Study on Evaluation Efficiency of Investment for Regional Public Works

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The estimation of the influence of a public investment program should include not only the direct effects but also the indirect ones. In these cases the most important benefits are indirect, since they make production possible in other sectors of the economy.

In this drafting, the author deals with an evaluation efficiency of investment for regional public works from the standpoint of indirect effects, by preparing the simplified model along the criterion of Jorge Ahumada. Thereupon, such efficiency is defined as the ratio of total value added in the region to the total amortization of direct costs plus associated costs. Then, the Econometric Model and Inter-regional Input-Output Analysis are promoted to the assumption of the value added and associated costs.

1. Introduction

The choice of a program of public investment project is one of the most important decisions to be made in the design of a development policy for nearly all newly developing countries. The choice of such an investment program raises many problems both of an economic and non-economic character. For example, decisions have to be made concerning the total volume of the investments, the distribution of the investments over the producing sectors and the techniques of production.

The estimation of the influence of a public investment program should include not only the direct effects but also the indirect ones. The problem is seen even more clearly when considering projects involving investments for increasing assets in social overhead capital, such as roads, railways, ports, industrial lands, waterworks, etc. These projects often show a low direct benefit-cost ratio, which may be less than unity if the services produced are not sold, but consideration of the benefits deriving from the execution of such projects

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often shows that they are of top priority. In these cases the most important benefits are indirect, since they make production possible in other sectors of the economy.

The direct effects consist of the immediate contribution to production; the indirect effects involve all other influences of the investment program on the economy. The changes in the inter-industry deliveries, as determined by the input-output structure, and the changes in prices due to the increase in production are two examples of indirect effects. It will be clear that the direct and indirect consequences of a public investment program can only be estimated properly with the help of a set of quantitative relationships describing the structure of the economy.

On the other hand, the estimation of considering direct and indirect effects will also depend upon the evaluation criterion applied, which will present different conceptual and measurement problems. A rational choice can only be made with the aid of an explicitly formulated criterion.

In this study, the author deals with an evaluation efficiency of investments for regional public works by preparing the simplified model along the criterion of "Direct and Indirect Value Added per Unit of Total Input", proposed by Jorge Ahumada.

2. Financial Equivalences

The most commonly used equivalence methods are those of equivalent annual standard value and of prsent worth. Since both are derived from the same formulae, neither has a greater intrinsic value than the other. The application of either method will depend upon the calculation facilities or data available or the aims pursued.

The method of uniform annual equivalent standard cost enables a sum invested on a given data to be converted into an equivalent series of equal annual values.

For this purpose, the following formula is used:

$$R_{qt} = P_{qt}\frac{i(1+i)^n}{(1+i)^n-1} \qquad \cdots\cdots(1)$$

The initial investment P_{qt}, may be converted into a series of equal annual payments R_{qt}, where suffix (q) represents the category of public work and (t) represents time period, with (n) as the period of recovery, and (i) the rate of interest.

Then, total amortization A_{qt} for time period (t) can be found by the formula;

$$A_{qt} = \sum_{t=t-n}^{t} R_{qt} = \frac{i(1+i)^n}{(1+i)^n-1} \sum_{t=t-n}^{t} P_{qt} \qquad \cdots\cdots(2)$$

3. Relation Between Economic Structure and Amortization of Public Investments for Public Works

In order to estimate the value of final demand of a regional economy, the Econometric Model Analysis may effectively be used. It is assumed that each value of final demand can be explained by linear equations with the amortization of investments for public works as explanatory variables under the following constraints of net income Y_{pt} in a region:

$$Y_{at} \leq Y_{pt} < Y_{bt} \qquad \cdots\cdots(3)$$

The following is the outline of Econometric Model Analysis, in which endogenous variables and exogenous variables are set as undermentioned:

Endogenous variables: Net income,
Regional consumption expenditure,
Regional net investment for producers' durables and equipment,
Regional investment for inventory,
Regional foreign exports of goods and services,
Regional foreign imports of goods and services,
Government expenditure (local government expenditure plus national government expenditure spent at the region),

Exogenous variables: Amortization of public investments for roads, railways, ports, reclaimed lands, waterworks, dwellings, etc.

And the economic structural equation can be derived as follows:

$$\boldsymbol{Y}_{pt} = \boldsymbol{B}\boldsymbol{Y}_{pt} + \boldsymbol{C}\boldsymbol{A}_{pt} + \boldsymbol{U}_{pt} \qquad \cdots\cdots(4)$$

where: $\boldsymbol{Y}_{pt}$, represents column vector of endogenous variables, and
$\boldsymbol{A}_{pt}$, column vector of exogenous variables,
$\boldsymbol{B}$, matrix of coefficients for endogenous variables,
$\boldsymbol{C}$, matrix of coefficients for exogenous variables,
$\boldsymbol{U}_{pt}$, vector of disturbance term included in the structural equations.

Solving the equation (4) in terms of the column vector $\boldsymbol{Y}_{pt}$, the reduced form below is obtained:

$$\boldsymbol{Y}_{pt} = [\boldsymbol{I}-\boldsymbol{B}]^{-1}\boldsymbol{C}\boldsymbol{A}_{pt} + [\boldsymbol{I}-\boldsymbol{B}]^{-1}\boldsymbol{U}_{pt} \qquad \cdots\cdots(5)$$

whers: I, represents unit matrix.

Solving the equation (5) by the use of the values given by equation (2), the values of macroscopic estimation of final demand of regional economy will be obtained.

4. Estimation of Value Added

For the assumption of the value added, it is generally thought effective to utilize the Interregional Iuput-Output Analysis. If the Interregional Input-Output Analysis is employed for this purpose, the equation will be generally formulated as follows:

$$\sum_{l=1}^{m}\sum_{j=1}^{n} t_i^{kl} a_{ij}^l X_j^l + \sum_{l=1}^{m} t_i^{kl} Y_i^{kl} = X_i^k \quad \cdots\cdots(6)$$

or

$$\sum_{k=1}^{m}\sum_{i=1}^{n} t_i^{kl} a_{ij}^l X_j^k + \sum_{k=1}^{m} V_j^{kl} = X_j^k \quad \cdots\cdots(7)$$

where: X_j^l, denotes the total output of (j) th industry in (l) th region,
Y_i^{kl}, final demand subtotal of (i) th industry in (k) th region,
V_j^{kl}, value added subtotal of (j) th industry in (l) th region,
a_{ij}^l, technical input coefficient,
t_i^{kl}, trade coefficient.

Equation (6) will be expressed as follows by introducing vectors and matrices:

$$\boldsymbol{TAX_p} + \boldsymbol{TY_p} = \boldsymbol{X_p} \quad \cdots\cdots(8)$$

where: $\boldsymbol{X_p}$, denotes the total output vector, and
$\boldsymbol{Y_p}$, final demand vector,
$\boldsymbol{A}$, matrix of technical input coefficients,
$\boldsymbol{T}$, matrix of interregional trade coefficients.

Solving the equation (8) in terms of the column vector X_p, reduced form below is derived:

$$\boldsymbol{X_p} = [\boldsymbol{I} - \boldsymbol{TA}]^{-1}\boldsymbol{TY_p} \quad \cdots\cdots(9)$$

Calculating the equation (9) by the use of the values given by equation (5), the estimated values of total output will be obtained. Then, solving the next equation (10) by the use of the values of total output given by above equation (9), it is possible to estimate the value added:

$$V_j^{kl} = X_j^{kl} - \sum_{i=1}^{n} t_i^{kl} a_{ij}^k X_j^k \quad (k = l) \quad \cdots\cdots(10)$$

5. Estimation of Direct and Indirect Value Added Per Unit of Total Investment

In order to examine the efficiency of investment for regional public works, the author includes all derived effects, and thus arrives at the following equation:

$$E = \sum_{j=1}^{n} V_j^{kl} / (\sum_{q=1}^{r} A_{qt} + I_t^{\beta Q}) \qquad (k = l) \qquad \cdots\cdots\cdots\cdots\cdots\cdots(11)$$

where: E , denotes the efficiency of public investments for regional public works, and

V_j^{kl}, value added of (j) th industry in the region,

A_{qt}, total amortization for time period (t),

$I_t^{\beta Q}$, regional net investment for producers' durables and equipment (associated investment).

6. Concluding Remarks

The model described in this report is somewhat more complicated than other models which were proposed by H. B. Chenery, J. Ahumada, J. Tinbergen, H. C. Bos, etc., the model is nevertheless still fairly shimple. This is partly a consequence of the simple structure of the economy the author has assumed.

Further, the method is besed on the principles of comparative statics and tries to measure only the effect of direct and indirect value added per unit of investments after the investments for regional public works, Therefore, the construction of a more complicated model is desirable.

The model described in this report will be applied to the Hanshin Metropolitan Region. The next paper to be prepared by the author in the near future, will deal with the consequences of the calculations.

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