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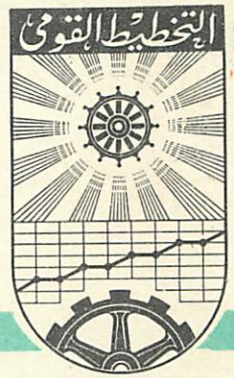

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Planning the Volume of Investment in the Long-run Period

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Planning the Volume of Investment in the Long-run Period

Problems of finding the most suitable method for the determination of the volume of investment in the long-run period have not yet been sufficiently solved. The theoretical studies and concepts presented by a number of authors do not go beyond an econometrical-model approach based on capital: output ratios et cet, zhich cannot be applied in the planning processThis is so particularly because of the "model-character" of such approaches; even the most sophisticated model is an extreme over-simplification as compared zith the actual life and problems of the national economy.

Many failures of such theoretical concepts, in my oppinion, are a logical conclusion of an inproper principal approach to the formulation of the problem itself. As a rule, many authors deal zith investment process as an independent category: planning and calculating the volume and rate of grozth of investment is taken as a primary category. As a matter of fact, the plan of investment can be only derived from the general concept of economic development. The aim of investment is to provide new capacities at an amount and structure pre-determined by the long term plan of production and services.

Which is, then, the specific duty and "field of activity" for investment planners and investment planning methodology itself?

As far as the long-run is concerned, two main aspects should be distinguished:

1/ Fixing the material sources of investment/supply side/; i.e.:

- construction capacities,
- capacities of the construction material producers, significantly modyfying the construction capacities;
- capacities of engineering industries
- import limitations.

For the five-year plan, this sources/input/side is almost fixed. For the long run/say, 15 years/, a number of measures can be taken to adjust the capacities available to the volume and structure of investment required, regarding other limitations of a basically macroeconomic substance (maximal rate of investment and other macroeconomic proportions determined by the central political and economic authorities).

2/ Finding the objective criteria and methods of determination of investment required.

The investment planning methodology should develop specific objective criteria and methods by means of which it is possible:

- to determine the volume of investment that must be necessarily spent if the targets formulated in the plan are to be met and - simoultaneously - to offer other alternative solutions if the plan targets are changed,
- to verify the necessity of investment volume, as it is claimed by subordinated authorities in the process of plan preparation,
- to fix some kind of upper limits of investment with regard to the pattern of economic effects that are to be achieved in the respective branche or sector.

Replacement and development investment differ in this methodological respect significantly. Therefore, they will be dealt with separately.

Planning the repacement investment

There are two methods of planning replacement that were widely used by our planners in the past. Unfortunately, they are far from any scientific approach - they are rather remnants of our "planning folklore".

1/ Method Based On Depreciation Rates

The depreciation approach is an typical "folklore inheritance". According to it, the annual volume of replacement

investment is identical to the reproduction value of the written-off fixed assets within the planned period.

The annual depreciation rate a /it should be noted, that the straight-line method of depreciation is used/ is an inverse of the estimated service life T_i/assuming the liquidation value is zero/

/1/ $$a_i = \frac{1}{T_i}$$ i = i-th group of the fixed assets

By means of the group depreciation rates a_i; the average service life of the fixed assets is determined:

/2/ $$\bar{T} = \frac{\sum_{1}^{n} F_i}{\sum_{1}^{n} \frac{F_i}{T_i}}$$

F_i = value of the fixed assets in the i-th group

The average "depreciation service-life" is taken as identical with the planned service life in the long run. Thus, the volume of replacement investment equals the reproduction value of the T_i years old fixed assets in the i-th group.

Which are the disadvantages of such a method? The criticism concentrates to the function of depreciation rates.

a/ Depreciation rates and depereciation service life are taken as identical with the planned service life. Consequently, there is no space for alternative solutions, there is no planning in the proper sens of the word, since everything is pre-determined by the depreciation rates. The depreciation rates are, as a rule, fixed for a rather long period/ in the CSSR, the current rates have been effective since 1967 and are expected to be used until 1980, at least/.

Therefore, the identification of the depreciation rates with the plan of replacement is a basically misleading idea for the long-term horizon, where alternative solutions and their comparisons are the essence of planning.

b/ The depreciation rates are an instrument of the current economic policy. The financial and fiscal aspects dominate when the rates are elaborated by the central authorities. In the CSSR, e.g., the current depreciation rates have been significantly affected by the situation in 1967. High profits and inflationary financial resources in the hands of industrial firms were the background that lead to a policy of high depreciation rates. High rates were to reduce firm's disposable profits and thus to contribute to the "tight money policy". The actual service life of the fixed assets/of

machines and equipment namely/ are longer than the depreciation rates anticipated. Prevailing fiscal criteria embodied in the depreciation rates make them useless for long-term planning.

2/ Replacement Planned By Means of the Fixed Assets Turnover Period - Static Approach

The essence of replacement planning, according to this method, lies on comparing a series of service-life alternatives and calculating the volume of replacement investment for the respective alternatives. Such an approach, so far, is quite correct. The criticism arises if the methods of calculation of the service life alternatives are analysed.

The average service life ex-post calculated from the statistical data is defined as:

/3/ $$\bar{T}_t = \frac{F_t}{L_t}$$

F_t = value of the fixed assets in the t-th year

L_t = reproduction value of the fixed assets liquidated in the t-th year.

The meaning of $\bar{T}_t$ calls for further precision. As a matter of fact, $\bar{T}$ is not the actual service life of the liquidated assets; it is merely the turnover period of the fixed

assets in the t-th year. Only in the F:L ratio becomes permanent for a long period, the $\bar{T}$ would become the actual ser of liquidated assets.

In the long run, the essence of planning replacement lies in the determination of alternative magnitudes of $\bar{T}$; from which the volumes of replacement investment for the respective alternatives are derived:

/4/ $$L' = \frac{F}{\bar{T}'}$$

The lower T', the higher L' and vice versa.

Formula /4/ reflects the essence of replacement planning: to confront alternatives of more or less intensive replacement in order to find the most suitable solution for the long run with respect to the limitation. The solution adopted must be consistent with the entire economic plan - this goes beyond the specific field of investment planning.

However, the method lacks dynamic approach. Consequently, the alternative magnitudes of L' - when calculated by means of form /4/ are not consistent to T'. Moreover, the turnover period T defined by equation /3/ is ill formulated, too.

The calculated values of L' as a function of an independent variable T would lead/ in the long run/ to the liquidation of fixed assets at the age of T years only in case of stagnation, i.e. if the volume of fixed assets F remains stable in the long run. In marxist terms, the forms /3/ and /4/ are adequate for the case of simple reproduction only. This, obviously, contradicts the real conditions and even the essence of planning/ the aim of planning is to achieve growth, not stagnation/ and makes the method described, despite its advantages as compared with the "depreciation approach", useless. It is simply another example of survining approaches inherited from the pioneering times, another example of our "Planning Folklore".

3/ Replacement Planned By Means of the Average Turnover Period - Dynamic Approach.

The drawback of the static approach is offset if the growth factor is included into the formulae. Domar's dynamic models of the depreciation:replacement and replacement:investment ratios can be applied also for a long term projection of replacement investment as a function of variable turnover periods T' as alternative solutions.

Let us briefly develope the dynamic formula of T and L.

If the annual rate of growth of gross investment/1+r/ is given, the volume of gross investment of the t-th year G_t as compared with the original volume of G at the time point 0 is

/5/ $$G_t = G_o/1+r/^t$$

Gross investment of the year "t" are a composition of replacement L_t(equal to the value of fixed assets liquidated) and of development investment I_t/ equal to the net increment of the stock of fixed assets/:

/6/ $$G_t = L_t + I_t$$

From /6/; the replacement ratio a_t can be derived

/7/ $$a_t = \frac{I_t}{L_t}$$

Let us assume a given service life T for all the fixed assets. The volume of fixed assets liquidated in the t-th year is, by definition, given by gross investment/ identical with gross fixed assets increment/ spent T years ago:

/8/ $$L_t = G_{t-T}$$

Since, by definition, the investment grow at an annual rate /1+r/, the gross investment G_t:

/9/ $$G_t = G_{(t-T)}/1+r/^T$$

Hence, the ratio

/10/ $$\frac{G_t}{L_t} = \frac{G_{t-T}/1+r/^T}{G_{t-T}} = /1+r/^T$$

Introducing the replacement ratio a_t, we obtain

/11/ $$\frac{G_t}{L_t} = \frac{L_t + I_t}{L_t} = /1+a_t/$$

Combining /10/ and /11/:

/12/ $$/1+a_t/ = /1+r/^T$$

The average turnover period of the fixed assets, if formula /12/ is used, equals

/13/ $$T = \frac{\log/1+a/}{\log/1+r/}$$

T is now a function of the replacement ratio "a" and of the rate of growth /1+r/. Compared with the "static" formula /4/ the advantages of the dynamic approach reflected by /13/ can be easily seen.

The volume of replacement investment within a time interval of "t" years equals

/14/ $$L_t = F_o \frac{/1+r/^t - 1}{/1+r/^T - 1}$$

Formula /14/ explicitely defines the volume of replacement investment as a function of two variables: of the rate of growth /1+r/ and of the replacement intensity reflected by means of the average turnover period of the fixed assets T. The magnitude T becomes an actual service life of the liquidated assets if the variables /1+r/ and T/ which is a function of "a"/ remain stable for a rather long period. In other words: The turnover period T says, that the chosen rate of growth of investment and the chosen replacement intensity / measured by means of "a"/ as a long term trend can be achieved only if the fixed assets are liquidated after T years of their service life.

Some experience has been collected in the CSSR in this respect. In metallurgical industries, the analysis of the past development in 1950-70 gave the following results / machinery and equipment/:

Period	Replacement ratio "a"	Turnover period T
1951-55	6.243	31.4
56-60	7.528	26.7
61-65	4.423	19.7
66-70	3.076	28.2
1951-70	4.421	24.2

Varying values of T reflect high fluctuations of the replacement during the last two decades in Czechoslovak metallurgy.

Several alternatives were calculated as a first approximation for the long term perspective 1975-1990, for example:

Alternative 1: The proportions of the most intensive replacement period 1961-65 / i.e. with T = 19.7 and r = 8.95%/ were extended over the next 15 years. This lead to the total volume of replacement investment higher than 30 mld crowns and total liquidation of all the machinery and equipment operating in 1970 by the end of the planned period would be a result of such an alternative.

Alternative 2: The proportions of the entire two decades 1950-70 were extended, i.e. T= 24.2 and r = 7,23%. The total volume of replacement is by one third lower than in the first alternative and approximately 70% out of the assets working in 1970 would be replaced by 1990.

At the present, we intend to use this method for an analysis of the long term trends in the replacement in all the productive branches in the CSSR during last 20 years as a first step to the preparation of the long term replacement projection.

4/ Aplication of demographical methods /vintage approach/

Further refinement of the abovementioned method can be achieved by means some methodological instruments widely used in the demographical statistics.

The stock of fixed assets and its development behave in a manner very similar to that of the population: we deal with such categories as age structure of the assets, procurement, liquidation, age composition of the assets liquidated et cet.

To use the demographical approach, the folowing data must be available:

a/ The composition of the fixed assets with respect to their age in homogeneous groups. For this reason, the asets must be arranged into the groups according to their technical parameters so that in each group only the assets with the same durability and average service life are included.

For instance: Road bridges: a/ concrete bridges
b/ steel bridges
c/ woodden bridges
et cet.