct (accessibility) and an indirect (relative tax rates) route. On the one hand the over-all locational shift for any given tax rate change will be much greater in the present model than in the first model with business location frozen. On the other hand, in this model E_{N_2} and E_{C_2} are not constant because they reflect the extent of residents' and businesses' continued dependency on the central city after moving to the suburbs. This dependency is based on the mix and scale of economic activities in the suburbs. As these become larger and larger with N_2 and C_2, the suburbs become increasingly independent of the central city. So each succeeding shift of resident or business generates a smaller and smaller externality. In the limit when suburb and city are equally self-dependent, further shifts cause no additional (asymmetric) externalities at all. Thus, the misallocative forces are greater for small to middling suburbs in this model than in our model of residential location, but they probably are weaker for large suburbs. Comparison of the over-all resultant misallocation in the two models is difficult in the abstract.[15] It rests on empirical particularities.

Epilogue: Intergovernmental Grants, Jurisdictional Consolidations and the Relevance of Local Government Scale Economies

Scale economies have relevance to the issues raised in these models. Home rule behavior tends to produce jurisdictions which are too small and homogeneous to be efficient. Two kinds of palliatives may be suggested: intergovernmental grants or consolidation. Scale economies concern the second. Intergovernmental grants to the central city or direct intervention from higher levels of government would mean for the redistributive function, either direct assumption of responsibility or transfers to permit the lower level city government to perform its continuing redistributive mission more effectively; for the externality issue, it would mean subsidization to effect partial or total offset to the adverse changes in relative tax rates, and thus to moderate the misallocative effects of externalities.

Jurisdictional consolidation (e.g., metropolitan government) would rectify the source of inefficiencies directly, but is not likely to be voluntarily accepted because the very incentives that led to jurisdictional fragmentation (the self-interest of small, homogeneous groups) would make it unattractive to the beneficiaries of that fragmentation. However, the benefits involved will be smaller if there are scale economies which prejudice small jurisdictions. Important scale economies often lead to creation of larger special districts. As suggested above (footnote

[15] The nonlinear impacts in this model make equilibria highly probable under reasonable circumstances with continuous functions.

2), these result in a different and undesirable form of fragmentation. Central city jurisdictions have bargaining wedges here that could lead toward partial or total jurisdictional coordination. They could offer to trade cooperative arrangements involving use of public goods they produce under substantial scale economies, cooperative arrangements involving functions where externalities, not scale factors, operate to *their* disadvantage. Such progressively extensive arrangements could be further enhanced if higher jurisdictions insisted on using them as agents for their intergovernmental transfers and other forms of local intervention.

We have argued in this paper that the efficiency of local collective decision making should not be taken for granted. Such efficiency is a subtly intertwined skein. We shall need more knowledge than we now possess to recognize the various forms of inefficiency that are likely to occur. We shall need much more knowledge—and patience and wisdom as well—to do something when we recognize that they do occur.

COMMENT

by GORDON TULLOCK, *Virginia Polytechnic Institute*

I should like to begin by welcoming Rothenberg to the club. He is now the third person (Mancur Olson and I are the other two) who has been applying the particular type of reasoning he has presented today to the problem of the optimal size of government units. This approach is, I think, a natural outgrowth of recent work in both political science and economics. Clearly, the market does not work perfectly. In fact, it rather rarely works even close to perfectly. On the other hand, the political apparatus also does not work perfectly, and we must offset the defects of one apparatus against those of the other in order to choose which we will use in any particular application. This means, in general, that we should offset what are customarily called economic externalities with what Professor Rothenberg has referred to as political externalities. My choice of a necktie, for example, generates externalities and there is a finite chance that a citizen of Afghanistan would see my necktie and be annoyed by it. There is, therefore, an externality that extends all the way to Afghanistan. Clearly, however, no one would suggest that we have a world government for this particular activity.

On the other hand, national defense is (as we frequently hear these days) something which oppresses certain people in our society. There are certain people in our society who would purchase very much less national defense if the choice were theirs. Nevertheless, in this case we would all insist that the particular activity should be dealt with by the government even though it involves a political externality on certain of our citizens. In each of these cases we would anticipate that the costs would be lower with the particular mechanism we suggest.

Let me, however, turn to a technical appraisal of Professor Rothenberg's paper. Let me for the moment confine myself to allocational problems. Here Professor Rothenberg lists three goals: the minimization of political externalities, the internalization of the economic externalities, and capture of economies of scale. The third of these criteria is a mistake. As a general rule, we do not have to choose our political unit in terms of productive efficiency for any particular activity. There is no reason why political units cannot contract out services to either public or private organizations which are optimal in terms of production. In fact, we see a great deal of this in modern times. Police departments, education, fire department, etc., are quite frequently contracted out. In the area immediately surrounding Los Angeles this practice has been particularly well developed and some of the new small communities in that area have literally reduced their own government to a city council. Everything else, including collection of taxes, is contracted out.

Once we realize that government activities can be contracted out, we are of course free from any necessity of selecting governmental units in terms of an efficient producing unit. What we need is a unit in which the externalities are rather well internalized. If such a unit is much smaller than the optimal producing unit, it will buy rather than produce public goods. It should, of course, be kept in mind that we will never be able completely to eliminate the externalities. Political externalities grow steadily as the size of jurisdiction is increased and fall to zero only when we have complete individual choice. The economic externality, on the other hand, will always exist if we have more than one political unit because there will always be some effect at the border of a political unit. Thus, what we want to do is minimize the sum of these two types of externalities, realizing that this will characteristically not involve reducing either one of them to zero.

It should be noted that if we follow this simple rule for each activity, choosing an optimal size of governmental unit by minimizing the sum of the two types of externalities, we would end up with thousands and thousands of governmental units with each individual being a member and voter in each of these thousands. Clearly this in and of itself would be inefficient, and therefore we must combine these functions into larger units in order to simplify the decision problem of the individual. This is not entirely a negative factor, however. It permits logrolling, and logrolling makes it somewhat easier to obtain adjustment with individual preferences. In particular, it makes it possible for individuals with intense preferences in one field to exert a disproportionate influence in that field.

Continuing to talk only about allocational matters, I should say that in my opinion the general approach offered by Professor Rothenberg as to the problems of the cities is not well founded empirically. I have never been deeply impressed with the theory that the central city is exploited by the suburbs. When an individual moves to the suburbs, he automatically carries with him the largest single governmental expenditure which will be made for him, i.e., the education of his children. Further, if he continues to retain his place of business in the central city, he will continue paying taxes. It is by no means obvious to me that the reduction in the expenditures which he works on the city by moving to the suburb is less than the reduction in the taxes. Even if he moves his place of business also to the suburbs, and only visits the city occasionally (let us say, to go to the theater), it is by no means obvious that he is exploiting the city. Presumably, his custom in the theater means that there are more theaters and hence that the tax rolls of the city are somewhat higher. How can we be certain that his consumption of city services is more important than this increase in the taxes?

But here we have a matter for empirical research, not exchange of subjective opinions. It should be noted that Professor Rothenberg's equations would operate just as well if my belief as to what is true in the real world is true as they would if his belief is true. It is simply that some factors which are positive in his presentation might turn out to be negative, and the consequence would be that we could find the central city subsidizing the suburbs.

So far, I have said nothing at all about redistribution of income. Clearly, this is an activity of existing governments, and equally clearly there are some externalities here. Hence government activity can be justified. The problem that I see with Professor Rothenberg's approach, then, is not the justification of government activity but an arbitrary circle in his reasoning. Once we have determined the optimum amount of redistribution, we could (at least theoretically) design a governmental unit which will produce that particular amount of redistribution. I am by no means sure that we know enough about politics at the moment to do this, but let us for the time being grant Professor Rothenberg's view that we can so design government units. This requires, however, that we have some method of determining the appropriate amount of redistribution of income. Rothenberg's approach, somewhat concealed but nevertheless it is his approach, is to take an existing unit of government (which I think is the national state although he refers to it as "the system as a whole") and determine by some unspecified way what this particular political unit feels is the optimum amount of redistribution. He then uses this particular amount of redistribution to determine the amount of redistribution to be designed into governments.

This procedure obviously is circular. If we are trying to design political units so that they have some optimum amount of redistribution, we cannot obtain that amount of redistribution from the design of political units. Having said this much, however, I should go on to say that I do not know any other procedure for obtaining the "right" amount of redistribution. As a result I am inclined to the view that we should design government units without much concern for their redistributional characteristics. This is not because I think it would not be desirable to design units to give optimal redistribution, but because I can see no way of obtaining data as to the proper amount of redistribution. I should, of course, in this connection repeat my earlier skepticism as to whether we know how to design a government to get a certain amount of redistribution. To elaborate slightly, my recent research into redistribution in the United States would seem to indicate that American citizens do not want to give very much to the poor. If this is so, an optimal redistribution might be very small.

I should like to close by pointing out that most of my criticism of Professor Rothenberg's paper has been concerned with details. His general approach seems to me to be sound, and it seems to me also that a great many of the differences which now exist between the detailed results obtained by this approach by Olson, Rothenberg, and myself are the result of the simple fact that it is a new technique. If we have further discussions of this sort and further scholars become interested in the field, I suspect that many of these problems will fairly shortly be solved.