REVENUE SHARING AMONG THE SUB-NATIONAL GOVERNMENTS: A MODIFIED FORMULA

PAWAN K. AGGARWAL
D.K. SRIVASTAVA

1/94 JANUARY 1994

REVENUE SHARING AMONG THE SUB-NATIONAL GOVERNMENTS: A MODIFIED FORMULA

PAWAN K. AGGARWAL
D.K. SRIVASTAVA

Abstract

The study presents a general formula for the allocation of federal transfers among the participating sub-national governments (States). It shows that two commonly used allocative criteria, namely, the distance and the inverse-income criteria are special cases of the general formula. It proposes another allocative criterion as a special case of the general formula, which combines the merits of both the distance and the inverse-income criteria. The proposed integrated criterion is based on the notion of relative fiscal deficiency of the States which seems to be intutively more appealing and is found to be more progressive as compared to the other two criteria in the allocation of federal transfers.

REVENUE SHARING AMONG THE SUB-NATIONAL GOVERNMENTS: A MODIFIED FORMULA

PAWAN K. AGGARWAL
D.K. SRIVASTAVA*

I. Introduction

In federal fiscal systems, a national government devolves a part of its revenue among the sub-national governments because of vertical fiscal imbalance between the different levels of governments. The devolved revenues are allocated among the participating sub-national (State) governments with due regard to horizontal fiscal imbalance among the States[1]. In different federations of the world, one or more criteria have been utilised for allocation of revenues among the States. Two of the criteria utilised in the Indian Federation[2], namely, `distance' and `inverse-income' criteria are comparable to those used in other federations. The distance criterion bears a close resemblance to allocative criteria utilised in countries like Australia, Canada and the Federal Republic of Germany[3]. The inverse-income criterion is being used in Brazil. The weights assigned to these criteria differ across federations and/or across different components of shareable revenue and these have not remained unchanged over time. Both the criteria are based on the same set of information, i.e., per capita income and population size of each of the participating States, and the differences in the weights assigned at any time and the changes in weights assigned over time are viewed as ad-hoc

---

* The authors are respectively **Fellow**, National Institute of Public Finance and Policy, New Delhi - 110067 and **Professor**, Department of Economics, Banaras Hindu University, Varanasi 221 005. They wish to thank Ms. Promila Rajvanshi, Shri S.B. Maan and Shri Satya Narain Sharma for word processing.

as no explicit explanation is available in this regard. The merit of these criteria is, generally, judged in terms of progressivity of the distributive scheme that they entail. Both the criteria are found progressive with reference to per capita income (hereinafter referred to as income) of States in the sense that a State with lower per capita income receives higher per capita share of the devolved revenues. However, the responses to population growth are found to be biased against the poor States. 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 (see Srivastava and Aggarwal, 1993).

Using the same information-base as these two criteria, this paper proposes a modified criterion. The modified criterion combines the merits of both the distance and the inverse-income criteria and is found to be more progressive as compared the both these criteria.

Section II of the paper describes the general formula for the allocation of federal transfers among the participating States and discusses the distance criterion, the inverse-income criterion and a modified criterion as the special cases of the general formula. Section III compares income responsiveness of the modified criterion with that of the other two criteria, in a static framework. Section IV compares income responsiveness of the modified criterion with that of the other two criteria, in a comparative static perspective. Section V compares the proposed modified criterion with the other two criteria with regard to responsiveness of State shares to population growth. Section VI contains concluding remarks.

II. Allocation Criteria : A Modified Criterion

The shares of the ith State a_i and b_i respectively under the distance and the inverse-income criteria are given by

$$a_i = N_i(y_n - y_i)/\Sigma_i N_i(y_n - y_i) \qquad i = 1,2,\ldots.n \qquad (1)$$

$$b_i = (N_i/y_i)/\Sigma_i(N_i/y_i) \qquad i = 1,2,\ldots.n \qquad (2)$$

where y_i and N_i denote per capita income and population of the ith State. The States are arranged in the ascending order of their per capita income, i.e., $0 < y_1 < y_2 < ---- < y_n$.

Both the distance and the inverse-income criteria are based on the consideration of relative deficiencies in fiscal capacities of the States where the per capita income of a State is taken to represent its fiscal capacity. These criteria are intended to allocate higher per capita transfers to a State with lower fiscal capacity and they utilise a common information base, viz., (y_i, N_i). The formulae expressing the distance and the inverse-income criteria can be shown to be the specific forms of a general formula that allocates transfers, among the States, in proportion to relative deficiencies in fiscal capacities of the States with due weightage for population size of different States. Such a general formula can be written as[4]

$$s_i = N_i R_i/\Sigma_i N_i R_i \qquad i = 1,2,\ldots.n \qquad (3)$$

Where s_i denotes the share of ith State in devolution and R_i denotes relative deficiency in fiscal capacity of the ith State. Population size (N_i) of the ith State can be interpreted as the weight assigned to its relative deficiency in fiscal capacity

(R_i). The implications of this general formula as to the progressivity and horizontal equity in allocation of federal transfers would depend on the specific form of R_i.

It may be noted that different modes of expressing the relative deficiency in fiscal capacity (R_i) give rise to different formulae or criteria for allocation of revenues among the States. In the distance criterion, the relative deficiency in fiscal capacity of a State is represented by the distance of its fiscal capacity from the fiscal capacity of the State with highest fiscal capacity, i.e., $(y_n - y_i)$. Thus, by substituting $(y_n - y_i)$ for R_i in formula (3) we get the expression for the distance criterion. Similarly, the expression for the inverse-income criterion is obtained by taking the relative deficiency in fiscal capacity of a State as the ratio of the fiscal capacity of a standard State (y_s) or the fiscal capacity of the State with highest fiscal capacity (y_n) to the fiscal capacity of the ith State, i.e., by substituting (y_n/y_i) or (y_s/y_i) for R_i in formula (3).

We propose another mode of expressing the relative deficiency in fiscal capacity of a State as the ratio of the distance of its fiscal capacity from the fiscal capacity of the State with highest fiscal capacity to its fiscal capacity. With this notion, the relative deficiency in fiscal capacity is given by $R_i = (y_n - y_i)/y_i$. This formulation of the relative deficiency in fiscal capacity combines the character of both the distance and the inverse-income criteria. It can be viewed as a simple multiple of the relative deficiencies in fiscal capacities under these two criteria. Therefore, the suggested formulation of relative deficiency in fiscal capacity can be termed as integrated criterion'. A few remarks on the integrated criterion in comparison to the other two criteria can be made on the basis of relative deficiencies in fiscal capacities they entail. The relative deficiency in fiscal capacity of a State under the integrated criterion can also be viewed as the relative deficiency in fiscal capacity of the distance criterion expressed as a proportion of its fiscal capacity. This implies that, for given relative deficiency a fiscal capacity of a State with the distance criterion, the higher will be its relative deficiency in fiscal capacity with the integrated criterion, the lower the per capita income of the State. So, the integrated criterion, in comparison to the distance criterion, will be more favourable to the poorer States and as such, it can be expected to result in a more progressive allocation of revenues among the States, in the sense of higher per capita transfers to the poorer States. Similarly, it can be argued that the integrated criterion will be more favourable to the poorer States as compared to the inverse-income criterion. Thus, the integrated criterion will be most progressive among the three allocative criteria.

The State shares (c_i) under the integrated criterion can be expressed as:

$$c_i = \frac{N_i(y_n - y_i)/y_i}{\Sigma_i(N_i(y_n - y_i)/y_i)} \qquad (4)$$

It would be noted later that income and/or size responsiveness of State shares a_i, b_i and c_i is not amenable to unambiguous interpretation as to the progressivity of these criteria. However, an unambiguous interpretation is plausible when the responsiveness is analysed in terms of respective per capita shares a_i^*, b_i^* and c_i^*. The per capita shares under the three allocative criteria are given by

$$a_i^* = a_i/N_i = (y_n - y_i)/\Sigma_i N_i(y_n - y_i) \qquad (5)$$

$$b_i^* = b_i/N_i = (1/y_i)/\Sigma_i(N_i/y_i) \qquad (6)$$

$$c_i^* = c_i/N_i = ((y_n - y_i)/y_i)/\Sigma_i(N_i(y_n - y_i)/y_i) \qquad (7)$$

Equations (5) to (7) can be rewritten as

$$a_i^* = \alpha\ (y_n - y_i) \qquad (8)$$

$$b_i^* = \beta / y_i \qquad (9)$$

$$c_i^* = \Gamma\ (y_n - y_i)/y_i \qquad (10)$$

Where

$$\alpha = 1/\Sigma_i(N_i(y_n - y_i)), \qquad (11)$$

$$\beta = 1/\Sigma_i(N_i/y_i), \qquad (12)$$

$$\Gamma = 1/\Sigma_i(N_i(y_n - y_i)/y_i) \qquad (13)$$

For a given distribution of (y_i, N_i), α, β and Γ can be taken as fixed.

It would be interesting to study the comparative merits and demerits of the integrated criterion which forms the subject matter of our discussion that follows.

III. Modified Criterion : Comparative Features

In a static framework, i.e., for a given distribution of (y_i, N_i), the per capita share of the ith State under the modified or integrated criterion can be written as

$$c_i^* = \Gamma\ y_n/y_i - \Gamma$$

or $$c_i^* + \Gamma = \Gamma\ y_n/y_i \qquad (14)$$

Defining $c_i^{*1} = c_i^* + \Gamma$, we get

$$c_i^{*1} = \Gamma\ y_n/y_i$$

or $$c_i^{*1}\ y_i = \Gamma\ y_n \qquad (15)$$

With per capita shares on the vertical axis, and per capita incomes on the horizontal axis, equation (15) defines a rectangular hyperbola with reference to the horizontal axis shifted vertically downwards by a distance (Γ). As discussed in Srivastava and Aggarwal (1993), the per capita shares under the distance formula (a_i^*) can be represented by a straight line, and those under the inverse-income formula (b_i^*) can be indicated by a rectangular hyperbola. The three dispensation curves relating to a_i^*, b_i^* and c_i^* are depicted in Figure 1 (see page 10). In the case of integrated criterion, the dispensation curve passes through the horizontal axis at income-level y_n. The distance-based shares are indicated by the solid straight line and the inverse-income-based shares are shown by the solid hyperbolic curve. The shares under the integrated criterion are shown by the dashed hyperbolic curve with reference to the shifted horizontal axis. The slope of this curve is given by

$$\frac{\partial c_i^*}{\partial y_i} = -\frac{\Gamma y_n}{y_i^2} < 0 \tag{16}$$

which shows the progressivity of the formula.

The curves a_i^* and b_i^* intersect at the points A and B which are given by y_1^* and y_2^* as follows (see Srivastava and Aggarwal, 1993):

$$y_1^* = y_n/2 - \sqrt{(y_n/2)^2 - (\beta/\alpha)} \tag{17}$$

$$y_2^* = y_n/2 + \sqrt{(y_n/2)^2 - (\beta/\alpha)} \tag{18}$$

Note that,

$$\beta/\alpha = \frac{\Sigma_i N_i (y_n - y_i)}{\Sigma_i (N_i/y_i)} \implies \Sigma_i (N_i/y_i) = \frac{\alpha}{\beta} \Sigma_i N_i (y_n - y_i) \tag{19}$$

The c_i^* curve intersects the a_i^* line at two points, which can be obtained by equation c_i^* to a_i^* as

$$\Gamma\, y_n/y_i - \Gamma = \alpha\,(y_n - y_i)$$

or $$\alpha y_i^2 - (\Gamma + \alpha y_n) y_i + \Gamma y_n = 0$$

This gives two points of intersection:

$$y_i = y_n \text{ and } y_i = \Gamma/\alpha \tag{20}$$

In Figure 1, point D is with reference to the value of $y_i = \Gamma/\alpha$. Note that this is to the right of point A, which is the point of intersection of a_i^* and b_i^*. The intersection at the point $y_i = y_n$ means that the problem encountered in the case of the inverse-income formula which, as noted in Srivastava and Aggarwal (1993), gives higher shares to very rich States along with very poor States, has been overcome in the integrated criterion. The effect of the shift of the curve is that at the cost of the very rich States, some of the poorer States are compensated. The integrated criterion is more progressive than the distance criterion since it gives relatively greater share to all States whose incomes are less than the threshold level ($=\Gamma/\alpha$). Towards the richer end of the income scale, all along, it gives a relatively lower share to the States as compared to the distance formula.

It can also be shown that the integrated criterion is more progressive than even the inverse-income criterion. The point of intersection of the c_i^* and b_i^* curves (point E) is obtained by equating C_i^* to b_i^* as

$$y_i = (y_n - \beta/\Gamma) \tag{21}$$

This implies that for States to the left of point E, the integrated criterion gives larger per capita shares than the inverse-income criterion at the cost of the richer States which lie to the right of this point.

Thus, the integrated criterion is more progressive as compared to both the distance and the inverse-income criteria.

With a view to obtaining some idea about the relative progressivity of the integrated criterion vis-à-vis the other two criteria, we consider the ratio (r_i) of the share of the ith State under the integrated criterion to its share under the inverse-income criterion, and the ratio (r_i') of the share of the ith State under the integrated criterion to its share under the distance criterion. These ratios can be expressed as

$$r_i = \frac{c_i}{b_i} = \frac{(y_n - y_i)\Sigma_i(N_i/y_i)}{\Sigma_i(N_i\ (y_n - y_i)/y_i)} = \frac{c_i^*}{b_i^*} \tag{22}$$

or $\quad r_i = (y_n - y_i)\ (\Gamma/\beta) = y_n\ (\Gamma/\beta) - (\Gamma/\beta)\ y_i$, and $\quad$ (23)

$$r_i' = \frac{c_i}{a_i} = \frac{\Sigma_i N_i(y_n - y_i)}{y_i\ \Sigma_i(N_i(y_n - y_i)/y_i)} = \frac{c_i^*}{a_i^*} \tag{24}$$

or $\quad r_i' = (1/y_i)\ (\Gamma/\alpha)$ $\quad$ (25)

or $\quad r_i' y_i = \Gamma/\alpha$ $\quad$ (26)

where α, β and Γ are constants for any given distribution of (y_i, N_i).

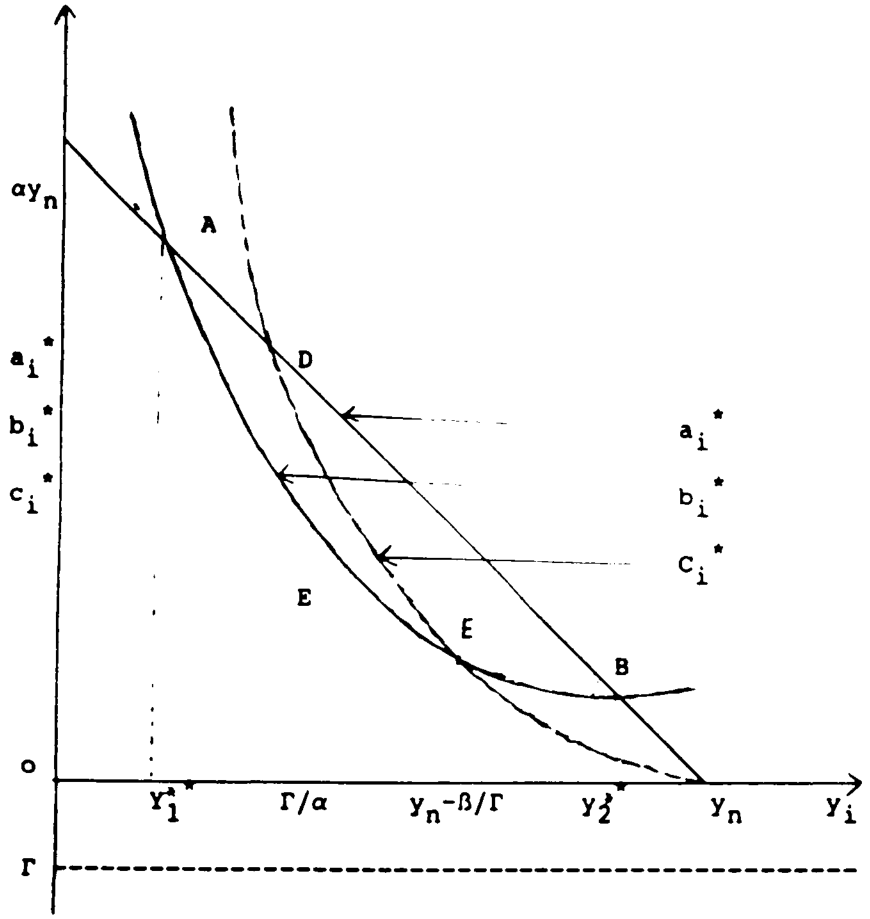

Figure 1

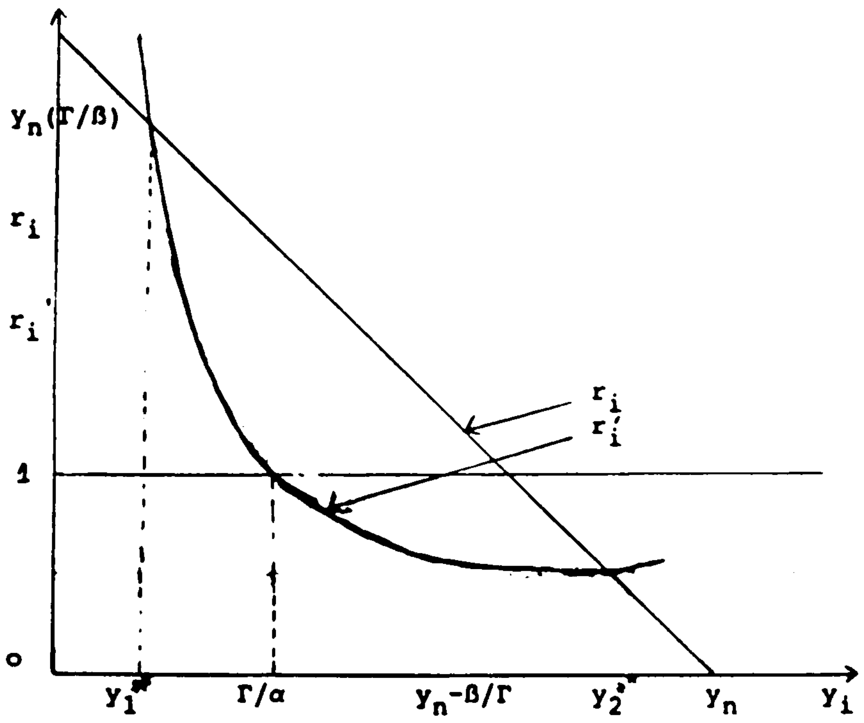

Figure 2

It may be noted that equation (23) represents a straight line, and the ratio r_i declines with a rise in y_i. The ratio r_i takes maximum value at the minimum income level, it declines to value one at an income level of $y_i = (y_n - \beta/\Gamma)$, and takes value zero at the maximum income level, i.e., when $y_i = y_n$, as shown in Figure 2. From equation (25), it follows that r_i' declines with a rise in y_i. It takes maximum value at the minimum income level and declines to value one at an income level of $y_i = (\Gamma/\alpha)$. Further, it may be noted from equation (26) that the relationship between r_i' and y_i can be represented by a rectangular hyperbola. The points of intersection of the two curves r_i and r_i' can be obtained by equating r_i to r_i' as

$$(y_n - y_i)\ (\Gamma/\beta) = (1/y_i)\ (\Gamma/\alpha) \tag{27}$$

or

$$y_i = \frac{y_n \pm \sqrt{y_n^2 - 4\ \beta/\alpha}}{2} \tag{28}$$

From equation (28), it follows that there are two points of intersection (say y_1^* and y_2^*) which are given by

$$y_1^* = (y_n/2) - \sqrt{(y_n/2)^2 - \beta/\alpha} \tag{29}$$

$$y_2^* = (y_n/2) + \sqrt{(y_n/2)^2 - \beta/\alpha} \tag{30}$$

The point y_1^* lies towards the lower end of the income scale and the point y_2^* lies towards the upper end of the income scale, as shown in Figure 2.

From the above results, certain interesting implications as to the relative progressivity of the integrated criterion emanate. The integrated criterion as compared to the inverse-income criterion is more progressive in the sense that all the lower income States (with income less than $(y_n - \beta/\Gamma)$) receive higher shares under the integrated criterion as compared to their shares under the inverse-income criterion. Also, the integrated criterion in relation to the inverse-income criterion favours most the lowest income State and the extent of favour declines with rise in the income and it reduces to the level of no favour as the income of the State approaches $(y_n - \beta/\Gamma)$. Similarly, the integrated criterion as compared to the distance criterion is more progressive in the sense that all the lower income States with income less than (Γ/α) receive higher shares under the integrated criterion as compared to their shares under the distance criterion. Further, the integrated criterion even in relation to the distance criterion favours most the lowest income State and the extent of favour declines with rise in the income and it reduces to nil as the income approaches (Γ/α).

It may be noted that (Γ/α) is lower than $(y_n - \beta/\Gamma)$, as shown in Figure 2. This can be explained as follows:

$$y_n - \beta/\Gamma = y_n - \frac{\Sigma_i N_i (y_n - y_i)/y_i}{\Sigma_i (N_i/y_i)} \tag{31}$$

or $$= y_n - \frac{y_n \ \Sigma_i (N_i/y_i) - \Sigma_i N_i}{\Sigma_i N_i/y_i}$$

or $$= \frac{N}{\Sigma_i N_i/y_i} \text{ , and} \tag{32}$$

$$\Gamma/\alpha = \frac{\Sigma_i N_i (y_n - y_i)}{\Sigma_i N_i (y_n - y_i)/y_i}$$

or $$\Gamma/\alpha = \frac{y_n \ \Sigma_i N_i - \Sigma_i N_i y_i}{y_n \ \Sigma_i N_i/y_i - \Sigma_i N_i} \tag{33}$$

This implies

$$\Gamma/\alpha < \frac{y_n N - \Sigma_i N_i y_i}{y_n \Sigma_i N_i / y_i} < \frac{y_n N}{y_n \Sigma_i N_i / y_i} = \frac{N}{\Sigma_i N_i / y_i} \tag{34}$$

By using equation (32), we get

$$\Gamma/\alpha < \quad y_n - \beta/\Gamma \tag{35}$$

This clearly shows that Γ/α is lower than $(y_n - \beta/\Gamma)$.

From Figure 2, it is evident that for the lower income States, the relative advantage of the integrated criterion in relation to the distance criterion declines faster than that in relation to the inverse-income criterion with rise in the income and accordingly, it disappears at a lower level of income when taken in relation to the distance criterion than that when taken in relation to the inverse-income criterion.

From the above discussion, it follows that among the three allocative criteria, the integrated criterion is most progressive with reference to per capita income of States, other things remaining the same. Therefore, it would be better to use the integrated criterion instead of using both the distance and the inverse-income criteria in the dispensation of tax revenues among the States. It is noteworthy that the Indian Finance Commissions, often attempt to use both the distance and the inverse-income criteria at the same time, with different weights.

A desirable property of any allocation criterion is that it should give equal treatment to equals. Thus, States with the same per capita fiscal capacity, as proxied by per capita income in the formulae discussed, should give the same per capita transfer. The integrated criterion like the other two criteria satisfies this, since

$$\frac{c_i^*}{c_j^*} = \frac{y_n/y_i - 1}{y_n/y_j - 1} \qquad (36)$$

This implies that, so long as y_i equals y_j, $c_i^* = c_j^*$. Thus, the ith and the jth States receive the same per capita shares of transfers under the integrated criterion, as long as their per capita incomes are the same.

IV. Responsiveness to Changes in Income

In this section, income responsiveness of the allocative criteria is discussed in a comparative static perspective. In this case, the terms α, β and Γ change with changes in y_i or N_i. Progressivity of responses of the allocative criteria can be judged on the basis of partial differentials of State shares with respect to income, which are given by

$$\frac{\partial a_i}{\partial y_i} = - \frac{a_i(1 - a_i)}{y_n - y_i} < 0 \qquad (37)$$

$$\frac{\partial b_i}{\partial y_i} = - \frac{b_i(1 - b_i)}{y_i} < 0 \qquad (38)$$

$$\frac{\partial c_i}{\partial y_i} = - \frac{y_n \, c_i(1 - c_i)}{y_i(y_n - y_i)} < 0 \qquad (39)$$

these results imply that all the three allocative criteria are progressive in the sense that the share of a State falls with an increase in its income, other things remaining the same. This would mean that among the equi-sized States, the share of a State declines with a rise in its income. By implication, it can be stated that among the equi-sized States, the per capita share of a

State also falls with an increase in its income. This is testified by the partial differentials of per capita shares of States with respect to income, which are:

$$\frac{\partial a_i^*}{\partial y_i} = \frac{1}{N_i} \frac{\partial a_i}{\partial y_i} < 0 \qquad (40)$$

$$\frac{\partial b_i^*}{\partial y_i} = \frac{1}{N_i} \frac{\partial b_i}{\partial y_i} < 0 \qquad (41)$$

$$\frac{\partial c_i^*}{\partial y_i} = \frac{1}{N_i} \frac{\partial c_i}{\partial y_i} < 0 \qquad (42)$$

Hence, the integrated criterion, like the other two criteria, gives progressive responses to income changes in the sense that per capita share of a State declines with a rise in its income, other things remaining the same.

The extent of percentage fall in the share of a State following a per cent increase in the income can be indicated by the expressions for the partial elasticities of the shares as:

$$e_{yi}(a_i) = - \frac{y_i}{y_n - y_i} (1 - a_i) \qquad (43)$$

$$e_{yi}(b_i) = - (1 - b_i) \qquad (44)$$

$$e_{yi}(c_i) = - \frac{y_n}{y_n - y_i} (1 - c_i) \qquad (45)$$

These results indicate that the income responsiveness of the share of a State depends only on the level of its share under the inverse-income criterion, and in the other cases, it depends also on the income level of the State and that of the State with highest income (y_n). In fact, it can be shown with respect to all the three criteria that, higher the income of a State higher will be the income responsiveness of its share. This would mean a faster decline in the share of a richer State following an increase in its income. This seems to be a desirable characteristic of an allocative criterion. This characteristic is inherent in all the three criteria. This result becomes evident from the following partial derivatives of elasticities of the shares of States with respect to income:

$$\frac{\partial e(a_i)}{\partial y_i} = - \frac{(1 - a_i)\ (y_i\ a_i + y_n)}{(y_n - y_i)^2} < 0 \qquad (46)$$

$$\frac{\partial e(b_i)}{\partial y_i} = - \frac{b_i (1 - b_i)}{y_i} < 0 \qquad (47)$$

$$\frac{\partial e(c_i)}{\partial y_i} = - \frac{(1 - c_i)\ y_n (y_i + y_n)}{y_i (y_n - y_i)^2} < 0 \qquad (48)$$

These results clearly show that under each of the three allocative criteria, the elasticity of the share of a State, which is negative, increases in magnitude with an increase in its income implying a faster decline in the share of a richer State with a rise in its income.

Something can be said about the comparative income responsiveness of the three allocative criteria. Srivastava and Aggarwal (1993) show that the inverse-income criterion as compared to the distance criterion is more income responsive within the group of low income States with income less than $y_n/2$. In order to obtain an idea about the comparative income responsiveness of the integrated criterion, we compare the relevant income elasticities.

We compare first the income responsiveness of the integrated and the distance criteria. In terms of magnitudes, $e_{yi}(a_i)$ will be greater than $e_{yi}(c_i)$, so long as

$$y_i(1 - a_i) > y_n(1 - c_i)$$

or $$y_i/y_n > (1 - c_i)/(1 - a_i) \tag{49}$$

This inequality is violated at least for income levels exceeding (Γ/α), i.e., for $y_i > (\Gamma/\alpha)$, as in this income range $a_i > c_i$ which implies that $(1-c_i)/(1-a_i) > 1$ whereas the left hand side of inequality (49) is always less than one. An implication of this inequality being violated is that the integrated criterion as compared to the distance criterion is more income responsive at high income levels. This means that the integrated criterion as compared to the distance criterion is more progressive at least within the group of States with per capita incomes greater than Γ/α.

We now compare the income responsiveness of the integrated and the inverse-income criteria. In terms of magnitudes, $c_{yi}(b_i)$ will be greater than $e_{yi}(c_i)$, so long as

$$(y_n - y_i)(1 - b_i) > y_n(1 - c_i)$$

or $$(1 - b_i)/(1 - c_i) > y_n/(y_n - y_i) \tag{50}$$

This inequality is violated at least at high income levels at which $b_i > c_i$ and hence $(1 - b_i)/(1 - c_i) < 1$, as the right hand side of this inequality is always greater than one. This implies that the integrated criterion as compared to the inverse-income criterion is more income responsive at high income levels as b_i is greater than c_i at high income levels. This means that the integrated criterion as compared to the inverse-income criterion is more progressive at least within the group of high income States with per capita incomes greater than $(y_n - \beta/\Gamma)$.

From the above discussion, it follows that among the three allocative criteria, the integrated criterion results in most progressive allocation of devolution at least within the group of high income States. In other words, the integrated criterion as compared to the other two criteria leads to a faster decline in the share of a high income State with a rise in its income.

V. Responsiveness to Changes in Size

Elsewhere, we have shown that in a comparative static perspective, when the distribution (y_i, N_i) is allowed to change, the per capita shares of all States with both the distance and the inverse-income criteria fall as the size of a State increases while holding the per capita income constant (see Srivastava and Aggarwal, 1993). Following the same analogy, it can be shown that even with the integrated criterion, the per capita shares of all States would fall as the size of a State increases while holding the per capita income constant. The responsiveness of the shares with respect to changes in size (N_i) of the ith State can be worked out as

$$\frac{\partial c_i^*}{\partial N_i} = - c_i^{*2} < 0 \tag{51}$$

$$\frac{\partial c_j^*}{\partial N_i} = - c_i^* c_j^* < 0 \tag{52}$$

$$\frac{1}{c_i^*} \frac{\partial c_i^*}{\partial N_i} = - c_i^* < 0 \tag{53}$$

$$\frac{1}{c_j^*} \frac{\partial c_j^*}{\partial N_i} = - c_i^* < 0 \tag{54}$$

From equations (51) and (52), it follows that the per capita shares of all States fall with an increase in the size of a State, indicated by N_i. It may be noted that *ceteris paribus* the fall in the per capita share of a State is larger, the larger the initial share of the State. The fall for the State experiencing the increase in population is given by the square of its original per capita share (c_i^{*2}), and that in the other States is given by the product of the initial share of the State experiencing the change and that of the other State ($c_i^* c_j^*$). Equations (53) and (54) indicate that the proportional fall in per capita shares of all the States following a unit change in the size of a State is given by the initial per capita share of the State experiencing the change. Further, 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 of a State. Thus, the integrated criterion like the other two criteria, has a built-in bias against the poor States with respect to growth of population. This character of a dispersion formula is interpreted as non-neutrality or regressivity of the transfer mechanism with respect to population changes, all other things remaining unchanged (see Srivastava and Aggarwal, 1993).

VI. Concluding Remarks

The study describes a general formula for the allocation of revenue devolution among the participating States. The two commonly used allocative criteria, namely, the distance and the inverse-income criteria are shown to be special cases of the general formula. A modified integrated allocative criterion is proposed as another special case of the general formula which combines the merits of both the distance and the inverse-income criteria.

The characteristics of the proposed integrated criterion are compared with those of the other two criteria. The proposed integrated criterion is based on the notion of relative fiscal deficiency (i.e., the ratio of fiscal deficiency of a State to the `standard fiscal capacity') which is intuitively more appealing than the notions of absolute fiscal deficiency and inverse of fiscal capacity which form the basis of the distance and the inverse-income criteria respectively.

Among the three allocative criteria, the proposed integrated criterion is found to be most progressive in the sense that a State with a lower per capita income receives a higher per capita transfer. It allocates higher per capita shares to the poor States at the lower end of the income scale at the cost of middle and higher income States in comparison to the other two criteria. The integrated criterion as compared to the other two criteria leads to a faster decline in the share of a State with a rise in its per capita income.

As examplified by the Indian Finance Commissions, an attempt is often made to use both the distance and the inverse-income criteria at the same time, giving them different weights. It is argued here that instead of this procedure, it is better to use the proposed integrated criterion which is most progressive in the relevant class of allocative criteria.

NOTES

1 See, for example, Mathews (1982, 1977, 1980a and 1980b).

2 See, for example, the reports of recent Finance Commissions in India (say 7th, 8th and 9th).

3 For revenue sharing in the Federal Republic of Germany and Canada see Hunter (1973) and Boadway (1980) respectively.

4 For an exposition of a general formula that takes into account also the fiscal effort and expenditures of sub-national governments, see Mathews (1977 and 1980b). Also, see Srivastava and Aggarwal (1993) for an interesting discussion on the resemblance of the general formula with the specific criteria utilised in different federations of the world.

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.

Srivastava, D.K. and Pawan K. Aggarwal (1993), "Some Revenue Sharing Criteria in Federal Fiscal Systems: Some New Insights", **National Institute of Public Finance and Policy**, Working Paper No. 6, July.