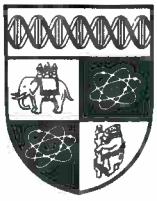
The Efficient Allocation of Local Public Factors in Tiebout's Tradition*

By

Wolfram F. Richter
Universitat Dortmund

No. 378

WARWICK ECONOMIC RESEARCH PAPERS



DEPARTMENT OF ECONOMICS

UNIVERSITY OF WARWICK
COVENTRY

The Efficient Allocation of Local Public Factors in Tiebout's Tradition*

By

Wolfram F. Richter
Universitat Dortmund

No. 378

Abstract

Tiebout's (1956) hypothesis is applied to the locational choice of firms in economies with local public inputs. A system of three source-based tax instruments is proposed that, in combination with an earmarking rule, sustains production efficient allocations by decentralized decision-making. The system includes a local tax on pure profits, a local tax on land rents and a local lump sum subsidy on the settlement of firms. Applications to international economics are straightforward.

* This paper was presented at the ESRC and SPES sponsored Warwick Economics Summer Research Workshop on the Role of the Public Sector in a Mixed Economy in July 1991. Support from the ESRC and the Department of Economics are gratefully acknowledged. (ESRC Award No. W10026-1035-01)

Address

Professor D Wolfram F. Richter
Universitat Dortmund
Wirtschafts-und Sozialwissenschaftliche Fakultat
Lehrstuhl Volkswirtschaftslehre II
Postfach 50 05 00
D-4600 Dortmund 50
F R Germany

September 1991

1. Introduction

Tiebout (1956) suggested that the efficient allocation of local public goods would not require the activity of a central planning authority. Instead, one could rely on the competitive forces of a market in which mobile households "vote with their feet" over the differentiated offers of local authorities. By making locational choices, households reveal their true preferences. They thus relinquish the information which the servicing suppliers need. The threat of migration forces local authorities to minimize costs and to design offers that meet demand. The outcome, according to Tiebout, will be efficient and no central intervention is needed.

The idea is admittedly intriguing, but it has been challenged by many succeeding writers. See among others, Buchanan and Goetz (1972), Stiglitz (1977), and Bewley (1981). There seems to be consensus, now, that Tiebout's hypothesis is less well-founded than the original article suggested. Signals produced by migration are in general not sufficiently differentiated to guide or even to sustain decentralized decision-making with respect to locally pure public goods in an efficient way. One would still have to rely on personalized Lindahl prices, information which market forces may not be expected to produce (Schweizer, 1986). Or, one would have to rely on specific local decision mechanisms which manage to internalize migration externalities (Boadway, 1982).

The purpose of this paper is to apply Tiebout's hypothesis to the sphere of production. This means that the focus is shifted from locally pure public goods to locally pure public factors. The suggestion is that Tiebout's hypothesis is better founded in the latter case. If problems of stability which are inherent to all kinds of resource allocations in spatial economies are ignored, then various forms of decentralized decision-making can be conceived which all yield production efficient outcomes. The focus is on a solution which is not too demanding with respect to local authorities' rationality. The assumption is thus made that local authorities myopically maximize tax revenue. In the sphere of consumption, myopic decision-making is a great obstacle to efficiency (Atkinson and Stiglitz, 1980, p. 551). In the present context, myopic decision-making can, however, be shown to sustain efficiency if it is only supported by a well-chosen set of rules and tax regimes. The respective tax regimes are source-based. There is, firstly, a local tax on pure profits, a cash-flow tax for instance. There is, secondly, a local tax on fixed immobile factors such as land and, thirdly, a local tax-subsidy on migration.

The latter means that local authorities are allowed to subsidize the settlement of firms and to tax symmetrically their departure. These three tax components have to be complemented by the provision that the revenue of the pure-profits tax is earmarked for local public factors. More precisely, if t_i^p is the rate at which profits are taxed in jurisdiction i, then an equal ratio t_i^p of public factors, valued at marginal local costs, has to be financed out of the revenue. It will be shown that every stable migration equilibrium which respects these rules is efficient. It will be shown further that none of the system's components is dispensable if (a) decentralized decision-making is to bring about efficient allocations, if (b) harmonization of profit-tax rates cannot be secured, and if (c) local budgets are to be balanced. The interesting feature of the suggested system is that it relies on the taxation of pure profits. This is noteworthy for the following reasons. Firstly, it shows that an allocative function can be assigned to the taxation of profits, which has been disputed before in the literature (Rose, 1991). Secondly, it becomes clear that lacking harmonization of profit-tax rates need not be an obstacle to locational efficiency. (The need of harmonization in a cash-flow tax regime has been stressed by Keen, 1991.) The overall suggestion is that one may well be able to rationalize the taxation of profits at the communal level as it is observed, for example, in Germany.

The sceptical reader may wonder why Tiebout's hypothesis should be more viable in production than in consumption. Obviously, there must be driving assumptions which are easier to justify in the sphere of production. In fact, there are two. The first one concerns feasibility of tax instruments. Following mainstream thinking, I believe it feasible to tax producer rents, say, by means of cash-flow taxes. There is no comparably operational instrument which would allow us to tax consumer rents. The second difference between consumption and production concerns the origin of rents. In production, it may be seen to be a defendable position to trace rents back to missing factors and to identify local public factors as the dominant missing ones. A convincing parallel is obviously lacking in consumption. One would hesitate to view public goods as the sole source of consumer rents.

The results of this paper are derived from a model that is interpreted as a collection of local authorities, communities for short. An alternative feasible interpretation is straightforward. It amounts to viewing locations as politically independent states. I slightly prefer the former interpretation as the main result rests on the enforcement of some minimal rules. The prerequisites for effective enforcement are, however, better in a politically unified country.

Section 2 sets the stage by analyzing production efficiency in a spatial economy. Efficiency may well be sustained by competition among land owners. This has been noticed before in models of household migration. It extends to the sphere of production as shown in section 3. Section 4 then turns to the competition among myopic tax authorities. The technical appendix deals with stability problems of decentralized decision-making.

2. Necessary Conditions of Production Efficiency

Consider an economy with N identical private firms. We assume identical firms solely for expository ease. Later we shall argue that the results extend straightforwardly to non-identical production units. Firms are said to be identical if they have access to the same technology, represented by the production function $F = F(g, l, k)$. Production makes use of three factors, a local public one, g, and two private ones, l and k. l stands for an immobile factor, "land", and k for a mobile factor, "capital". The economy is made up of I localities which may optionally be interpreted as communities, regions or countries. To indicate the factor quantities which are used by an average firm at locality $i = 1,..,I$ we use indices, g_i, l_i, k_i. Let n_i denote the number of firms which are located at i. For the sake of simplicity, we treat n_i as a real number. We thus assume that firms are arbitrarily divisible. Localities differ exogenously a) by the available fixed quantity of land $L_i > 0$ and b) by the costs $C_i(g_i)$ which are induced by the provision of g_i at i.

Achieving *first-best allocations* requires the maximization of aggregate net surplus

$$\sum_{i=1}^{I} [n_i F(g_i,l_i,k_i) - C_i(g_i)] \qquad (1)$$

in $g_i, l_i, k_i, n_i \quad (i=1,..,I)$ subject to

$$\sum_{i=1}^{I} n_i = N \qquad (2a)$$

$$\sum_{i=1}^{I} n_i k_i = K \qquad (2b)$$

$$n_i l_i = L_i \qquad (i=1,..,I) \qquad (2c)$$

(2a) ensures that all firms are located somewhere. (2b) is a global market clearing condition for capital and (2c) a local clearing condition for land. The global supply of capital, K, is exogenously fixed just as is the local supply of land, L_i.

Solutions of (1) and (2) are first-best in the restricted sense of *production efficiency*. This means that, given sufficient separability of consumption and production decisions, Pareto efficiency requires us to meet the first-order conditions belonging to (1) and (2). Separability is clearly a critical assumption. It would be violated, for example, if n_i or g_i entered individual utilities as external effects.

The fact that n_i does not enter the cost function $C_i(g_i)$ makes public inputs pure ones. It does not impose additional costs if more firms settle down at locality i. The absence of rivalry or congestion effects strongly encourages agglomeration. This tendency to regional concentration is only checked by the local scarcity of land. It is a characteristic feature of spatial economies that the resulting trade-off need not suggest "interior" solutions. That is, the economies of jointly using a pure public factor may be so strong that the counterbalancing effect of scarcity of land is overridden. First-best allocations are then characterized by distributions $(n_1,..,n_I)$ for which n_i equals zero for some localities. Consider, for example, the model specification where

$$C_i(g_i) \equiv c_i g_i + a_i \quad \text{is linear and} \tag{3a}$$

$$F = g_i^{\alpha} l_i^{\beta} k_i^{1-\alpha-\beta} \quad \text{Cobb-Douglas .} \tag{3b}$$

One can show that an optimum of (1), (2) is reached in the special case of $\alpha = \beta = 1/2$, only if all production is concentrated at localities where c_i/L_i takes on minimal values. These are the localities that have a comparative cost advantage in the provision of public factors. It would be inefficient to extend production to other areas.

In what follows, we shall ignore boundary solutions. In other words, we shall focus on solutions $\bar{g}_i, \bar{l}_i, \bar{k}_i, \bar{n}_i$ for which $\bar{n}_i > 0$ holds for all i. Such solutions have to satisfy the *first-order conditions*

$$\bar{n}_i F^i_g = C_i' \quad \text{for all } i, \tag{4a}$$

$$F^i_k = \mu \quad \text{for all } i, \tag{4b}$$

$$F^i - \bar{l}_i F^i_l - \bar{k}_i F^i_k = \lambda \quad \text{for all } i. \tag{4c}$$

Here, F^i is a short-form for $F(\bar{g}_i,\bar{l}_i,\bar{k}_i)$. $F_g,F_k,F_l > 0$ denote marginal products, C_i' marginal costs, and μ,λ Lagrangean variables. (4a) is the familiar Samuelson condition: The efficient provision of public factors at locality i is achieved when marginal costs and the sum of marginal products are equated. (4b) characterizes the efficient allocation of capital: The marginal product has to be equated across localities. (4c) finally characterizes the efficient spatial distribution of firms. Efficiency is achieved if pure profits are equated across localities. Notice that pure profits only make allowance for private opportunity costs. The provision of local public factors does not admit an individual imputation of costs. In other words, positive pure profits result from the existence of "missing (public) factors". Allocations that satisfy (4) shall be called *stationary*.

It should be stressed that stationarity does not guarantee production efficiency. The reason is that spatial economies display inherent non-convexities that cannot be assumed away by standard assumptions. See Starrett (a.o., 1988). In the example (3), we are dealing with the case where (4) stands for a minimum of aggregate net surplus when $\alpha > ß$, i.e., whenever the public input is more productive than land. In the *appendix* to this paper, we demonstrate that stationary allocations are first-best only if the spatial distribution of firms is *stable*. Stability means that the pure profit made by an average firm at locality i decreases when additional firms are located there and when the provision of public inputs at i is adapted efficiently. It is well conceivable that the economies of providing public factors with respect to n_i are so strong that pure profits go up as a result of immigration. Such a constellation would obviously reinforce spontaneous migration and it would destabilize every equilibrium solution of (4). In what follows we ignore problems of stability and we focus on notions of competitive behaviour generating stationary allocations.

3. Sustaining Stationary Allocations by Competition among Land Owners

Suppose that communities are under the control of land owners. The supply of public factors appears to them as an investment which helps to attract firms. The investment return is in the form of rent which the firms have to pay for the use of land. Competition among land owners may thus lead to an efficient provision of local public factors. This has been noticed before in models of household migration (Stiglitz, 1983, pp. 32) and can easily be confirmed in the present context. For this purpose we consider the following equilibrium notion:

Definition: $(\bar{g}_i, \bar{l}_i, \bar{k}_i, \bar{n}_i, \bar{\varrho}_i)_{i=n,..,I}$, r and π define an *equilibrium of land owners' competition* if

1. the allocation is feasible in the sense of (2) and if $\bar{n}_i > 0$ for all i;

2. at each locality i land owners maximize the local surplus $\varrho_i L_i - C_i(g_i)$ by choosing $\bar{g}_i, \bar{l}_i, \bar{k}_i, \bar{n}_i, \bar{\varrho}_i$ subject to the constraints

$$F(g_i,k_i,l_i) - rk_i - \varrho_i l_i = \pi ; \tag{5a}$$

$$n_i l_i = L_i . \tag{5b}$$

The idea is that land owners hire firms by promising them the profit π obtainable elsewhere. In exchange, firms have to produce whatever helps to maximize the land owners' surplus. Capital and land are available at the competitive prices r and ϱ_i. The cost of capital r is taken to be given whereas ϱ_i is controlled by land owners. It is straightforward to show that the maximization of $\varrho_i L_i - C_i(g_i)$ subject to (5) yields (4).

Proposition: Equilibria of land owners' competition define stationary allocations.

Several aspects of land owners' competition deserve special notice. First, observe that decentralization does not go very far. The production process is fully under the command of land owners. There is no real function left to firm owners except that land owners would not be able to produce without the firm owners' consent. Obviously, such a story makes little sense unless production is conditional on producers possessing a specific right.

The fact that land owners' competition is able to sustain stationary allocations is in line with the Tiebout hypothesis. Note, however, that the suggested equilibrium notion misses Tiebout's conjecture in one important respect. For Tiebout, migration of households is the mechanism by which the latter reveal their preferences for local public goods. The preferences are a priori unknown to local planners. This contrasts with the above equilibrium concept where it is understood that land owners have full knowledge about production possibilities.

Under the suggested equilibrium concept the cost of public factors $C_i(g_i)$ is totally financed out of land rents. This strongly reminds one of Henry George's proposal. A single tax on land would raise the needed revenue in an efficient way. Notice, however, that there is no direct relationship between the value of land $\bar{\varrho}_i L_i$ and the cost of providing public factors. This is best seen by adding an arbitrary fixed sum to the cost function $C_i(g_i)$. The addition would change

public expenditures without having any effect on the allocation, in general, and land values, in particular. The exercise shows us two things. Firstly, in the present model no "Henry George" theorem, according to which $\bar{\varrho}_i L_i = C_i(\bar{g}_i)$ characterizes the optimal number of firms $\bar{n}_i$, holds. (References to the theorem are, a. o., Stiglitz, 1977; Hartwick, 1980; Starrett, 1988.) Secondly, the efficient raising of funds and the sharing of costs according to benefits may well not be identical options. This remark is directed against a common understanding of benefit taxation. Parts of the literature give the impression that adopting the *benefit principle* is the same thing as taxing efficiently. (See, a. o., Hamilton, 1983; Musgrave and Musgrave; 1980, p. 470.) Such a view would certainly not be very convincing. An ideal tax on land is, no doubt, efficient. It is less clear, however, whether a land tax qualifies as a true benefit tax. Not only is the relationship between $\bar{\varrho}_i L_i$ and $C_i(\bar{g}_i)$ loose, the way by which land owners benefit from public factors is at most an indirect one. Direct beneficiaries are the producers and the benefits of these are reflected by $\bar{g}_i F^i_g$. Land owners benefit indirectly as they provide the land which the producers demand. The benefit principle may hence be interpreted as saying that producers should be taxed and that payments should be related to received benefits. The next section will show how a *benefit tax*, interpreted in this way, can be incorporated into a model of efficient spatial competition.

4. Sustaining Stationary Allocations by Myopic Tax Authorities

Consider a world of profit-maximizing firms and of revenue-maximizing tax authorities. In such a context, decentralized decision-making may well sustain stationary allocations if it is only restricted by the following system of taxes and rules:

i) All localities tax pure profits at an arbitrary *exogenous* rate t_i^p which is positive but less than one.

ii) The revenue of the pure-profits tax is earmarked. It has to be used by each local authority to finance an equal proportion t_i^p of public inputs g_i when the latter are valued at marginal cost C_i'.

iii) Local budget deficits have to be financed by local taxes on immobile factors, notably by an ideal tax on land, t_i^l.

iv) Subsidizing the settlement of firms by means of lumpsum payments is feasible. Let T_i denote the lumpsum subsidy per firm.

Note that the proposal comprises three local tax instruments and one rule concerning the expenditure of revenue. All three tax instruments are known to sustain efficient outcomes in economies for which locational choices are exogenous. When locational choices are endogenous, each single tax shows specific deficits and, as we are going to see, it makes sense to use all three instruments in combination.

Decentralized decision-making is formalized by the following equilibrium concept. Interpret ϱ_i as land rent and r as cost of capital.

Definition: $(\bar{g}_i,\bar{l}_i,\bar{k}_i,\bar{n}_i,\varrho_i,t_i^l,T_i)_{i=1,..,I}$ and r define a competitive *equilibrium with myopic tax authorities* if

1. the allocation is feasible in the sense of (2) and if $\bar{n}_i,\bar{g}_i > 0$ for all i;

2. at each locality i firms maximize their profit after tax

$$(1-t_i^p)[F(\bar{g}_i,l_i,k_i) - (1+t_i^l)\varrho_i l_i - rk_i] + T_i \qquad (6)$$

by choosing $\bar{l}_i,\bar{k}_i$; the maximum is denoted by π_i ;

3. profits after tax are equated,

$$\pi_i = \text{constant in} \quad i \; ; \qquad (7)$$

4. for each firm lumpsum subsidies match taxes on pure profits,

$$T_i = t_i^p[F(\bar{g}_i,\bar{l}_i,\bar{k}_i) - (1+t_i^l)\varrho_i\bar{l}_i - r\bar{k}_i] \; ; \qquad (8)$$

5. the local pure-profits tax revenue is used in accordance with the earmarking rule,

$$\bar{n}_i t_i^p[F(\bar{g}_i,\bar{l}_i,\bar{k}_i) - (1+t_i^l)\varrho_i\bar{l}_i - r\bar{k}_i] = t_i^p C_i' \bar{g}_i \qquad \text{for all} \quad i \; ; \qquad (9)$$

6. budget deficits are financed by the tax on land,

$$t_i^l\varrho_i L_i = C_i(\bar{g}_i) \qquad \text{for all} \quad i \; . \qquad (10)$$

Conditions (6),(7),(9),(10) are self-explanatory. (6) requires firms to maximize profits after having made their locational choice. Note that $\bar{g}_i$ is no private decision variable. (7) is an equilibrium condition for locational choices. Firms settle only at places that promise maximal profits after tax. (9) is the earmarking rule and (10) is a condition of balanced local budgets. The underlying assumption of (10) is that firms pay no taxes on balance. This is an immediate implication of (8), a condition deserving closer inspection. The suggestion is to interpret (8) as

an *equilibrium condition of myopic fiscal competition*. Local authorities are myopic in the sense that they only look at tax revenue. The settlement of new firms is attractive since it promises an increased revenue from the pure-profits tax. Having fixed t_i^p in advance, the subsidy T_i appears as a strategic variable with which new firms are induced to locate at i. If indirect effects of new firms on land tax revenue are ignored, (8) is the equilibrium condition of some Bertrand-like competition. It would make no sense to promise subsidies which exceed the expected revenue generated by the profit tax. On the other hand, subsidies below expected revenues cannot survive in unrestricted competition either. It appears to local authorities that by increasing subsidies they steal all the firms from competing localities.

We shall continue the discussion of (8) below. Before doing so, let us state the main properties of the suggested equilibrium concept.

Proposition: If there are constant returns to scale in production then

a) the pure-profits tax is a benefit tax, and

b) competition among myopic tax authorities generates stationary equilibrium allocations.

Furthermore, local budgets are balanced by definition.

Proof: (6) implies $F_l^i = (1+t_l^i)\varrho_i$ and $F_k^i = r$ and hence (4b). (8) in combination with constant returns to scale gives us $T_i = t_i^p [F^i - F_l^i \bar{l}_i - F_k^i \bar{k}_i] = t_i^p F_g^i \bar{g}_i$. This is statement a). Inserting into (9) yields (4a). Condition (4c) finally follows from (7) and (8). ■

The proposed equilibrium concept shares some intriguing features. Firstly, efficiency is ensured although the assumptions concerning tax authorities' rationality are not very demanding. Myopic behaviour is no obstacle to efficiency. Secondly, benefit taxation is assigned a basic allocative role. Efficiency cannot be guaranteed if t_i^p is exogenously fixed at the level zero. A non-zero profit tax is needed if the Samuelson condition (4a) is to follow from the earmarking rule. Thirdly, local lumpsum subsidies may have an important allocative function. They help to remove the distorting effect that a profit tax with non-harmonized rates would otherwise have on locational choices. If compared with land owners' competition, the land tax has lost in significance. The only function left to the land tax is that

it enables localities to balance their budgets. Notice that this function is only loosely connected to Pareto efficiency. Locally balanced budgets is not a condition that finds its rationale in first-best analysis. It is a desirable property of second-best analysis when, due to incomplete information, decisions are to be delegated from the centre to local authorities.

The proposed system of taxes and rules i) - iv) is primarily of normative relevance. It is all the more remarkable that Germany has a system of local taxes that is not too far from the proposal. There exist both local land ("Grundsteuer") and local profit ("Gewerbeertragsteuer") taxes. The effective taxes are admittedly far removed from their ideal. The Grundsteuer thus taxes structures and the Gewerbeertragsteuer extends the taxation of profits to capital income. Nevertheless, communities have the autonomous right to vary t_i^p, t_i^l. Furthermore, the settlement of firms is commonly subsidized; a practice that, by the way, has notoriously been criticized by the public at large. The element which has never been institutionalized is the earmarking rule ii). One may wonder why this is the case. One possible answer may be that the assumed distinction between public factors and public goods is difficult to carry through in practice. Besides this, one should, however, not disregard the influence of the traditional public finance school which has always argued decidedly against assigning taxes to specific uses.

Under the suggested equilibrium concept, fiscal competition drives subsidies up to the level where they match expected taxes on pure profits. This means that imperfect competition should find its expression in an inequality of (8). The implication of such inequality is that the spatial distribution of firms needs no longer be efficient. The allocative function of fiscal competition hence is to ensure efficient locational choices (4c). This is not the same as an efficient allocation of public factors. Under the suggested equilibrium concept, (4a) is instead ensured by the earmarking rule. As a consequence, public factors will be efficiently allocated even if fiscal competition is imperfect. This conclusion stands in marked contrast with Tiebout's (1956) intuition, according to which we need fiscal competition to ensure (4a).

The suggested equilibrium concept assumes that the localities fix tax rates in their own responsibility. Whether this is the result of desired fiscal decentralization or simply the result of lacking success in harmonization is largely irrelevant. The proposition makes the definite statement that non-harmonized profit-tax rates need not threaten efficiency. Any distorting effect that non-harmonized rates have on locational choices is neutralized by lumpsum subsidies. Efficiency only requires

harmonization if lumpsum subsidies are institutionally not feasible. The above proposition can thus be interpreted as saying that the *lumpsum subsidization of locational choices is a substitute for the lacking harmonization of profit-tax rates.*

Tax harmonization may appear to conflict with the goals of decentralized decision making. Harmonization is nevertheless a desirable objective if seen from a purely fiscal point of view. It makes lumpsum subsidization dispensable and thus helps to cut down public expenditures. Note, however, that this argument in favor of harmonization is not directly related to first-best efficiency.

It may be irritating that, in equilibrium, firms should pay no profit taxes net of subsidies. Condition (8), in fact, needs some qualifying remarks. First, we should mention that firms will always generate some indirect (land) tax revenue even if they appear to pay no taxes directly. Without firms, land would be a free factor and the land-tax base would have no value. Secondly, when applying the proposed tax system to real economies, one has to differentiate between old and new firms. Only new firms pay no taxes directly since they alone benefit from subsidies. The old firms have no claim to subsidies. They thus bear the full burden of the profit tax. At this point, the reader may object that old firms close down at some time so that the tax base is doomed to erode. This is true but still ignores the possibility of raising tax rates over time. If these changes are harmonized or if they come unexpectedly, firms eventually end up becoming net-payers.

In a dynamic setting, we must consider the possibility that firms shift their location with the sole purpose of cashing in on subsidies. The possibility is particularly realistic when subsidies precede tax payments. The obvious way of forestalling misuse is to establish recapture rules. Subsidies which have not been balanced by profit taxes have to be refunded when shifting location. Tax rule iv) should therefore be interpreted symmetrically: Not only is the settling of firms subsidized, shifting location is equally taxed in a lumpsum fashion.

I cannot preclude that it may become difficult in practice to differentiate between disinvestments which are not liable to lumpsum taxes and locational changes which are liable to taxation. However, related questions go beyond the scope of this paper. It remains a topic of future research to analyze the suggested equilibrium concept in a dynamic setting where information is asymmetric.

In closing, I would like to mention some model extensions which are more straightforward. For instance, the assumption of identical firms may easily be dropped. The only efficiency condition which could raise difficulties is (4a).

Samuelson's efficiency condition for public factor is, however, satisfied by the earmarking rule. Let $\bar{n}_{ij}$ be the number of firms of type j which settle down in equilibrium at locality i . Firms of type j make use of the production function $F_j = F_j(g_i,l_{ij},k_{ij})$. Notice that all firms at locality i use the same quantity g_i of the public input. Assuming constant returns to scale the equilibrium profit tax of firm j at locality i amounts to

$$t_i^p [F_j(\bar{g}_i,\bar{l}_{ij},\bar{k}_{ij}) - (1+t_i^l)\varrho_i\bar{l}_{ij} - r\bar{k}_{ij}] \quad = \quad t_i^p \bar{g}_i F^i_{gj} .$$

By making use of the earmarking rule we obtain

$$t_i^p \bar{g}_i \sum_j F^i_{gj}\, \bar{n}_{ij} \quad = \quad t_i^p C_i' \bar{g}_i$$

which, after division with $t_i^p \bar{g}_i$, is the extended Samuelsonian efficiency condition (4a).

We have chosen public inputs to be pure in Samuelson's original sense. The reason is that Bewley (1981) has nourished the impression that the absence of any service rivalry makes for the real test of the Tiebout hypothesis. According to Bewley, efficiency can be sustained in equilibrium only when per capita costs are constant, $C_i = C_i(g_i,n_i) = n_i c_i(g_i)$. See also Wildasin (1986, p. 20 - 21). I refrain from concealing that I find Bewley's analysis misleading. The present analysis shows that characteristics of goods are less decisive for the validity of the Tiebout hypothesis. The really important points seem to be those mentioned before, namely, (a) the question of whether private rents originate completely in public activities and (b) the question of whether we dispose of means of taxing these rents efficiently.

A final remark concerns the assumed exogeneity of N . It is obvious that any competitive equilibrium as discussed above can only prevail in the short run. As profits $\pi_i = \bar{g}_i F^i_g$ are strictly positive there will be a constant incentive to form new firms and to enter the market. In the presence of public factors the conception of rent dissipation, however, raises some subtle questions. I refrain from going into these as they have been discussed in the literature before. See Boadway (1973), Henderson (1974), and Hillman (1978). All problems are easily avoided if we are prepared to extend the model as follows: We assume that the formation of each new firm causes fixed set-up costs C_o . A competitive equilibrium will then sustain in the long run if profits just cover set-up costs. Note that such an equilibrium behaviour is efficient. If we subtract NC_o from the social objective function (1) and if we treat N as a choice variable, then first-best alloca-

tions require us to equate profits with C_o (i.e. to replace λ by C_o in (4c)).

5. Appendix

Let us consider the case of two localities $i=1,2$. We assume throughout constant returns to scale. Let $g_i(n_1)$, $k_i(n_1)$ $(i=1,2)$ and $n_2(n_1)$ denote an interior solution of

$$n_i F_g(g_i, \frac{L_i}{n_i}, k_i) = C_i' , \tag{11a}$$

$$F_k(g_1, \frac{L_1}{n_1}, k_1) = F_k(g_2, \frac{L_2}{n_2}, k_2) , \tag{11b}$$

$$n_1 k_1 + n_2 k_2 = K , \quad n_1 + n_2 = N . \tag{11c}$$

Aggregate net social surplus is seen as a function of n_1 :

$$W(n_1) \equiv \sum_i [n_i(n_1)F^i - C_i(g_i(n_1))] ,$$

where F^i is an abbreviation for $F(g_i(n_1), \frac{L_i}{n_i(n_1)}, k_i(n_1))$.

Proposition: If

$$\frac{d}{dn_1}[g_1(n_1)F_g^1] < 0 < \frac{d}{dn_1}[g_2(n_1)F_g^2] , \tag{12}$$

then $W(n_1)$ is strictly concave.

Proof: By the envelope theorem we have

$$W' \underset{(11a)}{=} F^1 + n_1[F_k^1 k'_1 - F_l^1 \frac{L_1}{n_1^2}] - F^2 + n_2[F_k^2 k'_2 + F_l^2 \frac{L_2}{n_2^2}] .$$

As returns to scale are constant we continue:

$$= F_k^1 k_1 + F_g^1 g_1 + n_1 F_k^1 k'_1 - F_k^2 k_2 - F_g^2 g_2 + n_2 F_k^2 k'_2$$

$$\underset{(11b)}{=} g_1 F_g^1 - g_2 F_g^2 + F_k^1 \frac{d}{dn_1}[n_1 k_1 + n_2 k_2 - K]$$

$$= \underset{(11c)}{} g_1 F^1_g - g_2 F^2_g ,$$

The proposition now follows from (12). ■

Let us say that a stationary allocation is *stable* if (12) holds in a neighbourhood. The shifting of firms from locality 2 to locality 1 then raises profits at the former and depresses profits at the latter. This must have a stabilizing effect on migration.

Let us have a closer look at the determinants of stability. For reasons of symmetry, we may restrict consideration to locality 1. For further analyses of stability see Stiglitz (1977).

Proposition: We obtain the LHS inequality of (12) if C_1' is constant in g_1 and if $g_1(n_1)$ increases regressively in n_1.

Proof: Differentiating (11a) for $i=1$ with respect to n_1 gives us

$$F^1_g - F^1_{gl} L_1/n_1 + n_1[F^1_{gg} g'_1 + F^1_{gk} k'_1] = 0 . \qquad (13)$$

We wish to show

$$0 > \frac{d}{dn_1}[g_1(n_1)F^1_g]$$

$$= g'_1 F^1_g - g_1 F^1_{gl} L_1/n_1^2 + g_1 [F^1_{gg} g'_1 + F^1_{gk} k'_1]$$

$$\underset{(13)}{=} g'_1 F^1_g - g_1 F^1_g/n_1$$

$$\Leftrightarrow \quad g'_1 < g_1/n_1 \qquad \blacksquare$$

We obtain regressivity of $g_1(n_1)$ if the economies of providing local public inputs with respect to group size n_1 do not fully dominate the adverse effect which new firms have on the local scarcity of land. The precise shape of $g_1(n_1)$ hence depends generally on the full list of local production characteristics, C_1, F^1 and L_1, in particular.

More can be said in the special case where

C'_i is constant in g_i and where (14a)

$F(g_i,l_i)$ does not depend on k_i. (14b)

Applying the implicit function theorem to (11) then gives us

$$g_i' = -\frac{F^1_g - F^1_{gl}L_1/n_1}{n_1F^1_{gg}} = -\frac{F^1_g + g_1F^1_{gg}}{n_1F^1_{gg}}.$$

$g_1' < g_1/n_1$ thus holds if, and only if, $\varepsilon_{F_g} > \frac{1}{2}$ where $\varepsilon_{F_g} \equiv -g_1F^1_{gg}/F^1_g$ is the *elasticity of the marginal productivity of* g_1.

Proposition: Assuming (14), $W(n_1)$ is strictly concave if the elasticity of the marginal productivity of local public inputs is greater than $\frac{1}{2}$.

In the special case of Cobb-Douglas production functions, $F(g,l) = g^{\alpha}l^{\beta}$, $\alpha + \beta = 1$, we have $\varepsilon_{F_g} = 1 - \alpha$. Strict concavity of $W(n_1)$ hence results if $\alpha < \beta$. Land must be more productive than the public factor if a stationary allocation is to be stable and efficient. For $\alpha = \beta = \frac{1}{2}, \frac{c_1}{L_1} \neq \frac{c_2}{L_2}$, there does not exist any interior stationary allocation. For $\alpha > \beta$, any stationary allocation is instable and not efficient.

References

Atkinson, A. B., and J. E. Stiglitz, 1980, Lectures on Public Economics, Maidenhead

Bewley, T. F., 1981, A Critique of Tiebout's Theory of Local Public Expenditures, Econometrica 49, 713-740

Boadway, R., 1973, Similarities and Differences between Public Goods and Public Factors, Public Finance 28, 245 -257

Boadway, R., 1982, On the Method of Taxation and the Provision of Local Public Goods: Comment, American Economic Review 72, 846-851

Buchanan, J. M., and C. J. Goetz, 1972, Efficiency Limits of Fiscal Mobility: An Assessment of the Tiebout Model, Journal of Public Economics 1, 25-43

Hamilton, B. W., 1983, A Review: Is the Property Tax a Benefit Tax?, in: Local Provision of Public Services: The Tiebout Model after Twenty-Five Years, G. R. Zodrow, ed., New York, 85-107

Hartwick, J. M., 1980, The Henry George Rule, Optimal Population, and Interregional Equity, Canadian Journal of Economics 13, 695-700

Henderson, J. V., 1974, A Note on the Economics of Public Intermediate Inputs, Economica 41, 322-327

Hillman, A. L., 1978, Symmetries and Asymmetries between Public Input and Public Good Equilibria, Public Finance 33, 269-279

Keen, M., 1991, Corporation Tax, Foreign Direct Investment and the Single Market, in: European Integration: Trade and Industry, L. A. Winters and A. J. Venables, eds., Cambridge, 165-198

Musgrave, R. A., and P. B. Musgrave, 1980 (1973): Public Finance in Theory and Practice, New York

Rose, M., 1991, Cash-flow-Gewerbesteuer versus zinsbereinigte Gewerbeertragsteuer, in: Konsumorientierte Neuordnung des Steuersystems, M. Rose, ed., Berlin, 205-216

Schweizer, U., 1986, General Equilibrium in Space and Agglomeration, in: Location Theory, R. Arnott, ed., Chur, 151-185

Starrett, D. A., 1988, Foundations of Public Economics, Cambridge, Mass.

Stiglitz, J. E., 1977, The Theory of Local Public Goods, in: The Economics of Public Services, M. Feldstein and R. P. Inman, eds., London, 274-333

Stiglitz, J. E., 1983, The Theory of Local Public Goods Twenty-Five Years after Tiebout: A Perspective, in: Local Provision of Public Services: The Tiebout Model after Twenty-Five Years, G. R. Zodrow, ed., New York, 17-53

Tiebout, C. M., 1956, A Pure Theory of Local Expenditures, Journal of Political Economy 64, 416-424

Wildasin, D. E., 1986, Urban Public Finance, Chur