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# GENERAL CRITERIA OF INDUSTRIAL PROJECT EVALUATION


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## I. Introduction

The different approaches to the evaluation of alternative industrial projects can be broadly classified into two groups: (1) those that try to relate the exercise to some explicit attempts at optimization, and (ii) those that suggest some rules of thumb without any explicit use of optimizing methods or concepts. The adherents of the first type of approach tend to regard the adherents of the second to be unduly crude, and the latter in their turn tend to regard the former to be somewhat impractical. The unfortunate fact is that each group is essentially right about the other, and there does not seem to exist at the moment any definite approach to the problem of project evaluation that is both intellectually satisfactory and practically usable. This is a dilemma that is difficult to escape from, and we do not intend to try to do so in this paper. Instead our object will be to outline some methods of evaluating industrial projects that are essentially practical but which try to catch some of the more important elements of the problem of optimization involved in the exercise. It can be regarded as a cross between the two types of approaches outlined above, and while it probably has some of the merits of both approaches, it also shares some of the defects of each.

There has been a great deal of discussion in recent years on the efficiency of market-induced allocation of resources. The question is not necessarily related to that of socialism versus capitalism, as it is sometimes interpreted to be; indeed some socialist economies seem to make very wide use of the market while some capitalist economies have very restricted markets. It is perhaps also worth mentioning that some of the earliest and the best works on the efficiency of the market mechanism came from economists advocating socialism. [1/] The position will be taken in this paper that while the market mechanism has some extremely serious drawbacks, it provides a useful starting point for resource allocation in general and for project evaluation in particular. As such, we start with an examination of the notion of commercial profitability, and move from there on to the general question of national economic profitability.

## II. Commercial Profitability

Each project that might be proposed can be described in terms of a specific blue-print indicating how much of the different types of productive resources are planned to be used, and when they will be applied. Also, it will indicate the expected time stream of output or outputs. Thus, what we have are two time streams, one representing input flows and the other representing output flows. While these two streams completely describe the physical features of the project, they do not, by themselves, tell us as yet much about the profitability of the project. For this we need some more information, viz., a set of prices of the inputs and the outputs at the different dates. Given these prices, we can convert the two time series into one of net profits in each period, representing the gap between the aggregate value of the outputs and that of the inputs of that period. To convert this into one profitability figure, we need further information, viz., some means of making inter-temporal comparisons. Much of the controversy of the recent years on investment allocation has been precisely connected with this question. So we might first devote some attention to this problem of time series evaluation.

To formalize what was said in the last paragraph, let a time series $(R^i_1, R^i_2, \ldots, R^i_m)$ represent the flow of planned inputs of type i in periods 1, 2, ..., m, respectively. We have one such time series for each type of input i, with i = 1, 2, ..., r, where there are r types of inputs. Similarly, when there are k outputs, there are k number of time series of the type $(Q^j_1, Q^j_2, \ldots Q^j_n)$, representing the flow of output of type j in period, 1, 2, ..., n, with j = 1, 2, ..., k. In this model of r inputs, k outputs, m periods of input application and n periods of output production, we have a complete description of the "physical features" of a project. For convenience, we shall take m = n, and make up for the gap by putting zero values to the relevant inputs or outputs when m as originally defined is less or more than n. Indeed, in a typical model, there are some inputs and no outputs for a while, and there might be later on some outputs and no inputs in a number of periods. We shall simply attach a zero value to stretch the time series of each over the entire period.

If the prices of input i in periods 1, 2, ... n, be given by the respective items in the series $(p_1^i, p_2^i, \ldots, p_n^i)$, the physical time series of inputs of all types can be converted into one series of aggregate "costs" in each period, of which the m-th element looks like the following:

$$C_m = \sum_{i=1}^{r} i_m \cdot p_m^i \qquad (1)$$

We have such a time series $(C_1, C_2, \ldots, C_n)$.

Similarly, given the prices of the outputs for each period, $(\pi_1^j, \pi_2^j, \ldots, \pi_n^j)$, representing the series for the typical output j, we have a time series of aggregate value of returns derived in an identical manner, $(V_1, V_2, \ldots, V_n)$. By subtracting from the value of returns of each period, the value of costs of that period, we can easily obtain the time series of net profits $(\Pi_1, \Pi_2, \ldots, \Pi_n)$.

So far it is plain sailing, and we have spelled this out only for the sake of clarity. Once, however, we get the series of net profit, which we shall refer to by the vector $(\Pi)$, we have a difficult problem in constructing a scalar index of profitability from this. Two methods in particular have been suggested, viz., the estimation of the "internal rate of return" and the evaluation of the "present value of the series" at a given rate of interest, or at a given sequence of rates of interest. Let us start with the simpler version of the second, i.e., the evaluation of the present value at a given rate of interest q. The present value in period 0 of the series $(\Pi)$ at the rate of interest q, is given by:

$$P\left[q, (\Pi)\right] = \sum_{t=1}^{n} \frac{N_t}{(1+q)^t} \qquad (2)$$

This is the standard formula for obtaining the discounted value, and need not be elaborated here. Given a rate of interest q, therefore, all the time series of the type $(\Pi)$ can be converted into a present value of the type $P\left[q,(\Pi)\right]$, and after that the projects can be simply ranked in terms of present value. Any project that has a positive present value will justify itself at that rate of interest.

An alternative approach, we mentioned earlier, is that of the internal rate of return. This consists not in comparing the different projects at the same rate of interest, but in finding out for each project the rate of interest that makes its present value nil. To illustrate, take any project (N), and use any interest rate q, and calculate $P\left[q,(N)\right]$, as given by (2). If this present value is positive, consider a lower interest rate, and if the present value is negative, take a higher interest rate. 2/ Through these iterations one can find out that rate of interest which makes the present value of the series (N) to be exactly zero. The rate of interest q(N) at which this happens is defined as the "internal rate of return" of (N).

$$P\left[q(N),\ (N)\right] = 0 \qquad (3)$$

Alternative projects can be classified according to their internal rates of return, which provides an alternative measure of their respective profitability.

In what has been said above, the implicit assumption is that for each project there exists one and only one internal rate of return. This is not necessarily the case. We shall not here go into the question of the <u>existence</u> of the internal rate of return, which might be threatened in the case of discontinuity, but which is, in general, not a serious objection to the internal return rule. 3/ However, the question of <u>uniqueness</u> is a very important one, and the fact remains that a project may have more than one internal rate of return. For example, the three-element stream of net profit (-1, +5, -6) has two internal rates of return, viz., 1 and 2, since the present value of the stream is zero if we discount it at 100 per cent, <u>or</u> at 200 per cent. 4/

There is, however, one case where the problem of uniqueness of the internal rate of return does not cause any difficulty. This is the case when the project in question is of the "investment" type, 5/ i.e., has negative returns (costs) up to a point and positive returns beyond that. More formally, there exists a time period $\theta$ such that for $t < \theta$, $R_t < 0$, and for $t > \theta$, $R_t > 0$. It is perhaps of some comfort to note that the

typical investment projects that are to be considered very often fit this description, and are thus free from the possibility of having more than one internal rate of return. However, when we are comparing two projects and try to look at the differences between their net returns each period, this one-switch pattern may not hold.[6]

In my judgment, the problem of non-uniqueness of the internal rate of return is not perhaps the most significant objection to it, for even if all internal rates are unique, maximizing the internal rate of return may not be the best thing to do. What we are concerned with is not only the rate of return per unit of investment, but also with the size of the undertaking. For example, given the choice between two incompatible projects, it does not follow that the one with the higher internal rate of return should be chosen for it might be a much smaller project. We might prefer to have 10 per cent on £100 rather than 100 per cent on £1, when the market rate of interest is, say, 5 per cent.

The main advantage with the alternative "present value" approach is that it gives a clear expression of the <u>total</u> net benefit expected from the project as evaluated to-day with the proper rate of interest. By the proper rate of interest is meant the market rate, assuming the market to be perfect, which makes it the relevant rate for the commercial profitability calculation. The individual taking the decision has the option of borrowing or lending at the market rate of interest, and so the proper basis for the evaluation of the time series from the point of view of his personal profits is to discount it throughout at the market rate of interest.

Thus the conclusion we arrive at is that the proper basis for a commercial evaluation is not the internal rate of return but the present value. This point has of course been much discussed in the literature,[7] and is repeated here only because the appeal of the alternative criterion of maximizing the "rate of profit" or the "internal rate of return" still seems to be very great. It should perhaps be noted that the conclusion quoted is based on a number of simplifying assumptions which may be rather restrictive. In particular, the assumption of a perfect market for borrowing and lending is a serious assumption for the efficiency of the present value rule. If, for example, the indivisible project was so big that the assumption of

atomistic calculation was no longer appropriate, we shall then have to consider not only the market rate of interest, but the possible changes on the market rate itself as a result of the project evaluation in question. Only with atomistic competition can one assume that the market price of everything, including the rate of interest, is fixed irrespective of the decision at hand. The present value rule is based on this assumption, but it may not be a very good one in the case of a big lumpy project; and when we come to the giant sized projects that the government might consider, e.g. canals across the country, the question of the variation of the market rate of interest in response to the project must be brought in. It should also be noted that an underlying assumption of the present value technique is that the market rate of interest is not only fixed irrespective of individual actions, but all individuals who have to take decisions can in fact have access to such a market for as much borrowing and lending as they want. Any restriction in the market is ruled out, and it is of course quite relevant to ask whether the government can be treated like an individual vis-a-vis the market. Even from the point of view of the private entrepreneurs, one limitation of the present-value rule clearly lies in the non-perfect nature of the capital market. Indeed the importance of the "availability" of funds as a determinant of investment that has been discussed in the context of private investment decisions in a capitalist economy,[8/] is clearly an indicator in the direction of an imperfect capital market.

We need not go further into the question of commercial profitability. Our interest in it is only incidental, being confined to the light it throws on industrial project evaluation from the point of view of the society. For such a background, it is sufficient to note at this stage that the greatest private profit is obtained by evaluating projects at the market rates of interest, converting them into present values. The rule of internal rate of return does not give a proper indication of what to do in this case. We have also noted that the soundness of this present-value rule from the point of view of commercial profitability is crucially dependent on the assumption of a perfect market for borrowing and lending to which each decision-taker has unlimited access.

## III. National Economic Profitability

The calculation of commercial profitability is analytically similar to that of evaluating national economic gain from a project, but the variables that we have to deal with are often quite different. Since the term "efficiency" and "optimality" are used in economics in some widely different senses, it is perhaps worth making analytical distinctions before we go further into the analysis of national economic profitability.

The most widely used notion of optimality in economics is a surprisingly limited one, viz, the so-called "Pareto optimality". A Paretian improvement indicates a situational change such that some people (at least one person) gain and nobody loses. Each individual is assumed to be the relevant judge of his own welfare, so that the Paretian improvement consists of at least one person regarding himself to be better off and no person regarding himself to be worse off. Now, this is indeed an improvement in a very fundamental sense. What the notion of "Pareto optimality" does is to define an economic situation as optimal if no Paretian improvements are possible starting from such a situation. It is obvious that this is a very weak sense of an optimum. Such an optimum can, for example, be achieved even when some people are suffering acutely from hunger while others are disgustingly rich, provided the unhappiness of the poor men cannot be reduced except by cutting the happiness of the rich. In short, Pareto optimality says nothing about distribution, and is consistent with any degree of inequality.

The main appeal of the criterion of Pareto optimality is that it is something which most of us will find to be necessary for welfare maximization though we may not find it sufficient. Treated as a necessary condition, the criterion is indeed a remarkably good one. The only difficulty with it has been a tendency to confuse this necessary condition with a sufficiency condition. We shall go further into it presently.

The optimality of the perfectly competitive market mechanism has been proved, within the range of certain specific assumptions, by using the notion of Pareto optimality. Briefly, it is shown that given certain economic assumptions, e.g., no external effects, no saturation of wants, every competitive equilibrium is a Pareto optimal situation.[2/] So that if projects are evaluated

at free market prices and people act like competitive decision units, it will be assured (given the assumptions) that we arrive at a situation such that no person can be made better off without making someone else worse off. Indeed this result lies at the root of the practice, followed by many institutions, of identifying market profitability with economic soundness.

There are serious reasons for differing from this position substantially. First of all, the assumption that all markets are perfect is crucial, and is certainly untrue for practically any economy that one can think of. In particular the imperfection of the capital market has drawn a lot of attention, and in the context of planning for labour surplus economies, the fact that the wage rate often differs from the alternative marginal product of labour, which in such economies is zero, has been noted. Furthermore, it is necessary for the optimality result that not only does one decision-taker, or even a very large number, follow the competitive rules, but that everyone does so. If one market is imperfect, then it no longer follows that the best that the other decision-takers can do is to follow themselves the competitive rules. Indeed the optimality of the competitive rules in one field is crucially related to the same rules being followed in every other field. If there is imperfection elsewhere, then we need a different set of calculations to achieve what is sometimes called the "second-best". There is indeed hardly any situation in the world where the competitive rules can be put forward without any hesitation, because the condition of all other units following the competitive rule is such a restrictive one.

Secondly, even if it is assumed that all markets are perfect, the assumption of no external effects may stick in our throat. This implies that all the inter-dependences that different individuals have, work through the market and each has a price attached to it. When I purchase a telephone, I am the only one who gets something out of it, and people do not value the opportunity of being able to ring me up. When an individual passes on an infectious disease to another, there is a price attached to it which affects how much care the individual takes in keeping himself confined. These examples might be thought to be far-fetched in the context of industrial project evaluation, but exactly similar problems of external effects come in

there also. One very significant effect in this line is the training of the labour force that specific industrial projects might achieve, and the value of the output sold certainly does not fully reflect this particular contribution of the project to national profitability.

Thirdly, any project selection affects not only the welfare of the people today but also those of tomorrow. In such a context the assumption of no external effect has to take a curious form. If we take the assumption literally, then all that the market mechanism will achieve is that no one in the present generation can be made better off without making someone else in the present generation worse off, this guarantees nothing whatever about the welfare of the future generations. Faced with this problem, the convention of those advocating purely market-based decisions has been to assume that the members of the present generation identify their own interests with those of their heirs, so that the future generations are also represented indirectly in the market operations of today. To some extent this is undoubtedly true. The question, however, is whether these future welfare interests are adequately represented by the market prices. This will be an important consideration for us to take up in the context of correcting market prices.

Finally, so far we have not raised any objection to the goal of achieving only Pareto optimality and nothing more. Clearly this is a very limited goal. We are interested in the distributional questions also, even if we cannot always formulate this consideration very precisely.[10/] The market attaches no price to the reduction of income inequality, whereas we might wish to do precisely that. Thus, in this respect we need to distinguish the question of national economic profitability from that of commercial profitability. With these problems in mind, we can now go on to discuss the important question of how to move from an evaluation of commercial profitability to that of national profitability.

## IV. From Commercial to National Profitability

Essentially, the problem of finding a set of general criteria for industrial project evaluation is one that is only a part of the optimization exercise for the economy as a whole. The problem cannot be solved without solving the more general problem for the entire economy. The trouble is, however, that such a giant "general equilibrium" analysis of optimum allocation

is well outside the capabilities of practical planning of any country at the moment. An alternative is to give the exercise up as a bad job, and follow some clear-cut rules of thumb irrespective of their consequence. Neither, as we mentioned before, is particularly appealing. Before we go into a compromise solution, it is important that we briefly evaluate two approaches that are often put forward in dealing with these questions, and which, I would like to claim, are grossly misleading.

One approach is to claim that the problem of social optimum invariably involves valued judgments, and economists are not permitted to indulge in this luxury, so that the best he can do is to take up some "objective" criterion like the financial "feasibility" of the project. The notion that it is sinful to make valued judgments, qua economist, has been the dominant attitude in economics since the celebrated book by Professor (now Lord) Robbins,[11] and the argument is usually made that the economists are much better off making only analytical points rather than policy recommendations. The fact is, however, that the economists really have no choice in this matter once they are actually involved in project evaluation, and the "objectivity" of the "feasibility" criterion is essentially an illusion. The point is that anyone can put forward one billion criteria for project selection that are all equally "objective", varying from commercial feasibility to maximizing the specific gravity of the output, or minimizing the number of bald-headed men on the project site. Here objectivity does not, by any means, separate out any of these criteria from the others, and if we want to defend any one of them we have to do so on some grounds other than objectivity. After all, what we are concerned with is trying to find out some criteria that correspond to our, or the society's, notion of goodness, and to expect that we can do this job without making some serious value judgments is naivete. It can of course be mentioned that there is no reason why the economist's own value judgment should be given a special place, and indeed this is a valid objection up to a point. The economist's job, however, consists in representing as faithfully as he can the values that are generally held in the community in question, and while this may be difficult to do precisely, the imprecision involved here is probably no greater than that involved in a variety of other exercises that the economist is continually forced to do. Once the problem is viewed in

this light, it must be admitted that one can hardly get by this problem by using some criteria simply on grounds of their "objectivity".

A second approach, closely connected with this one, is to point out that the hope of getting a social welfare function based on the values of the members of the community is very weak, for these values cannot really be combined into a consistent set of social orderings. In so far as this objection is meant to point out that the problem of social decision-taking is exceedingly complex, the point is well taken, though it is difficult to see what exact policy implication this recognition does have. Some time, however, this point is made in an analytically stronger form, claiming that there is something inherently wrong in expecting social values to be consistent. Much of this criticism arises from the well-known "impossibility" theorem of Arrow,[12] though he himself was anxious to point out that under certain circumstances the problem of combining individual values into social orderings may not be serious. In particular, Arrow, showed, following a suggestion of Duncan Black,[13] that when individual preferences are "single-peaked", the method of majority decisions provides a consistent method of combining these values. Thus, under these circumstances over-ruling ofmarket decisions by some political ones may well be justifiable in purely democratic terms. This result of Arrow can be further extended, and it can be demonstrated that when the members of a community have a small degree of symmetry in their preference pattern, of which Arrow's "single-peakedness" is a special case, political decisions based on the values of the individual members of the community, can be altogether consistent.[14] We do not propose here to go further into this question, and only wish to point out that the movement from market decisions to political ones need not necessarily violate the usual cannons of democracy,

We have claimed so far that market evaluation may grossly violate our notions of social welfare, and also that our preferences on social questions can, under certain circumstances, be perfectly consistently combined in a democratic manner. We have not, however, as yet said anything on how exactly we shall proceed to do this exercise. In the line of the general approach of steering somewhere in between formal optimization exercises and practical

rules of thumb, we can consider the following procedure. We can start with the market evaluation of costs and benefits, and compute the "present value" of each project at the market rate of interest. We can then systematically "correct" the set of market prices by bringing in those factors that the market does not reflect, e.g., "external effects", considerations of inequality, the weights to be attached to the welfare of future generations. The correction will include the market interest rate also, and therefore the basis of the present value calculation. Thus modified, the profitability figures will give some indication of our notions of social desirability, and will provide the basis for project selection.

What is suggested above can be easily cut into the framework of "shadow" or "accounting" prices. However, for a variety of reasons the notion of accounting prices has got mixed up almost completely with that of the "true" prices that would have ruled <u>if</u> the market were perfect.[15/] Our notion of shadow prices, however, goes beyond that, and brings in a variety of considerations that are not based on marketed (or even marketable) commodities. Nevertheless, the basic conceptual structure can be easily expressed in terms of such shadow prices. One general complication in fixing these prices must, however, be borne in mind. What relative weights we attach to different types of benefits or to different types of costs, will depend on how much of each we are having. This is, the relative "shadow" prices cannot be taken to be independent of the projects that are selected, unless of course the projects are so small that they have little or no impact on the relative availability of the different types of benefits or the use of different types of factors. To give an example, we cannot say what weight we should attach to the welfare of the future generation vis-a-vis that of the present until we know how rich the future generation is going to be compared with the present, and if the investment project in question is a big one, the relative opulence of the different generations will not be independent of it. That is, in this case while the project selection will depend on the rate of interest, the rate of interest in its turn will depend on the projects actually selected.

Even if each individual project is small, altogether they add up to something with considerable impact on the relative weights to be attached to

the different types of benefits and costs. Here again an analogy with the market might be helpful. The perfectly competitive firm takes prices as given, and maximizes profits within that set of prices. On the other hand, the collective actions of all firms and all individuals involved in that market, affect the prices themselves, which is the problem of the equilibrium of the industry and of the economy in general. While the job of individual project selection is analogous to that of the individual firm, if the project is small, there is the further question of getting the right set of "shadow" prices given the totality of the decisions taken in all fields of project selection and resource allocation. It is with this latter problem in view that various methods of iterations have been suggested in the literature, whereby the planners might start with one set of shadow prices, do all the exercises with respect to them, and then in view of the actual results, ask once again whether the shadow prices chosen were in fact right. If not, some method of successive approximation can be followed, and under certain hopeful circumstances the process will converge onto a set of consistent optimal shadow prices. There is an enormous literature on this subject,[16] and we do not intend in this paper to go more deeply into the question of which type of iteration is best. However, since the problem involved here is quite basic to project evaluation, we can illustrate it further with a concrete example.

Suppose the exercise in question involves allocating some investment funds into investment goods industries and consumer goods industries, and also deciding whether more funds should be invested altogether. On the basis of our values, we might decide what weight to attach to oneunit more of present consumption vis-a-vis one unit more of future consumption, which is essentially the problem that is involved. Suppose we decide that the relative weight to be attached is that of 2 units of future consumption being equivalent to 1 unit of present consumption. With this shadow price given, the investment allocation can be completed, and looking at the collection of projects in fact chosen, we can then ask the question: was the 2:1 weight the right shadow price ratio? If the projects had turned out to be mostly of the present consumption variety, so that future generations are relatively neglected, we can decide that the 2:1 weight was unduly unfavourable to the future generations in question. The weight might then be revised in a

downward direction. The essential point is that our notion of the relative importance of the two types of benefits, represented by the price ratio, is not independent of the relative amounts of these benefits. Hence the problem is more complex than that of selecting a set of accounting prices once for all, and doing all exercises with respect to them.

A related point is worth making in this context. In the recent years, there has been a very welcome tendency to use modern analytical methods to solve actual problems of resource allocation, and programming techniques have naturally taken the most important place among these methods. In particular, linear programming has occupied a very special place in most resource allocational exercises of a practical type. The method, however, is restricted to the solution of problems involving linear constraints and a linear objective function. Now, a linear objective function implies a fixed set of relative weights (of the type of 2:1 quoted above), and the problem is that very often our values are sophisticated enough (as in the above example) to require modification of these relative weights depending on the exact amounts of the different types of benefits or costs involved. Indeed the well-known problem of diminishing marginal utility with increasing income is only an example of this kind of dependence. Now, if the objective function has to take into account such changes in weights, it no longer remains a linear objective function, and the exercise no longer is one of linear programming. What is really needed is the use of some powerful non-linear programming techniques, but often these techniques are too complicated to use given the limitation of the computational equipment. An alternative is to do a series of linear programming exercises, thereby trying to approximate a non-linear function by a series of linear functions. This is, indeed, exactly equivalent to the method of iterations outlined above, taking first a given set of prices, doing the exercise with them, and the revising the prices in the light of the decision taken, and proceeding this way, until the prices and the decisions are mutually consistent. In practice, even this might be unduly complicated to do. However, the use of linear programming in the resource allocational problems of the type described, depends really on the feasibility of such iterations. This point unfortunately

is not made sufficiently clear in some of the popular introductions to the applicability of linear programming to practical planning,[17] giving the impression that the only thing holding up the use of this method is the lack of data, when in fact other serious problems are also involved.

We shall not here go too much into the computational aspects of the problem of project evaluation. We shall instead confine our attention to the types of corrections of the market prices that need to be made. In the next section we discuss a variety of such corrections in a general manner.

VI. From Commercial to National Profitability: Specific Corrections

Following the approach outlined earlier, we might start by looking at the market evaluation of costs and benefits, and computing the market indicated "present values". In order to proceed from there to the social evaluation of costs and benefits, we have to bring in at least the following "corrections". The list here is drawn up with specific reference to industrial project evaluation.

(a) External Effects: These could be both positive or negative. Some specific ones are mentioned here, partly as illustrations, and partly as suggestions of the more important corrections that need be made in this general field.

(a.1) Skill formation: The process of skill formation is an exceedingly complex process, but it is obvious that much of it takes the form of external effects. In recent years a great deal of time and energy have been spent on the question of productivity of education, but in the field of skill formation, "learning by doing" is perhaps just as important as formal education and training. And since this learning depends much on the kind of experience that a person has, and since the experience in its turn depends on the extent of industrial activity, the development of industrial skill can really be viewed as a by-product of the process of industrialization. As a general recognition, this thought is of course not unknown, but the quantitative importance of it has probably not been fully recognized.

When doing industrial project evaluation, what one has to do, therefore, is to supplement the commercial profitability calculations by some value to be attached to the skill-formational effects of more work and more work experience.

It has been conventional in the recent years to point out the importance of "human capital" in the process of economic growth; what we are suggesting here is an extension of that concept, to include "learning by doing", and to incorporate this external effect into the profitability of different projects.

Much more work needs to be done on the general question of relating productivity to experience, and only when we have a clear picture of this, can project evaluation be really satisfactory. Meanwhile, we might have to do with some rough measure of the contribution of different projects to future productivity through their influence on labour skill.

(a.2) Social and Economic Infra-structure: A variety of products are typically not sold in the market, and some, while sold, are traditionally sold well below the price that people might be ready to pay for them. Education itself is an example of this, with free education at some ranges being an extreme illustration. Health services are also often provided much below the possible market price. These require corrections. However, what is even more important is the case where the price that the buyer is ready to pay represents a minute or a small part of the benefit that will be received by the nation. Economic and Social infra-structures fit this picture very well. In the context of industrial project evaluation, we might not be unduly concerned with projects such as education and health, but in so far as industrial projects of the conventional type compete with these projects for scarce resources, this might come in indirectly.

In addition, the interdependences between the different types of investment projects indicate that an under-valuation in one field might reflect heavily on another that is closely connected with it. For example, if health facilities are undervalued in the market, and if the economy happens to be run largely by market forces, then it will be fair to expect that the prices of equipment used in health facilities will be below their true benefits, and thus the industries concerned might look less profitable than they are from a national point of view. In all cases such indirect corrections might not be easy to do, but the need for such operations must be borne in mind to make possible use of it whenever data and computational ability permit this.

(a.3) Non-saleable goods: Some goods are simply non-saleable, e.g., traffic control, and because of the special problems they involve, this case has been much discussed in the literature. We shall not, however, go into this problem. The industrial products are by and large all saleable. It is of course true that many industrial products are used in producing goods that are non-saleable, but here the problem is exactly the same as discussed in the last section. Whether the good is saleable or not, if there is an external effect in its use, this affects all goods that go into its manufacture directly or indirectly, and this requires correction as we have pointed out. The case of non-saleable goods is subsumed in this general problem.

(b) Market Imperfections: The market prices have some significance only if the markets are perfect, as we have discussed earlier. Some markets are, however, notoriously not so. In the evaluation of national profitability this fact has to be kept in view. Some important examples of market imperfections are discussed below.

(b.1) Labour Market: In the developing economies of a certain type, it is thought that there is a big volume of surplus labour. This means that the opportunity cost of unskilled labour is zero, since it has no alternative use. However, the market price of labour does not fall to zero, and hence there is a gap between the market wage rate and the alternative marginal product of labour. This market imperfection is certainly one argument for not taking commercial evaluation of projects too seriously in economies of the type described. Even when there is no significant volume of surplus labour, it is in some cases pointed out that there is a gap between the "true" cost of labour and the wage rate because of market imperfections of different types. For example, a significant gap between industrial and agricultural wage rates has provided the background to some discussions of "dual" economies. Even within a sector there might be a gap between the labour cost of self-employed labour and the wage cost of hired labour. All these imperfections require modification of commercial profitability estimates. What should be the correct method of fixing the "shadow price" of labour has been a subject of very great controversy, and in view of the importance of the topic, we shall devote an entire section to this (section VIII).

(b.2) Capital Market: The imperfection of the capital market has been noted in a number of different contexts. Some have claimed that the market rate of interest is too low and does not reflect the "true" price of capital, and have suggested higher shadow interest rates. Some others have claimed that the market interest rate is too high, and have suggested a lower social rate of discount. At first glance these views will be found to be contradictory; that is not strictly true. The rate of interest represents a variety of things, and in competitive equilibrium it is supposed to equate a number of economic magnitudes. On the one hand it represents the alternative marginal productivity of capital, and on the other it is a reflection of the rate of discount of future income vis-a-vis present income. Essentially, what the literature quoted suggests is that the market rate of interest has a tendency to lie below the alternative marginal product of capital and above the proper social rate of discount. This entire area is an exceedingly complex one, and we go into this question in greater detail in section VII.

(b.3) Foreign Exchange: Many developing economies and some developed ones maintain, for one reason or another, an over-valued currency. The "true" market price of the country's currency may be considerably below the official market price, and to that extent the allocational role of the market may be distorted. We do not wish to go here into the question of whether such over-valued currencies are a good thing, but given that fact, clearly there is an argument for using a shadow-price for foreign exchange different from the official one.

In principle, there are two ways of going about this correction. One way of securing foreign exchange is further import control, and if this method is resorted to, the opportunity cost of foreign exchange in the project in question is the cost of not having the alternative possibility of imports. We need here a judgment of the loss to the nation from not having the alternative import. On the other hand, foreign exchange can also be secured by expanding exports, possibly at the cost of reduced terms of trade. The loss to the nation in this case represents the value of the domestic goods that have to be sent out to meet the foreign exchange requirement. Both systems will imply a higher value of foreign exchange than that given by the official rate, and indeed if the policy of how much to import and export is decided on purely

social welfare grounds, then the two measures should give us exactly the same result. If the measures indicate different costs, then there will be an argument for charging the total volume of exports and imports, until the two costs are equal.

(b.4) Monopolistic Elements: Quite apart from general market imperfections in such fields as labour, capital and foreign exchange markets, there are specific monopolistic elements to be found in some branches of the economy. Since in the monopolistic firms the factors of production may get a price less than their contribution to production, the factor prices might in general under-estimate the alternative marginal product. It is in the context of situations of this type that Richard Kahn put forward his controversial suggestion that a public enterprise in a monopolistic, private-enterprise economy should not try to follow the competitive rule, and should instead try to imitate the general degree monopoly surrounding it.[18] The argument is indeed convincing up to a point. Because suppose that in industry 1 the marginal factor productivities ( $A_i^1$) are all uniformly above the corresponding factor prices ($P_i$) by a margin of x; now the only way of getting the marginal productivities of each factor equated in the two industries is to follow the same gap in industry 2 also. Then, and only then, we have:

$$A_i^2 = P_i(1 + x) = A_i^1 \qquad (4)$$

The trouble with this, however, is that this does not get the allocation of labour right, since labour is paid uniformly below the marginal product.[19] How much distortion this will produce depends essentially on how elastic the supply of labour is. If it is fairly inelastic, the distortion may be small, and may even be negligible. If elastic, it can be serious.

In a completely socialist economy, this problem does not of course arise. For there each enterprise in all fields can be, if necessary, asked to follow rules corresponding to social welfare, at least in principle. Whether in the actual economy in question this problem of monopolistic distortion elsewhere is serious enough to require specific correction of factor price indicators is a decision on which not much can be said on general grounds, and we leave the

problem here to specific studies related to the country in question.

(c) Income Distribution: So far we have said nothing on income distribution. The market prices do not attach any special weight to this consideration, and simply abstracts from this question. In effect, it is assumed that a dollar spent by everyone represents the same total amount of welfare, which really amounts to assuming that people's relative incomes are proportional to their needs. If we want to attach any special weight to reducing the inequality of the distribution of income, we can introduce this as an explicit consideration in project evaluation, and attach a value to the measure of equality, for which we can choose one of many statistical measures. An alternative, which in many ways might be preferable is to attach some extra weight for parts of income received by a depressed group or a depressed region. That is, there could be one price simply for the total income generated and another price (or set of prices) for incomes received by the poorer group (or groups). Marglin [30] has discussed this in the context of general objectives.

(d) Other Corrections: The planners', or the politicians', or the people's, evaluation of different types of wants might not be properly reflected by the market prices under certain circumstances which are really special cases of imperfection or external effect but which can be conveniently treated somewhat separately.

(d.1) Merit Wants: It might be thought that, say, due to ignorance there is a chronic tendency for people to spend too little on sanitation or health facilities. In such circumstances one might simply add an extra weight on such wants over and above the market price. The concept of "merit wants" has been discussed by various authors including Marglin [30] and we need not go further into the question here. It should of course be borne in mind that if one's social welfare considerations are based ultimately on individualistic ethics, then the deviation of the shadow prices of merit wants from the market prices can really be translated into either imperfection (including incomplete knowledge), or external effects, or distributional considerations. That is, strictly speaking corrections of the types (a), (b), and (c), should cover all cases of "merit wants", given a basically individual-based welfare approach. However, convenience might demand that some such wants be given

special treatment and separated out from the general run of considerations in (a), (b), and (c). It is a matter of convenience and not of principle.

(d.2) Consumers' Surplus: For purely marginal allocation "consumers' surplus" does not make any difference, for the marginal consumers' surplus at equilibrium is always nil. However, when one is dealing with a number of alternative fixed blue-prints, this is a consideration of some importance, for the benefits derived from the products are not fully represented by the prices paid, since the price equals only the so-called marginal utility of the commodity. Thus in dealing with a discreet set of fixed alternatives, rather than with the marginal question of changing the amount applied of each factor by tiny amounts, the consideration of consumers' surplus is worth bringing in explicitly. This might also necessitate departing from market profit calculations.

It should be noted, however, that when doing an explicit programming exercise, or a neo-classical type of constrained maximization of the Lagrangian variety, the question of "consumers' surplus" need not be brought in explicitly. So strictly speaking it is not a price, in the sense of a fixed value per unit, that is being altered in the suggestion outlined here. It is a reformulation of the aggregate benefits when we are comparing a number of fixed projects, that is being proposed. It should also be added that in some exercises the consideration of producers' surplus might also be worth bringing in. The marginal price of a factor might only measure the marginal loss from its use, and multiplying all the units of the factor by that price might over-state the loss incurred in aggregate. The principle of correction involved here is similar to that with consumers' surplus.

In all the considerations outlined in this section, the primary intention has been to focus attention on some important problems of correction. The method of carrying out any of these corrections is not necessarily unique, and the project evaluater might be able to think of more than one way of bringing in a particular consideration. Our general approach, however, has been that of starting from market prices and market profits, and the corresponding present value, and then introducing systematic corrections in the total values of costs andbenefits. We could end with two general observations on this approach.

First, it is very important to have a consistent normalization procedure. That is, we should convert all benefit and cost magnitudes into some common unit, and here a money value might mislead us somewhat. When one says that an extra weight should be attached to income going to the poorer community, in determining the weight what one is looking for is some expression of this in the units in terms of which the calculation is being made. If present consumption to an average group of consumers is the unit, then the relevant question is how much of this benefit compensates for the loss of one extra unit of present consumption for an average group of consumers.

Secondly, it is worth bearing in mind that with well-behaved economic functions, the various alternative methods of setting the objectives can usually be translated into one another. For example the aim of maximizing one objective given the constraint on the other, or vice versa, or maximizing a weighted sum of the two, or even maximizing a non-linear function of the two satisfying the usual requirements of concavity, can be usually replaced by one another when we are ready to do several iterations. We pointed out in the last section how these iterations are really necessary to get the relevant marginal prices, and that was essentially a case of approximating a case of welfare maximization by that of a weighted average value maximization. The point has been discussed extensively by Marglin [30].

VII. The Time Horizon and the Rate of Interest

One of the more important considerations in project selection is the choice of time horizon and the rate (or rates) of interest to be applied within the horizon. This is a field where the difference between individual and national considerations tends to be very sharp, and the importance of this difference in project evaluation can be enormous.

For our purpose, there is some advantage in lumping together the problems of the rates of interest and of the time horizon. This is analytically quite sound, because what the time horizon means is that beyond this point the rate of discount is 100 per cent. The general question, "What are the proper social rates of discount?" subsumes the more specific question, "When should the rate of discount be 100 per cent?" The time horizon is simply an extreme case of discounting.

The main appeal of the private sector rate of interest lies in its correspondence, or supposed correspondence, with two magnitudes. Firstly, it is supposed to represent the time preference of the population of the country, expressing the relative weights to be attached to present consumption compared with future consumption. Secondly, it is supposed to express the productivity of private capital investment and this represents the opportunity cost of public sector projects. The two problems have to be studied separately.

One obvious difficulty in taking the rate of interest in a free market economy to be the right time preference for public sector projects, lies in the supposed irrationality of the individuals on a question of this kind. Distant objects look smaller, and individuals are supposed to attach an unduly small weight to future needs. There has been enough discussion on this problem so that it is unnecessary to repeat the argument on both sides.[20] It should be mentioned, however, that from the point of view of an individual it may not be entirely irrational to have such a pure time preference because the longer he looks into the future the less is his chance of survival. However, the life of the nation does not terminate with the life of the present generation, and thus there may be an argument for departing from the present generation's evaluation of present consumption vis-a-vis future consumption. But an element of authoritarianism is inevitable if we take this line of approach, since some people, perhaps the government, has to take the part of being a guardian of the nation, as the future generation is not here to express its views on the problem of relative weights to be attached.

There is another argument which is sometimes called the "schizophrenic" argument,[21] which suggests that in their day-to-day behaviour individuals are irresponsible. If the matter of time preference was put to vote individuals might vote differently there from what they express in their day-to-day actions. An analogy is often given in terms of traffic regulations. We may be quite prepared to vote for a rigid set of traffic rules, which we may, however, be prepared to violate in our individualistic actions. However, this problem is not worth pursuing too much. For while the argument is broadly valid, it takes us very far in a practical planning exercise.

A third and more important line of argument points out that even if there is no such schizophrenia, people's voting decisions might differ from

their individual market behaviour. Individuals may feel that they are ready to make certain sacrifice of present consumption for the sake of the future generations, in order to make the others do the same.[22] There is no method by which the individual can bring about such a contract between himself and others through the market mechanism.

A simple illustration might make the point clearer. Suppose each individual can consider two alternatives for himself, viz, to increase his rate of saving by one unit ($I_1$), and not to do it ($I_o$). For others, let us imagine he considers two alternatives also, viz, that they raise their saving by one unit ($R_1$), and that they do not do it ($R_o$). Now, the individuals may all have some concern for the future of the nation, for the benefit of which the saving is intended (through some long-term project). They might prefer that others do this saving and not themselves, but given the alternatives that nobody saves and everybody does, they prefer the latter. The ordering of the individuals will then be represented by the following series, in decreasing order of preference.

$$I_oR_1, \quad I_1R_1, \quad I_oR_o, \quad I_1R_o \qquad (5)$$

This is not an uncommon type of psychology when dealing with development plans. Now, the interesting point is that left to atomistic actions on their own, each individual will prefer not to do the saving, for no matter what he assumes about the actions of others, it is better for him not to do the marginal unit of saving. If the others save anyway ($R_1$), it is better to have $I_oR_1$, rather than $I_1R_1$; if the others do not ($R_o$), it is better to have $I_oR_o$ rather than $I_1R_o$. So left to atomistic action each individual will prefer not to do the marginal unit of saving, since that strategy strictly dominates over that of saving. However, the combined outcome, viz, no one doing the marginal unit of saving ($I_oR_o$), will be strictly worse in everyone's preference pattern than the alternative of everyone doing the marginal unit of saving ($I_1R_1$), as can be checked from (5). I have called this kind of problem elsewhere the "isolation paradox", and it really is simply an N-person extension of a result in the 2-person, non-zero-sum, non-cooperative game of the "Prisoners' dilemma".[23]

Considerations of this type lie at the core of the optimum savings problems in development planning. As Marglin has pointed out, the inoptimality of the market savings arising from this type of interdependence indicates the inappropriateness of the market rate of interest as the social rate of discount.[24] There has been a vigorous discussion in recent years on the proper social rate of discount based on considerations of this type.[25] But it has been carried on at much too abstract a plane to be useful for practical project evaluation, so that we shall not go into it here. Furthermore, considerations of the type of "isolation paradox" are not the only reasons for taking a social rate of discount different from the market rate. What the isolation paradox shows is that the market rate of interest does not necessarily represent even the views of the present generation about discounting future benefits, for some collective alternatives are simply not presented to to-day's individuals in the context of market choices. However, we may not wish to base our rates of discount for project evaluation exclusively on the preferences of the present generation. This is really a political problem of immense complexity, for there is really no way by which the future generations can express their views on to-day's project evaluation, and at the same time with long-lasting projects they are clearly involved in this decision directly. At the risk of sounding authoritarian, we would like to suggest, therefore, that considerations of the type of "isolation paradox" have to be supplemented by those that try to represent the interests, if not the views, of the future generations.

The total effect of these considerations will be to choose social rates of discount considerably below the private rates of interest for the corresponding periods. We do not really believe that an economist can give a very precise guidance to project selectors on this general question, except to point out the expected direction of the correction needed, and the considerations on which it should be based.

For practical planning it might be convenient to express the intertemporal political judgments in the form of a clear-cut time horizon and a fixed rate of interest up to the end of the horizon. Indeed this is how the problem is usually posed. An even simpler procedure is to do no discounting

at all until the end of the horizon, and to have a sudden shift of the discount rate from zero per cent to one hundred per cent. In either version we have a sudden discontinuity which may be analytically unappealing. The planner will have to choose between having such simple formulae and making use of more sophisticated formulations (e.g., infinite horizon with a continuously increasing social rate of discount). It is a question of striking a balance between convenience and sophistication.

Among the reasons for using a social rate of discount is the important one of rising standard of living over time. The future people will be better provided than members of the present generation, so that one unit of future benefit is really less important than one unit of present benefit. In terms of a given social utility function, the relation between the rates of interest and the rate of rise in the standard of living is easy to quantify.[25] Therefore, one of the considerations to be borne in mind in the project evaluation is the rate at which the nation can be expected to grow richer over time. If the project is a small one, the rate of rise in the standard of living can be assumed to be approximately independent of the project in question. If, however, it is a big project, or if a number of projects are being considered together, making up a big total, then the effects of the project (or the projects) in question on the rates of rise of the standard of living over time must also be considered.

Over and above this consideration, the social rates of interest can take into account other factors, e.g., the question of fairness involved in making the present generation sacrifice for the sake of the future. It is possible to take a position intermediate between the assumption that the present generation's views are the only things that matter and the assumption that all generations, however distant, should receive equal weighting in today's project evaluation. The exact problem of the social rates of discount and the time horizon to be chosen must depend on the explicit assumptions about this totality of considerations. Because of the complexity of this evaluation, it has been tempting to use the market rates of interest for this purpose, but as we have seen, the market rates of interest are really of no normative significance for the exercises of project evaluation. The present value

estimates have to be done with deliberately chosen social rates of discount and the time horizon, and the problem cannot really be escaped by attributing to the market rates an ethical significance they simply do not possess.

Incidentally, it is certainly true that the market rates of interest have a strong relationship with the productivity of capital investments in the private sector. This does not, however, make the market rate of interest the appropriate discount rate for public project evaluation. What it does imply is that both public and private sector costs and benefits must be evaluated at the appropriately determined social rates of discount. Therefore, in calculating the opportunity cost of capital in public projects, we must take into account the returns that obtain in the private sector, but the method of evaluation will be to compare the two time series aggregated with the appropriate social rates of discount. The problem of the corrections needed in the opportunity cost of public investments has been studied in detail by Marglin (/29/, /30/), and his formulae can be applied to project evaluation in the convenient forms in which he has presented them. This correction is, however, over and above any other corrections that we would like to make because of introducing other non-market factors in our objective, e.g., reducing inequality, supporting "merit wants". The social rates of discount have to be applied to the already corrected time series of benefits and costs, taking into account these other factors.

VIII. Technology and Employment

In the labour surplus economies, the social opportunity cost of labour is nil, judging the opportunity cost in terms of alternative output sacrificed by drawing labour away from other fields into this one. Since labour can be taken out of the pool of unemployment, no sacrifice of alternative output need be made. Some have, therefore, suggested that in these economies, a shadow price of labour equal to nil is the appropriate assumption.[27/]

One can, in fact, go even further than this. Since unemployment can be regarded as a social evil, it can be argued that in such economies extra employment, far from being a cost, is in fact a direct benefit in itself. This means that the shadow price of labour cost might be taken as negative rather than positive.

It is, however, not altogether clear that employment is really a virtue in itself, rather than being desired for the sake of some of its consequences which are in any case valued in our weighting system. The main consequence of employment in the shape of extra output produced is of course already included in our evaluation. Another consequence of extra employment, viz, better income distribution, in providing the means of living to some more families, is also included in our evaluation. These do not, however, necessarily exhaust all good consequences of extra employment. There is the question of dignity and security that people can have only with employment. This consideration may not, nevertheless, be very important when the alterrative to employment is not <u>open</u> unemployment, but <u>disguised</u> unemployment, say, in a peasant sector.

The argument for rejecting the market wage rate and treating labour as costless is not altogether a weak one. But there are problems involved here also. When more labour is employed, more wage expenditures have to be made, even if we draw it from the pool of the unemployed. This adds to the purchasing power, and leads to more consumption. And if more consumer expenditure is not to lead to inflation, we have to increase the production of consumer goods and shift resources from making investment goods into making consumer goods. This means that from the point of view of long run growth, employment of otherwise unemployed labour does have a cost, since extra employment reduces investment and possibilities of future growth.

How serious is the problem? It depends on a number of things. In a developing economy, the wage earners tend to consume practically everything they earn. So the extra wage bill will roughly correspond to the extra consumption generated. But there are possibilities of taxation, and also of absorbing some part of the extra purchasing power through inflation. But given the practical limitations of the fiscal machinery and the political limitations of having too much of an inflation, the link between employment and consumption cannot be entirely severed. So, in terms of future growth, there remains a cost of labour. What weight we want to attach to it will depend on our relative valuation of future consumption compared with present consumption. The more we discount the future and prefer the present, the less is the relevant cost of labour; and the less we discount the future, the higher becomes the relevant labour cost. Thus, the weight to be attached to labour cost depends

on our assessment of present needs compared with future needs.

The impact of employment on consumption can be brought into our project evaluation in the context of the choice of technology, in the following manner. Let the weight attached to today's consumption be our unit, and let the weight of today's savings be $(1+\lambda)$, where $\lambda$ can be positive, zero, or negative, depending on whether we want to attach more, equal, or less, weight to saving than to consumption. Thus the aggregate benefit is given by:

$$B = X + S(1+\lambda), \qquad (6)$$

where X = consumption, and S = savings.

Since total output (Y) is given by consumption plus savings, we can also write (6) as:

$$B = Y + S.\lambda \qquad (6A)$$

Now, labour has, in the case under discussion, no opportunity cost. But extra employment increases the wage bill and of the extra wages paid out a part c is consumed, and the rest is saved. As far as non-labour income is concerned, a part $c'$ is consumed, and the rest saved. We have $c \geq c'$. When the wage rate is w, the response of aggregate benefit to increased employment is given by:

$$\frac{dB}{dL} = \frac{dY}{dL} + \lambda \frac{dS}{dL}$$

$$= \frac{dY}{dL} - \lambda \left[ w(c-c') - \frac{dY}{dL}(1-c') \right] \qquad (7)$$

Since there is no direct opportunity cost of labour, the application of more labour should be continued until the point where the extra benefit from it is zero, i.e., as long as $(\frac{dB}{dL})$ is positive, more and more labour-intensive techniques should be considered. Maximum net benefit is achieved when:

$$\frac{dB}{dL} = 0 ,$$

i.e., when $$\frac{dY}{dL} = \frac{\lambda}{1+\lambda(1-c')} w.(c-c') \qquad (8)$$

Since the left-hand side represents the marginal product of labour, equation (8) can be interpreted as equating the marginal return to marginal cost, so that the right-hand side can be taken to be the appropriate marginal social "cost" of labour. Here we get a precise expression of exactly the measure that we have been looking for.

Those[28] who believe that labour is really costless in an economy with surplus labour, must argue that the right-hand side of equation (8) is zero. In principle there are two ways of arguing this. First, it can be argued that there is no point in attaching any extra weight to savings, i.e., we should take $\lambda = 0$. This implies that the rate of savings is just right, and the value of a marginal unit of saving is the same as that of a marginal unit of consumption. For the reasons discussed in the last section, this seems to be an inappropriate assumption for most developing economies. Second, it can be argued that the wage earners do not have a markedly higher propensity to consume than the recipients of capital income, i.e., $c = c'$. In either case, we have the right-hand side of equation (8) equal to zero, i.e., labour being really costless. The second assumption ($c = c'$) does not also seem to be particularly appropriate for an underdeveloped economy, even when the possibilities of taxing wages are taken into account. Particularly when the project in question is a public project, this is a very bad assumption, since the marginal propensity to consume of the government out of its income can be taken to be approximately zero, and that cannot clearly be an appropriate assumption for the wage earners.

On the other hand, those[29] who take the appropriate cost of labour as given by the market wage rate can do so only by another set of extreme assumptions. For example, if the wage earners consume everything ($c = 1$), capital income earners save everything ($c' = 0$), and the weight attached to saving is so high that the relative importance of consumption is negligible ($\lambda$ "very large"), then the right-hand side approximates w. When we have a very long time horizon and no discounting of the future benefits, this last assumption is appropriate, but that is an extreme case.

In general, the proper social "cost" of labour, when there is surplus labour, is given by the right-hand side of equation (9), and the extreme

values of it are given by zero (with $c = c'$, or with $\lambda = 0$), and w(with $c = 1$, $c' = 0$, and $\lambda$ very large). How labour-intensive a technique we choose will depend on this social "cost" of labour,[30] and barring the extreme assumptions it is likely to lie above zero but below the market wage rate. Equation (8) expresses the relevant concept of cost in a manner that can be directly related to observed magnitudes (w,c and c') and an explicit value judgment ($\lambda$). Incidentally, it is through the choice of $\lambda$ that the link between the last problem, viz, the choice of the social rate of discount, and the present one, viz, the choice of the social "cost" of labour, is established; both depend on whether the present rate of saving is taken to be too low or not.

IX. Strategy of Industrial Development: Concluding Remarks

The approach used in this paper has been one of detailed calculation of costs and benefits from a social point of view. We have outlined the different types of corrections needed to move from an estimate of commercial profitability to one of national gains. To solve the problem satisfactorily there are no alternatives to these detailed calculations, making use of observations as well as of explicit judgments.

A general reference should, however, be made to the approaches that lay down some general principles, e.g., choosing "balanced" growth, or selecting "quick-yielding" projects, or going in for "basic" industries. In avoiding discussion of these general principles we do not intend to question their wisdom. Some of these are indeed very helpful guides to general planning, and spot-light certain strategic considerations. For example, since "basic" industries produce mostly investment goods, the emphasis on "basic" industries is no different from our earlier discussion of the social desirability of raising the rate of saving from the figure given by the market rate (section VII). Similarly, the emphasis on "balanced" growth outlines the factors of inter-dependence between different projects, and that will, of course, be part of the cost-benefit evaluation outlined in this paper.

However, while these principles are almost invariably full of wisdom and often quite helpful, they can never really be taken to be substitutes for the detailed cost-benefit evaluation on which project selection must be based to avoid unnecessary mistakes. The principles in question can give no

more than a preliminary idea of what type of projects need be considered. The actual selection needs more specific estimation.

An illustration may be helpful. In the Bhakra Nangal project in India, the enormous dam construction required a gigantic amount of earth moving. This was done by heavily mechanized cranes and conveyor belts, rather than by more labour intensive methods. Why was this decision taken? We have two alternative explanations from Shonfield and Raj, each attributing the selection to a rather general principle.

Shonfield:

"I was struck by the contrast when, in 1959, I visited the great dam being built at Bhakra in the north of India - the largest dam in the country and the highest in the world. There was an almost complete absence on the site of pick-and-shovel men or of people carrying earth, stones or anything else. The skyline was filled with cranes and hoisting equipment, while a great length of machine belting, electrically driven, climbed like an endless vibrating snake over the hills, across a bridge over the river, and then up the steep side of the bank up to the dam itself, bringing its continuous load of stone from a quarry several miles away. Why, I asked the engineers in charge, did they not draw on the huge reserve of unemployed Indian labour to replace some of the machinery? They could also have saved some electricity, which was so short it was holding up the production of factories in the area. The official answer was that the dam site was too narrow for masses of people to work on it; also a high dam by its nature requires a lot of mechanical handling. No one could deny, however, that there was plenty of room for many more people than were actually there. The essential point which emerged in the course of further conversation was that these technicians did not want thousands of primitive and probably half-starved Indians crawling all over their site. They would be out of control, they would get in the way, and everything would be slowed down."[31]

Raj:

"Taking the last two alternatives, the facts broadly are that the capital cost of trucks required to carry a specified amount of earth would be only about half of the capital cost of a fleet of earth-moving machinery required to do the same work; but the labour needed in the former case -

for excavation, loading and unloading, compacting and watering, and for driving and maintaining the trucks - will be about 15 times as high (although undoubtedly a larger proportion of this need be only unskilled labour). On the conventional basis of cost valuation, the unit rate per 1,000 cubic feet of laid bank has been found to be, therefore, about 20 per cent higher in the case of the motor-truck technique."[32]

Whichever the correct explanation, the nature of the principle on which the decision was taken seems to be a general one, and the merits of the decision seem to be very much in question. Whether the engineers wanted to keep the dam-site clear of backward men, or whether they believed that commercial profitability was the best guide to project selection, they seem to have ignored the evaluation of social costs and benefits on which project selection must ultimately be based. As Raj points out:

"Now it should be obvious that given certain conditions and assumptions concerning the investment programme as a whole, it would be appropriate in an under-developed economy to impute a lower cost to the employment of unskilled labour and a higher cost to the employment of imported machinery, equipment, and materials than will be normally done on the conventions of private cost accounting. If even minor adjustments are made along these lines, it is doubtful whether the technique involving earth-moving machinery will have the comparative economic advantage which has been claimed for it."[33]

This brings us back to the question of shadow prices as opposed to the market ones, influencing a major decision.

General principles can give us some guidance but cannot take us all the way. To take them as preliminary hints on what questions to ask and what to expect can lighten the burden of project selection, but to take them as sufficient ground for straightforward choice of projects seems to be a course full of pitfalls. In the last analysis there is no substitute for the evaluation of social costs and benefits in making a proper selection of projects. That is why this paper has been devoted to the issues involved in this detailed evaluation.

FOOTNOTES

1. See in particular, Lange and Taylor [20], Lerner [21].
2. It is being assumed here that the present value is a decreasing function of the rate of interest. While this is true of projects typically of the investment type with which we are mainly concerned, this is not universally true. The question is related to the problem of uniqueness of the internal rate of return, which is discussed in the text as follows.
3. Apart from the problem of existence as such there is the problem of whether the internal rate might not be "imaginary" (see Hirshleifer [16], p.349), a problem we do not go into here.
4. On this question of uniqueness, see Lorie and Savage [25], Hirshleifer [16], McKean [26], Pitchford and Hagger [32], Wright [18], Feldstein and Fleming [11], and Sundrum [44].
5. See Wright [48].
6. This is related to Irving Fisher's "rate of return over cost rule".
7. See in particular Hirshleifer [16], Bailey [2], Feldstein and Flemming [11]. For an engaging defence of the internal rate of return criterion in a modified form, see Sundrum [44]. Incidentally, one further advantage of the present value criterion is that it can take into account variation of the market rate of interest over time, if the time path of such interest is known at the point of decision-making. Equation (2) has to be correspondingly modified, when $q_1, q_2, \ldots, q_m$, are the relevant rates of interest in the time periods 1, 2, ..., m, respectively.

$$P\left[(q), (N)\right] = \sum_{t=1}^{n} \frac{N_t}{(1+q_1)(1+q_2)\ldots(1+q_t)} \qquad (2A)$$

8. See Kalecki [18], Myer and Kuh [31].
9. The reverse statement, viz, that every Pareto optimal situation is a competitive equilibrium with respect to some set of prices, requires the further assumption of convexity, ruling out possibilities such as increasing returns to scale. Both propositions are based on ruling out "external effects" which can of course be important. See Scitovsky [37] and Samuelson [36].

10. On this see Little [24] and Graaff [14].
11. Robbins [35].
12. Arrow [1].
13. Black [3].
14. Sen [40].
15. See, in particular, Tinbergen [45].
16. See, especially, Marglin [27].
17. For example, see U.N. [47]. On this general question, see also Chakravarty [4], Chenery [5], Dorfman [8], Sen [38] Appendix E.
18. On this see Lerner [21].
19. Lerner [21]. See also Debreu [6], and Koopmans [22].
20. See particularly, Ramsey [34], and Dobb [7].
21. Marglin [28].
22. On this see Sen [39], [41], and Marglin [28].
23. Sen [39], [41].
24. Marglin [28].
25. See Marglin [28]. Lind [23], Tullock [46], Feldstein [10], Harberger [15], Sen [41].
26. See Ramsey [34], Eckstein [9].
27. For example, Tinbergen [45], Kahn [17], Lewis [22].
28. ibid.
29. Galenson and Leibenstein [13], Dobb [7], Little [24]. Another set of issues is raised by the relation between nutrition and productivity, which we do not go into here. See, however, Galenson and Pyatt [12]. See also Srinivasan [43].
30. Sen [38], Chapters II and V.
31. Shonfield [42], p.15.
32. Raj [33], pp. 23-4.
33. Raj [33], p.24.

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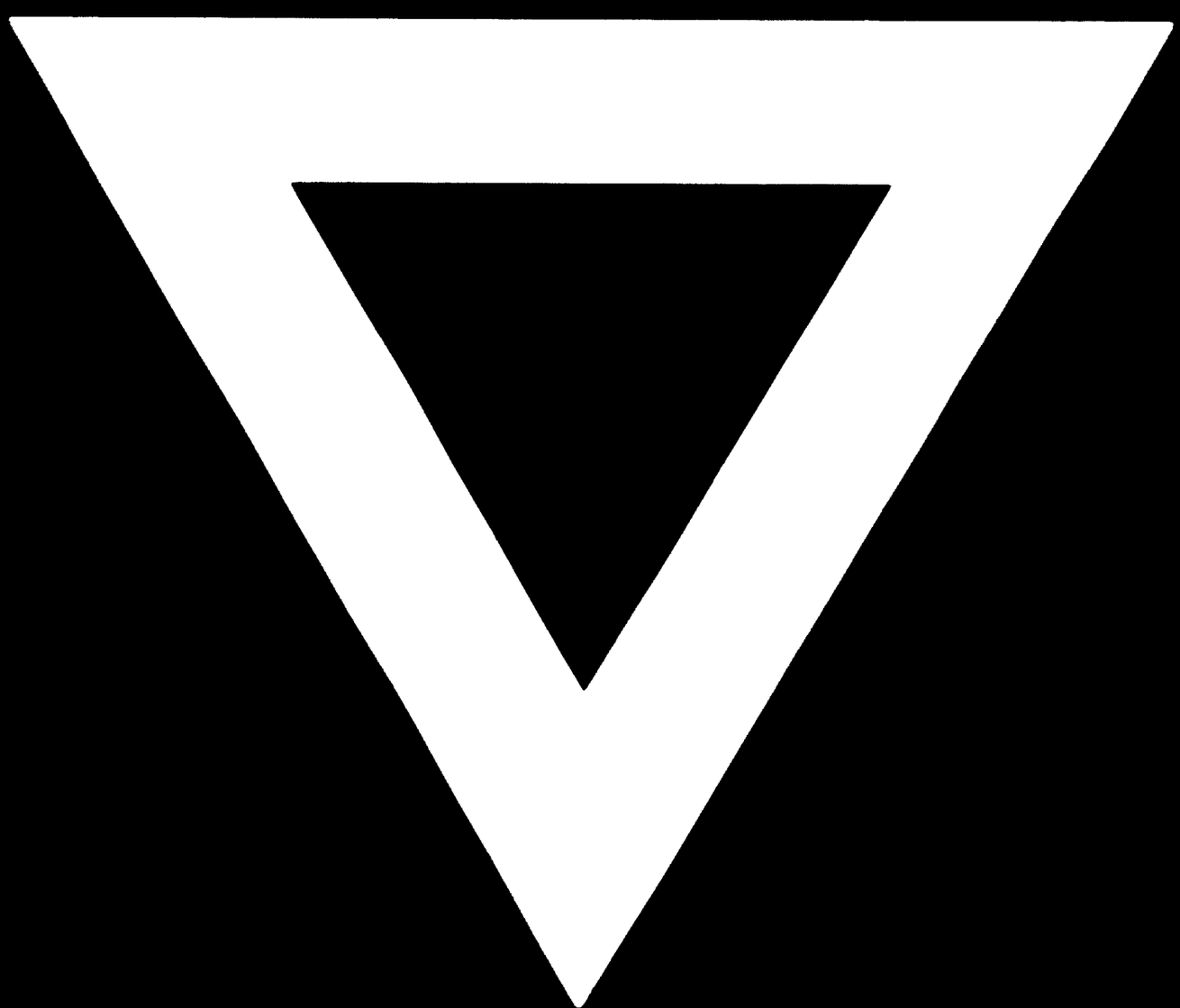
C-676



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