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Choice Of Techniques For The Public Sector In The U.A.R.

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I. Introduction:

The U.A.R. was considered as an agricultural country. Its national economy was depending mainly upon agricultural products. Cotton exports represented most of its exports to more advanced countries. The country as an underdeveloped one, depended upon imports of all its needs from final products and machinary except for some few industries, as the sugar industry which in turn depending upon agricultural raw materials.

After the Revolution, the Government intended to raise the standard of living of the citizens. Industrialization is considered the main tool to achieve this target. To assure the control of the Government upon production and consumption, the public sector began to take its place in industrializing the country from 1961. Now the public sector represents about 80% of all the industrial activities in the country, while the private sector represents only about 20% of these activities. Being at present a developing country as a result of the revolution in all our economic sectors, the burden increases too much specially on the industrial sector concerning the different problems of production. One of the main problems of production in developing countries is the Choice of Techniques. This is considered as a main problem due to the lack of experience in the industrial field at the first stages of industrialization. The study and discussion of the problem of Choice of Techniques become an important one to help the planners, technical personnel in choosing their techniques for the different industries. Few of these studies have been carried out in the U.A.R. and this present study is considered as a continuation of the previous ones.

II. The Problem of Choice of Techniques

To establish an industry there are many alternatives of the techniques to be chosen for the production process. The number of alternatives varies from one industry to another and from one country to another, depending upon its degree of development. Different techniques often imply quite different strategies of economic development with very different effects on the performance of the economy. For example planner can choose either the labour - intensive techniques or capital - intensive ones. Of course in under - developed and developing countries having a considerable "reserve of army, of unemployed labour, labour - intensive techniques are considered the best to be chosen, at least for most of the industries. This is not the case in developed countries where labour represents a scarce factor of production.

The main factors which affect the choice of techniques are:

(a) Capital.
(b) Labour.
(c) Raw Materials.
(d) International Trade.

In what follows we shall give a brief discussion of the effects of each of these factors upon the coice of techniques for any production process.

(a) Capital

In underdeveloped and developing countries Capital is a bottleneck for economic and social development. The following considerations have to be mentioned when examining the capital requirements for an industrialization program:

(i) More underdeveloped countries suffer from a serious shortage of capital in relation to both land resources and labour resources. This is the case specially for heavy industries.

(ii) In general a manufacturing establishment requires substantially more capital than agriculture or commercial units.

(iii) Most of the capital invested in a factory is usually far more fixed in nature and location and far less flexible in function than that invested in a farm or a shop. This necessitates the acceptance to take the risk of each establishment which can be carried out by the public sector as will be mentioned later.

(iv) Most of underdeveloped countries have no tradition of industrial investment.

The balance of payments in most cases limits the programs of industrialization in its first stage due to the defficiency of the exports to cover the needs of foreign currency necessary to import the required machinary.

(b) Labour:

Special care has to be taken in underdeveloped countries having a large surplus of unskilled labour, for in such circumstances money wages will not reflect the real social cost of using labour. The wage rate may vary from technique to technique depending upon productivity, skill and so on. A more capital-intensive technique may involve a higher wage rate. When the pool of unemployed labour force is limited this is an important factor to bear in mind in choosing between different techniques. We choose the technique which maximizes the level of immediate output, given the investment and choose whatever saving rate we want by manipulating the wage rate.

To illustrate how the different techniques and consequentely the different combinations of capital and labour, in carrying out a certain job, affect the total cost, consider the following equations:-

$$V = a \cdot L^{\lambda} \cdot K^{k}$$

where V = output
L = Labour
K = Capital
λ = elasticity of output w.r.t. labour
k = " " " " Capital
a = scale factor whose value depends on units of measurement.

The following table(1) gives nine different costs corresponding to nine different techniques to carry out a simple production process in highway building in West Germany - The excavation of certain fixed quantity of earth and its transportation over a given distance.

Production costs of transporting 1000 m^3 of earth over a distance of 600 m, in DM of 1950; alternative technique

Production Method	Labour Cost	Capital Cost	Total Cost
I	4440	326	4766
II	3895	422	4317
III	2485	542	3027
IV	1088	1260	2348
V	896	1099	1995
VI	799	1022	1821
VII	765	1330	2095
VIII	400	1635	2035
IX	372	2005	2377

(1) F. Ritter, Die technische Auswirkung progressiver Investierung an einem Element der Bauwirtschaft, Mainz 1952; quoted by L.J. Zimmerman, Arme en rijke landen, The Hangue, 1960, p. 80

The table shows that the total cost of the process varies with the different alternatives depending upon the combination of capital and labour. These costs vary also from one country to another according to its degree of development, i.e. according to the relative costs of capital and labour.

C. Raw Materials:

Underdeveloped and developing countries have to depend as much as possible on its local raw material and natural resources in industrialization. The goals of this dependency are:

(i) To guarantee the cheapest costs of raw materials necessary for the different industries.

(ii) To save the foreign currency required to import these raw materials from more advanced countries.

(iii) To process localy the primary products to be exported from the country as far as possible, due allowance being made for relative costs both of processing and of transport and for the special requirements of the overseas markets.

For the price of raw materials to be law, productivity in the primary activities of mining and farming should be high; this is also the basic prerequisite for the release of factors for the development of industry.

In the U.A.R. the Government took these points into consideration in many industrial activities. The textile industry is the best example in this respect. Also we began to make the best use of our natural resources, e.g. the generation of electricity necessary for industries by the cheapest costs from the hydroelectric power stations (Aswan Dam and High Dam Hydroelectric power stations).

(d) International Trade:

The underdeveloped countries are characterized by the lack of Capital goods sector and in order to exploit modern technology they must import capital goods from abroad. The problem of the choice of capital-intensity for an underdeveloped economy cannot be studied satisfactorily without bringing in the balance of payments consideration. The prices valuation of foreign costs should depend upon the way the foreign exchange requirement is met.

If the reduction of imports were possible we should have to calculate the "Social Cost" of the import-cuts.

Also if a country intends to export its industrial products to the international markets, it has to take into consideration the requirements and specifications of these markets when choosing the different techniques to produce its products for exportation having the required international specifications with the lowest possible prices.

III. The Role Of The Public Sector In The Choice of Techniques:

The U.A.R., as mentioned before, began to divert from a capitalist economy to a socialist one from 1961. The Government took the burden of planning production and solving all its problems on the national level. In the first stage of industrialization the choice of tehniques represents a main problem. This is due to many factors such as lack of experience in the industrial field. The public sector has a main role in this respect and can gain better results if compared with the possibilities of the private sector as mentioned in the following points:

(i) The Government represented by the public sector has a definite role to play in the process of economic development. That is to establish the infrastructure (roads, transport, etc) necessary for industrialization.

(ii) National and comprehensive planning and foreseeing, includes technical and technological progress, can be carried out by the government. This is to give the country the possibility to manage independently the main factors of general economic progress.

(iii) The public sector can allocate the required investments necessary for big projects (heavy industry) and can take the risk which is not the characteristic of the private sector.

(iv) The social benefits of the different industries are always taken into consideration by the public sector, e.g. employment of maximum number of manpower, producing the necessary products with minimum costs, etc. The private sector always aim to maximize its profits regardless of these social benefits.

(v) The public sector has the ability to establish the necessary institutions and training centers to prepare the required manpower having the adequate skill and experience.

(vi) The public sector can coordinate and integrate between the different industries on the national level to get the best results; e.g. many secondary industries can be created to get a coordinated industrial branch.

(vii) The public sector has the ability of directing the available raw materials and natural resources to get the maximum revenue on the national level.

IV. Industrial Estates and Choice of Techniques:

The establishment of industrial estates is a modern system which is applied successfully in many developing countries, specially in Asia and the Far-East. This is a result of the supervision of the public sector on the industrial activities. In the U.A.R., the Government recently recognized the benefits of this system and already a decision has been taken to establish 3 industrial estates in the country beginning by the industrial area in Helwan. The following estates will be in Alexandria and Suez.

Factors affecting The Choice of The location Of Industrial Estates:

Careful studies have to be conducted before deciding the location of an industrial estate. At the national level to avoid haphazard growth, industrial location policy should be integrated with policies of industrial dispersal, regional development and town and country planning. The following conditions have to be fulfilled when choosing the location of an industrial estate:-

1. Availability of basic facilities, such as power, water supply and transport.

2. Proximity to the markets, sources of supply of labour and, where possible, of raw materials.
3. The vinicity of the industrial estates to a big project, as possible. Around such big projects, industrial estates could be utilized to assist the growth of small-scale units.
4. The availability of land, at low prices, for the establishment of the estate, including factories, housing, etc., and for any future extensions.
5. The suitability of the climatic conditions for the industrial activities of each estate (As an example, the Texitle industry has to be located in a humid region).
6. Strategic considerations have a great effect in deciding the location of industrial estates.

The choice of Helwan region for the establishment of the first industrial estate in the U.A.R. was stated after the fulfillment of many of the above conditions. First of all, the existance of the big project, i.e. The Iron and Steel Factory is the main factor of this choice. Also its vinicity to Cairo where required labour force and markets are available and the availability of land at low prices have important effects on that choice. Transport facilities and many other subfactors have also been considered.

On the other hand different conditions have affected the choice of the industrial estates in Alexandria and Suez such as the proximity to raw material resources (Petroleum in Suez), and the vinicity to the ports where water transport is available in both cities.

Location of industrial estates in the rural areas presented many problems. For example the shortage or almost complete lack of basic facilities, difficult of transport and absence of an industrial atmosphere but held out promise of providing employment and income to workers nearer their place of residence. The availability of electric power would be a limiting factor affecting the location of industrial estates in the rural areas.

This will not be the case in the U.A.R. after the erection of the High Tension Electric network from the High Dame Power Station. In the other direction, the location of industrial estates in the rural areas is a main tool for rural planning and development. This is to avoid the population crash to the big cities which is the case at present in the U.A.R.

It is clear that the industrial estates system and the choice of techniques have a mutual effect on each other. This means that before the erection of any industrial estate the techniques to be used in it has to be studied and chosen (capital or labour-intensive). There may be a combination of different techniques either in the big project or in the small ones to be created around it.

On the other hand, there should be in any industrial estate, a central technical office with the necessary staff having the required scientific and practical experience. This office can carry out the necessary researches and follow up the modern techniques to choose the best ones to be applied in the estate. This will not be available for any single project, but only on a very small scale.

Due to the importance of the choice of techniques, the German Democratic Republic(1) follows a system of planning the technical progress which has to start on the central level. This is so, because the economic growth basically depends upon combined and coordinated efforts in the field of technique and technology. Modern planning, therefore, means that any national plan should have a special section which may be called the technical plan. This section of course, has to be coordinated with all the other sections of the comprehensive plan on many lines. This section includes all the technical studies of the industrial activities and the choice of techniques for the different industries represents one of its main items.

(1) Memo. No. 262.

Technique L gives a larger, equal or smaller volume of corn output than technique H in the first period depending on whether

$$\frac{P_c}{a} > , = \text{or} < \frac{P'_c}{a'}$$

$$\text{i.e.} \quad \frac{P_c}{P'_c} > , = \text{or} < \frac{a}{a'} \qquad \text{(condition 1)}$$

The total wages bills in department II with techniques L & H are given respectively by:

$$W_{c_1} = L_{c_1} \cdot w = \frac{S \cdot w}{w \cdot a} \qquad (3)$$

$$\text{and} \quad W'_{c_1} = L'_{c_1} \cdot w = \frac{S \cdot w}{w \cdot a'} \qquad (4)$$

Thus the total surplus of corn produced with the two techniques is given respectively by :

$$N_1 = \frac{S}{w \cdot a} (P_c - w) \qquad (5)$$

$$\& \quad N'_1 = \frac{S}{w \cdot a'} (P'_c - w) \qquad (6)$$

Technique L gives a larger, equal or smaller rate of surplus than does technique H, depending upon whether

$$\frac{P_c - w}{a} > , = \text{or} < \frac{P'_c - w}{a'}$$

$$\text{i.e.,} \quad \frac{P_c - w}{P'_c - w} > , = \text{or} < \frac{a}{a'} \qquad \text{(condition 2)}$$

The maximization of surplus (N) per unit of investment (S) leads to the maximum rate of growth. Thus condition 2 gives us the condition for choosing the technique L or H if we wish to maximize the rate of growth.

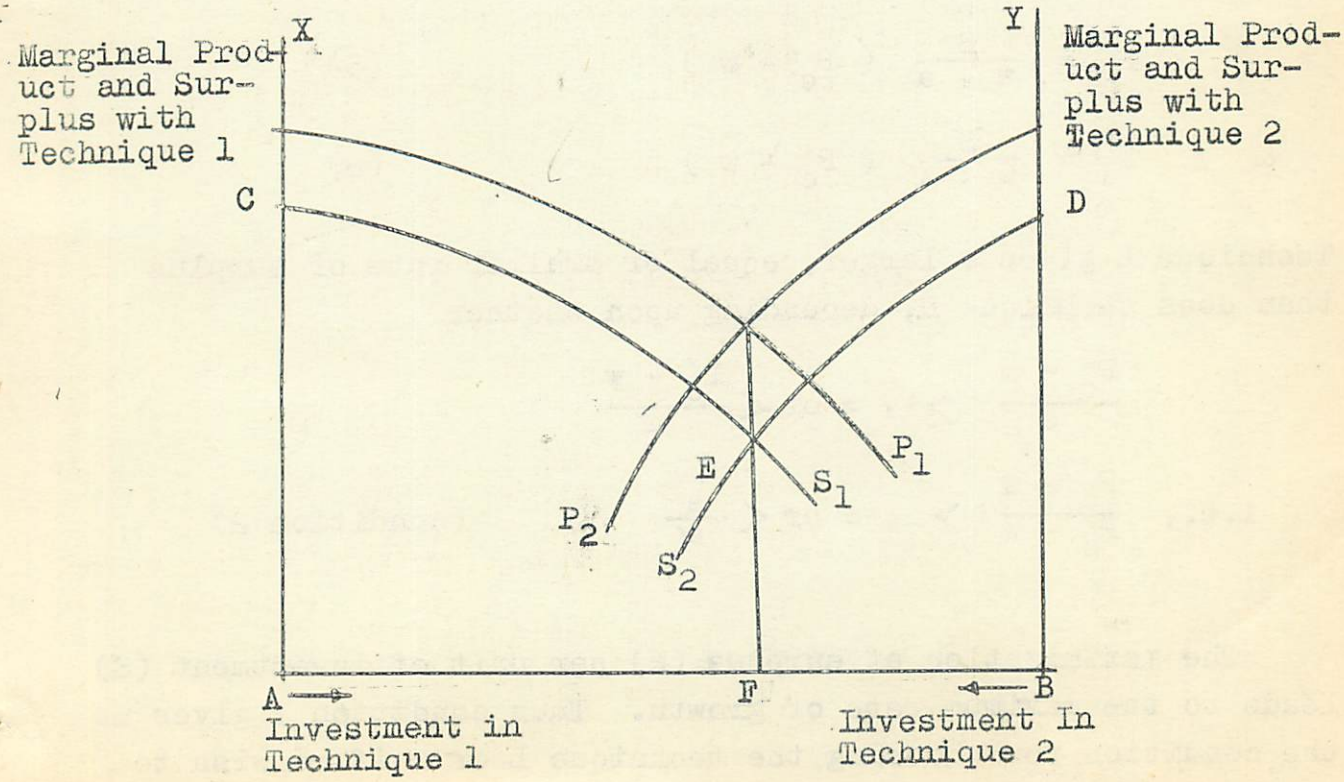
In the above model we assumed away all complications in order to illustrate the problem of choice between two alternative techniques for producing a certain product.

Here we shall release the assumptions mentioned at the beginning of this chapter to get a more practical model. The inclusion of land as a factor of production raises the question of diminishing returns. If land is an important factor of production, as in the case of agriculture, a doubling of labour and Capital will not necessarily double the output.

In what follows we shall consider the case of using a combination of two different techniques in the same operation (instead of one technique) consider the following diagram where:

X : represents the marginal product and surplus with technique 1.

Y : represents the same with technique 2.



This digram illustrates the possible case for choosing a combination of techniques rather than only one, to produce one good. Assuming that we wish to maximize the rate of surplus. $\overline{AB}$ = total amount of investment we can make.

The curve P_1 gives the marginal net product per unit of investment with techniques 1, keeping labour to capital ratio constant.

The curve P_1 - (the wages cost of employing more labour with more investment) = Curve S_1.

Similarly we get the curve S_2 for technique 2. The total investment in techniques 1 & 2 equals $\overline{AB}$, and the maximum surplus we can get equals the area ACEDB, when AF amount is invested in technique 1 and BF in technique 2. If we wish to maximize the surplus, this combination is optimal.

If it is possible to foresee the exact course of the progress of technological knowledge over time, in theory it is possible to consider the cases of all possible time combinations of techniques. If there are m techniques existing this year, n in the next, p in the year after and q in the year following, the number of possible combinations over the four years is (m.n.p.q). We may choose the combination which gives us the time series closest to our values.

The other assumptions can be treated and released in the same manner mentioned in the above pragraph.

PERT System And The Choice Of Techniques

PERT (Project Evaluation and Review Technique) is a modern technique for evaluating projects. As illustrated in Memos. No. 544 and 564, it can be applied to give the different time series for erecting any project with the corresponding costs. To get different time series, different techniques have to be applied. Thus the PERT can be considered as one of the main tools which can be used for choosing the different techniques to be applied in the different projects.

VI. Conclusions & Recommendations.

1. Due to the presence of a quite large number of unemployed labour (with low wage rates), it is advisable to choose labour - intensive techniques in most of the industries, specially in the first stage of industrialization.

2. The Public sector has the ability to take the risk of establishing the different industrial enterprises which is not the case with the private sector which is aiming mainly for profits, regardless of the different social benefits.

3. Special attention has to be given to those industries upon which our exports depend. Primarily, very simple industrial processes can be chosen for processing our local raw materials for exportation to raise its value in the foreign markets. This is also a mean for finding the opportunities of work for many workers.

4. Productivity has to be studied and developed, specially in the primary products to guarantee the lowest prices which have its effect on exporting the maximum possible exported quantities of these materials to the foreign markets.

5. International trade has a considerable effect on the choice of techniques for the different industries. To reduce the imports of the country, as a mean of saving foreign exchange, we should have to calculate the "social cost" of the import-cuts

6. The establishment of industrial estates, having many advantages, has to be considered and studied with respect to its location. The locations of these estates would be as much as possible in the rural areas which has a great effect on developing these areas and avioding the population crash on the cities. The electric power which will be available from the High Dam Power Station will facilitate this problem.

7. Due to the importance of the technical and technological problems on the national level, we recommend to include all of these problems and studies in a special section of the national plan. This section may be called the technical plan. This system is followed successfully in many of the socialist countries, where the public sector manages most of the industrial activities.

8. The problem of choice of techniques can be solved by applying some sort of mathematical models. The given model is an illustrative, simple one, but in practice all practical assumptions and modifications can be introduced.

   Computers can play a very effective role in solving the complicated realistic mathematical models in very short time, giving accurate results for all alternatives.

9. The choice of techniques must be studied, not only for the industrial sector, but also for all the other sectors of the economy such as the agricultural and trade sectors.
   The reason is to get the best qualities and the maximum production from such integrated and comprehensive growth pattern for all sectors.

10. Large scale projects usually have lower capital coefficients and input requirement and should be applied whenever possible in developing countries.

To conclude, we have to mention that underdeveloped and developing countries often have no choice even though the available technique may not be the best for them. This means that, in those countries, the choice of techniques is limited to the distribution of investment over the different sectors which differ in capital intensity. Efforts must be made to create a new kind of technology which is at the same time sufficiently small - scale corresponding to their markets.

For the U.A.R. and similar developing countries, the best

technique to be used is a mixed one. Modern techniques have to be applied in the big factories, while the traditional, labour - intensive techniques can be chosen for some other sectors of the economy. This will not be the case after the absence of the reserve of unemployed labour force in the near future.

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