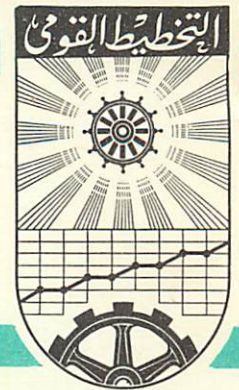


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The Appraisal of Investment
Projects

by

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THE APPRAISAL OF INVESTMENT PROJECTS

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THE APPRAISAL OF INVESTMENT PROJECTS

1. Introductory.

Among the information on which a development plan for an economy must be based the information about a considerable number of individual projects ranks high. From it we must learn in which activities the country considered possesses comparative advantages, that is, will be most successful in international competition and hence in enlarging its national income. This information on single projects can only be obtained at the cost of much work of many different experts and hence requires much time. This alone may be the reason why the collection of this information should be the work to be undertaken first of all. After the information has been collected the projects must be selected; priorities must be apportioned and this requires an appraisal. This paper mainly deals with the methods of appraisal available and the necessary information.

2. Description of Projects.

As a project we will usually consider a set of activities carried out in an organized way by an institution immediately responsible for it. Most frequently projects will be the construction and operation of a factory, a mine, a road, a railway, a school or a hospital. We may also consider as a project a well-defined measure of government policy (say, the institution of a consulting service for farmers in a certain district or the whole country) or a scheme (say, a marketing scheme). As a rule the description of such projects must be given in considerable detail: all the information necessary to carry it out. This implies a large number of technical details and specifications, time tables for the various activities to be undertaken and so on. While it is a matter of the technicians involved to determine how this type of information has to look, the economist in charge of the appraisal of the project also needs a certain minimum of information not always necessarily included in the usual description. We will deal, in this section, with the principles involved in this part of the information needed.

Basically information must be provided on two categories of phenomena to be represented by variables x_i and y_j . The former will be called the contributions the project is expected to make to the aims of development policy and the latter will be called the quantities of scarce factors to be used in the project's execution. As a rule the former category represents the "advantages" of the project and the latter the "sacrifices" to be made. By the special terms we have chosen we want to stress that there should be a correspondence, in setting out these advantages, with the general aims of the government's development policy; and, in estimating the sacrifices, with the concept of scarce factors. In other words, the use to be made of factors of production in abundance should not influence our choice.

Both concepts can best be illustrated by summing up the most frequent examples of them. Among the aims of development policy an increase in national

product is the most important one. Further aims may be increases in employment, more generally improvements in the distribution of income, among individuals, classes and regions. There may be further aims such as the improvement of health conditions or various cultural aims. The information needed is as much as possible to indicate the quantities of the contributions expected. Thus x_1 may represent the increase in national product, x_2 the increase in employment - say, in man-years - ; x_3 may be some measure of the improvement in income distribution. In this latter case the units in which to measure the phenomenon at stake are more open to debate, or at least to choice, than in the former two cases. Here we must make this choice before knowing what to do. One possible measure is the percentage of national income going to, say, the peasants, or the workers, or both. With changes to be expected in relative numbers of the various classes of the population the ratio between the average per capita income of peasants or workers and the population at large may be a better figure to choose. Similar considerations may be applied in order to represent the distribution between regions. As a final example, x_4 may be the decrease in the frequency of some diseases.

As for scarce factors frequently the most important examples are capital, foreign exchange and various types of qualified labour. Thus, y_1 may be the capital to be invested, y_2 the amount of foreign exchange needed and y_3 may be the number of engineers needed. Many more examples, especially of other kinds of qualified labour, may be added.

For both the contributions to aims x_i and the quantities of scarce factors needed y_j it will be necessary to specify the quantities in the various future years.

It would lead us too far to discuss in detail how the various variables mentioned must be estimated. Suffice it to say that a considerable number of methodological traps have to be avoided. The estimation of the contribution to national product, for instance, must be based on sound concepts as to how to deal with depreciation, debt repayment and so on. We must refer to economic handbooks for this sort of question.

3. Technological Scrutiny.

Before the figures of the technological description of any project are accepted as the basis for estimating the variables x_i and y_j just discussed, technicians must scrutinize the description and judge its degree of realism. Thus, if a project for an industrial plan is considered and the figures have been based on an experience in some highly developed country, these figures must be corrected for the difference in circumstances between that country and the country in which the project will be carried out. There may be differences in labour productivity, in water supply, in climate, in maintenance of capital goods and so on and so forth. Sometimes some broad statistical studies may be available as a clue for this sort of correction; more often the personal experience of entrepreneurs or experts must be called on.

Next, market studies may have to be made in order to scrutinize the assumptions made with regard to sales. Similarly, inputs needed may be a subject for market studies as well: will the goods needed be available at the prices assumed in the description of the project. A number of legal and tax assumptions made may have to be scrutinized as well.

An important aspect, somewhat related with the preceding ones but worth mentioning separately, is the one of the optimum plant size under the conditions prevailing in the country concerned. Sometimes precise studies will be available to find out which production volume represents the optimum, that is, leads to lowest per unit cost. Sometimes crude statistical indications from production statistics or censuses of production may be helpful. As a rule, no units should be established clearly below the optimum size.

Most of the checks briefly described under the present heading will have to be carried out in narrow co-operation between technicians and social experts. They are not described in detail here since they are not typically part of the economic appraisal, but rather constitute a preliminary stage of the work. The volume of work involved will be considerable, however.

4. The Complementarity Method.

Before embarking upon the treatment of the most desirable method of appraisal we must briefly deal with a "second-best" method which, for lack of sufficient data, must often be applied. Whenever the information described in section 2 is not available, or highly incomplete, we are compelled to use a simpler and cruder type of appraisal to be called the complementarity method. In principle this method is based on the phenomenon that, very broadly speaking, there is a parallelism between a country's general level of well-being and the level of its activities in various fields. This parallelism, which is not necessarily a proportionality, is brought out by the so-called Engel curves, indicating the relation between family income and family expenditure on consumer good items. It applies also to a number of non-consumer activities or activities not paid for by the consumer, including the development of the road system, energy production or education. It applies more particularly to what will be called national - in contradistinction to international - activities. These are activities whose products cannot be imported or exported, since their transportation costs are prohibitive. Examples of national activities are

- (i) building,
- (ii) the operation of buildings,
- (iii) energy (except when electricity nets are interconnected),
- (iv) personal services,
- (v) retail and a considerable portion of wholesale trade,
- (vi) inland transportation and communications,
- (vii) government services.

The method consists of accepting projects to a total volume corresponding with the "normal" relation between income per head and the activity's production per head, provided the project is efficient. The "normal" relation may be read off from international comparisons. Examples may be the volume of education of various types, the volume of health facilities, several other "social" activities and the production electricity.

The complementarity method may also be applied whenever a project of minor importance has to be appraised which is technically complementary to some big project already accepted. An example may be a minor extension of the road system in order to connect a factor.

5. Complementary Bunches: the Semi Input-Output Method.

We are now going to discuss the main method of appraisal based on information on the contributions made to the aims of development policy and the use of scarce factors. The first question we must answer is to what complex as a unit or building block in national development we must apply our method. Contrary to what is often done we cannot take single projects as our subject matter. The reason is to be found in another type of complementarity characteristic of the structure of economies, due to the existence of national activities as defined in section 4. Because of the impossibility to import the products of these sectors, each extension of an international sector must be accompanied by an extension of the national sectors. This would not be necessary only if there were considerable overcapacity in the national sectors, but it is in the nature of a development plan to assume no overcapacities: in most cases they are a waste.

Let us take an example. Let the extension of the spinning capacity of the country be considered; this is an international project, since yarns can be imported and exported. The spinning industry needs inputs from a number of national sectors, however; and these themselves will need further, indirect, inputs from national sectors. Of course there will also be needed inputs from international sectors, but these can be imported and there is no necessity of an increase in production. What has to be combined with the execution of our spinning project is an expansion of the capacities of all national sectors, covering the direct as well as all the indirect inputs of all "rounds". These expansions can be estimated with the aid of the so-called semi-input-output method. We will set out this method presently.

Let v_h be the increase in production of sector h and let c_h be the increase in consumption, s_h the increase in export surplus (which may be negative and then represents an import surplus). The equations of an input-output model for the increases in production, consumption and export surplus - assuming no changes in investment - may then be written:

$$v_h = c_h + e_h + \sum_{h'} \phi_{hh'} v_{h'} \quad (5.1)$$

We may assume that $c_h = \gamma_h y$, where y is the increase in national income.

$$y = \sum_h (1 - \sum_{h'} \varphi_{h'h}) v_h = \sum_h \varphi_{oh} v_h \quad (5.2)$$

The problem we want to solve is the following. We are given the increases in production of the international sectors; if the spinning industry is $h = 1$, then v_1 is equal to the planned increase in spinning production and all other v_h for international industries are $= 0$. We are also given that for the national industries $e_h = 0$. The unknowns of our problem are the production increases in the national sectors and the changes in export surpluses of the international sectors.

By writing down the equations for the national sectors we will find that these equations contain as unknowns only the v_h for these sectors. That means that the problem can be solved by using only a portion - and probably the smaller portion - of the total set of equations of the input-output method. This is why the method has been coined the semi input-output method. An example may illustrate the situation more easily than a completely general notation. Let us assume that we have 6 international and 3 national sectors and let the latter be indicated by $h = 7, 8, 9$. We then have v_1 given and $v_2 = v_3 = v_4 = v_5 = v_6 = 0$; also $e_7 = e_8 = e_9 = 0$. As a consequence (5.2) becomes;

$$y = \varphi_{01} v_1 + \varphi_{07} v_7 + \varphi_{08} v_8 + \varphi_{09} v_9 \quad (5.3)$$

The relationships between consumption increase c_h and income may be written.

$$c_h = \gamma_h y \quad (5.4)$$

from which we deduce;

$$c_7 = \gamma_7 (\varphi_{01} v_1 + \varphi_{07} v_7 + \varphi_{08} v_8 + \varphi_{09} v_9) \quad (5.5)$$

and similar expressions for c_8 and c_9

Equations (5.1) for the national sectors will become:

$$v_7 = \gamma_7 (\varphi_{01} v_1 + \varphi_{07} v_7 + \varphi_{08} v_8 + \varphi_{09} v_9) + \varphi_{77} v_7 + \varphi_{78} v_8 + \varphi_{79} v_9 \quad (5.6)$$

and similar equations for v_8 and v_9 .

These in fact only contain the unknowns v_7 , v_8 and v_9 and their solution is much simpler than the solution of a complete traditional input-output system. The remaining unknowns e_1 e_6 each of them can be found from one single equation, namely the one for the sector concerned.

We now know the increases in production v_7 , v_8 and v_9 which are complementary to the planned increase v_1 in spinning. We will call the joint investments needed in order to attain this increase in v_1 and the complementary v_7, v_8 and v_9 the complementary "bunch" of investments needed and our method of appraisal will be applied to such a bunch instead of to a single project such as the increase in spinning capacity.

It should be kept in mind that international projects are always independent of each other. We can carry out a project in the weaving industry without increasing the capacity of the spinning industry, because yarns can always be imported. In fact the Netherlands, for instance, have always had a larger weaving capacity than corresponded to their spinning capacity, since they regularly imported yarns.

Since the traditional problem of the input-output method always assumed that the input structure would not be changed we cannot apply the method in its traditional form.

6. The Main Criterion of Appraisal.

In order to choose between a large number of "bunches" of projects those which are the most attractive ones we will construct a criterion to be called the main criterion of appraisal. By this phrase we remind the planner of the necessity to apply additional criteria in some circumstances which we will discuss later (section 8). The main criterion as we conceive it compares, in a ratio r , the "advantages" with the "disadvantages" of the bunch, or, in our terminology of section 2, the contributions to the aims of development policy with the sacrifices in terms of scarce factors to be used. If there is only one aim, say to contribute to national product, and only one scarce factor, say capital, the criterion will take the simple form

$$r = \frac{x_1}{y_1} \quad (6.1)$$

where x_1 is the addition to national product and y_1 is the quantity of capital invested. If x_1 is calculated on an annual basis, this criterion coincides with the output-capital ratio and $1/r$ represents the capital-output ratio or the recoupment period as used in communist countries.

As a rule there will be more than one aim of development policy and more than one scarce factor. The problem then arises how the combined effect of such contributions or uses can be expressed. In principle we must know the relative importance of the various aims and the relative scarcity of the various scarce factors; both may be given the form of prices and only relative prices matter. That is, we can attach a price 1 to the first aim and a price 1 to the first scarce factor; then our criterion runs

$$r = \frac{x_1 + p_2 x_2 + p_3 x_3 + \dots}{y_1 + q_2 y_2 + q_3 y_3 + \dots} \quad (6.2)$$

where p_i represents the price of aim i in terms of aim 1 and q_j the price of factor j in terms of factor 1. It will be understood that there is a difference in the nature of prices p and q . The former can be autonomously determined by the policy makers but the latter must reflect the relative scarcities of the scarce factors. Their estimation will be discussed in section 7.

It is deemed desirable to make a distinction between the contributions to aims made in successive years, the x_i will be relatively numerous and among them may be the contribution to national income made in years 1, 2, 3 and so on; the prices to be attached to the later contributions will then reflect the discount applied to later contributions.

If x_1 represents, as before, the contribution to national income and x_2 , for instance, the one to employment, then p_2 stands for the importance attached, by the policy maker, of a unit of employment, say a man-year, in terms of a unit of income, say a pound. It may be ascertained by interviewing policy makers. Of course it may be different for different policy makers and the fundamental problem arises which "average" to take of the different quotations obtained. Since this is again a policy decision the economist as such has no answer.

The use of the criterion consists of selecting the project bunches showing the highest r first and descending to lower values until the total amount of capital available has been used up. If the prices q are chosen in the correct way the other scarce factors will be exhausted at the same moment (cf. section 7). The quantities of scarce factors available are the ones derived from a previous stage of the planning process, the macro-stage; but they may have to be revised during later stages. A portion of these quantities may already be earmarked, however, because of the execution of projects already started before.

Finally we must be aware of the fact that the estimate of the contribution to national product to be expected from any project requires the application of some prices; especially of the goods produced and the necessary inputs. These prices have in common with the prices to be applied to the use of scarce factors that they should reflect the relative scarcity of the commodities concerned (see also section 7 below).

7. Shadow Prices for Scarce Factors.

As already observed, the prices q_j in our main criterion must reflect the scarcity of the scarce factors j used by the project bunches. The difficulty one encounters in developing countries is that so often the market or official prices do not do so. They are often fixed without regard to scarcity conditions, as a number often called accounting or shadow prices. In principle these should be equilibrium prices, that is, prices at which demand for and supply of the scarce factor concerned are equal.

It will not often be possible to make very precise estimates of shadow prices, but even crude guesses may be better than the market prices. We will discuss a number of possibilities to arrive at such guesses.

A relatively simple case is the one of a protected commodity, that is a commodity on which an import duty is levied. Although such commodities are not usually considered as factors of production, they may occasionally be among the inputs of other commodities and then be treated as a factor. Moreover, it may be necessary to know their "true" prices in estimating the contribution to national product, whenever they are themselves outputs of any project. For such protected commodities not the internal (national) price, but the import prices (c.i.f.) should be considered the better estimate of the shadow price. Exception may be made only when there are clear indications that the world market is in disequilibrium as a consequence of overproduction.

Less simpler is the next case, the one of foreign exchange rates. Often currencies of underdeveloped countries are overvalued meaning that foreign exchange is undervalued at the official rates. An estimate must then be made of the rate at which the balance of payments would be in equilibrium. The ideal method to do so is to construct an economic model, of which some well-known examples have been given by Professor H.B. Chenery *). This may not always be possible; the planning agency may lack the staff needed for such an exercise. A substitute may then be an intelligent guess of an expert in monetary policy. The error should be avoided, however, to consider "black" or "free" rates a good estimate. These often refer to relatively small portions of the market. If, say, the official rate is 100 and the black rate is 200, but the amounts traded at the black rate are supposed to be some 10% of total turnover in foreign exchange, then a better estimate may be a weighted average of the two rates using as weights 90% for the official and 10% for the black rate, hence:

$$0.9 \times 100 + 0.1 \times 200 = 110.$$

Still more difficult are estimates of shadow prices for capital and qualified labour. If they are serious bottle necks - and they often are - shadow prices should be taken higher than market rates; but the guesses may be crude indeed. The same applies to the time discount to be applied to future goods. One may think of the interest rate as a substitute, but since the interest rate itself, as the price of the use of capital, may have to be corrected in an unknown way, there remains a considerable range of doubt. Sometimes simply a few alternative guesses may be tried in order to get information on the consequences.

Ideally the complete set of shadow prices may be obtained by an exercise in programming, provided that we have information on the quantities of the scarce factors of all sorts available and on all project bunches which will be carried out, including the ones in sectors not under the control of government, such as small-scale business and agriculture. In essence this exercise consists of assuming a set of shadow prices and computing the main criterion for each conceivable bunch of projects. Taking then, in a tentative program, all bunches, starting from the "best", until one factor is exhausted, we will find what happens to the other factors. If they are all exhausted at the same time we had the correct set of shadow prices. If some factor is not yet exhausted, we must lower its price and repeat the exercise. If some other

*) H.B. Chenery and P.G. Clark, *Interindustry Economics*, New York 1959, Chap.11.

factor was exhausted already before the others were, its price must be raised. Thus, by trial and error, we may arrive at the correct set. There are a number of exceptions to this procedure which have been the subject of a highly sophisticated literature; we will disregard them. They refer to the complications due to indivisibilities. For small countries such cases may be important enough. We may hope that for small countries the exercise may be feasible even with such complications; some more trial and error will be needed in order to find out what choice leads to the highest contribution to the aims of development possible with the scarce factors available.

One of the outcomes of the exercise which need not bother us is the possibility that one or more factors cannot be exhausted, while some other will be. Then the former factors are not actually scarce and their shadow price can be taken equal to zero.

Finally it should be emphasized that if shadow prices cannot be ascertained for each single future year, they should reflect the average scarcity to be expected for the life time of the project. That implies that they may have to be built on a careful analysis of future conditions and should be based on conditions some five or ten years ahead.

If shadow prices are applied by government planners in their appraisal of project bunches, a divergence with the appraisal by private investors will be the consequence. A project bunch may be attractive on the basis of shadow prices but not on the basis of market prices or the other way round. An important policy question then arises. Can private investors be induced to make the same choice as the public planners? The well-known answer is that a system of taxes and subsidies may create that inducement: the use of factors whose shadow prices are below their market prices may be subsidized while the use of factors in the opposite condition may be taxed. Such subsidies and taxes need not be the subject of separate schemes but can be built in into existing tax schemes or social insurance schemes. Thus, investment tax facilities may be different for projects of a labour-intensive character and for projects of a capital-intensive character. Or social insurance premiums may be transferred from enterprises to public authorities, partly or wholly.

8. The Use of Additional Criteria.

We already mentioned that no practical choice will ever be based on a mechanically applied criterion only, even if it is a sophisticated one, as our main criterion. This is so because the assumptions underlying the theories on which such a criterion must be based cannot be correct under all circumstances. In practical terms the last word must always be spoken by "wise men" who intuitively take into account the neglected factors. Policy-makers must be wise men and we can only hope that this is so. In theoretical terms we may try to indicate which type of deviations between theory and reality may interfere. There are too many to sum them up all, since almost every portion of an analysis contains approximations, certainly in economic matters.

One general type of deviations only will be mentioned. It may be indicated as the existence of external effects; in the present context this means that the execution of any particular project bunch A may influence the attractiveness of another bunch B; this means that one cannot independently decide on A and B. By the very introduction of the concept of bunches we have of course eliminated this possibility in its most obvious forms; but there may be cases where some external effects remain. X

Finally there may be some particular aims which it is difficult to express in quantitative terms and which only play a role in a few projects; decisions concerning such projects may have to be taken in an ad hoc way.

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use in the assistance of needy persons outside the United States.

d - Aid under Title IV of PL 480 which provides for long-term supply contracts. "The purpose of this title is to utilize surplus agricultural commodities and the products thereof produced in U.S. to assist the economic development of friendly nations by providing long-term credit for purchases of surplus agricultural commodities for domestic consumption during periods of economic development so that the resources and manpower of such nations may be utilized more effectively for industrial and other domestic economic development without jeopardizing meanwhile adequate supplies of Agricultural commodities for domestic use". (1)

9. To recapitulate, the American system of aid includes an extensive variety of operations each one of which is subject to specific conditions designed to attain given objectives. Aid may be effected on a grant basis or loan basis repayable in dollars or local currency as the case may be. It may be given in money or in kind, and may be committed to certain projects in the recipient country or granted generally without such commitment.

The major aid legislation is the Mutual Security Act of 1954 as amended (Public Law 665, 830 Congress) which provides for the following types of aid :

1 - Military Assistance.

2 - Economic assistance :

- a) Defense support.
- b) Development loan fund.
- c) Technical cooperation.
- d) Special assistance.

This is supplemented by the Act for International Development of 1961 which provides for the following types of aid :

- a) Development grants.
- b) Investment guarantees.
- c) Surveys of Investment opportunities.
- d) Development research.

In the educational and cultural field American aid is subject to the United States Information and Educational Exchange Act of 1948 as amended (Public Law 402 80 th Congress) and the Fulbright Amendment to the surplus property Act of 1944. The former provides for assistance in the form of interchange of persons, books and materials, and aid to educational and cultural institutions. The latter provides for the use of local currency to finance studies research, education and transport incident to scholastic activities.

The Agricultural Trade Development and Assistance Act of 1954 as amended (Public Law 480, 83 Congress) provides for aid in the form of surplus agricultural commodities.

Such are the major operations carried out by the United States Government under foreign aid programmes. In addition account must be taken of aid operations undertaken by private organizations such as Ford Foundation, Rockefeller Foundation, and scores of other private, secular and denominational, organizations. Their programmes consist of grants, in money or in kind, for charitable as well as developmental purposes.

10. Soviet aid, on the other hand, is much more simple. The usual form is to accord long-term credit facilities, at generous terms of repayment and low rates of interest.

The beneficiary is entitled to use these facilities within a specified period to pay for services, commodities and experts from the Soviet Union. In the majority of cases credit agreements provide for the establishment by the Soviet Union of industrial enterprises as running concerns; so that economic and technical aid are wrapped up in one package deal. The main point is that credit, not grants, is the dominant form of aid. For various considerations to be enunciated later on grants play a minor role in the Soviet System of aid. This goes for all Soviet Block countries with the notable exception of China. (1)

Other countries of the Western Block as well as Japan engage in practically all types of aid operations whether in the form of grants - although on a modest scale compared with U.S. - or credit facilities; technical as well as financial. In the case of Egypt, however, aid from these sources was mainly in the form of credit facilities. As

(1) Klaus Billerbeck : " Soviet Block Foreign Aid to the Underdeveloped Countries ", Hamburg Archives of World Economy, pp. 40-44