SOME REVENUE SHARING CRITERIA IN FEDERAL FISCAL SYSTEMS: SDME NEW INSIGHTS

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Abstract

This paper considers the relative merits of two commonly used allocative criteria for the dispensation of federal transfers among subnational governments (States), viz., distance and inverse-income formulae. Both the allocative criteria satisfy the principle of horizontal equity. By examining the relative progressivities of the two formulae, it is shown that the inverse-income criterion relative to the distance criterion, favours States which are either very poor or very rich while assigning relatively lower shares to the middle income States. The responsiveness of per capita shares of States under the two dispensations with respect to income and population size changes is also studied in a dynamic framework. There are progressive responses with respect to income changes. However, an increase in population size of a State results in a fall in per capita shares of all States, and this fall is larger for a poorer State.

SOME REVENUE SHARING CRITERIA IN FEDERAL FISCAL SYSTEMS: SOME NEW INSIGHTS*

I. Introduction

In federal fiscal systems, revenue sharing between the national and subnational (State) governments, requires some allocative criteria for determining the share of individual State governments. Once the amount to be shared between the national and subnational authorities is decided on the basis of considerations of vertical equity, it is the consideration of horizontal equity which governs the distribution among the State governments. In this paper, the built-in properties of alternative allocative criteria are discussed in the context of the consideration of horizontal equity in the distributive scheme that they entail.

The allocative criteria have differed in different federations. Even in the same country, they have differed over different periods of time, or more than one criteria have been used at the same point of time. As such, an odd assortment of alternative criteria is available which may be adopted by the working federal systems. The analytical properties of alternative

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criteria offer interesting comparisons and shed light on the built-in merits as well as the basis of different criteria. Often a competition among the States ensues advocating the use of one rather than another criteria, depending on which criteria suits a particular State compared to others. The dispensation formulae utilised in different federations are found to bear close resemblance. In India, different allocative criteria are used for allocating different components of revenues among the States. The allocative criteria adopted in other federations are found to resemble one or more of the criteria utilised in the Indian Federation. Therefore, this paper analyses some of the allocative criteria used by the more recent Finance Commissions in India (7th, 8th, and 9th) with a view to highlighting their properties and implications. Some points of comparison of allocative criteria utilised in India with those used in other federations are also highlighted.

The outline of this paper is as follows. Section II contains salient features of tax revenue sharing in India and a comparison of allocative criteria used in India with those used in other federations. Section III describes two commonly used allocative criteria and their presumed role in revenue sharing in India. Section IV analyses the progressivity of the two criteria in a static framework. Sections V and VI analyse responsiveness of allocative criteria to variations in per capita income and population size of States respectively. Section VII contains concluding remarks.

II. Tax Revenue Sharing in India: Salient Features

Under constitutional provisions and specific recommendations of the Finance Commissions, the divisible pool of shareable taxes is divided among States on the basis of three distinct considerations. For some taxes and/or to some extent, the guiding principle is that of a tax rental arrangement wherein attempt is made to return the tax revenue to the States in proportion to the amount that they would have raised in the absence of the revenue-sharing arrangement. Additional excise duties in lieu of sales tax on specified commodities and 10 per cent of the shareable part of income tax are being shared under the purview of this principle. Another portion of tax revenues is distributed among the States on the basis of `notional' deficits of the States estimated by the Finance Commission. A limited number of States are benefitted by this provision. The overwhelming part of tax devolution, accounting for about 81 per cent of the shared tax revenues, is distributed on need and equity based criteria. There are three main criteria which have been utilised in this context, viz. population, population weighted by distance of per capita income from the highest per capita income, and population weighted by the inverse of per capita income. In addition, sometimes poverty ratio or index of backwardness has also been used. Among these, quite a large weight has been assigned to the `distance' and `inverse-income' formulae which have been used to impart a marked degree of progressivity in the scheme of devolution. It can be shown that the distance formula bears a close resemblance to allocative criteria being utilised in countries like Australia, Canada and Federal Republic of Germany, as indicated in the general formula proposed by Mathews (1977 and 1980b) (see the Annexure). Similarly, the inverse-income formula is being used in Brazil and it is given a substantial weight (50 per cent). It is these two formulae that constitute the basic subject matter of the discussion that follows.

III. Distance and Inverse-Income Criteria

The information base of these two allocative criteria consists of per capita incomes (y_i; hereinafter called `income') and population (N_i; $i = 1, 2, \ldots, n$) of each of the States. If the State incomes are written in an ascending order,

$$0 < y_1 \leq y_2 \leq y_3 \text{ ------ } \leq y_n$$

then the `distance' formula gives the shares of the States (a_i) according to:

$$a_i = \frac{(y_n - y_i)\, N_i}{\Sigma (y_n - y_i)\, N_i} \quad (i = 1, 2 \ldots\ldots, n) \qquad (1)$$

The inverse-income criterion, on the other hand determines these shares (b_i) as:

$$b_i = \frac{(1/y_i)\, N_i}{\Sigma\, (N_i/y_i)} \qquad (2)$$

Both of these formulae are being utilised by the Finance Commissions in India. The 7th Finance Commission gave a weight of 25 per cent to both these criteria for the distribution of the shareable portion of Union Excise Duties (UED). The 8th Finance Commission assigned a weight of 50 per cent to the distance criterion, 25 per cent to the inverse-income criterion, and also enlarged the scope of their application by using them for the distribution of 90 per cent of the divisible pool of income tax and 40 per cent out of 45 per cent of the net proceeds of UED, which constituted the divisible pool. The 9th Finance Commission gave two awards. Its first award was for one year (1989-90) only. Its main award was for a five year period (1990-91 to 1994-95). In their first award, the distance factor was given a weight of 50 per cent and the inverse-income factor, a weight of 12.5 per cent. They were applied to 90 per cent of the shareable part of income tax and 40 per cent of the net proceeds of UED. In their main award, the weights remained 50 per cent for distance factor and 12.5 per cent for the inverse-income factor for the distribution of income tax proceeds. The weights were 33.5 per cent for the distance factor and 12.5 per cent for the inverse-income factor for the distribution of 45 per cent of the net proceeds of UED.

Two messages emanate from this recounting of the relative weights given to the distance and the inverse-income criteria. First, there appears to be a growing preference for the distance criterion in relation to the inverse-income criterion. Secondly, the relative weights assigned to the two criteria have been varied in an *ad-hoc* manner without any explicit explanation or objective discussion in the Finance Commission reports as to the basis of giving them specific weights as also the basis of changing these weights from one Commission to another or for the same Commission from one report to another. It is also not clear as to why two criteria are being utilised when the information base (y_i, N_i) is absolutely the same in both cases.

An analysis of the analytical properties of these two alternative criteria vis-a-vis their progressivity and sensitivity with respect to changes in income and population sizes, would therefore help in identifying the objective grounds which may form the basis of expressing a relative preference between them. It may also help in formulating more general forms of the allocative criteria.

IV. Properties of Allocative Criteria: A Static Perspective

a. Progressivity

The properties of the allocative criteria can be studied in a static as well as a dynamic perspective. In a static frame of analysis, the distribution of (y_i, N_i) is fixed at a given point of time. One can study the changes in shares and per capita shares by moving from lower to higher income States. In a dynamic perspective, the income and/or population of a State is allowed to change, and one may study how the allocated shares would change, *ceteris paribus*.

In a static frame of analysis, it is expected that a progressive criterion would allocate higher per capita shares to lower per capita income States. Thus, for the distance criterion to be progressive, we expect

$$a_1^* > a_2^* > \ldots\ldots > a_n^*, \text{ where } a_i^* = a_i/N_i$$

Similarly, for the inverse-income criterion to be progressive, we expect

$$b_1^* > b_2^* > \ldots\ldots > b_n^*, \text{ where } b_i^* = b_i/N_i$$

Equation (1) and a_i^* can be rewritten as

$$a_i = \alpha N_i\ (y_n - y_i), \text{ and} \tag{3}$$

$$a_i^* = \alpha y_n - \alpha y_i \tag{4}$$

where $\alpha = 1/\Sigma(y_n - y_i)N_i > 0$, which is fixed for a given distribution of (y_i, N_i).

This describes a straightline relating per capita shares (a_i^*) to per capita incomes (y_i) with an intercept term as αy_n and a slope given by

$$\frac{\partial a_i^*}{\partial y_i} = -\alpha \tag{5}$$

This indicates the progressivity of the distance criterion. Further, the degree of progressivity at different levels of y_i is constant in this case. It can be seen correspondingly that for the inverse-income formula,

$$b_i^* = \beta / y_i, \text{ where } \beta = [1/\Sigma(N_i/y_i) > 0 \tag{6}$$

In this case

$$\frac{\partial b_i^*}{\partial y_i} = \frac{-\beta}{y_i^2} \tag{7}$$

which is also negative, for a given β, thus indicating progressivity of the dispensation criterion. In this case, however, the degree of progressivity changes with y_i. Further, the curve relating b_i^* to y_i can be drawn as a rectangular hyperbola, since:

$$(b_i^*)(y_i) = \beta \tag{8}$$

where β is fixed for a given distribution of (y_i, N_i).

In Figure 1, two curves indicating the relationships (a_i^*, y_i) and (b_i^*, y_i) are drawn. It is seen that the inverse-income criterion gives shares which are closer to the distance formula on both the extremes, and the shares under the two formulae depart more and more as we move towards the middle income States.

b. Relative Progressivity

An interesting question is as to which of these two formulae is more progressive, i.e., gives a larger share to the poorer States. Since the sum of the shares in both cases add up to unity, it is obvious that if one of the formulae gives larger shares to States with lower incomes, it would be giving smaller shares to the States after a certain level of income, as compared to the other formula. It has generally been assumed that the distance formula is more progressive, and it is for this reason that it has been given a greater weight as compared to the inverse-income formula. Some idea as to the relative progressivity of the two criteria can be obtained by considering the ratio of the shares of the States under the two dispensations. Defining this ratio as r_i, we may write,

$$r_i = a_i/b_i = a_i^*/b_i^* = y_i(y_n - y_i).\ C \tag{9}$$

where
$$C = \frac{\Sigma(N_i/y_i)}{\Sigma(y_n - y_i)N_i} = \frac{\alpha}{\beta} \tag{10}$$

which is a constant for any given distribution of (y_i, N_i). It is clear that r_i takes a maximum value at an income level of $y_n/2$. This is obtained by writing the first and second order conditions for maximising r_i with respect to y_i as

$$\frac{\delta r_i}{\delta y_i} = (y_n - 2\ y_i).C = o \qquad \Rightarrow \qquad y_i = \frac{y_n}{2}$$

and

$$\frac{\delta^2 r_i}{\delta y_i^2} = -2C < o$$

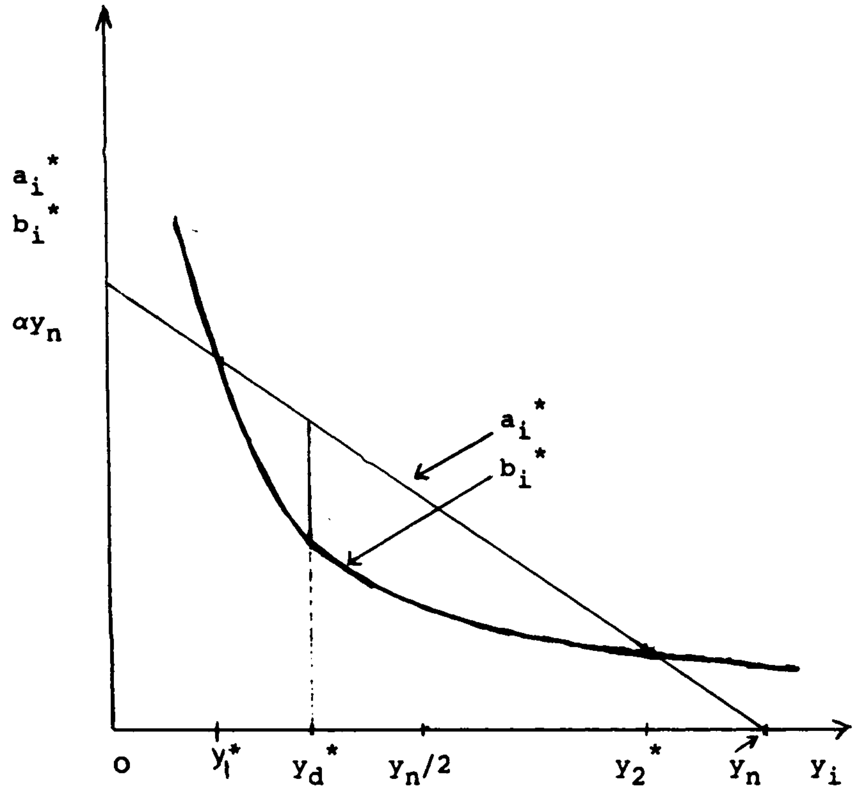

Figure 1

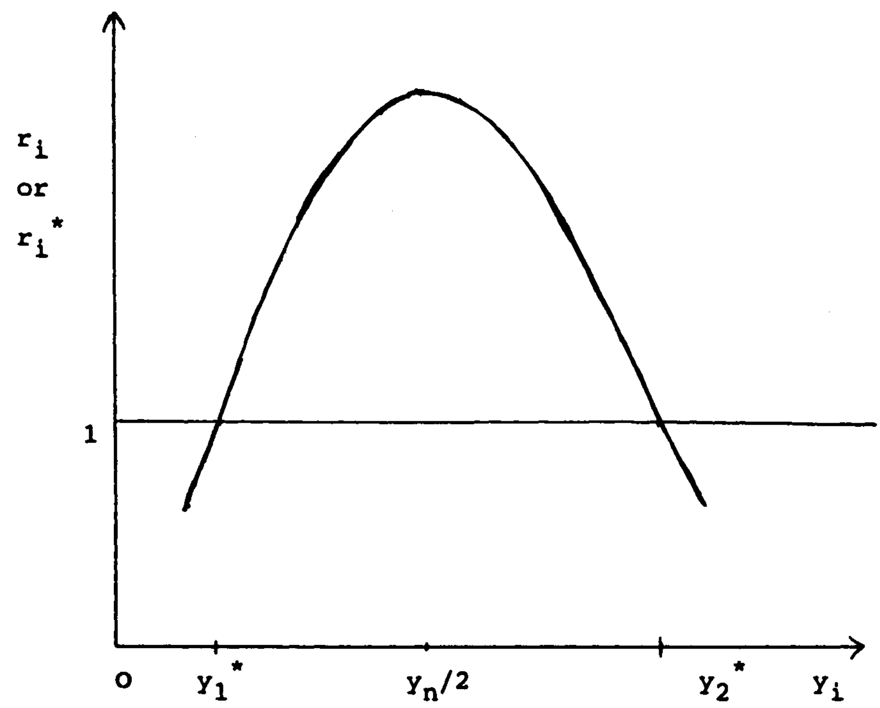

Figure 2

These results imply that the distance formula relative to the inverse-income formula favours the middle income States most. The critical values of y_i beyond which the share given by the inverse-income formula becomes larger ($b_i > a_i$ or $b_i^* > a_i^*$) can also be worked out. The levels of income at which the two formulae would give equal shares can be obtained by equating the value of r_i to unity as

$$y_i(y_n - y_i).C = 1$$

or $$y_i^2 - y_n y_i + (1/C) = 0$$

or $$y_i = \frac{y_n \pm \sqrt{y_n^2 - (4/C)}}{2} \qquad (11)$$

So, the critical values of y_i (say y_i^* and y_2^*) are given by

$$y_1^* = \frac{y_n - \sqrt{y_n^2 - (4/C)}}{2} = (y_n/2) - \sqrt{(y_n/2)^2-(1/C)} \qquad (12)$$

$$y_2^* = \frac{y_n + \sqrt{y_n^2 - (4/C)}}{2} = (y_n/2) + \sqrt{(y_n/2)^2-(1/C)} \qquad (13)$$

The critical value y_1^* is towards the lower end of the distribution ($y_1, y_2 \ldots, y_n$) whereas y_2^* is towards the higher end. It may also be noted that $y_1^* < y_n/2$, and $y_n/2 < y_2^* < y_n$.

Now it can be said that $a_i/b_i = a_i^*/b_i^* > 1$ as long as $y_1^* < y_i < y_2^*$, $= 1$ for $y_i = y_1^*$ or y_2^* and < 1 for $y_i < y_1^*$ and for yi $> y_2^*$. This situation regarding relative progressivity of the two dispensations is shown in Figure 2. Thus, between the distance formula and the inverse-income formula, the former gives higher shares to all the States with incomes in the range (y_1^* to y_2^*) and lower shares to all the States with income less than y_1^* or greater than y_2^* as shown in Figure 1.

It is interesting to observe that the difference between the two sets of shares $(a_i - b_i)$ or $(a_i^* - b_i^*)$ is maximised at a value different from $y_n/2$. Writing,

$$D_i = a_i - b_i = (\alpha y_n - \alpha y_i)N_i - \beta N_i/y_i, \qquad (14)$$

we obtain the first order condition for maximisation as

$$\frac{\partial D_i}{\partial y_i} = -\alpha N_i + \beta N_i/y_i^2 \qquad (15)$$

setting this equal to zero, gives

$$y_i = \pm \sqrt{\beta/\alpha}$$

Since $$\frac{\partial^2 D_i}{\partial y_i^2} = \frac{-2\beta N_i}{y_i^3} < 0 \text{ for } y_i > 0, \qquad (16)$$

for positive values of y_i, the maximum is attained at the positive root of $\sqrt{\beta/\alpha}$. It can be ascertained that $(a_i^* - b_i^*)$ would also be maximised at the same value of y_i at which $(a_i - b_i)$ is maximised, which may be referred to as y_d^*.

For spotting the placement of y_d^* *vis-a-vis* the other critical values of y_i, let us express y_d^*, by using equation (10), as

$$y_d^* = \sqrt{(1/C)} \quad \text{or} \quad y_d^{*2} = 1/C \qquad (17)$$

Now, substituting y_d^{*2} for $1/C$ in equation (12), we get

$$y_d^{*2} = y_1^* \, y_n - y_1^{*2} \qquad (18)$$

or $$y_d^{*2} = y_1^{*2} \, (y_n/y_1^* - 1) \qquad (19)$$

Since $y_1^* < y_n/2$, substituting y_1^* by $y_n/2$ in equation (19) gives

$$y_d^{*2} > y_1^{*2} \, (y_n/(y_n/2)-1)$$

or

$$y_d^{*2} > y_1^{*2} \tag{20}$$

This implies that $y_d^* > y_1^*$ for all positive values of y_i.

From equation (18), it may be noted that y_d^{*2} is an increasing function of y_1^*. Thus, substituting y_1^* by $y_n/2$ in equation (18) gives

$$y_d^{*2} < (y_n/2)y_n - (y_n/2)^2$$

or $$y_d^{*2} < (y_n/2)^2$$

This implies that $y_d^* < (y_n/2)$ for all positive values of y_i. Thus y_d^* lies in the range y_1^* to $y_n/2$.

To summarise, it may be noted that in the comparison between the distance and the inverse-income formulae, four critical values of y_i have been identified. These are:

y_1^*, below which $b_i^* > a_i^*$

y_d^*, which maximises $(a_i^* - b_i^*)$

$y_n/2$, which maximises $a_i^* - b_i^*$, and

y_2^*, after which $b_i^* > a_i^*$

These values are also indicated in Figure 1. It may be noted that the inverse-income formula gives relatively larger shares to the higher income States mostly at the cost of the middle income States, but generally from all States lying in the income range y_1^* to y_2^*. The States closer to y_1^* can in fact be quite poor.

A numerical example is constructed here to illustrate the benchmark values of y_i. In Table 1, a hypothetical economy with six States sharing in the devolution process is indicated. Population is kept at unity in order to concentrate on the variations in y_i. It will be observed that b_i is larger than a_i for the poorest State and the two richest States. In the middle income ranges a_i exceeds b_i. The ratio a_i/b_i is largest for the State with $y_i = y_n/2$, whereas the difference between a_i and b_i is largest for a value of y_i lower than this which is closer to y_d^*.

Thus, the distance formula is more progressive as compared to the inverse-income formula for the range of incomes above y_1^*. The inverse-income formula, however, gives higher per capita shares at the two extremes, which is a desirable feature at the lower end of the income scale, but not so at the higher end. In other words, except for the very poor States, it is the distance criterion which appears to be better. Even so , if a large part of population lives in the poorest States, it may be beneficial for them if the inverse-income formula is used. As such, the choice between the two formulae becomes an empirical question.

V. Responsiveness to Changes in Income

In this section, the static framework of analysis is replaced by a dynamic perspective with a view to studying how the shares of States under the two systems would respond to changes in income and population, *ceteris paribus*. In this case, the terms α and β in the two criteria will not remain fixed as these will change with changes in y_i or N_i.

Table 1

Shares of States with Two Allocative Criteria

y_i	N_i	$(y_n-y_i)N_i$	N_i/y_i	$a_i=a_i^*$	$b_i=b_i^*$	a_i-b_i	a_i/b_i
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
10	1	40	0.100	0.32	0.373	-0.053	0.858
20	1	30	0.050	0.24	0.187	0.0535	1.283
25	1	25	0.040	0.20	0.149	0.0508	1.342
30	1	20	0.033	0.16	0.123	0.037	1.301
40	1	10	0.025	0.08	0.093	-0.037	0.860
50	1	0	0.020	0.00	0.075	-0.075	0.000
Total		125	0.268				

$y_1^* = 12.405$
$y_d^* = 21.59$
$y_n/2 = 25$
$y_2^* = 37.595$

Both the distance and the inverse-income criteria give progressive responses to changes in income in the sense that the share of a State falls as its per capita income increases, other things remaining the same. This can be established by deriving expressions for partial differentials of State shares with respect to its income, i.e. $\partial a_i/\partial y_i$ and $\partial b_i/\partial y_i$. These are given by

$$\frac{\partial a_i}{\partial y_i} = \frac{-N_i(1-a_i)}{\Sigma(y_n-y_i)N_i} = \frac{-a_i(1-a_i)}{(y_n-y_i)}, \text{ and} \tag{22}$$

$$\frac{\partial b_i}{\partial y_i} = \frac{-N_i(1-b_i)}{y_i^2\ \Sigma N_i/y_i} = \frac{-b_i(1-b_i)}{y_i} \tag{23}$$

Since $y_i > o,\ y_n - y_i > o,\ (1-a_i) > o$ and $(1-b_i) > o$;

equations (22) and (23) suggest that

$$\frac{\partial a_i}{\partial y_i} < o \quad \text{and} \quad \frac{\partial b_i}{\partial y_i} < o$$

Hence, the two formulae indicate progressive responses.

Responsiveness of per capita shares, a_i^* and b_i^*, with respect to y_i is given by

$$\frac{\partial a_i^*}{\partial y_i} = -\frac{a_i^*\ (1-a_i^*\ N_i)}{y_n - y_i} \tag{24}$$

$$\frac{\partial b_i^*}{\partial y_i} = -\frac{b_i^*\ (1 - b_i^*\ N_i)}{y_i} \tag{25}$$

Since $1 - a_i^*\ N_i = 1-a_i > o$ and $1-b_i^*\ N_i = 1-b_i > o$, equations (24) and (25) suggest that

$$\frac{\partial a_i^*}{\partial y_i} < o \quad \text{and} \quad \frac{\partial b_i^*}{\partial y_i} < o \tag{26}$$

These results suggest that both the formulae give progressive responses in the sense that per capita share of a State falls with rise in its income, other things remaining the same.

Given other things, a per cent increase in y_i leads to a fall in the shares under the two dispensations. The extent of percentage fall can be indicated by expressions of partial elasticities $e_{yi}(a_i)$ and $e_{yi}(b_i)$ as

$$e_{yi}(a_i) = - \frac{y_i(1 - a_i)}{y_n - y_i} \quad (27)$$

$$e_{yi}(b_i) = - (1 - b_i) \quad (28)$$

In the case of the distance formula, the elasticity depends on y_i, y_n and a_i whereas in the inverse-income case, it depends on the existing share, viz., b_i only.

In terms of magnitudes, $e_{yi}(a_i)$ is greater than $e_{yi}(b_i)$, so long as

$$y_i(1 - a_i) > (y_n - y_i)(1 - b_i) \quad (29)$$

or $$y_i/(y_n - y_i) > (1 - b_i)/(1 - a_i)$$

or $$(1 - b_i)/(1 - a_i) < y_i/(y_n - y_i) \quad (30)$$

It may be noted that the right hand side of inequality (30) is $\lesseqgtr 1$ according as $y_i \lesseqgtr y_n/2$. Since $a_i/b_i > 1$ for $y_1^* < y_i < y_2^*$, the left hand side of inequality (30), i.e., $(1 - b_i)/(1 - a_i)$ would be >1, as long as $y_1^* < y_i < y_2^*$. These results imply that atleast for the income range y_1^* to $y_n/2$, condition (30) is violated implying that the magnitude of $e_{yi}(b_i)$ is greater than that of $e_{yi}(a_i)$. This suggests that the inverse-income formula as compared to the distance formula, is more progressive within a group of low income States with per capita incomes falling in the range y_i* to $y_n/2$. By working with partial elasticities of a_i* and b_i*, it can be shown that this result remains unchanged.

VI. Responsiveness to size: Horizontal Equity and Non-neutrality

a. Horizontal equity

An allocative criteria can be said to satisfy the principle of horizontal equity if the States with the same per capita income receive the same per capita share of transfers irrespective of their population size. It can be shown that both the distance and the inverse-income criteria satisfy the principle of horizontal equity. This can be explained as follows:

$$\frac{a_i^*}{a_j^*} = \frac{(y_n - y_i)}{(y_n - y_j)} \quad \text{, and} \tag{31}$$

$$\frac{b_i^*}{b_j^*} = \frac{(1/y_i)}{(1/y_j)} = \frac{y_j}{y_i} \tag{32}$$

where a_j^* and b_j^* denote per capita shares of the jth State with the distance and the inverse-income criteria respectively.

It would be noted from equations (31) and (32) that, so long as y_i equals y_j, $a_i^* = a_j^*$ and $b_i^* = b_j^*$. This implies that the ith and the jth States receive the same per capita share of transfers under each of the two allocative criteria, as long as their per capita incomes are the same. Thus, both the allocative criteria satisfy the principle of horizontal equity.

b. Non-neutrality

In a dynamic perspective, it can be seen that the per capita shares under the two dispensations would fall as the size of a State increases while holding per capita income constant. The responsiveness of the shares with respect to changes in size (N_i) of a State can be worked out as below:

$$\frac{\partial a_i}{\partial N_i} = \frac{a_i(1 - a_i)}{N_i} \tag{33}$$

$$\frac{\partial a_i^*}{\partial N_i} = \frac{1}{N_i} \frac{\partial a_i}{\partial N_i} - \frac{a_i}{N_i^2} \tag{34}$$

This can be rewritten, by using equation (31), as:

$$\frac{\partial a_i^*}{\partial N_i} = - a_i^{*2} < o \tag{35}$$

The corresponding change in the per capita shares of other States not experiencing a change in their population is given by

$$\frac{\partial a_j^*}{\partial N_i} = - a_i^* a_j^* < o \tag{36}$$

The proportional change in the initial shares of different States following a change in the size of the ith State can be expressed as

$$\frac{1}{a_i^*} \frac{\partial a_i^*}{\partial N_i} = - a_i^* < o \tag{37}$$

$$\frac{1}{a_j^*} \frac{\partial a_j^*}{\partial N_i} = - a_i^* < o \tag{38}$$

Similarly, the corresponding derivatives for the inverse-income criterion can be obtained as

$$\frac{\partial b_i}{\partial N_i} = \frac{b_i(1 - b_i)}{N_i} \, , \tag{39}$$

$$\frac{\partial b_i^*}{\partial N_i} = - b_i^{*2} < o \, , \tag{40}$$

$$\frac{\partial b_j^*}{\partial N_i} = - b_i^* \; b_j^* < o \, , \tag{41}$$

$$\frac{1}{b_i^*} \; \frac{\partial b_i^*}{\partial N_i} = - b_i^* < o \tag{42}$$

$$\frac{1}{b_j^*} \; \frac{\partial b_j^*}{\partial N_i} = - b_i^* < o \tag{43}$$

From these results, it follows that in both cases, as the size of a State, indicated by N_i, increases, the per capita shares of all States fall. From equations (35), (36), (40) and (41), it may be noted that *ceteris paribus* the fall in the per capita share of a State is larger, the larger the intial share of the State. The fall for the State experiencing the increase in population is given by the square of the original per capita share (a_i^{*2} or b_i^{*2}) and that in the other States it is given by the product of the initial shares of the State experiencing the change and the other State ($a_i^* \; a_j^*$ or $b_i^* \; b_j^*$). Further, from equations (37), (38), (42) and (43), it may be noted that the proportional fall in the per capita share of each of the States is given by the original per capita share (a_i^* or b_i^*), other things remaining the same. The poorer the State, the larger would be its original per capita share and the larger would be the fall in its per capita share following an increase in the population size of a State. Thus, in both the allocative criteria, there is a built-in bias against the poor States with respect to growth of population. In this context, it is interesting to note that the practice in India, of using the population figures of an earlier year (i.e., with a lag) in the application of these criteria seems to be in favour of the poor States. This is interpreted as non-neutrality or regressivity of the transfer mechanism with respect to population changes, holding other things constant.

VII. Concluding Remarks

The analytical properties of the distance and the inverse-income formulae studied in this paper show that both the formulae are progressive with reference to per capita income and regressive with respect to a relatively higher growth rate of population of a lower per capita income State. The regressivity with respect to population size seems to enhance the progressivity of both the allocative criteria when a State experiencing higher growth rate of population is also the richer State or when a State with higher rate of decline in population is also the poorer State. Both the formulae are found to satisfy the principle of horizontal equity. The States with the same per capita income receive the same per capita transfers irrespective of their population size.

In the comparison of the relative progressivities of the two criteria, four critical values of y_i have been identified. It is observed that the inverse-income formula favours States at the extreme ends of the income scale, which is a desirable property only at the lower end of the income scale. For the rest of the entire range of per capita income, the distance formula is more progressive. In relative terms, the inverse-income formula works out more adversely for the middle income States.

Over time, as income and population increase, both formulae respond progressively to income changes. The effect of increase in population is negative. In both the dispensations there is a built-in bias against the poor States with respect to growth of population. An increase in population size of a State leads to a fall in per capita shares of all States. The fall in per capita share of a State is larger, the larger the initial share of the State. In this context, the practice in India, of adopting the population figures of an earlier year in the application of these criteria seems to be in favour of the poor States.

Annexure

ALLOCATIVE CRITERIA USING FISCAL EQUALIZATION NORMS

Mathews (1977, 1981) discusses a fiscal equalization model which describes a number of revenue-sharing arrangements. In specifying the equalization norms, the objectives may include (i) revenue-raising equalization, (ii) revenue raising equalization augmented by a fiscal effort factor, and (iii) revenue as well as expenditure equalization. Considering, for example, the first of these objectives only, the general formula outlined by Mathews may be written as:

$$G_i = N_i \frac{R_s}{Y_s} \left[\frac{Y_s}{N_s} - \frac{Y_i}{N_i} \right]$$

where G_i = the grant or entitlement of the ith State,
N_i = the population of the ith State, and
Y_i = the income of the ith State.

The subscript `s' refers to the `standard' State which may be an `average' income State or the `highest' income State. Thus, N_s, Y_s etc. refer to the corresponding figures for the standard State, and R_s refers to the revenue collections in this State. Mathews argues that this formula (with additional fiscal effort and expenditure terms, as necessary), can be used to describe capacity equalization arrangements in different federations like Australia, Canada and Federal Republic of Germany. In Australia, for example, the subscript `s'; refers to the highest fiscal capacity State(s); in Canada it refers to the `national average standard of all provisions'. In Germany also it refers to the national average.

If the total amount to be shared among the State governments is denoted by G, the share of the ith State (a_i) in total grants can be written as:

$$a_i = G_i/G$$
$$= (K_s/G)N_i (y_s - y_i)$$

where y_i denotes per capita income of the ith State and $K_s = R_s/Y_s$. For given G and K_s the share of the its State can be interpreted to be proportional to $N_i(Y_s - Y_i)$. Thus, reading y_s as referring to the highest per capita income State, this formula reflects the `distance' formula being used by the Indian Finance Commissions.

REFERENCES

Boadway, Robin W. (1980), **Intergovernmental Transfers in Canada**, Canadian Tax Foundation, Toronto.

Government of India (Ministry of Finance), **Reports of the Finance Commissions** (Seventh, Eighth and Ninth)

Hunter, J.S.H. (1973) **Revenue Sharing in the Federal Republic of Germany**, Research Monograph No. 2, Centre in Research on Federal Financial Relations, Australian National University, Canberra.

Mathews R.L. (ed.) (1982) **Public Policies in Two Federal Countries: Canada and Australia**, Centre for Research on Federal Financial Relations, Australian National University Canberra.

Mathews R.W. (1977), **Report of the Study Group on the Role of Public Finance in European Integration**, Vol. II, Commission of the European Commission, Brussels.

Mathews R.W. (1980a), **Revenue Sharing in Federal Systems**, Research Monograph No. 31, Centre for Research on Federal Financial Relations, Australian National University, Canberra.

Mathews R.W.(1980b) **"Mechanism for Fiscal Equalization"** in Grewal, B.S., G. Brennan and R.W. Mathews(ed), The Economics of Federalism, Australian National University Press, Canberra.

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