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An Empirical Study on the Optimal Size of Revenue Sharing:
The Case of Korea

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This paper attempts to present an indirect approach which can estimate the optimal size of local revenue sharing. Two types of functions are specified to represent the positive and negative effects of revenue sharing system in Korea. Based on these functions, the associated parameters are estimated using the data for 11 local autonomies during 1970-1986. Estimating results suggest the existing rate of revenue sharing be optimal only when equalizing effect is more imprtantly regarded rather than fixing effect.

I. Introduction

In many countries fiscal imbalances among local governments is a prevailing phenomenon due to interregional economic inequalities. To alleviate such imbalances Korea has implemented the local revenue sharing system which is a kind of financial aid from the central government to the local governments without any restrictions to its use.[1]

The size of revenue sharing has been set by the local Shared Tax Law as a certain portion of the internal national tax revenues, but its specific rate has been changed several times since 1960. For example, during 1969-1972, 17.6% had been set as a legal ratio of revenue sharing while 13.27% after 1982.

One of the interesting research questions regarding the size of revenue sharing is whether the present legal ratio, 13.27%, is really optimal. In

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1 Subsidies is another type of intergovernmental transfer of which use is assigned to some specific projects.

fact, there is no theoretical background for this figure since the present ratio is simply the result of political compromise between politicians and bureaucrats.[2]

While some scholars insist the present ratio is far below from the optimal level just because it is lower than the ratio of past years,[3] it is clear this is not a scientific argument at all. In this respect, many researchers have recently emphasized the necessity of more rigorous empirical study on this subject.[4]

With this in mind, this paper attempts to present a theoretical model by which the optimal size of revenue sharing can be indirectly estimated, and then to apply it in empricial study using the time-series data for 11 regions in Korea.

For this purpose, the theoretical background of the model is explained in the next chapter. Chapter 3 describes the data and estimating methods used in this study, and discusses the policy implications of the empirical results. Finally some concluding remarks for the future research diretion are made in Chapter 4.

II. The Model

As explained before the central purpose of local revenue sharing system is to alleviate the disparities of local public finance among regions. This equalizing effect of revenue sharing is mainly affected by two important factors: its absolute size and its allocation scheme. In other words the bigger the size of revenue sharing funds is and the more the distribution formula is designed reasonably, the greater the equalizing effect of revenue sharing system is.

To reflect this let us assume *equalizing-effect function* as follow:

(1) $V_t = V(r_t, S_t)$

where V_t : equalizing effect of revenue sharing at time t, and

r_t : the ratio of revenue sharing at time t, and

S_t : the allocation scheme of revenue sharing at time t.

It is reasonable to assume at present S_t is constant over time since allocation of revenue sharing to local governments has been based upon a

2 See Jeong (1983) for details.

3 For example, Lee (1983).

4 For example, Oh (1988) and Lee (1987).

fairly standardized formula constituted by several factors such as standard fiscal demand and revenues, coefficient of adjustment, unit cost, and unit of measurement. Thus equation (1) can be rewritten as equation (2) under the assumption of ceteris paribus:

(2) $V_t = V(r_t) \quad , \quad r_t \geq 0$

Furthermore it is assumed that equation (2) satisfies two conditions: positive first derivative ($dV_t/dr_t > 0$), and negative second derivative ($d^2V_t/dr_t^2 < 0$). These conditions suggest the equalizing effect (V_t) increases with decreasing rate as the amount of revenue sharing (r_t) increases.

Equation (3) is an explicit functional form of equation (2) satisfying such restrictions.

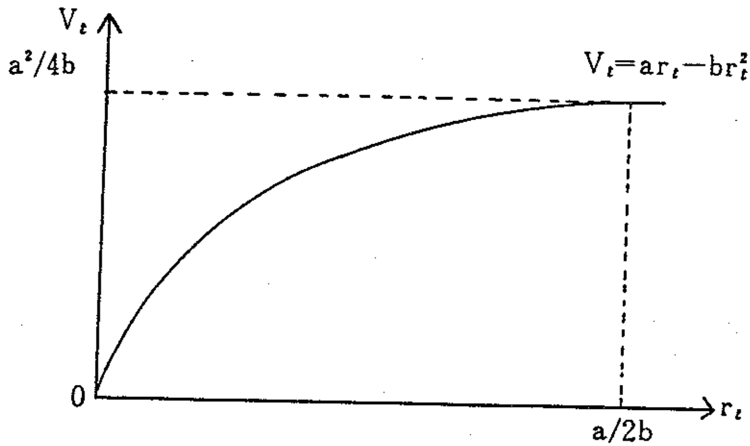
(3) $V_t = a\, r_t - b\, r_t^2$

where $0 \leq r_t \leq a/2\, b$[6] and $a, b \geqq 0$

Equation (3) and its marginal form can be represented as Figure (1)

Figure 1

Equalizing-Effect Curve



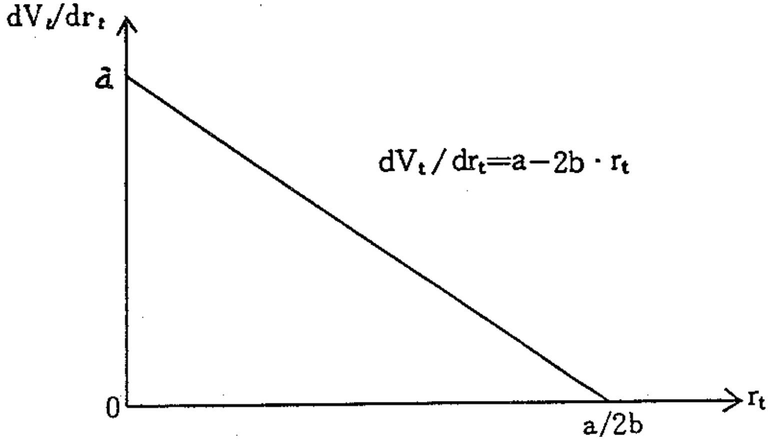
[5] For more detailed explanation about the distribution formula, refer to Ahn (1988) or Lee (1987).

[6] This inequality constraint is obtained from the condition of positive first derivative; $dV_t/dr_t = a - 2b\, r_t \geq 0$.

and (2). Let us call these *equalizing-effect curve* and *marginal equalizing-effect curve,* respectively.

Figure 2

Marginal Equalizing-Effect Curve



Although the expansion of revenue sharing funds is desirable from the viewpoint of local governments, it is not so the the central government. Since the size of local revenue sharing is fixed by the law, increasing its portion makes the central government's budget more inflexible.

To reflct this, let us define a *fixing effect function* as follow:

(4) $F_t = F(r_t)$

where F_t: fixing effect of revenue sharing at time t.

Since it is more reasonable to assume F_t increases in proportion to r_t, the explicit functional form of equation (4) can be given as equation (5).

(5) $F_t = c\ r_t \qquad 0 \leq c$

Let us represent equation (5) and its marginal form as Figures (3) and (4), and call them hereafter as *fixing-effect curve* and *marginal fixing-effect curve,* respectively.

As discussed so far, the two different effects of local revenue sharing

Figure 3

Fixing-Effect Curve

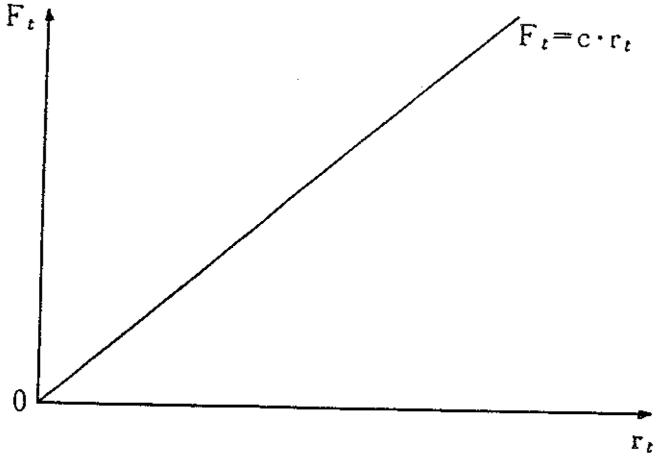
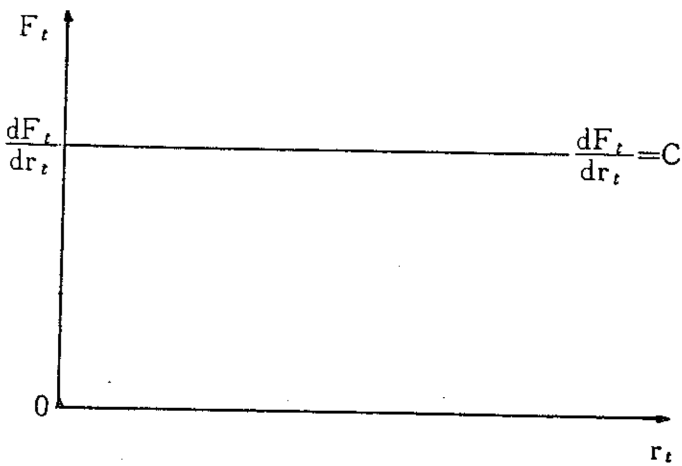


Figure 4

Marginal Fixing-Effect Curve



system have been assumed; positive effect reducing intergovernmental fiscal disparities (i.e., V_t) and negative effect increasing the portion of fixed expenditures in national budget (i.e., F_t). Under this population it is logical to define the optimal size of revenue shating as a rate $r_t{}^*$ maximizing the net positive effect (N_t) which is a difference between positive effect and negative effect.

In defining, however, the specific functional form of the net positive effect there arises a weighing problem between V_t and F_t. To solve this problem we assume that the relative importance of each effect can be represented in terms of an arbitrary weight variable, ω. In this respect, the net positive effect N_t is defined as follows:

(6) $$N_t = \omega\ V_t-(1-\omega)F_t \qquad 0\leqq\omega\leqq 1$$

If ω is given as 0.5 this implies an equal weight scheme is assumed, whereas if greater than 0.5 higher weight is given to equalizing effect (V_t) than fixing effect (F_t).

Under these assumptions, finding the optimal size of revenue sharing is mathematically equivalent to solving the following optimization problem:

(7) $$\text{Maximize } \omega\ V_t-(1-\omega)F_t$$

$$\text{Subject to: i) } V_t = a\ r_t - b\ r_t^2$$

$$\text{ii) } F_t = c\ r_t$$

Substituting the contraints into the objective function the first order condition can be easily derived as follow:

(8) $$\omega(a-A\ b\ r_t) = (1-\omega)\ C$$

Note that this condition requires marginal equalizing effect should be equal to marginal fixing effect. Figure (5) shows that in case of equal weights the optimal rate of local revenue sharing (r_t^*) is determined where the marginal equalizing effect curve and marginal fixing effect curve intersect each other.

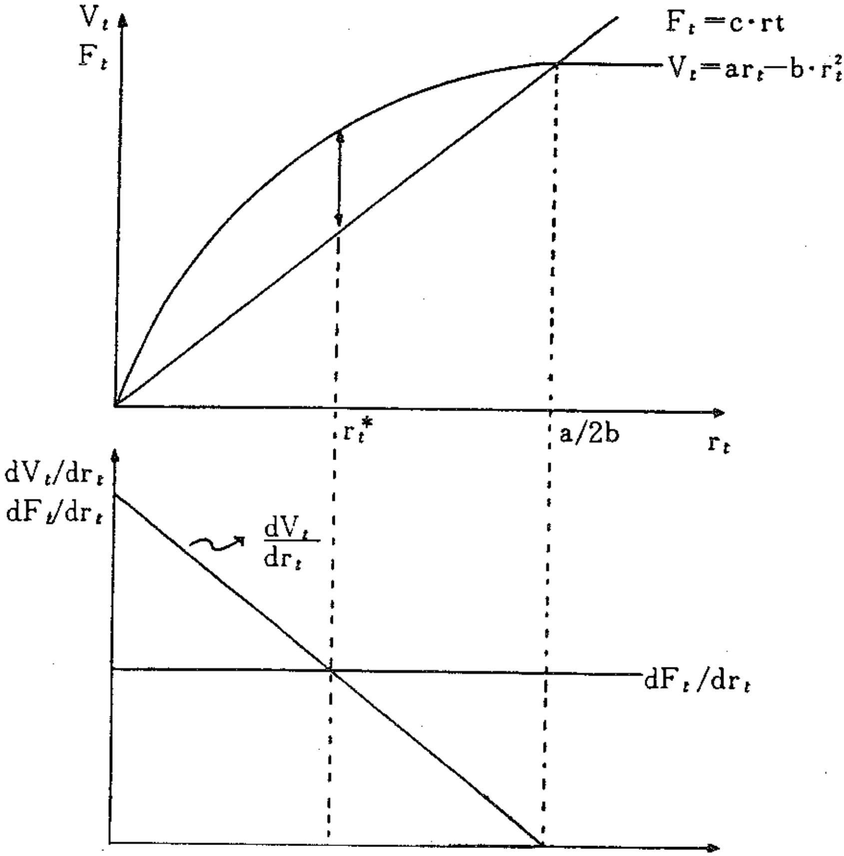
The operating formula to compute r* can be obtained by rearranging equation (8):

(9) $$r_t^* = \omega\ a-(1-\omega)\ C/2.b.\omega \qquad 0\leqq r^*\leqq a/2b$$

Note if the parameters such as a, b and c are empirically estimated, we can investigate what rate of revenue sharing would be optimal under a given value of ω.

Figure 5

Optimal Rate of Revenue Sharing ($\omega = 0.5$)



III. Estimating Results

The most difficult problem that we are facing is what kind of data should be used to properly represent equalizing effect, V_t, and fixing effect, F_t, when estimating the parameters required for computing the optimal rate of revenue sharing, r_t^*.

In this research the data for V_t and F_t were obtained according to following methods:

(10) $V_t = I_t^b - I_t^a / I_t^b$

(11) $F_t = D_t^a - D_t^b / D_t^b$

where I_t^b : interregional disparties of public finance before distributing of revenue sharing at time t, and

I_t^a : interregional disparties of public finance after distributing of revenue sharing at time t, and

D_t^b : the amount of fixed expenditures in national budget excluding revenue sharing at time t, and

D_t^a : the amount of fixed expenditures in national budget including revenue sharing at time t.

The degree of interregional inequalities of public finance, I_t, was expressed in terms of coefficient of variation based on 11 regions[7] using the data for local government's expenditure per capita. And fixed expenditures were defined as a sum of general administrative expenditures, military expenditures, local revenue sharing and debt redemption expenditures. Time-series data for 17 years from 1970 to 1980 were used for estimating the parameters.

In particular equation (3) and (5) were estimated by Maximum Likelihood (ML) method to remedy the auto-correlation problem frequently arising in time-series analysis. The estimating results are summarized in Table (1).

Table 1

ESTIMATING RESULTS

	Equations	R^2	D.W.
Equalizing-Effect Function	$V_t = 4399\ r_t - 0.138\ r_t^2$ (3.063)** (-1,421)*	0.36	2.22
Fixing-Effect Function	$F_t = 1{,}441\ r_t$ (12,923)**	0.85	2.21

Notes: Numbers in brackets are t-values

* denotes significance at 10% level

** denotes significance at 5% level

7 Those are two large cities (i.e., Seoul and Pusan) and nine provinces (i.e., Kyunggi, Chungnam, Chungbook, Kangwon, Kyungbook, Kyungnam, Jeonnam, Jeonbook and Jeju).

The table shows the empirical results are quite satifactory. That is, all the signs of coefficients are consistent with the theoretical prediction, and the estimated parameters are all statistically significant. Furthermore the Durbin-Watsons's d statistics suggests there are no auto-correlation problem.

The R^2 value, however, of equalizing-effect function is relatively low as 0.36. This is because V_t was measured by aggregated regional data. Since various countervailing effects are working together in case of aggregated data, equalizing effect turns out to be weaker rather than the case of disaggregated regional data.

Computed optimal rates are reported in Table 2, which is based on equation (10) using the estimated results of Table 1.

Table 2

COMPUTED OPTIMAL RATES OF LOCAL REVENUE SHARING

	Higher weight to equalizing effect			Equal Weights	Higher Weight to fixing effect	
Weights (ω)	0.8	0.7	0.6	0.5	0.4	0.3
Optimal rate (%)	14.6	13.7	12.45	10.72	8.11	3.76

The table shows how the optimal rate should be changed as the relative importance of each effect differs. From this result, we may say the existing rate of revenue sharing, 13.27%, can only be optimal under the assumption that the central government, explicitly or implicitly, regards equalization effect more important than fixing effect in operating local revenue sharing system. Therefore if the government perceives fixing effect as important as equalization effect, the existing rate may be lower to 10-11%.

IV. Concluding Remarks

Although the necessity of study on the optimal size of revenue sharing has been emphasized by many scholars in Korea, no research has been made in this subject. With this in mind this paper attempted to present a theoretical model by which the optimal size of revenue sharing can be indirectly computed and to examine the policy implications of the estimating results.

The empirical results were statistically significant and their policy implications were also interesting. However, this research still has several shortcomings associated with data and methodology.

First of all note the specified functional forms of both equalizing effect and fixing effect are too simple. Hense more rigorous specifications are needed to enhance the reliability of empirical estimation.

Next, as mentioned earlier, since the use of the aggregated regional data is likely to lower the statistical confidence, it is more desirable to use the disaggregated regional data in a future study.

Finally, and perhaps most importantly, note that the method introduced so far is in essence an indirect approach. In other words, we have not specified the underlying causal mechanism among the associated variables. While such an indirect approach can make the problems in question very simple, it is conceptually preferable to develop a direct approach such that we may understand how the change of one variable such as rate of revenue sharing affects other variables, in depth.

In this respect, the results presented in this paper should be interpreted as tentative rather than conclusive.

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