Se nós admitirmos que $\lambda = 0$, isto é, se nós não atribuirmos nenhum prêmio às poupanças adicionais ou se nós admitirmos que $S_1 = S_2$ então $W' = 0$, como supunham Polak, Buchanam e Lewis.

Por outro lado, se nós estabelecermos como nosso objetivo a maximização da taxa de crescimento da economia, então tende para o infinito e $W'$ se aproxima de $\left(\frac{S_2}{S_2 - S_1}\right) W$. Se admitirmos em seguida que $S_2 = 1$ e $S_1 = 0$, evidentemente $W' = W$, como era defendido por Galenson e Leibenstein. Entre êsses dois extremos, existem muitas possibilidades de que $0 < W' < W$ (Chenery, Kahn, etc.).

Dessa forma, o problema seria o de definir os objetivos sociais ou a função de bem-estar do país.

Problems of Project Evaluation in Relation to Underdeveloped Countries

1. Introduction

The application of methods and techniques of economic planning, in underdeveloped countries, has followed two main trends.

One is the approach of planning top to bottom, which begins with the elaboration of econometric models and the preparation of ambitious long-term development plans.

Another is the more pragmatic approach of starting from the bottom up, by means of an extensive system of project preparation and evaluation, on the basis of a few general and unquantified macroeconomic goals.

Of course, both approaches are complementary, rather than mutually exclusive; each of them, when considered in isolation, will present serious disadvantages.

The efficient preparation and implementation of global plans usually depends on a number of factors which are particularly scarce in underdeveloped countries — statistical and technical information, trained personnel, adequate administrative facilities, etc.
On the other hand, the preparation of individual projects without an adequate frame of reference concerning general objectives of economic policy may lead to conflicting results and misallocation of resources.

All things considered, however, I think that if one is interested in developing a strategy of meaningful economic planning, the project approach seems to be a better starting point.

In the first place, projects will have to be developed anyway, if the plan is to have any real significance. There is, however, a large gap between the formulation of general policy guidelines and the translation of those goals into detailed investment projects. To bridge gap much information has to be gathered and evaluated and very often, as a result of this process, the assumptions which underlied the original policy objectives are denied or proved false. In these circumstances, the premature formulation of a global plan may lead to serious losses.

In the second place, one of the common defects of a planning system is its centralization bias — the tendency to concentrate all decision making in the upper levels, even in relation to aspects which require specific knowledge of local conditions. We may speculate that this problem would not arise if the planning process (at least, in the earlier stages) were to start from below and gradually move up, along the hierarchical lines of the planning structure. From an administrative point of view, it is much easier to centralize a decentralized system than to do the reverse. And the efficiency of a planning system is to a great extent an administrative problem.

For those reasons, I think that in the early stages of the planning process, the project approach yields larger returns. It implies a more realistic and responsible approach toward economic problems, allows for more participation, experimentation and division of risks, thereby favoring the slow build up of information, the training of personnel and the development of institutional and administrative arrangements which are necessary for the construction of an efficient planning system ¹

In this connection, an analysis of the problems related to project evaluation has special significance for underdeveloped countries and the purpose of this paper is to make a general review of those problems.

¹ See VERNON, Raymond. Comprehensive Model Building in the Planning Process (unpublished paper) for some suggestions relating to the strategy of gaining information little by along the process of solving short-term problems.
2. General Problems of Project Evaluation

A project may be defined as the smallest unit of investment which is part of a development programme.

The evaluation of projects is, therefore, an important part of the overall planning process.

In underdeveloped economics, the evaluation of projects presents a number of difficulties which I will classify in two groups:

a) theoretical problems in the definition of investment criteria;

b) practical problems in the application of those criteria.

2.1. Empirical Problems

Let us dispose first of the second group of problems. Assuming away, for the time being, the theoretical difficulties, we may say that the effective use of investment criteria in underdeveloped countries depends on the existence of the following basic conditions:

a) availability of a "universe of candidate projects", in the sense of a large number of investment alternatives, among which an effective choice can be made;

b) knowledge of specific standards of evaluation of projects of different economic sectors, which implies the knowledge of the resources available in the country and of the objectives of its economic policy;

c) availability of technical resources (trained personnel) and existence of institutional conditions (political support, public understanding, etc.) favorable to an effective selection of projects.

The possibility of developing an effective system of project evaluation in underdeveloped countries is severely constrained by the fact that those conditions very often are not met.

In the first place, there is a scarcity of real projects. In many cases, for example, development banks have had a supply of resources that is greater than their demand, in terms of technically feasible projects.3

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8 This has been the case for a number of development banks in Brazil. See Holanda, Nilson. A Experiência de Crédito Industrial do BNB. Fortaleza, 1962. The same fact has been reported for other countries. See Diamond, William. Development Banks.
Secondly, the knowledge of the economic structure of the country is
deficient, there is neither and adequate global and sectoral planning nor
sufficient experience in the preparation of projects; moreover, the general
purposes of economic policy are not spelled out in a way sufficiently
detailed and precise to allow the definition of standards of evaluation.

Finally, there are shortages of trained personnel and lack of
institutional arrangements favorable to project evaluation; the absence of
a central authority to coordinate the sectoral and regional programs and
the interference of non-economic factors (political influences) are typical
problems in this connection.

This does not imply that the preparation of projects is a worthless
or impossible exercise. Quite the opposite. One cannot expect to have
those ideal conditions for the selection of projects without the availability
of the projects themselves. And our main contention is that it is fruitless
to try to establish any planning system — global, sectoral or regional —
without developing, in the first place, considerable expertise in the field
of project development and evaluation.

2.2. Theoretical Problems of Definition and Measurement

Quite aside from those practical difficulties the evaluation of projects
presupposes the solution of a number of theoretical problems, such as:

a) What criteria should be used; what are the advantages (benefits) and
disadvantages (costs) of a particular project?
b) How are we going to measure those benefits and costs?
c) In which way can we combine different criteria to obtain a single
and final evaluation of the project?

Those are the problems of definition, measurement and combination
of criteria.

Definition of the Criteria

First of all, it should be pointed out that the family of investment
criteria is quite complex and varied. The criteria might be single (only
one coefficient) or multiple (several coefficients); objective (quantifiable)
or subjective (non-quantifiable); relative (expressed in an index or
relation) or absolute (expressed by a number). Obviously, the selection
of the criteria to be used in a particular program will depend on a number of factors which vary from one country to another — information, personnel, administrative resources and institutional arrangements. Among those, the most important are probably the information requirements in relation to availability of resources (capital, labor, raw materials, infrastructure, etc.) and the objectives of economic policy. Sometimes those objectives are not well defined; in other circumstances, they imply a multiplicity of goals, not always compatible or consistent among themselves — growth, stability, full employment, equilibrium in the balance of payments, increased savings reduction in income and regional inequalities, etc.

By and large, three main objectives are in the forefront of all policy goals of practically any underdeveloped country:

a) to increase real income *per capita*, throughout the relevant planning period, with the purpose of improving the standards of living of the population;

b) to increase the level of employment to accommodate the expected increase in population and labor force and to allow the absorption of the unemployed or underemployed labor already existing;

c) to improve the balance of payments (except for those few countries which do not have this problem such as Venezuela, for example).

All other objectives can usually be accommodated within those three basic ones and, indeed, if adequate prices are used, they can all be subsumed into the general real income growth objective. If correct shadow prices are used for labor and foreign exchange, for instance, the solution that maximizes the growth of income *per capita* is also the same that allows an optimal utilization of the scarce (foreign exchange) and abundant (labor) factors.

*Measurement of Benefits and Costs*

The second problem — measurement of advantages and disadvantages — implies, in reality, two different questions, which are of a fundamental nature:

a) valuation of inputs and outputs, that is to say, consideration of eventual discrepancies between market and social prices, as well as between direct and indirect effects;
b) homogenization of financial flows, namely, the choice of a rate of discount.

Combination of Criteria

The third problem is related to the way of harmonizing and synthesizing the different conclusions that might be obtained when multiple criteria are used.

As it is pointed out in a United Nations publication "the difficulty in project evaluation consists of the fact that the problem has to be determined on a multi-dimensional basis and that from this a one-dimensional decision pattern has to be derived".  

3. Social and Private Benefits and Costs

From a static point of view and under conditions of perfect competition, market, prices and social prices are equivalent to one another. That is to say, market prices truly reflect, under those ideal conditions, the relative scarcities or opportunity costs, for society as a whole, of different factors, goods and services. Therefore, those prices are perfect guides for an optimal allocation of resources.

3.1. Why Social and Market Prices Differ

However, once one considers the characteristics of underdeveloped economies, it becomes necessary to take into account the lack or reality of those assumptions.

Imperfect Competition

To begin with, markets are far from perfect. Competition is severely hampered by the smallness of the markets and the interference of monopolies, labor unions, organized pressure groups and, above all, governmental policies. The influence of government intervention is all pervading — levying taxes, granting subsidies, controlling rates of exchange and interest rates, placing limits to prices and decreeing minimum wages. The conditions of free mobility, perfect knowledge are also conspicuously absent.

Dynamic Framework

In the second place, the problems of underdeveloped countries have to be analyzed in a dynamic context and this approach implies the consideration of significant external economies and diseconomies which are not adequately evaluated by the pricing process.\(^5\)

In these circumstances, market prices tend to deviate to a large extent from the social prices, and the allocation of resources induced by the imperfect markets is far from optimal.

Also, to the extent that the indirect effects of particular investment decisions, in the sense of external economies and diseconomies, are important, there will be a divergence between private and social benefits and costs. Common examples are the cases of those investments in public services which, by supplying, at a lower cost, inputs of generalized consumption, affect in an indirect and beneficial way a large number of economic activities (by creating a producer's or consumer's surplus). In those circumstances, the use of market prices, imply an underestimation of the social benefits of the investment.

Surplus Labor

Full employment of resources is not attained and in some circumstances it becomes possible to increase the output of a particular commodity, through the use of idle factors, without decreasing the production of any other good; a common example is that of the utilization of surplus labor and, in those circumstances, although a market wage or private cost is involved, there is no cost for society as a whole.\(^6\)

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Taxes and Subsidies

Private calculations also diverge from social costs and benefits whenever goods and services are provided at subsidized prices, through governmental intervention (railway rates, sales of fertilizers, etc.) and whenever profits or goods are taxed (corporate income taxes and indirect taxes).

Income Distribution

Finally, one may also argue that market prices do not adequately reflect the relative social valuation of different goods and services when the distribution of income does not correspond to a socially acceptable pattern.

3.2. Criteria for the Determination of Social Prices

Once it is recognized that market and social prices usually diverge in underdeveloped countries, the problem arises of which prices to use for an adequate evaluation of a specific project, from the point of view of an optimal (or suboptimal) allocation resources.

In this connection two basic approaches are found in the literature.

The General Equilibrium Approach

One is the programming approach suggested by Chenery, Frisch and Tinbergen which is based upon the determination of shadow or “accounting” prices by means of the solution of a general equilibrium system.7

The shadow or accounting prices determined in the process are used to replace the market prices in the evaluation of specific projects.

Two basic criticisms are directed against this approach. One refers to the process itself, in the sense that the “application of linear programming techniques in practice requires that the problem be drastically oversimplified” and that the resulting shadow prices are usually “very sensitive to the way in which the simplification is done”.8 One might


also add that the amount of information and expertise needed to arrive at a reliable and meaningful programming solution is certainly not available in underdeveloped countries. The second line of criticism deals with the concept of equilibrium with which the shadow prices are associated. It is argued that either this equilibrium is unlikely to be attained in any foreseeable future or that there is no unique equilibrium solution, but an infinitive number of solutions depending on the different configurations of development policies of a given country.

The Short-Run and Partial Equilibrium Approach

From this criticism emerges the second approach which pertains to the estimate of shadow prices of the relevant factors through the introduction of corrections to the market prices, on the basis of the empirical observation of the real conditions of underdeveloped countries.

The first position relates to an idealistic and long-term view of the economy; the second is concerned with a more realistic and relatively short-run view of the conditions actually faced by underdeveloped economies.

In relation to the second approach, which we find more useful for purposes of immediate policy implementation, we shall analyze below some of the suggestions that have been advanced for the estimation of shadow prices for labor and foreign exchange.

3.3. The Price of Labor

In relation to the price of labor, the trends in the literature have sometimes changed full course. The earlier discussions of Rosenstein-Rodan, Nurkse and Lewis generally assumed the existence of a substantial amount of unemployed labor in underdeveloped countries.

Recent theoretical work and some attempts of statistical testing have qualified to a considerable extent those earlier hypotheses.

By and large, it is generally recognized that, in underdeveloped countries, although market wages tend to overstate the cost of labor, for

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9 See PAPANEK, Gustav & QUEESHI, Moen. The Use of Accounting Prices in Planning, Economic Development Reports, Center for International Affairs, Harvard University.

society as a whole, this cost is not necessarily zero, except in some extreme cases.

The problem is more complex than it appears at first sight and several aspects should be taken into account such as the types of labor (skilled and non-skilled), their regional mobility, the nature of their unemployment (structural, frictional and seasonal) and the time path of the expected discrepancies between social costs of labor and market wages. If the use of additional labor, for example, implies the movement of people from the farms to the cities, the social cost of labor should be estimated by taking into consideration not only the wage required to induce this movement but also the increased costs of social overhead services that should be provided to the additional population.\textsuperscript{11}

In the case of community development projects which are devised to absorb the unemployed local labor, a cost that is frequently overlooked is that of organizational and administrative abilities that are required to implement the project and that often are some of the most scarce resources in underdeveloped countries.

Bearing in mind all those difficulties, one first approximation to the social cost of labor would be the level of wages paid to casual laborers that are not protected by law or union agreements and therefore is closer to a free market determined wage.\textsuperscript{12}

Also, if one is interested in maximizing the rate of growth of the economy, the effects to the additional employment and corresponding additional consumption upon the rate of savings should be taken into account. Marglin has shown that, under some special circumstances, the shadow wage may be even greater than the market wage.\textsuperscript{13}

3.4. The Price of Foreign Exchange

Underdeveloped countries show a strong predilection for the manipulation of exchange rates and the imposition of foreign trade restrictions, among

\textsuperscript{11} Cf. PAPANEK & QUERESH. \textit{Op.cit.;} also HARBERGER. \textit{Op.cit.} One could also argue that the investments in social overhead capital have benefits of their own or that the services would have to be provided anyway. If we further services, (education is a typical example) then the migration to the cities implies a benefit rather than a cost.

\textsuperscript{12} This is suggested by HARBERGER. \textit{Op.cit.}

\textsuperscript{13} In Public Expenditure Criteria. This result, however, will depend upon the assumptions made in relation to the propensities to save of wage-earners and profit earners as well as on the relative weights placed upon the conflicting goals of increasing the rate of savings and improving the income distribution.
different instruments of economic policy. This is not difficult to understand since it is much easier to keep track of foreign trade transactions than to control other aspects of economic activity.

However, as a result of those interferences in the foreign exchange market, deviations are created between the official and the equilibrium exchange rates, that is to say, between the market and the official rates of exchange.

If the general equilibrium approach is disregarded, the shadow price of foreign exchange should reflect the domestic market clearing, price (at port of entry) of a marginal unit of foreign exchange spent on imported goods. The underlying assumption is that the marginal utility of foreign exchange is equivalent to the marginal utility of the goods and services bought with it.14

*Market Prices plus Tariffs and Indirect Taxes*

In the absence of direct quantitative restrictions and assuming uniform *ad valorem* tariffs and indirect taxes, the shadow price of foreign exchange (P) should be

\[
P = (1 + d) r + [(1 + d) r] t \quad \text{or} \quad P = (1 + (d + t + dt) r)
\]

where \( d = ad \text{ valorem duties} \)
\( r = \text{market rate of exchange} \)
\( t = \text{proportion of indirect taxes} \)

If there are differentiated tariff rates, \( d \) should be estimated on the basis of a weighted average of the duties levied on marginal imports. It should be noted that the accuracy and relevance of those estimates depend upon the assumptions of freedom of imports and perfect competition in the internal market. But we know that quantitative restrictions rather than *ad valorem* duties are very often the really important limitations imposed on the foreign trade market.

In that case, it would be necessary to estimate the proportion of excess profit accruing to importers as a result of their privileged position in a licensing system. In the case of Pakistan, for example, it has been observ-

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ed that quantitative restrictions were more important than landed costs in determining the domestic market prices. Taking into account the extent of the licence created profit Mati Lal Pal estimated a shadow rate of exchange of Rs. 7.00/US$ 1.00 as against the official rate of exchange or Rs. 4.75 per dollar.\(^\text{15}\)

Since many projects have only a marginal effect on the balance of payments, foreign exchange and benefits, valued at their shadow prices, are usually incorporated into some general framework of project evaluation, such as the social marginal productivity criteria proposed by Chenery and others.

However, for some particular countries or in relation to specific programs of export promotion and import substitution, the foreign exchange effect becomes the relevant variable to be considered.

This is case, for example, of some small countries which have a large proportion of foreign trade to national income, such as Hungary, Israel or the Netherlands.

In relation to the particular needs of countries of this type, some alternative criteria for the selection among different export promotion projects have been suggested.

**Domestic Cost of Foreign Exchange**

One such criteria is the *domestic cost of foreign exchange* (B) proposed by Michael Bruno, on the basis that the cost of a unit of foreign exchange earned or saved (in a net sense) is equal to the direct and indirect resource costs incurred domestically, divided by the difference between the foreign price of the product and the foreign exchange cost of direct and indirect inputs.\(^\text{16}\)

Or

\[
B = \frac{W}{P - M}
\]

where

- **B** = domestic cost of foreign exchange
- **W** = domestic value added, under protection
- **P** = world market price of the commodity
- **M** = imported inputs, at world market prices

Where numerator is the production cost in domestic currency of a good in terms of use of domestic resources, and denominator shows,


in foreign currency, the foreign exchange saved or earned in view of the production of one unit of said good.

Given a specific project, the formula above shows the amount of domestic resources which must be used in order that one unit of foreign exchange may obtain — that is to say the rate of exchange of the project.

Once these coefficients are calculated it will be easy to rank different projects according as they are more or less costly as viewed from the standpoint of foreign exchange saved or earned, priority being obviously given to such projects as would require less domestic resources per unit of foreign exchange saved or earned.

Alternatively a project may be dismissed or allowed than the equilibrium rate.

For example, let the unit cost of a unit of good be Cr$ 200,00, including Cr$ 40,00 of imported inputs corresponding to U.S. $ 10.00 at an equilibrium rate of exchange of U.S.$ 4.00/Cr$1.00 (r), and let the price of said good in the world market be U.S.$ 90.00 then:

\[
B = \frac{160}{90 - 10} = \frac{160}{80} = \frac{2}{1}
\]

Since \( B < r \) the project should be given priority in view of its effects upon the Balance of Payments.

**Effective Rate of Protection**

An alternative criterion is that of the effective rate of protection suggested by Balassa, Corden and Johnson and defined as the excess of remuneration of domestic factors of production in a situation of tariff protection as against a situation of free trade. It measures the effective rate of protection on value added, in contrast to the nominal rate of protection on the total value of the product.

The effective rate of protection \( Z \) is defined as

\[
Z = \frac{W - V}{V} \quad \text{where } V = \text{domestic value added, at world market prices}
\]

\[
W = \text{domestic value added under protection}
\]

As Balassa and Schydowsky stress the rate of effective protection attempts to measure the degree of protection on the value added in a
given stage of the industrial process. It shows the excess in value added obtainable by reason of the imposition of tariffs as a percentage of value added in a free-trade situation. The effective rate of protection is affected by tariffs laid upon outputs and inputs alike: effective rates would equal nominal rates only is the weighted average of tariffs laid on inputs (imported raw materials) is equal to tariffs imposed on output itself. The effective tariff will be higher than the nominal tariff if the tariff laid upon output is higher than the tariff on its inputs and the other way round. Effective tariffs may be negative and will usually be negative on exports which are burdened by implicit taxes under the form of tariffs upon their inputs.¹⁷

This may be shown as follows:

\[ V = P - M \]

\[ W = P(1 + d) - M(1 + e) \]

\[ Z = \frac{W - V}{V} = \frac{[P(1 + d) - M(1 + e)] - (P - M)}{P - M} = \frac{Pd - Me}{P - M} \]

If \( d = e \) we have that \( Z = \frac{Pd - Md}{P - M} = \frac{(P - M)d}{P - M} = d \)

On the other hand if \( d < e \) \( Z = \frac{(P - M e/d) d}{P - M} \)

\[ \therefore z > d \]

The difference between nominal and effective tariff may be shown as per the following example:

Example: Given a rate of exchange of Cr$ 4.00 per dollar, let the price of good \( y \) in the world market be U.S.$ 10.00. This good may be domestically produced at the unit price of Cr$ 75.00. The required imported inputs are valued at U.S.$ 8.00. Whereas the customs protective duties laid upon good \( y \) amount to 200%, trosse laid on imported inputs amount to 25%.

In the case W would amount to Cr$ 25,00 corresponding to Cr$ 75,00 minus Cr$ 40,00 (8 x 4 x 1.25) of imported inputs and V would amount to Cr$ 40,00 (4 x 10) minus Cr$ 32,00 (8 x 4) that is to say Cr$ 8,00.

The effective rate would amount to

$$\frac{35 - 8}{8} = \frac{27}{8} = 3,375 = 337.5\%$$

while the nominal rate amounted to 200%.

In the selection of projects those should be choosen which would require the lowest effective protection.

Balassa and Schydlowsky have shown that the effective rate of protection is a better index of evaluation because it does not penalize those industries which utilize domestic inputs that are produced by relatively inefficient industries.18

4. The Choice of a Discount Rate

A projects is a plan for a trade-off between present and future. Its implementation implies the willingness to apply resources in the exploitation of a given economic opportunity at a certain point of time, for the sake of prospective benefits or returns.

Within this general framework, different projects have different shapes, especially in relation to:

a) the length of their useful lives during which costs are incurred and benefits obtained;

b) the time pattern of the distribution of those costs and benefits.

When projects are compared different situations may arise. Let two projects be assumed which require the same investment outlays but which have different flows of net returns (benefits minus costs) through time as disclosed in the following graphs.

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In the mounting phase and as long as the plant is not put to work, net profits \((B - C)\) are negative, its value being exactly equal to the investment value.
Obviously in that case no discount rate is in need. In both cases project A is better than B either because it yields higher returns on the same investment outlay or because it requires lower investment to yield the same return.

Let us assume however that the flow of net returns are distributed through time as portrayed in the following graphs.

**GRAPH 3  Financial Flows of Two Projects (Case 3)**

![Graph 3](image)

**GRAPH 4  Financial Flows of Two Projects (Case 4)**

![Graph 4](image)
In both cases a rate of discount is in need to make the projects comparable. In case of graph III project B yields higher returns than project A in phase a — b, while the contrary holds true in phase b — n.

In case of graph IV project A yields higher returns than B in phase a — n but B as longer life and still yields positive returns from period n to m when project A is longer productive.

Several other financial flows may arise.

If we consider n periods, for example, we may have a lump cost in period t₀ and a lump benefit in period tₙ; or a lump cost in period t₀ and continuous benefits from period t₁ to period tₙ; or continuous costs from period t₀ to period t₅ and continuous benefits from period t₆ to period tₙ; or alternative periods of benefits and costs, and so forth.

Therefore, to make those projects comparable, we have to make them homogeneous, from a definitional and quantitative point of view. This implies the use of a rate of discount (i), by means of which future values are given an equivalent valuation, in present terms.

In this connection, the discussion in the literature is centered on two main questions:

a) one is the methodological problem of the internal rates of return vs. present value;
b) another is the conceptual problem of what should be the rate of discount.

4.1. Methodological Problems

The Internal Rate of Return

The internal rate of return is defined as the rate of discount (i) which makes the present value of all benefits of the project equal to the present value of all costs (exclusive of depreciation charges and actual or imputed interest), through the entire length of useful life of the project

\[ \sum_{t=1}^{N} \frac{B_t}{(1 + i)^t} = \sum_{t=1}^{N} \frac{C_t}{(1 + i)^t} \]

This concept is often associated with the names of Fisher and Keynes, in relation to their theories of interest and investment.
Keynes, for instance, defines the marginal efficiency of capital as "that rate of discount which would make the present value of the series of annuities given by the returns expected from the capital asset during its life just equal to its supply price".19

Keynes observed that his concept was similar to that of Fisher's rate of return over cost, which is defined in the following way: "The rate of return over cost is always that rate which employed in computing the present worth of all the costs and the present worth of all the returns will make those two equal. Or, as a mathematician would prefer to put it, the rate which, employed in computing the present worth of the whole series of differences between the two income streams (some differences being positive and others negative) will make the total zero."20

Also, it appears, at first sight, that the only difference between the concepts of present value and internal rate of return is one of methodology: in the first case, we have the interest rate with which we estimate the present value; in the second case, we start from a given present value (the original cost of the investment) to derive the rate of return. Therefore, one should expect that the rankings given by both calculations would always be consistent with one another and that the internal rate of return would present the added advantage of avoiding the controversial issue of which rate of interest to select.

Unfortunately, this is not the case. Alchian has shown that the fisherian and keynesian concepts are different and that the rankings obtained with their use may diverge if the time path of the projects being compared is not the same.

"Fisher's rate of return over cost always involved a comparison of two options, not a discounting of merely one option"21 and the ranking of two projects by one and another method, when different time paths are assumed will coincide only if we add the assumption of a perpetual re-investment of the net receipt stream at the same internal rate of return.

In the second place, the solution for an internal rate of return may not exist, or, if it exists, may not be unique. This is especially the case

when the time profile of the financial flows of benefits (positive values) and costs (negative) crosses zero more than once.

Normally, projects have a financial flow characterized in that only two main phases can be distinguished along all their lifetime: the investment phase with negative flows (B - C) and the operating phase with net positive flows. This is graphically portrayed by a curve of financial flows that intercepts the zero line only once, as seen below:

**GRAPH 5 Financial Flow of One Project (Case a)**

![Graph 5](image)

This case involves no methodological problem for estimating the internal rate of return since a single solution obtains. It may happen however that the curve of financial flows intercepts the zero line more than once, as in a case where an investment is needed to clean (for example atomic plants) demolish, or restore the plant when its lifetime comes to a close.

**GRAPH 6 Financial Flow of One Project (Case b)**

![Graph 6](image)
Limitations of the internal rate of return

In that case it may happen that there is not only a unique solution for the internal rate of return. If a flow of $-900, +1.710, -810$ is analysed it is seen that two rates make it equal to zero: 11% and zero per cent. 22

If the flow takes the form $-1 + 6 - 11 + 6$, for example, three solutions are possible: zero, 100 and 200 per cent.

In the third place when the choice between two projects is considered, another methodological problem arises when flows have the form appearing in graph III. The flow in here intercepts the zero line only one and the solution is unique. But in that case the solution maximizing the internal rate for return is not the same as the one maximizing the present value at any discount rate.

Alchian gives an example of two alternative opportunities requiring the same initial investment of $25, the first one (A) yielding and yearly return of $5 during 10 years whereas the other yields $1 in the first year, 2 in the second 3 in the third ... and so up to the tenth year.

GRAPH 7 Financial Flows of Two Projects (Case 5)


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The graph above shows the present values of both flows when different discount rates are used. The internal rate of return is given by the rate of discount which makes the present value of the flows equal to the initial investment, that is to say 17% for A and 12.5% for B.

According to the internal rate of return project A would be better than project B. But this would true only for discount rates higher than 6%. It lower rates are used project B would have a higher present value.

At a discount rate of 6% both projects are equally convenient and this rate will correspond to the Fisher's concept of rate of return over cost.

Finally, the internal rate of return is not really independent from the rate of interest. On the one hand, the internal rate of return depends upon present and future prices, and the structure of prices depends upon the rate of interest. “Thus, the internal rate of return cannot be measured independently from the existing rate of interest”.23 On the other hand, once an internal rate of return is estimated, it has to be compared with an exogeneously determined rate of interest.

It is possible that, for practical purposes, those points are not extremely important. The examples portrayed by Hirschleiffer of jumping from a rate of 100 per cent to a rate of 200 per cent hardly reflect the real range of choices daily faced by investors. And the internal rate of return is still regarded as important concept, for theoretical analyses and practical work.24

By and large, the present value method is considered to be the most useful. In that case, the selection of the appropriate rate of interest or discount becomes the relevant problem. Once this rate is established, the problem is simply one of determining whether or not the present value or benefits exceeds the present value of costs.

4.2. Conceptual Problems

The choice of a rate of discount has been aproached in two different ways:

24 See, for example, McKEAN, Roland. Efficiency in Government Through System Analysis.
a) one position, which is synthesized by Harberger, is that the rate of
discount should be the marginal productivity of capital (r) in the private
sector of the economy; if public funds are scarce or "when the budgetary
constraint is binding" — the rate of discount (i) should be higher than r.

In that case r would be a lower limit. Another situation in which
i > r would be that in which as a result of technological change r under­
states the productivity of new investments, since the observed r is an
unweighted average of the returns on old and new plants.25

b) the second position in that advanced by Eckstein, Marglin, Sen and
Feldstein, who advocate the use of a social rate of time preference (STP)
or social rate or discount (r') presumably lower than that which could
be inferred from observed rates of interest.

The contradiction between the two positions is more apparent than
real. It is mainly a result of the different set of assumptions and value
judgments that are made in each case, in relation to the nature of the
economic system and the objectives of economic policy.

The Assumption of the Marginal Productivity Approach

Harberger, for example, seems to be concerned mainly with the selec­
tion of projects in the private sector and, as a result, he implicitly assumes
some sort of fisherian mechanism, by means of which the marginal rate
of transformation in production, as shown by the marginal productivity
of investment, is equated to the marginal rate of transformation in
consumption, as defined by the rate of interest, (See graphs VIII, IX and
X). The fact that "market rates of interest substantially underestimate the
opportunity cost of capital says Harberger" is only a result of market
imperfections, namely the failure of market rates "to reflect the taxes
that are paid on account of the profits of the private sector projects ... and
other external benefits ... particularly where there are divergences
between marked prices and opportunity costs of factors of production and
goods". 26

The market line AB shows the possibility of interchanging present income for future income in the capital market through borrowing and lending. The indifference curves portray consumer's subjective appraisals when he compares present with future incomes that is to say his rate of time preferences. At equilibrium this rate equals the rate of interest. Thus consumer who compares a presente income flow Ob₂ with a future flow Oa₁ (corresponding to point f) will find advantageous to lend, transforming present income flow b₁b₂ (which will decrease) into future income a₁a₂ (which will increase). On the contrary, consumer at point d will be induced to borrow.

Curve AB corresponds to Fisher’s opportunity line picturing investment possibilities or the possibilities to transform present into future incomes, through direct employment of resources to exploit rentable investment opportunities. At equilibrium investor will attain point e where marginal rate of return over cost equals the marginal rate of time
preference. In that case there is no possibility to change the shape of the financial flow through borrowing or lending.

GRAPH 9  Fisherian Mechanism of Equilibrium Between the Marginal Rate of Return Over Cost and the Marginal Rate of Time Preference

In that case two alternatives are opened to the consumer-investor who is initially at point \( f \): to invest from \( f \) to \( g \) and then borrow from \( g \) to \( h \). At this point the marginal rate of return over cost (measured by the slope of curve AB at point \( g \)) equals the rate of interest (measured by the slope of the market line AB) and the marginal rate of time preference (measured by the slope of the indifference curve at point \( h \)).

The Assumptions of the Social Rate of Discount

The Eckstein-Sen-Marglin approach, on the other hand, is primarily concerned with the problem of public investment, particularly (at least in case of Sen) within the more general framework of a planned economy.
According to Sen the social rate of discount is the rate at which marginal utility of consumptions falls as consumption increases.

If investment increases, present consumption falls to increase future consumption. Marginal utility of future consumption falls while marginal utility of present consumption increases; thus the trade-off between present and future consumptions improves as related to present consumption and worsens as related to future consumption — that is to say the discount rate increases. It is therefore seen that the social rate of discount (i) is directly related to investment, whereas the marginal productivity of capital is inversely related to investment.

They who defend the use of r as a discount rate in the appraisal of projects assume that capital is optimally accumulated at $I^*$ when $r = i$. 
It happens that, actually, capital accumulation is under political and institutional constraints which force it down below optimum level $\overline{I}$. Under these conditions $\overline{I} < I^*$ and therefore $r \neq i$ or $i < r$.

At the level $I^*$ where capital is optimally accumulated the interest rate equals the investment marginal productivity. Under conditions of imperfect capital formation however there is a gap between the two rates. The marginal yield of investment, which reflects the extent to which opportunities of capital formation are exploited, remains highly above the rate of interest which shows the community time preferences.

This is why Sen and others object to the idea that the marginal productivity of investment should be used as the social rate of discount.

At equilibrium the investing and saving decisions are related by the rate of interest. Actually or under the imperfect conditions under which the projects are to be appraised those decisions are not related to each other. The social time preference rate is not equal to the marginal productivity of investment.
Furthermore other arguments may be used to challenge the thesis that the social rate of discount should correspond to the marginal productivity investment:

a) If public investment is financed through taxation and part of the fiscal revenue comes from reduced consumption, the opportunity cost of capital is not necessarily the marginal productivity of capital in the private sector.

b) Even in the case of perfect capital markets, the rationality of individual decisions in relation to savings would imply the knowledge of future incomes, wants and prices. As Feldstein points out "the individual cannot possibly have the information he requires for rationally redistributing his income through time". 27

c) As a result, says Eckstein, the interest rate which supposedly equates supply and demand for capital, "cannot be given the usual normative interpretation. When government determines the rate of capital accumulation as a matter of social policy it rejects not only the market judgment about the share of national income to be devoted to investment, but also rejects the market's relative valuation of outputs at different points of time". 28

This corresponds to what Marglin calls the "authoritarian answer" to the social irrationality of individual's preferences for their own consumption as against consumption by future generations. 29

d) There is a possibility that individual savings decisions are different from collective savings decisions. This corresponds to Sen's Isolation Paradox or to Marglin's interdependence answer to the problem. 30

Finally, Feldstein and Marglin have added recently a still stronger argument which implies a rejection of the fisherian analysis, in relation to the social rate of discount. Feldstein observes that "for the community

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as a whole, it is impossible to redistribute consumption through time by merely monetary borrowing-lending transactions; ... (society) must evaluate the alternative investments in the terms of their specific profiles”.

The Indeterminacy of the Rates of Discount

Therefore, concludes Marglin “the Government cannot escape from a decision and the appropriate rate of discount ... can be inferred only from intertemporal consumption preferences that the government holds as a proxy for the people”.

Thus, the choice of the rate of discount comes to depend entirely upon a value judgment in relation to intertemporal choice and Marglin argues that this decision is no more complex than that implicit in the decisions made in connection with interpersonal choice when income tax schedules are drawn.

An Analysis of the Controversy

The arguments presented against this position are related to the fact that different rates of interest would have to be used in the private and in the public sector or that the use of a low social rate of discount would lead to the acceptance of more projects than could be financed.

It seems to me that some confusion in the discussion arises from the fact that each author criticizes other theories on the basis of one's own assumptions. One says: if there were no imperfections in the capital market, the rate of interest would not be that low; the other replies: with an optimal rate of capital accumulation the marginal productivity of capital could not be that high. One assumes limited capital accumulation and advocates an accounting price of capital which is higher than market rate of interest (Harberger, Tinbergen, Papanek, etc.). The other presupposes an optimal rate of capital accumulation and a rate of discount.

which is lower than the market rate of interest and reflects the relative valuation of present and future consumption, from the point of view of society as a whole (Sen, Marglin, Eckstein, Steiner, etc.).

It appears that, from a practical point of view, the first approach seems to be more realistic, within the framework of a predominantly private enterprise underdeveloped economy. Even though, the problem remain of whether or not the marginal productivity of capital can be used as a rate of discount.

If one defines the marginal productivity of capital as the discounted sum of prospective yields of a given investment this definition implies a previous specification of a rate of discount. Or if the definition is equivalent to that of an internal rate of return, we still need some exogenously given rate of discount to make any signification comparisons.

In other words, once we admit that the market rates do not reflect a point of tangency of the social investment opportunity curve to the social time preference curve, there is no way to link the two rate — $r$ and $STP$ — since the option of borrowing and lending in the market is not open to society as a whole.

Granted that the social discount rate has to be defined as a matter of public policy, what are the factors should be taken into account in its determination?

At this point, the discussion is — to my mind — still unsettled. Some argue like Feldstein that "the search for a perfect formula to specify the social time preference is futile". Others, like Frisch, have tried to find such a formula.

According to Feldstein the main factors that should be taken into account are the position of the society in the consumption space (which depends on the consumption level and the rate of growth) and the slope of the indifference curve at that point (which in turn reflects the social consumption utility function, the rate of population growth and the pure time preference).

Frisch devised a formula to define an "incentive free interest rate", which depends on the rate of growth, the rate of decline in marginal

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utility which accompanies the increase in come and the “perspective shortening” (in the case of one year, for example, this is the utility of \( Y_{t+1} \) “as it appears when visualized from year \( t \')).

Others, like Sen (in the tradition of Ramsey) would eliminate pure time preference altogether and replace it by an allowance for uncertainty.\(^{37}\)

For anyone directly involved in policy making this discussion does not seem to be very useful. However, in spite of the indeterminacy and sometimes unnecessary cloudiness that surrounds the subject, some progress has been made, especially in relation to the specification of the assumptions that underlie the different arguments and theoretical positions.

From the point of view of an underdeveloped country, where very often public investments are undertaken without consideration to benefits and costs, even the notion that the social rate of discount depends on a value judgment might be an improvement. If policy makers are required to specify their preferences in relation to the trade-off between present and future consumption, the resulting rate of discount — however arbitrary — may help to introduce a minimum of consistency and rationality in the process of selection among alternative public investments.

5. Conclusion

In this brief and superficial analysis I have tried to survey some of the major theoretical and empirical problems of project evaluation, with special reference to underdeveloped countries.

My basic point is that not only project evaluation is an extremely important part of the overall planning process, but also that, in spite of the difficulties involved, considerable progress has been made in relation to the controversial issues that have dominate the literature in the last two decades.

From the point of view of an underdeveloped country, I would say that the basic problems are:

a) to define in a precise and consistent way the basic objectives of economic policy;

\(^{37}\) Sen. Choice of Technique. Chapter VIII.
b) to accept a reasonable compromise between theoretical rigour and administrative convenience in the application of investment criteria.

Once this is done, a wide range of possibilities is available to the policy maker, from simple rules of thumb to complicated programming devices. There is nothing inherently right or wrong with any specific criteria or method of evaluation and the basic requirement should be one of consistency – that once the goals are set, the methods of evaluation should adequately reflect those goals.

A typical example of problems which may arise when an adequate definition of goals, assumptions, and hypothesis is lacking is the well-known controversy which raged on whether labour or capital intensive methods of production should be used.

Said controversy stemmed from it that in the last two decades at least three groups of criteria have been set forth to provide for a method of evaluating projects:

a) The rate of Turnover criterion put forward by Buchanam (1943) and Polak (1945) which seeks to maximize the ratio:

\[
\frac{\text{OUTPUT}}{\text{CAPITAL}}
\]

b) The social marginal productivity criterion put forward in the 50's by Kahn, Eckstein and Chenery which seeks to maximize the ratio:

\[
\frac{\text{OUTPUT} \text{ minus COSTS (at social prices)}}{\text{CAPITAL}}
\]

c) The rate of surplus criterion suggested by Leibenstein and Dobb which seeks to maximize the ratio:

\[
\frac{\text{OUTPUT} \text{ minus COSTS (at market prices)}}{\text{CAPITAL}}
\]

The first two criteria particularly the rate of turnover rested on the assumption that there is an excess labour and that therefore employment should be increased up to the point at which the labour marginal productivity fall down to nilil; the result would be the employment of labour intensive techniques.
On the contrary, the rate of surplus criterium backed by Leibenstein sought to maximize the difference between the value of output and total wages and rested on the following assumptions:

i) The basic goal of the economic policy is to maximize income in a relatively remote future;

ii) wages remain unchanged at subsistence level and therefore any capital formation can only be the result of the reinvestment of profits.

This rationale necessarily led to the defense of capital intensive techniques.

The following graph illustrates the differences between both criteria:

**GRAPH 12 Output and Wages Bill (Case 1)**

According to the first two criteria the level of employment should raise up to point \( N_2 \), corresponding to optimum output \( (E) \); should the rate of surplus criterium be followed the marginal productivity of labour would be equal to the wages rate \( (\bar{w}) \) or.

\[
\frac{dQ}{dN} = \bar{w} \text{ where } \bar{w} = \frac{W}{N}
\]

This would be the point at which excess labour, measured by distance \( PT \), would attain its highest level. Accordingly the employment equilibrium level would be at point \( N_1 \).
Sen proves that those two criteria not only are different but may as well yield contradictory results. Under some circumstances, the marginal social productivity criterion may lead to the use of labour intensive techniques which imply a negative excess of labour; to put it differently, it may result in such a large increase in consumption that the capital stock is reduced thus jeopardizing future output.

The following graph portrays this extreme case:

**GRAPH 13 Output and Wages Bill (Case 2)**

At the maximum output point, the wages bill is higher than total output ($WN > EN$). That is to say the economy is desinvesting.

Besides, Sen has shown that given a social welfare function $V = C + S_1 (1 + \lambda)$, where $C =$ consumption, $S_1 =$ savings, and $\lambda =$ the premium or shadow price of savings, the real cost of labor is

$$W' = \frac{DV}{DL} = \left[ \frac{\lambda (S_2 - S_1)}{1 + \lambda S_2} \right] W$$

where $DV/DL =$ the marginal contribution to welfare of an additional unit of labor, and $S_1$ and $S_2$ are the propensities to save of wage earners and non-wage earners, respectively. If we assume that $\lambda = 0$, that is to say, if we do not place any premium on additional savings, or if we assume that
$S_1 = S_2$, then $W' = 0$, as it was assumed by Polak, Buchanan and Lewis. On the other hand, if we set as our objective the maximization of the rate of growth of the economy, then $\lambda$ tends to infinity and $W'$ approaches
\[
\frac{(S_2 - S_1)W}{S_2}
\]
If we further assume $S_2 = 1$ and $S_1 = 0$, clearly $W' = W$, as it was argued by Galenson and Leibenstein. In between, there are many possibilities that $0 < W' < W$ (Chenery, Kahn, etc.).

Therefore, the basic problem is one of defining the social goals or the social welfare function of the country.