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The Welfare Effects of Intergovernmental Grants in an Economy with Independent Jurisdictions[1]

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A general equilibrium model is presented of an economy where mobile and immobile households engage in decentralized market behavior and where immobile households control the expenditure and tax policy of each local government, subject to a local budget constraint. It is shown how central government grant policy (which is a formula with lump-sum, matching, and population elements) affects the general equilibrium of the system determined through market and local political decisions. The welfare effects of grants are discussed, with particular emphasis on distortions that may arise at lower levels of decision making that grants may be useful in (partially or completely) correcting.

I. INTRODUCTION

It is natural to approach the analysis of intergovernmental grants in an equilibrium framework. Viewed from the perspective of a grant-giving government, however, the system that establishes an equilibrium for any specific grant policy operates on at least two levels. At the first level, individual agents act in a decentralized market framework. Households and firms buy and sell goods in markets, and they expect their individual decisions to have no effect on the policies of central and local governments. Thus, levels of public service provision and tax rates constitute parameters determining the environment within which market decisions, including the decision about where to live and work and how much property services to consume, are made. At a second level of decision making, individuals participate in a local political process that generates local public policies. Presumably individuals act in this process in a self-interested way, which means, for example, that they may consider the marginal benefit and tax/price of local public goods, as assumed in many studies.[2] Of course, this

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[2]See Barr and Davis [2] for an early study, and Inman [9] for several additional references and a useful critical survey. In the specific context of intergovernmental grants, see, for example, Bradford and Oates [3, 4].

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is utility-maximizing behavior only under certain circumstances, and one needs to justify the assumption by examining explicitly the choice environment of the voter. One could argue, for instance, that individuals recognize that local public policies affect the market environment in which they act, and that they weigh these effects in attempting to shape local policy. Thus, voters might take into account the effects of local policy choices on their wages (if they are public employees, for example), and they might recognize that the value of their property depends on the choices they make. Such behavior means that the two levels of decision making, in the market and local political processes, are simultaneously determined. The outcome of decisions made at these levels determines, conditional on grant policy, a general equilibrium of the system, including local public goods levels, tax rates, locational choices, and all other market prices and quantities. This general equilibrium can be disturbed by a change in central government grant policy, the welfare effects of which we wish to evaluate.

In this paper I consider a simple economy in which some welfare effects of grant policy can be analyzed within a framework that accords with this general view and that should lend itself to future extensions. I examine a world in which each locality contains a single immobile household (or a group of identical households) that initially owns all land in the city. We can think of this household as representing the class of property owners in a city. There is, in addition, a class of renters. At the *market* level, both categories of households make utility-maximizing decisions subject to budget constraints; for mobile households this involves the added dimension of locational choice. At the local *political* level, taking central government grant policy as exogenous, the immobile household in each city chooses a level of public good provision, land taxation, and, possibly, head taxation, subject to a local government budget constraint. The landowner controls the local political process to the complete exclusion of renters, but is assumed to realize that local public policy influences the number of mobile households in the city, the crowding of local public services, the equilibrium land price, and the amount of grant funds received. (It may seem restrictive to assume this strong asymmetry in political decision-making, but it is shown to be the logical consequence of the structure of the model.) Within the context of this model, I examine the nature of the local public policy chosen by the landowner, and the ways it depends on the presence of mobile households. In what respects and in what senses is the policy chosen likely to be nonoptimal? Finally, and centrally, what are the welfare effects of intergovernmental grants in this setting, whether lump-sum, matching, or population-based?

It should be stressed that there are several strong simplifying assumptions in the analysis. For instance, I abstract from the existence of multilevel overlapping jurisdictions (school districts within counties within states within a country, etc.), focusing on just a two-level governmental structure consisting of, say, cities and a central government. Also, the only function of the central government in the analysis is to redistribute a *fixed* amount of funds *among* localities in some way, so that the welfare effect of a scaling up or down of the size of the grant program, and of central government tax collections, is not examined. The only justification that can be given for these assumptions is simplicity; but it is a compelling justification. I do not pretend to analyze the welfare effects of grants in all their complexity, but rather to bring out, in an intelligible way, some aspects of grant policy that seem not to have been noted previously and to provide a useful general framework within which further more realistic analyses may proceed.

II. THE MODEL

A. Economic Structure[3]

Let A represent the number of jurisdictions, indexed by subscripts α, β; $A \geqslant 2$; $l_{h\alpha}$, $\bar{l}_{h\alpha}$ the land consumption and land endowment, respectively, of the single immobile household in city α ($\bar{l}_{h\alpha}$ is the total, fixed amount of land in city α); $x_{h\alpha}$, $\bar{x}_{h\alpha}$ the all-purpose private good (henceforth, just "private good") consumption and endowment, respectively, of the single immobile household in city α; $l_{R\alpha}$, $x_{R\alpha}$ the land and private good consumption, respectively, of a mobile household residing in city α; $\bar{x}_R$ the private good endowment of each mobile household; $n_{R\alpha}$, $\bar{n}_R$ the number of mobile households residing in city α and the number of such households in whole economy, respectively; p_α the price of land relative to the private good in city α; t_α the tax per unit of land in city α, denominated in units of private good; τ_α, $\bar{\tau}$ the head tax collected from residents of city α and paid to the local government in city α, and head tax collected from all households regardless of location and paid to the central government, respectively, both denominated in units of private good; and z_α the level of public good provision in city α.

The model does not accommodate trade among cities, so we can use the private good as a numeraire for each city. The private good is physically homogeneous in all locations.

Without loss of generality, interpret p_α as the tax-inclusive price of land. Then, for city α, the budget constraint for the immobile household is

$$p_\alpha l_{h\alpha} + x_{h\alpha} = (p_\alpha - t_\alpha)\bar{l}_{h\alpha} + \bar{x}_{h\alpha} - (\tau_\alpha + \bar{\tau}) \qquad (1.1)$$

[3] The analysis that follows has been carried out in a more general model, allowing for arbitrary numbers of traded and nontraded private goods, transformed by general constant returns production processes in each city. All of the results carry through in this more general framework, the only significant difference being that real income changes resulting from the response of equilibrium prices (of both traded and nontraded goods) to changes in grant policy cannot arise, except with regard to land, in the present model. See Wildasin [14] for details.

while, for any mobile household residing there,

$$p_\alpha l_{R\alpha} + x_{R\alpha} = \bar{x}_R - (\tau_\alpha + \bar{\tau}). \tag{1.2}$$

City α uses the private good as an input to produce a single public good. Let $C_\alpha(z_\alpha, n_{R\alpha})$ denote the cost of providing z_α units of the public good when there are $n_{R\alpha}$ mobile households residing in city α. The term $n_{R\alpha}$ reflects crowding effects. The cost of public good provision is met out of taxes on land, local head taxes, and grants received from the central government; the grant received by city α, denominated in units of numéraire, may depend on z_α and on $n_{R\alpha}$ and is denoted $L_\alpha(z_\alpha, n_{R\alpha})$. Both C_α and L_α are assumed to be twice continuously differentiable, with derivatives indicated by subscripts. The local budget constraint for city α allows one to solve for

$$t_\alpha = \frac{C_\alpha - L_\alpha - (n_{R\alpha} + 1)\tau_\alpha}{\bar{l}_{h\alpha}} \tag{2}$$

which may be substituted into (1.1) to eliminate t_α in the remaining discussion.

The central government is assumed to control grant policy by choosing parameters in the L_α functions. Throughout this paper, I assume that the tax revenue of the central government—as determined by $\bar{\tau}$—is fixed, so that it operates subject to the constraint

$$\sum_\alpha L_\alpha(z_\alpha, n_{R\alpha}) = \sum_\alpha (n_{R\alpha} + 1)\bar{\tau}. \tag{3}$$

In market decision making, households maximize utility subject to budget constraints, viewing public policies as given. Utility functions of both immobile and mobile households depend on private and public good consumption, and are assumed to be well behaved. The maximum utility household hα can achieve, given p_α, z_α, and $I_{h\alpha} = \bar{x}_{h\alpha} + L_\alpha + n_{R\alpha}\tau_\alpha - C_\alpha - \bar{\tau}$, is obtained by maximizing $u_{h\alpha}(x_{h\alpha}, l_{h\alpha}, z_\alpha)$ subject to (1.1), yielding the indirect utility function $v_{h\alpha}(p_\alpha, z_\alpha, I_{h\alpha})$ where z_α enters both directly, and indirectly through $C_\alpha - L_\alpha$. (Derivatives of $u_{h\alpha}$ and $v_{h\alpha}$ are indicated by subscripts: e.g.,

$$\partial v_{h\alpha}/\partial p_\alpha \underset{\text{df}}{=} v_{h\alpha p},\ \partial v_{h\alpha}/\partial z_\alpha \underset{\text{df}}{=} v_{h\alpha z}.\ \partial v_{h\alpha}/\partial I_{h\alpha} \underset{\text{df}}{=} v_{h\alpha I}$$

is the marginal utility of income.) Similarly, the optimal consumption bundle $(x_{h\alpha}, l_{h\alpha})$ depends on these parameters. As far as mobile households are concerned, there are two stages conceptually involved in rational market choices. First, conditional on the choice of location in city α, $x_{R\alpha}$ must be chosen to maximize $u_{R\alpha}(x_{R\alpha}, l_{R\alpha}, z_\alpha)$ subject to (1.2). This gives rise to the indirect utility function $v_{R\alpha}$ and demand functions $(x_{R\alpha}, l_{R\alpha})$ which depend on p_α, z_α, and $I_{R\alpha} = \bar{x}_R - \tau_\alpha - \bar{\tau}$. Second, an optimal locational choice must be made, the implications of which are that

$$V_{R\alpha}(\cdot) < \max_\beta v_{R\beta}(\cdot) \to n_{R\alpha} = 0 \tag{4.1}$$

$$n_{R\alpha} > 0 \to v_{R\alpha}(\cdot) = \max_\beta v_{R\beta}(\cdot). \tag{4.2}$$

The effect of individual optimizing behavior at the market level is to establish (for given z_α, τ_α, $\bar{\tau}$, and for given functions L_α) equilibrium land prices (p_α), an equilibrium distribution of mobile households across cities $(n_{R\alpha})$, and an equilibrium utility level for mobile households $(\hat{v}_R)$ satisfying

$$l_{h\alpha} + n_{R\alpha} l_{R\alpha} - \bar{l}_{h\alpha} = 0 \qquad \forall\alpha \tag{5.1}$$

$$x_{h\alpha} + n_{R\alpha} x_{R\alpha} + C_\alpha + (n_{R\alpha} + 1)\bar{\tau} - \bar{x}_{h\alpha} - n_{R\alpha}\bar{x}_R - L_\alpha = 0 \qquad \forall\alpha \tag{5.2}$$

$$v_{R\alpha} - \hat{v}_R = 0 \qquad \forall\alpha \tag{5.3}$$

$$\sum_\alpha n_{R\alpha} - \bar{n}_R = 0. \tag{5.4}$$

Equations (5.1) and (5.2) are market-clearing conditions, while (5.3) is equivalent to (4) on the assumption that $n_{R\alpha} > 0$ for all α. (Though we could easily extend the model to accommodate $n_{R\alpha} = 0$ for some α's, this would add notational complexity and no insight. So in the discussion below we assume that $n_{R\alpha} > 0$ in all the equilibria that are analyzed.) It is easy to show that satisfaction of the remaining conditions imply equilibrium in each local market for the private good—which leaves equations and unknowns equal in number. This completes the description of the basic economic framework of the model.[4]

[4] The referee has asked why, in the special case of a world with *pure* local public goods (i.e., $C_{\alpha n} = 0$ for all α), not all mobile households would move to one city, to exploit scale economies there. The basic reason that population remains dispersed is that there is a locationally fixed scarce private good, namely, land. Speaking informally, if mobile households were to leave one city and locate in another, land prices would adjust to slow and finally stop the flow. (Remember that land is a consumption good for mobile households.) This is analogous to what happens in similar models where land, instead of being a consumption good, serves as a fixed factor of production that combines with mobile labor. In this case, relative wage rates adjust to ensure that, in general, all mobile households do not end up in one place. See Buchanan and Wagner [6], Flatters *et al.* [8], or Wildasin [13], for examples of such models. (In the more general version of the model of this paper alluded to in footnote 3, land can function in either of the above roles, not simply, as in the present version, as a consumption good.)

B. The Local Political Process

We now describe the determination of local public policy in this economy. Assume that each city is small so that the utility of the mobile households is determined independently of the public policy in any *particular* city. This assumption is natural if mobility is costless, the number of cities is large, and many (or all, as will be assumed for convenience) cities contain a nonnegligible number of mobile households in equilibrium. It implies, however, that mobile households (renters) are indifferent to, and therefore do not attempt to control, the local political process. By default, the immobile households (landowners) determine local public policies in their own self-interest. Note that this is the natural consequence of the assumed differentials in mobility and property ownership across households. These differentials, in more complex forms, would presumably be present in more realistic models. Here, however, we confine attention to a polar case for clarity and tractability.

Imagine now that all local governments and the central government have announced policies, and that a general *economic* equilibrium conditional on those policies, satisfying (5), has been reached. This will be a Nash *politico-economic* equilibrium if no immobile household finds it advantageous to vary local public policy (z_α, τ_α), conditional on fixed central and other local government policies. Given the small-city assumption, $\hat{v}_{\mathrm{R}}$ is exogenously given to the landowner in city α, and if local policy in city α is varied, the variables p_α and $n_{\mathrm{R}\alpha}$ will have to vary to ensure satisfaction of (5.1) and

$$v_{\mathrm{R}\alpha}(p_\alpha, z_\alpha, I_{\mathrm{R}\alpha}) - \hat{v}_{\mathrm{R}} = 0. \tag{5.3$'$}$$

This two-equation system can be solved recursively for p_α and $n_{\mathrm{R}\alpha}$ as functions of the parameters (z_α, τ_α). We denote these functions, and others depending on them, with asterisks, and assume that they are known to the landowners.[5] (Of course, a landowner does not know, and does not need to know, the utility function or utility level of renters. The functions $p^*_\alpha(z_\alpha, \tau_\alpha)$ and $n^*_{\mathrm{R}\alpha}(z_\alpha, \tau_\alpha)$ could be inferred from observation of the equilibrium response to variations in (z_α, τ_α), the policies of other localities held constant.) Then the Nash equilibrium condition is that, for each α, $v_{\mathrm{h}\alpha}(\cdot)$ be maximized with respect to (z_α, τ_α), given $p^*_\alpha(z_\alpha, \tau_\alpha)$ and $n^*_{\mathrm{R}\alpha}(z_\alpha, \tau_\alpha)$. The specific conditions characterizing this equilibrium will be derived in the next section.

Finally, note for later use some implications of the small-city assumption. Defining $\mathrm{MRS}_{\mathrm{R}\alpha}$ to be the marginal rate of substitution between the private

[5] Of course, $\hat{v}_{\mathrm{R}}$ is also a parameter of this system. This argument of the $p^*_\alpha(\cdot)$, $n^*_{\mathrm{R}\alpha}(\cdot)$ functions can be suppressed for notational simplicity, however.

and public good, (5.3)′ implies[6]

$$\frac{1}{v_{\mathrm{R}\alpha I}}\frac{dv_{\mathrm{R}\alpha}^*}{dz_\alpha} = -l_{\mathrm{R}\alpha}\frac{\partial p_\alpha^*}{\partial z_\alpha} + \mathrm{MRS}_{\mathrm{R}\alpha} = 0 \tag{6.1}$$

and

$$\frac{1}{v_{\mathrm{R}\alpha I}}\frac{dv_{\mathrm{R}\alpha}^*}{d\tau_\alpha} = -l_{\mathrm{R}\alpha}\frac{\partial p_\alpha^*}{\partial \tau_\alpha} - 1 = 0. \tag{6.2}$$

While (6.2) is obvious, (6.1) is more striking: landowners (or outside observers) who know how the local equilibrium land price varies in response to local public good provision can infer renters' marginal rates of substitution between the private and public good. Since the landowners also know their own MRS's, (marginal) preferences for the local public good are fully revealed to them, although they do not have any incentive to take renters' preferences into account per se.

Although inessential for the analysis to follow, we can also compute

$$\frac{\partial n_{\mathrm{R}\alpha}^*}{\partial z_\alpha} l_{\mathrm{R}\alpha} = -\left(\frac{\partial l_{\mathrm{h}\alpha}}{\partial p_\alpha} + n_{\mathrm{R}\alpha}\frac{\partial l_{\mathrm{R}\alpha}}{\partial p_\alpha}\right)\frac{\partial p_\alpha^*}{\partial z_\alpha} - \frac{\partial l_{\mathrm{h}\alpha}}{\partial z_\alpha} - n_{\mathrm{R}\alpha}\frac{\partial l_{\mathrm{R}\alpha}}{\partial z_\alpha} \tag{6.3}$$

and

$$\frac{\partial n_{\mathrm{R}\alpha}^*}{\partial \tau_\alpha} l_{\mathrm{R}\alpha} = \frac{\partial l_{\mathrm{h}\alpha}}{\partial I_{\mathrm{h}\alpha}} + n_{\mathrm{R}\alpha}\frac{\partial l_{\mathrm{R}\alpha}}{\partial I_{\mathrm{R}\alpha}} - \left(\frac{\partial l_{\mathrm{h}\alpha}}{\partial p_\alpha} + n_{\mathrm{R}\alpha}\frac{\partial l_{\mathrm{R}\alpha}}{\partial p_\alpha}\right)\frac{\partial p_\alpha^*}{\partial \tau_\alpha} \tag{6.4}$$

which both are direct results from (5.1). If the demand for land by both landowners and renters is independent of z_α, and if land is a normal good for both, (6.3) implies that $\partial n_{\mathrm{R}\alpha}^*/\partial z_\alpha > 0$ since $\partial p_\alpha^*/\partial z_\alpha > 0$ by (6.1). In the special case where landowners do not consume land, $l_{\mathrm{h}\alpha} \equiv 0$, (6.4) implies $\partial n_{\mathrm{R}\alpha}^*/\partial \tau_\alpha > 0$. But neither of the derivatives of $n_{\mathrm{R}\alpha}^*(\cdot)$ can be signed in general, nor need they be for what follows.

III. THE ANALYSIS OF GRANT POLICY

A. Without Head Taxes

In this subsection, I investigate the special case where no city uses local head taxes ($\tau_\alpha \equiv 0$ for all α), perhaps because of institutional constraints.

[6]Equation (6.1) follows using standard properties of the indirect utility function, particularly the well-known $v_{\mathrm{R}\alpha p}/v_{\mathrm{R}\alpha I} = -l_{\mathrm{R}\alpha}$, and also the perhaps less well-known $v_{\mathrm{R}\alpha z}/v_{\mathrm{R}\alpha I} = u_{\mathrm{R}\alpha z}/u_{\mathrm{R}\alpha x} = \mathrm{MRS}_{\mathrm{R}\alpha}$. ($\mathrm{MRS}_{\mathrm{h}\alpha}$ is similarly defined.) The marginal rate of substitution between the private and public good $\mathrm{MRS}_{\mathrm{R}\alpha}$ is, of course, evaluated at $(p_\alpha, z_\alpha, I_{\mathrm{R}\alpha})$. These properties of the indirect utility function will be used repeatedly in the following discussion.

Then, in political decision making, the local landowner only needs to choose z_α to maximize $v_{h\alpha}$, recognizing that p_α and $n_{R\alpha}$ depend upon this choice as described by the functions $p^*_\alpha(\cdot)$ and $n^*_{R\alpha}(\cdot)$. The first-order condition for z_α is

$$\begin{aligned}\frac{1}{v_{h\alpha I}}\frac{dv^*_{h\alpha}}{dz_\alpha} &= \mathrm{MRS}_{h\alpha} + \left(\bar{l}_{h\alpha} - l_{h\alpha}\right)\frac{\partial p^*_\alpha}{\partial z_\alpha} - \frac{d(C_\alpha - L_\alpha)^*}{dz_\alpha} \\ &= \mathrm{MRS}_{h\alpha} + n_{R\alpha}\mathrm{MRS}_{R\alpha} - \frac{d(C_\alpha - L_\alpha)^*}{dz_\alpha} = 0 \qquad (7)\end{aligned}$$

where the second equality follows from (5.1) and (6.1). Note the similarity with the traditional Samuelsonian condition: the last equation in (7) shows that the marginal benefit of the local public good, summed across landowners *and* renters, gets balanced against the effective net marginal cost to the city. (In the absence of grants and congestion effects, this latter would be just $C_{\alpha z}$, the marginal cost of one more unit of the good.) Intuitively, this is so because landowner and renter real income changes resulting from land price changes must be equal and offsetting (by (5.1)) while the renters' real income changes from land price changes must in turn be equal and opposite to their valuation of the public good (by (6.1)).

Equations (5.1), (5.3), (5.4), and (7) describe a Nash politico-economic equilibrium for this system. Assume that an equilibrium exists, and that the equilibrium responds smoothly to changes in the parameters of the system.[7] This is the natural perspective of a central government contemplating a change in policy, recognizing that such a change will affect both the market equilibrium and the outcome of the local political process. The problem now is to characterize the welfare effects of a change in central government policy.

It is easy enough to compute the effect of a change in grant policy on the utilities of the individual households. But to evaluate the overall effect of the policy, these utility changes must somehow be compared. I therefore assume that there is a function $W(\{v_{h\alpha}\}, \hat{v}_R)$, smoothly increasing in every argu-

[7]Assumptions of this type will be made repeatedly in the following analysis. In effect what is required is local uniqueness of equilibrium, coupled with an assumption that the system does not jump discontinuously from one equilibrium to another in response to policy changes. In a general way one may perhaps appeal to results such as those cited in Debreu [7] for support. The fact is that a detailed analysis of this question would be quite complex and, I feel, quite inappropriate given the highly tentative nature of the basic theoretical framework being used. Essentially this paper is directed toward a sketch, in broad strokes, of the effects of grant policy, where the emphasis should be on identifying some of the principal issues, unobscured by technicalities. I do not believe that the basic economic insights that the analysis produces would be overturned in a more rigorous treatment.

ment, that represents the way in which these comparisons are made. We call W a social welfare function (SWF), but it is not necessary to interpret W as the outcome of some ideal collective choice process. It simply represents any way of making an evaluation of the policy that respects individual preferences. Note that W treats all mobile households equally, regardless of location.

I begin by sketching the analysis of the special case where $C_{\alpha n} \equiv L_{\alpha n} \equiv 0$, so that there is no crowding effect with respect to local public goods, and grants are not tied to population. More specifically, I assume that the grant to city α is a combination of a uniform lump-sum grant and a matching grant at a uniform rate:

$$L_\alpha = L_0 + L_1 z_\alpha. \tag{8}$$

Then, starting from any given $\bar{L}_0$ and $\bar{L}_1$, we have, for $i = 0, 1$,

$$\begin{aligned}
\frac{dW}{dL_i} &= \sum_\alpha W_\alpha \frac{dv_{\mathrm{h}\alpha}}{dL_i} + W_{\mathrm{R}} \frac{d\hat{v}_{\mathrm{R}}}{dL_i} \\
&= \sum_\alpha W_\alpha \frac{dv_{\mathrm{h}\alpha}}{dL_i} + \sum_\alpha W_{\mathrm{R}} \frac{n_{\mathrm{R}\alpha}}{\bar{n}_{\mathrm{R}}} \frac{dv_{\mathrm{R}\alpha}}{dL_i} \qquad (9.1)\\
&= \sum_\alpha W_\alpha v_{\mathrm{h}\alpha I}\left[\left(\mathrm{MRS}_{\mathrm{h}\alpha} - [C_{\alpha z} - \bar{L}_1]\right)\frac{\partial z_\alpha}{\partial L_i} + \frac{\partial L_\alpha}{\partial L_i} + \left(\bar{l}_{\mathrm{h}\alpha} - l_{\mathrm{h}\alpha}\right)\frac{\partial p_\alpha}{\partial L_i}\right] \\
&\quad + \sum_\alpha \frac{W_{\mathrm{R}} v_{\mathrm{R}\alpha I}}{\bar{n}_{\mathrm{R}}}\left[n_{\mathrm{R}\alpha}\mathrm{MRS}_{\mathrm{R}\alpha}\frac{\partial z_\alpha}{\partial L_i} - n_{\mathrm{R}\alpha} l_{\mathrm{R}\alpha}\frac{\partial p_\alpha}{\partial L_i}\right].
\end{aligned}$$

This result follows directly from the definition of W (first equality), the conditions (5.3) and (5.4) of market equilibrium (second equality), and the properties of the indirect utility functions (last equality). It is valid even if z_α's are not determined according to (7); any system that generates a smooth response of the z_α's can be evaluated using (9.1). One could consider the hypothetical case $z_\alpha = \bar{z}_\alpha$, exogenously fixed, for all α, for instance, as well as more general alternatives. However, if we do assume locally optimizing choices of the z_α's in accordance with (7), as we shall hereafter, every term in (9.1), except for the welfare weights $W_\alpha v_{\mathrm{h}\alpha I}$ and $W_{\mathrm{R}} v_{\mathrm{R}\alpha I}/\bar{n}_{\mathrm{R}}$, is in principle observable—even, from (6.1) and (7), the MRS's. Thus (9.1) contains all of the information needed to evaluate an incremental change in grant policy.

From (9.1), it is clear that equity considerations, as reflected in the welfare weights, are important in judging a change in any L_i. Consider, for instance, whether an increase in the matching rate L_1 would be desirable, starting from a situation where all grants are lump sum, i.e., $\bar{L}_1 = 0$.

Evidently one cannot claim that welfare will not increase (or decrease), since the real income changes of particular households need not all vanish, and so, depending on one's weighting scheme, welfare may in general go up or down. In any event, we see that $L_1 = 0$ need not be optimal from the viewpoint of an arbitrarily given W.

Does this, however, reflect some "intrinsic" as opposed to purely interpersonally redistributive function of matching grants? After all, one does not want to have to justify a policy because it sets up a pattern of more or less capricious real income changes about which one is not, in general, indifferent. One way to avoid this problem, it might seem, is to assume

$$W_\alpha v_{\mathrm{h}\alpha I} = \frac{W_{\mathrm{R}} v_{\mathrm{R}\alpha I}}{\bar{n}_{\mathrm{R}}} = \mu, \qquad \forall \alpha \tag{10}$$

at the particular equilibrium of the system one is evaluating, so that a dollar's real income change is treated indifferently, no matter to whom it accrues.[8] Then, using (5.1) and (7) in (9.1), we get

$$\frac{1}{\mu}\frac{dW}{dL_i} = \sum_\alpha \frac{\partial L_\alpha}{\partial L_i} = \begin{cases} A & \text{if } i = 0 \\ \sum_\alpha z_\alpha & \text{if } i = 1 \end{cases} \tag{9.2}$$

which would imply that a balanced-budget increase in L_1, with L_0 adjusting to satisfy (3), increases or decreases welfare as

$$\frac{1}{\mu}\left.\frac{dW}{dL_1}\right|_{\overline{\Sigma_\alpha L_\alpha}} = \sum_\alpha z_\alpha - A\frac{[\Sigma_\alpha z_\alpha + \bar{L}_1 \Sigma_\alpha (\partial z_\alpha/\partial L_1)]}{[A + \bar{L}_1 \Sigma_\alpha (\partial z_\alpha / \partial L_0)]} \gtrless 0. \tag{11}$$

Clearly $\bar{L}_1 = 0$ implies that there is no effect on welfare, while welfare increases with a movement of L_1 toward zero as long as both the numerator and denominator of the second term in (11) are positive (a rather trivial condition) and as long as $(\Sigma_\alpha\, \partial z_\alpha/\partial L_1)/\Sigma_\alpha z_\alpha > (\Sigma_\alpha\, \partial z_\alpha/\partial L_0)/A$—that is, as long as a grant dollar distributed in matching form stimulates local public good provision more than a dollar distributed in lump-sum form.[9] Thus, given (10), there is a case *against* the use of any matching grant policy.

[8] Notice that W_α, W_{R}, $v_{\mathrm{h}\alpha I}$, and $v_{\mathrm{R}\alpha I}$ depend on the state of the system, so that even if (10) holds in one state, it need not hold in another state. We are therefore at best talking about a local property.

[9] This is the well-known "stimulative effect of matching versus lump-sum grants" question. For an analysis in a simpler context, see Oates [10], Atkinson and Stiglitz [1], Break [5], and references therein.

One must recognize that (10) is not just a distributional judgment, however. It is easy to find a SWF satisfying (10), for a given initial state, *if* the utility function for mobile households is linear in good x—that is, of the form $u_{R\alpha} = \psi_{R\alpha}(l_{R\alpha}, z_\alpha) + x_{R\alpha}$—for in this case $v_{R\alpha I}$ is the same for all α. But if this unrealistic form is *not* assumed, one *cannot* in general have $v_{R\alpha I} = v_{R\beta I} \forall\ \alpha, \beta$, since this marginal utility of income depends on the other variables in the indirect utility function—prices and public goods levels (as well as location per se, perhaps)—and these variables are not the same in every city. Thus it is in general *impossible* for (10) to hold. On the other hand, suppose that $W_{h\alpha} v_{h\alpha I} = W_R v_{RAI}/\bar{n}_R = \mu$ for all α. (This certainly does occur with a well-chosen W.) Then (9.1) can be written as

$$\frac{1}{\mu}\frac{dW}{dL_i} = \sum_\alpha \frac{\partial L_\alpha}{\partial L_i} + \sum_\alpha \left[\frac{W_R v_{R\alpha I}}{\mu \bar{n}_R} - 1\right] \times \left[n_{R\alpha} \mathrm{MRS}_{R\alpha} \frac{\partial z_\alpha}{\partial L_i} - n_{R\alpha} l_{R\alpha} \frac{\partial p_\alpha}{\partial L_i}\right] \tag{9.3}$$

which is to say that a unit increase in L_i generates a benefit equal to the amount of grant funds distributed plus an adjustment equal to the sum over all mobile households of their real income changes times the amount by which the social valuation of their income exceeds the social valuation of a dollar's worth of income accruing to a mobile household in city A. One could now use (9.3) to derive an expression analogous to (11) to determine whether a balanced-budget increase in L_1 would increase or decrease welfare; the result would differ from (11) in an obvious way.

In the following discussion, I shall continue to present general expressions for welfare change, and then present simpler versions by assuming (10) to hold. We know now that, strictly speaking, this is a very restrictive assumption. Nonetheless, it aids one's understanding of the *sources* of the welfare effects generated by a change in grant policy, which is the main focus of discussion in the remainder of the paper. Where desired, the reader can easily reintroduce redistribution among mobile households, as we have already done in presenting (9.3).

We now consider the more general grant structure

$$L_\alpha = L_0 + L_1 z_\alpha + L_2 n_{R\alpha} \tag{8$'$}$$

so that a population-based element enters the formula, and drop the assumption that $C_{\alpha n}$ is necessarily the same for all α. The general expression for the welfare effect of a change in L_i is derived just as was (9.1):

$$\frac{dW}{dL_i} = \sum_\alpha W_\alpha v_{\mathrm{h}\alpha I}\left[\mathrm{MRS}_{\mathrm{h}\alpha}\frac{\partial z_\alpha}{\partial L_i} - \frac{d(C_\alpha - L_\alpha)}{dL_i} + \left(\bar{l}_{\mathrm{h}\alpha} - l_{\mathrm{h}\alpha}\right)\frac{\partial p_\alpha}{\partial L_i}\right]$$
$$+ \sum_\alpha \frac{W_{\mathrm{R}} v_{\mathrm{R}\alpha I}}{\bar{n}_{\mathrm{R}}}\left[n_{\mathrm{R}\alpha}\mathrm{MRS}_{\mathrm{R}\alpha}\frac{\partial z_\alpha}{\partial L_i} - n_{\mathrm{R}\alpha} l_{\mathrm{R}\alpha}\frac{\partial p_\alpha}{\partial L_i}\right]. \tag{12.1}$$

If (10) holds, then, using (5.1), (5.4), (7), and (8)′, we have

$$\frac{1}{\mu}\frac{dW}{dL_i} = \sum_\alpha \Bigg\{\left[\mathrm{MRS}_{\mathrm{h}\alpha} + n_{\mathrm{R}\alpha}\mathrm{MRS}_{\mathrm{R}\alpha} - \left(C_{\alpha z} - \bar{L}_1\right)\right]$$
$$\times \frac{\partial z_\alpha}{\partial L_i} - \left(C_{\alpha n} - L_2\right)\frac{\partial n_{\mathrm{R}\alpha}}{\partial L_i} + \frac{\partial L_\alpha}{\partial L_i}\Bigg\}$$
$$= \sum_\alpha \Bigg\{\underbrace{\left[\left(C_{\alpha n} - \bar{L}_2\right)\frac{\partial n^*_{\mathrm{R}\alpha}}{\partial z_\alpha} - \bar{L}_1\right]\frac{\partial z_\alpha}{\partial L_i}}_{\mathrm{A}} - \underbrace{C_{\alpha n}\frac{\partial n_{\mathrm{R}\alpha}}{\partial L_i}}_{\mathrm{B}} + \underbrace{\frac{dL_\alpha}{dL_i}}_{\mathrm{C}}\Bigg\}. \tag{12.2}$$

Evidently (12.1) generalizes (9.1), and reduces to it if we make the appropriate simplifying assumptions. In a sense, (12.1) tells us nothing new: to evaluate a change in L_i, one simply evaluates all of the real income changes that result. On the other hand, these real income changes are computed in a new way now, and include not just the price effects and the first-order effects of changes in the z_α's that appeared in (9.1), but also the effects of changes in the $n_{\mathrm{R}\alpha}$'s. The nature of these latter two are easily grasped if one considers (12.2), in which the price effect terms can be ignored.

Term A shows the real "marginal net benefit" of a unit of z_α, namely $\mathrm{MRS}_{\mathrm{h}\alpha} + n_{\mathrm{R}\alpha}\mathrm{MRS}_{\mathrm{R}\alpha} - C_{\alpha z}$, times the change in z_α caused by a change in L_i. Only fortuitously—for example, if the $C_{\alpha n}$ were the same for all α, and $\bar{L}_1 = 0$ and $\bar{L}_2 = C_{\alpha n}$—would this term vanish. Thus, an increase in L_i is more beneficial, the greater the extent to which it increases (decreases) public good provision in cities in which the marginal net benefit thereof is greater (less) than zero.

Term B shows the added congestion cost associated with the change in population in city α caused by a change in L_i. To the extent that an increase in L_i shifts population in such a way as to lower congestion costs, this is beneficial.

Term C just shows that an increase in L_i causes a benefit equal to the amount of additional grant funds disbursed thereby.

In contrast to the special case $C_{\alpha n} = L_{\alpha n} = 0$ considered above, (12.2) shows that an optimal grant policy is not generally characterized by

$L_1 = L_2 = 0$. The optimal policy, given (10), involves a balancing of the kinds of effects just discussed.

At the risk of belaboring the obvious, let us be very explicit about why there is a misallocation of resources when $L_1 = L_2 = 0$, and why matching or population-based grants may improve the situation. First, landowners, acting at the local political level, will not set z_α "optimally," that is, such that $\text{MRS}_{\text{h}\alpha} + n_{\text{R}\alpha}\text{MRS}_{\text{R}\alpha} = C_{\alpha z}$, because they perceive that a change in z_α brings a change in the number of renters that in turn leads to congestion costs which the landowners end up paying for in higher taxes. This affects the margin of decision making with respect to z_α. If city α were compensated by the central government for such costs, for example, if $L_{\alpha n} = C_{\alpha n}$, then this "distortion" of local political decision making would be eliminated. Second, as has been discussed amply in the literature (see, e.g., Flatters *et al.*, [8]; Wildasin [13]), congestion effects may result in inefficient locational choices by renters since the entrant to a city generates congestion costs that it does not bear. A policy change that causes a shifting of households away from high and toward low marginal congestion cost cities is, to that extent, beneficial—as term B in (12.2) indicates. In contrast to the distortion of local public good provision, however, there is no obvious choice of grant instruments that could be used to correct the inefficient locational choices of renters—essentially because grants give no direct leverage over those choices.

B. The Role of Head Taxes

One way that direct leverage on household locational choices can be effected is by local head taxation. Such a tax, by definition, is one that a household pays merely by virtue of its presence in a city; such a tax can be avoided, but only by moving to another city. In this subsection I briefly consider a system in which landowners in each city, acting at the local political level, choose both local public good provision and local head taxes paid by renters. We first characterize an equilibrium and then determine the welfare effects of a grant-induced disturbance of it.

The conditions for locally optimal choices of (z_α, τ_α) are

$$\frac{1}{v_{\text{h}\alpha I}}\frac{dv^*_{\text{h}\alpha}}{dz_\alpha} = \text{MRS}_{\text{h}\alpha} + n_{\text{R}\alpha}\text{MRS}_{\text{R}\alpha} - \frac{d(C_\alpha - L_\alpha - n_{\text{R}\alpha}\tau_\alpha)^*}{dz_\alpha} = 0 \tag{13.1}$$

$$\begin{aligned}\frac{1}{v_{\text{h}\alpha I}}\frac{dv^*_{\text{h}\alpha}}{d\tau_\alpha} &= -n_{\text{R}\alpha} - \frac{d(C_\alpha - L_\alpha - n_{\text{R}\alpha}\tau_\alpha)^*}{d\tau_\alpha} \\ &= -(C_{\alpha n} - L_{\alpha n} - \tau_\alpha)\frac{\partial n^*_{\text{R}\alpha}}{\partial \tau_\alpha} = 0.\end{aligned} \tag{13.2}$$

The latter of course implies that $\tau_\alpha = C_{\alpha n} - L_{\alpha n}$, the net additional cost to landowners of an added household. Substitution into (13.1) yields

$$\mathrm{MRS}_{\mathrm{h}\alpha} + n_{\mathrm{R}\alpha}\mathrm{MRS}_{\mathrm{R}\alpha} - (C_{\alpha z} - L_{\alpha z}) = 0, \qquad (13.1)'$$

which can be compared with (7).

Now what of the effect of changes in grant policy? Assume that the grant to a city α is determined by (8)$'$. Then

$$\frac{dW}{dL_i} = \sum_\alpha W_\alpha v_{\mathrm{h}\alpha I}\left[\mathrm{MRS}_{\mathrm{h}\alpha}\frac{\partial z_\alpha}{\partial L_i} + (\bar{l}_{\mathrm{h}\alpha} - l_{\mathrm{h}\alpha})\frac{\partial p_\alpha}{\partial L_i} - \frac{d(C_\alpha - L_\alpha - n_{\mathrm{R}\alpha}\tau_\alpha)}{dL_i}\right]$$
$$+ \sum_\alpha \frac{W_{\mathrm{R}} v_{\mathrm{R}\alpha I}}{\bar{n}_{\mathrm{R}}}\left[n_{\mathrm{R}\alpha}\mathrm{MRS}_{\mathrm{R}\alpha}\frac{\partial z_\alpha}{\partial L_i} - n_{\mathrm{R}\alpha} l_{\mathrm{R}\alpha}\frac{\partial p_\alpha}{\partial L_i} - n_{\mathrm{R}\alpha}\frac{\partial \tau_\alpha}{\partial L_i}\right]. \qquad (14.1)$$

If we assume that (10) holds, we get, using (13.1)$'$, (13.2), and (5.4),

$$\frac{1}{\mu}\frac{dW}{dL_i} = \sum_\alpha \Bigg[(\mathrm{MRS}_{\mathrm{h}\alpha} + n_{\mathrm{R}\alpha}\mathrm{MRS}_{\mathrm{R}\alpha} - C_{\alpha z})$$
$$\times \frac{\partial z_\alpha}{\partial L_i} - (C_{\alpha n} - \tau_\alpha)\frac{\partial n_{\mathrm{R}\alpha}}{\partial L_i} + \frac{dL_\alpha}{dL_i}\Bigg]$$
$$= \sum_\alpha \left[-\bar{L}_1\frac{\partial z_\alpha}{\partial L_i} - \bar{L}_2\frac{\partial n_{\mathrm{R}\alpha}}{\partial L_i} + \frac{dL_\alpha}{dL_i}\right] \qquad (14.2)$$
$$= \sum_\alpha \left[-\bar{L}_1\frac{\partial z_\alpha}{\partial L_i} + \frac{dL_\alpha}{dL_i}\right]$$

which can be compared directly with (12.2). Using the intuition developed in the earlier analysis, it is easy to see the effects of head taxation. The distortion of local decision making caused by landowners attempting to avoid the congestion associated with new entrants is now eliminated: by (13.1)$'$, the "marginal net benefit" of the local public good is equated to zero except to the extent that a matching grant interferes with this. By the same token, an entrant household to a community pays a tax that, by (13.2), is equal to the congestion cost it causes, except to the extent that cities receive grants based on population. But, since the population-based grants are given out at a uniform rate L_2, the *differential* cost of locating in city α rather than city β is $\tau_\alpha - \tau_\beta = C_{\alpha n} - C_{\beta n}$, so that the head tax differentials correctly signal differential marginal congestion costs. This intuition suggests that it would be optimal to have no non-lump-sum grants, or at least no matching grants.

To check this, one can solve the central government constraint (3) for L_0 as a function of L_1 and L_2. The effect of a balanced-budget increase in L_1, assuming (10) and thus exploiting (14.2), is

$$\frac{1}{\mu}\frac{dW}{dL_1}\bigg|_{\overline{\Sigma_\alpha L_\alpha}} = -\sum_\alpha \bar{L}_1\left[\frac{\partial z_\alpha}{\partial L_1} - \frac{\partial z_\alpha}{\partial L_0}\left(\frac{\Sigma_\beta(dL_\beta/dL_1)}{\Sigma_\beta(dL_\beta/dL_0)}\right)\right]. \tag{15}$$

As long as matching grants have a greater stimulative effect per dollar than lump-sum grants, (15) shows that welfare is enhanced by a move of the matching rate toward zero, so that if (15) is evaluated at $\bar{L}_1 = 0$, a true maximum with respect to L_1 obtains. As far as population-based grants are concerned, their welfare effect is easily seen to be zero, as long as the matching grant rate is zero. If not, population-based grants will be welfare enhancing to the extent that they offset the distortions introduced by matching grants.

IV. CONCLUSION

A general equilibrium framework has been presented within which one can analyze the welfare effects of intergovernmental grants. The objective has been to focus attention on *some* of the considerations that must enter into a determination of rational grant policy, within the context of a simple model in which these considerations stand out clearly. For several reasons, some of which I shall discuss below, the analysis presented here cannot support conclusions about specific real-world grant policies. First, however, we may summarize some conclusions (with references to the supporting analysis). (i) Grant policy involves interpersonal redistribution. This redistribution takes the form, in part, of reduced tax burdens on landowners, and of changes in equilibrium prices faced by all households in the economy. These effects are redistributive in that their dollar total, summed over all households, is zero (see Eqs. (9.1), (12.1), and (14.1)). (ii) Redistribution among households who live in different cities, but who are alike in all other respects, can, in general, improve welfare because the marginal utility of income for such households differs. This should be taken into account when evaluating the effects of grant policies (see Eq. (9.3)).

Grant policies have other welfare effects which are especially easily interpreted if the redistributive effect is "ignored" by assuming that a dollar's real gain is viewed as of equal worth, no matter to whom it accrues. (iii) In the absence of congestion costs and matching grants, self-interested landowners set local public goods levels that satisfy the Samuelsonian conditions, so that a balanced-budget marginal change in some grant instrument has a net welfare effect only if the matching rate is initially nonzero, in which case the grant policy should be altered by bringing the matching rate closer to zero (see eq. (11)). (iv) If there are congestion costs, an equilibrium without grants will be nonoptimal for two reasons. First, the landowners of a city anticipate the effect of the local public good level on the number of renters in the city, and set that level taking into account the added congestion cost that is induced by an extra unit of public good. Thus, there is a distortion of the level of local public good provision. Second, congestion costs are not borne by mobile households, resulting in an inefficient distribution of renters across cities, whatever level of public good provision is ultimately determined by landowners. It follows that grant policy will be welfare enhancing to the extent that it offsets these two distortions. There is no simple rule that describes the optimal grant policy because there is no grant policy that will fully eliminate the distortions; an optimum is then characterized by a balancing of gains and losses at both distortionary margins, a balancing that depends on the general equilibrium response of public goods levels and local populations to grant policy instruments. (see eq. (12.2)). (v) Finally, if landowners are allowed to collect head taxes from renters as well as set local public goods levels, the two congestion-related distortions, just mentioned, disappear. The first is eliminated because head taxes are set by landowners at a level that allows them to be just compensated for any congestion costs induced by changes in the level of local public good provision. The second is eliminated because the head taxes provide incentives for mobile households to locate, *ceteris paribus*, where the marginal congestion cost is low. In this world, with distortions eliminated, the first-order welfare effects of grants are just as in case (iii). (see eq. (14.2)).

These conclusions emerge in the context of a specific model and would not, in their details, survive generalization of the model. But the essence of the conclusions—that initial residents may distort public good provision to discourage immigrants who add tax burdens because of congestion effects, that locational choices are inefficient because of congestion externalities, and that grant policies should be designed in a way that reflects these distortions—is plausible and should reappear, albeit in modified form, in any generalization. While the emphasis on fiscally induced migration in this analysis may seem overstated, it assumes a leading role in much of the literature on local public goods. It therefore seems quite appropriate to consider this phenomenon in the analysis of grants.

How might this analysis be extended? First, one might wish to allow for spillover effects. This is straightforward, and modifies the conclusions in an obvious way: matching grants can be used to correct for inefficiencies in local public expenditures. This is not a surprising result, and the analysis is sketched in a footnote.[10]

[10]Suppose that z_α enters the utility function of households not in city α. Let $\mathrm{MRS}^{\beta}_{h\alpha}$ be the marginal rate of substitution between the private good and the public good in city β by household hα, and define $\mathrm{MRS}^{\beta}_{R\alpha}$ similarly. In the context of the model of Section III-B, for

There are more fundamental questions to be raised, however. First, the model of the local political process presented here is highly stylized (though it seems to have interesting implications), and this could easily affect the welfare analysis of grant programs. The nature of the change in the analysis that this would require is fairly obvious. Second, a very strong simplifying assumption is that the taxed commodity, land, is totally fixed in supply and immobile. This assumption is best justified on grounds of simplicity, although a strained case for it could be made by appealing to supposed long lags in the adjustment of the housing stock. I attempt a relaxation of this assumption elsewhere (Wildasin, [15]).[11] Third, one would like to make allowance for changes in the level of central government tax revenues, and hence in the scale of the grant program; but it must be recognized that the central government taxes used to finance transfers are likely to give rise to significant distortions themselves.[12] Grants, in this setting, involve increased reliance on one distortionary tax system and decreased reliance on another. See Sheshinski [11] for some discussion of this question.

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example, the choice of z_α and τ_α will still satisfy (13.1)′ and (13.2). Suppose that the grant structure allows differential matching rates $L_{1\alpha}$ for different cities. Then, in place of (14.2), we have

$$\frac{1}{\mu}\frac{dW}{dL_i} = \sum_\alpha \sum_\beta \mathrm{MRS}^\beta_{\mathrm{h}\alpha} \frac{\partial z_\beta}{\partial L_i} - \frac{d(C_\alpha - L_\alpha - n_{\mathrm{R}\alpha}\tau_\alpha)}{dL_i} + \sum_\alpha \sum_\beta n_{\mathrm{R}\alpha} \mathrm{MRS}^\beta_{\mathrm{R}\alpha} \frac{\partial z_\beta}{\partial L_i} \quad (14.2)'$$

$$= \sum_\alpha \left[\sum_{\beta \neq \alpha} \left(\mathrm{MRS}^\alpha_{\mathrm{h}\beta} + n_{\mathrm{R}\beta} \mathrm{MRS}^\alpha_{\mathrm{R}\beta} - \bar{L}_{1\alpha} \right) \frac{\partial z_\alpha}{\partial L_i} + \frac{dL_\alpha}{dL_i} \right]$$

so that, if the matching rate for each city is set equal to its "spillout" rate, the first-order conditions for a welfare maximum are achieved.

[11] See Wiegard [12] for an interesting analysis oriented toward the institutional structure of some European countries.

[12] The analysis presented above could be made to look more realistic by assuming that the central government uses a tax on inelastically supplied labor to finance transfers to local governments. The really interesting extension, however, would allow for distortionary effects of central government taxes.

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