PRESENT VALUE RULE AND THE SOCIAL DISCOUNT RATE

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Introduction :

The purpose of this paper is to clarify the distinction between the well-known two investment appraisal methods; namely the present value (PV) and the internal rate of return (IRR) rules. Taking a critical view, we attempt to indicate their respective validity as well as their theoretical and practical limitations. Throughout the analysis, it will be demonstrated that present value rule is the most operational and reliable method for appraising investment projects. In doing so, however, the paper necessarily touches on a number of other complex issues related to the choice of the social discount rate. As is known the issue of discount rate has been debated extensively in theory and practice. At the outset, it should, however, be admitted that we do not claim to come up with any definite answer or propose clear-cut solutions pertaining to the social discount rate. We shall, merely survey the various views advocated on the choice of a proper discount rate and propose some second-best solutions to determine the most valid discount rates particularly in developing countries.

The paper is in six sections. The first explains the formulation of both criteria with some details and discusses their respective validity in the evaluation of public expenditure projects. The second section illustrates the alleged superiority of the present value rule over the internal rate of return, while the third section deals with the thorny problems involved in determining the acceptable discount rate for evaluation purposes. The discussion in this section, raises practically all of the theoretical and practical difficulties that beset social discount rate in benefit-cost analysis. Section IV, introduces a simple model for determining a social discount rate. The fifth section deals with the specific problems encountered in determining an appropriate discount rate in developing countries.

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The final section sets forth the major points made in the paper and attempts to capture the most noteworthy features of the earlier discussions.

I. INTERNAL RATE OF RETURN VERSUS PRESENT VALUE RULE :

The simplest criterion used in the evaluation of investment projects is the pay-off period, which is defined as the number of years that it takes for a stream of benefits, $\sum_{t=0}^{t} B_t$, to make up for the initial capital outlay of a project. The analyst would choose projects according to the quickest pay-off or would undertake projects which do not exceed the "maximum" recoupment period. However, despite the fact that it is easy to work out and it can be used as a short-cut to eliminate any project whose outlook is unpromising, it has many serious limitations which make it quite a misleading measure for appraising and ranking projects[1].

Nevertheless project analysts most commonly think in terms of the present value criterion (PV) or of the internal rate of return (IRR) rule. The internal rate of return (or yield) by definition is the rate of discount which makes the net present value of the project equal to zero. Internal rate of return rule can be expressed as follows:

$$NPV = \sum_{t=0}^{n} \frac{B_t}{(1+r^*)^t} - I = 0$$

where I is the initial capital cost, B_t is annual net benefits, r^* rate of discount and t is the lifespan of the project. Internal rate of return here is defined as r which satisfies the above equation. It must be noted that B_t is merely the difference between receipts derived from the project and operating cost for the project $(R_t - D_t)$. This criterion tells us to rank projects according to the highest r^* or after setting the minimum value for $\bar{r}$ (cut -off rate)[1], an investing agency would undertake all projects for which $r^* > \bar{r}$.

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(1) This may be an adequate criterion for firms with plenty of investment opportunities but limited capital funds and also useful to determine the quality of extremely risky investments in fields where rapid technological progress may cause equipment to become outdated before it has to be replaced through wear and tear. For a detailed account of this rule, see, Little and Mirrlees [1968 : 135-137] and also Mishan [1972 : 185-186]

(1) This rate may be the borrowing rate or some normative rate reflecting a government decision on the time preference to be used for planning purposes.

Present value rule, on the other hand, indicates that an investment should be carried out if the sum of all revenues less all costs, each adjusted for futurity by an appropriate discount rate is positive. In the present value rule, for every year all expected expenditures on goods and services for the project, including capital expenditures and all expected receipts from the project are recorded. For each year, the subtraction of the former from the latter shows how much cash the firm gains or loses as a result of the project[1]. The next step is simply to discount future cash flows back to the present. The rate of discount selected for private evaluation is usually market rate of interest or some average form of it. But for public evaluation the discount rate is based either on the social time preference rate or the social opportunity cost of capital (see, Section III).

The formula for the social present value rule can be written as :

$$NPV = \sum_{t=0}^{n} \frac{R_t - D_t}{(1+i)^t} - I$$

where R denotes receipts, D is operating cost, i is the discount rate, I is the initial investment and t is the lifespan of the project. It should, however, be noted that if $B_t = R_t - D_t$ is computed on the basis of shadow prices and discounted according to a social discount rate the formula will give the "social net present value" and when it is valued at market prices it will reflect the "net present value" from the standpoint of the firm.

According to this rule investment projects will be ranked on the basis of benefit-cost ratio or discounted net benefits. In some exceptional cases the benefit-cost ratio can be used as a ranking device[2], but the net present value (NPV) variant of the rule is more meaningful

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(1) Public sector will include taxes paid in the annual cash flows while the private sector would exclude them from their calculation. It should be noted that direct taxes are not a cost to soicety but rather a transfer of benefit to the government and should be added back to obtain the social benefit. For treatment of taxes see, Little and Mirrless [1969 : 20]

(2) O. Eckstein maintains that benefit-cost ratio can be an appropriate rule for selecting among projects which do not differ largely in respect to capital intensity or riskiness. The test can be used to choose among projects that have similar turnover and risks. It might also be meaningful to apply the benefit-cost ratio where the benefits are identical in both projects. See Eckstein [1961 : 460]

and reliable[1]. If independent projects[2] are the case, of such investments the planners should undertake those which have positive present values when the streams are discounted at the pre-determined rate. The same rule can also be applied to interdependent projects including those which are mutually exclusive. In this case, the analyst would choose those projects which have the highest present value when the streams are discounted at the specific rate[3].

At the outset, it should however, be noted that under some circumstances such as perfectly competitive capital markets, completely divisible projects and no interdependencies among projects the two criteria will perhaps lead to the same choice[4]. But all these assumptions are not realistic and especially with respect to the first one developing countries are far removed from these strict premises. In other words, the internal rate of return rule becomes meaningful only under the system of perfect competition in which capital market contains no rationing and is equated by the interest rate serving as the price. But once the marginal returns inside the budget being planned differ from returns elsewhere in the economy and from the rates being offered to supliers of capital, the IRR rule loses any normative significance.

It is often argued that if the cost of capital is constant and no capital rationing is imposed, the net present value (NPV) method should be chosen over the internal rate of return (IRR) method whenever a conflict arises. On the other hand, if capital rationing is imposed or if the cost of capital is not constant it is not easy to

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(1) The benefit-cost ratio (or the profitability index) of a project is the present value of future net cash flows over the initial cash outlay. It can be expressed as :

$$PI = \frac{\sum_{t=1}^{n} \frac{R_t}{(1+i)^t}}{\text{Cost}}$$

For any given project, the net present value method and the profitability index give the same accept-reject signals. If mutually exclusive projects are concerned, then the NPV measure is preferred because it expresses in absolute terms the expected economic contribution of the project. For more details see, Horne [1974 : 76]

(2) Those projects whose costs and receipts do not depend upon whether or not any of the other ventures are undertaken.

(3) These projects are not necessarily with the highest internal rate of return.

(4) On the comparison of both Criteria see, Dryden [1964 : 241]

generalise about which method is preferable. However, if the opportunity cost of cash flows are quite high, well above the cost of capital then the IRR rule will probably make better selections. But if the opportunity cost of cash flows is close to the cost of capital then the NPV method will provide more reliable ranking. In the case of a rising cost of capital perhaps the most reasonable approach would be to undertake computer simulation where a number of assumptions about future investment opportunities and discount rates are fed into a computer and present values of the firm are estimated under alternative courses of action[1].

II. ADVANTAGES OF THE PRESENT VALUE RULE :

In the light of the above argument developed, one might ask why is that the present value rule is more advantageous than the IRR rule. In our opinion there are many theoretical and practical reasons which make the present value (PV) rule superior to the internal rate of return. These can be cited as follows :

(i) The present value rule procedurally is much simpler to apply than the internal rate of return criterion. The latter is sometimes ambiguous because the present value can be zero at two or more discount rates. In normal case, a project is associated with two phases where an initial period of negative net benefits is followed by the second phase in which the stream of net benefits is positive. When the sign of the stream of benefits changes only once from negative to positive; there is a single unique solution for the internal rate of return. This is the case where in the latter periods, gains exceed operating costs. If, however, there is more than one change of sign so that the period of the life of the projects falls into more than two phases, there will then be more than one value for the internal rate of return. Sometimes the values of the rates may not even be real values[2].

(ii) The use of present value does and the use of internal rate of return does not involve a discount rate representing our relative evaluation of current and postponed returns and costs. If

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(1) For more details on capital rationing and rising cost of capital, see, Weston and Brigham (1972 : 165-169).

(2) Examples for having non-real values for internal rate of return are: investments which involve terminal costs for damage, disposal or restitution i.e., mineshafts which lead to subsidence, nuclear power and iron-ore works. On this issue see Henderson (1965 : 61-62).

the government or society cares about the relative futurity of gains and losses, if that is to say, the objective is a present value of benefit streams the internal rate of return is the wrong criterion.

In other words, the present value rule reflects the social time preference rate which is different than that of the private time preference rate which is represented by the market interest rate. Internal rate of return rule, however, does not take care of this social time preference function.

(iii) Besides, while in present value rule discount rate can be changed **overtime,** internal rate of return rule considers only a uniform discount rate. In the case of present value, one is not committed to using the same rate of discount throughout the life of projects. Thus the planners are entirely free to adopt any time preference function which can be varied according to circumstances. Also as a result, computations of the present value of the projects for different rates of discount provide a reliable and sound decision when investment projects are selected.

(iv) When mutually exclusive projects are in question, the ranking according to internal rates of return points to the wrong set. Let us illustrate this point by an example.

Let us suppose, we have projects A, B and C and also assume that A and B are mutually exclusive projects[1].

TABLE 1, IRR and PV of Mutually Exclusive Projects.

Alternative Projects	Initial Investment $	Net Benefits Year 1	Year 2	IRR %	Present Value of Net Benefits at mg. IRR of $ 3 %
A	— 100	0	115	7	108
B	— 100	110	0	9	107
C	— 100	104	0	4	101
D Alternative Investment, "yield"				3	

If we are pursuing the internal rate of return rule, B and C are the best investments. But suppose that the rate of return of the next best investment, D is 3 %, which is then the marginal internal rate of return. If the benefit streams are discounted at that rate, A

(1) Mutually exclusive projects are those projects which cannot be udertaken simultaneously.

becomes a better project than B and the correct set of projects is A plus C. It should be noted that, if A and B were not mutually exclusive, both would be undertaken and A and B would be the best set of investment projects. In this case, a simple ranking by internal rate of return would lead to the correct set. But as far as the two projects are mutually exclusive simple internal rate of return rule becomes misleading.

(v) More important, to rank projects according to the present value rule gives a clear and straight-forward idea of the present value of net benefits accruing, while the internal rate of return would rank projects on the basis of their internal rates of return regardless of the scale of net benefits provided. A small project with a higher internal rate but with a less present net receipts will be preferred to a project with a lower internal rate of return but with a larger present value of net benefits. This is obviously a wrong choice. Thus, there is a danger that project sizes and the combinations of inter-related projects will not be taken into account when internal rate of return rule is adopted.

(vi) It is sometimes argued that a distinction should be made between the **"simple internal rate of return"** rule and the more improved version of it, that is Fisher's **"rate of return over cost"** rule[1].

Fisher's **"Rate of Return Over Cost"** rule implies taking the stream of differences between the net benefits of the two projects and calculating the internal rate of return of these. This rate is then compared with the "predetermined" rate of interest. Here with a given rate of interest the two rules, that is present value and internal rate of return rules will give the same result provided that a unique internal rate of return exists[2].

The simple internal rate of return rule, on the other hand, would rank projects according to their internal rate of return or in other words, the projects which have rates of return greater than the borrowing rate or some arbitrary rate would be qualified for selection. The simple internal rate of return rule, however, has been argued to be incorrect since a larger project may have a lower internal rate of return than a smaller one but still have a rate of the

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(1) On Fisher's Rate of Return Over Cost, see Feldstein and Flemming [1964 : 80-81]
(2) Ibid. pp. 80-82.

difference of the outlays which exceeds the minimum required. When this minimum is the market rate of interest it does, of course, represent the opportunity cost of the finance. So when the marginal rate of return exceeds the minimum, it represents a better investment than the next best alternative use of the funds it requires.

While simple internal rate of return fails to take into account the problem of size, the problem can be resolved by using Fisher's "rate of return over cost" rule[1].

Let us illustrate this point by referring to an example. Assume that we have two incompatible projects A and B and both have unique internal rate of return. (See, Table 2)

TABLE 2, IRR and PV of the Projects and Rate of Return Over Cost :

	Initial Investment	Benefit Streams									Present Value of Benefit Streams	
Projects	$	1	2	3	4	5	6	7	8	IRR	at i=5%	i=9%
Stream A	—100	2,	10,	15,	20,	25,	35,	30,	30	0.10	29.0	4.2
Stream B	—100	5,	15,	25,	30,	25,	20,	20,	20	0.11	27.6	6.7
Stream (A-B)	0	—3	—5	—10	—10	0	15	,10	10	0.06		

The internal rate of return of A is 10% and that of B is 11 per cent and consequently the simple rate of return rule would tell us to choose B. However, if we consider Fisher's "Rate of Return Over Cost" rule, we find that it is 6 per cent for (A-B) and (B-A). Since the stream (A-B) changes sign from negative to positive, it represents a profitable investment at any interest rate less than 6 percent. On the other hand, at rates above 6 percent (B-A) would be more profitable.

Therefore, in applying Fisher's rule an analyst would choose project A if the minimum value of the rate of return were less than 6 % and B if it were more. This is exactly the same as the (PV) rule for Fisher's rate of return over cost is that rate which equates the present values of the two projects. For instance, at 5 % discount rate A has present value of 29 and B 27.6; and at 9 % the order is reversed with A at 4.2 and B at 6.7[1].

From the above example, it follows that the simple rate of return rule is deceptive and the Fisher's "Rate of Return Rule"

(1) For an extensive treatment of Fisher's Rate of Return Over Cost, See,, Alchian [1955 : 938]

(1) For this example see, Feldstein and Flemming. [1964 : 82]

should be applied instead as it points to the same result as the present value rule with a constant discount rate.

But even this interpretation of the internal rate of return rule is not free from weaknesses as in some cases non-uniqueness arises. Besides the comparison of the IRR, both simple and the "incremental rates of return", with any current interest rate may seem irrelevant, if the discount rate is assumed to change over the life of the project. Whereas in the case of present value rule, planners are not committed to using a constant rate of discount all the time. Further, it is much easier to compute and compare the present values of incompatible projects than to calculate Fisher's "rate of return over cost" for a large set of projects[1].

For example, if one wishes to evaluate combination of independent projects, it is much simpler to add present values than to re-calculate the IRR of the overall time streams. The present value of two independent projects taken together is the sum of their separate present values. But no such simple rule can be devised for combining rates of return [Feldstein and Flemming; 82-83]

The above discussion leads us to the conclusion that present value rule is superior to internal rate of return rule whatever interpretation is given to it. But this does not man that the PV formula is always the correct decision rule in whatever form it has been applied. For one thing, the selection of an appropriate discount rate is not always easy. Surely there is not a clear-cut solution to the determination of the social discount rate. The arguments vary between the use of the social time preference rate (STP) or the social opportunity cost of capital (SOC). Sometimes, a social discount rate which reflects both is recommended for project appraisal[2]. These two methods have been extensively debated in theory and practice and selection of either is bound to involve serious objections[3].

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(1) M.M. Dryden argues that a strong case can be made for preferring the present value to IRR rule : He maintains that the PV is easier to calculate than solving IRR by trial-and-error method. He also adds : "Thus in practical situation of having to choose the best projects from a set of proposals... it is evident that a variety of side calculations must be made in order to treat cases in which the IRR is not applicable. Not a very tidy scheme", See, Dryden [1965 : 120-121]

(2) For a very useful analysis on social discount rate, see, Henderson [1965 : 62-74]

(3) It is mainly for this reason that use of IRR has been suggested to be the choice. Some authors claimed that IRR rule will avoid the subjective value judgement associated with the determination of an appropriate discount rate.

III. THE SOCIAL DISCOUNT RATE

The present value of benefits and costs and consequently the choice of projects will largely depend upon the discount rate selected. The determination of discount rates raises many questions which ought to be taken into account. For instance, which rate of discount, private or social should be used? Should the social time preference rate or the social opportunity cost of capital be the choice? Is there a valid reason for choosing higher discount rates for developing countries as compared to developed countries?

The question of discount rate has been considered extensively in the past and at present by authors like Pigou (1950), Sen (1961), Eckstein (1961), McKean (1958), Marglin (1963), Feldstein (1964), and Baumol 1968), but none of them has come up with any single simple clear-cut solution to the problem of determining an appropriate and workable discount rate. The problem of discount rate does not only arise because of the imperfection of the capital market, but also because of the variation in the private and social time preferences in respect to the well-being of present or future generations. The debate on the choice of discount rate has centred on two types of discount rates; (i) the social time preference rate (STP) and (ii) the social opportunity cost of capital (SOC).

(i) The case for the STP rate is based on the assertion that consumer sovereignty cannot be a measure of inter-temporal values, namely that individuals take a "myopic" view of their own future interests and they attach an inconsiderably small value to the consumption of future generations[1]. As a rule, both the individual and society place a higher value on present consumption than on future consumption. But the rates of time preference of the two do not coincide because the factors which govern the preferences of each have different values. These factors include expectation of life

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Therefore, Merrett and Sykes are in favour of the IRR and recommend it as the best criterion. They state that "Our main conclusion is that for the vast majority of simple capital-budgeting decisions we consider that yield (IRR) is both technically and practically superior to NPV." They also add that "the yield method is more easily understood and accepted by businessmen and that it has the advantage of obviating needless dispute about a firm's cost of capital". See, Merrett and Sykes, (1973 : 123-124) and Merrett (1965 : 117-118)

(1) Pigou (1950 24-30) argued that individulas are "short-sighted" about the future and that government intervention is needed to give adequate weight to the welfare of future generations.

and other risks, private as oppposed to public welfare, anticipated patterns and scale of expenditure and growth rates of income.

The exponents of the first method argue that the government should choose and impose a discount rate which reflects the time preferences of the society as a whole. Pigou (1950) Dobb (1969) Holzman[1] and Sen[2] are in favour of imposing on the public a responsibility for the welfare of future generations; while authors like Eckstein [1961 : 453] and Marglin [1963 : 15] maintain that the interests of future generations should be recognized to the extent that the current public sanctions them through the democratic process. [Marglin, 1963 : 15]

Feldstein (1964 : 367) on the other hand, is advocating that, for public investment decisions, market-determined evaluation of future consumption must be rejected in favour of a politically-determined social time preference function. Feldstein states that a social time preference rate (STP) should be "a normative rate reflecting the government's evaluation of the relative desirability of consumption at different points in time"[3]. He also argues that the rate chosen by the government should be used to discount the stream of consumption which is foregone by society because the public project under consideration has been undertaken. This implies that there should be a link between a social time preference rate and the estimation of the social opportunity cost of a public project.

(ii) The other approach suggested to determine the discount rate is the "social opportunity cost of capital" outstanding in the project. In other words, the opportunity cost of capital measures the value to society of the production (or consumption) which the funds that it pre-empts would have generated in the next best use to which they might have been put.

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(1) Holzman (1958) states that "true consumer sovereignty requires that the wishes of consumers of the future be presented in the decision".

(2) Sen (1961 : 486) argues that a democratic solution to an intertemporal problem is impossible if the opinions of all who are concerned must be considered; therefore it should be a government responsibility to select a rate which reflects social time pereference of the society.

(3) See. [Ibid. p. 368]. By indifference curve analysis Feldstein has shown that the STP rate can vary through time in response to changes in the level and growth rate of consumption, the rate of population growth and the pure time reference rate. Thus the STP rate is not solely a function of time. [Ibid. 378-9].

Under perfect competition the measurement of the social opportunity cost incurred by a project would present no problems. It would simply be the sum of the prices paid for the factors of production used in the project; but in a world of market imperfections other means have to be found of measuring social opportunity cost. It can be measured as a sum of money, discounted present value of the stream of consumption that would have been obtained if the project in question had not been undertaken or as a rate of return.

Eckstein and Krutilla[1], for instance, strongly argue the case for establishing social opportunity cost as the discount rate. They both argued that since there are imperfections in the capital market, opportunity cost should be measured and utilized as a criterion in determining public budgets and must be valued at a social rate of interest. Similarly R.N. McKean argues that when there is market imperfection and there is a fixed budget the internal rate of return of the marginal project will represent the opportunity cost of capital and this should be used as social discount rate[2]. Therefore, by expressing the opportunity cost as an equivalent rate of return it is possible to derive an opportunity cost discount factor.

The method of social opportunity cost of capital, however, presents some diffulties since it is hard to find private businesses which can be regarded as closely comparable to the public agencies concerned. On three points this method has received serious objections. First of all, it is stressed that the benefits which will accrue to society from private investment will generally exceed the private rate of return to investors[3]. Thus the social opportunity cost of a public project which displaces an equivalent amount of private investment will be understated by taking the marginal rate of return

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(1) Eckstein and Krutilla (1961) have assumed a tax-cut as an alternative to the public project when the funds are collected through taxes. They considered the ways in which a likely tax-cut would affect income groups and forecast how the national recipients would utilise their hypothetical receipts. Under some assumptions they have arrived at a weighted average rate of return and the opportunity cost in the second half of 1950's was found 5-6 percent.

(2) It should be noted that when all of a fixed budget is to be spent there will be no need for an opportunity cost rate of interest. McKean has even argued that in this case there is no need for a discount rate of interest either and the market rate of interest will be sufficient. See, McKean [1958 : 78-82]

(3) This stems from the simple fact that external economies emanating from a private investment are not taken into account in the computation of the rate of return.

on private investment. Secondly, it may be a mistake to suppose that any single rate can be found which will measure the opportunity cost of public investments. Thirdly, it may very rightly be asked as what reason there is to assume that public investment will displace at the margin private investment rather than private consumption or government current expenditure on goods and services [Henderson, 1965]

Therefore. the analvst has to determine the present value of the displaced expenditure in each of these categories that is, the opportunity cost of the capital expenditure in the public project. Clearly each alternative suggested above may easily lead to very different results.

(iii) Another method is perhaps to consider the "past average social rate of return" to capital as the best approximation for a desirable rate in present value computations[1]. What is required is an estimate of the social rate of return on investment which may be considerably higher than the private rate of return. If for example, we define the social rate of return as the marginal output-capital ratio this rate in Turkey might well be put at 38 pencent or even higher[2].

IV. A SIMPLE MODEL FOR A DISCOUNT RATE

A crude model which might help us to determine the upper and lower limits for a social discount rate can be worked out. We know that real national income in a closed economy is :

$$Y = C + I + g \qquad (1)$$

This expression can also be written as :

$$Y = wL + rpK \qquad (2)$$

where w is the wage rate, L labour force, r discount rate (or profit rate), p is relative price of capital and K is capital stock. On the other hand, saving function for the overall economy will be the summation of the saving coefficients of profit receivers and saving coefficient of wage earners. From this hypcthesis we can write;

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(1) This rate should include taxes paid on the income from capital, as well as any other external effects not perceived by the individual investor. On this point see. Harberger, [1972 : 8-9]

(2) This is computed on the assumption that marginal capital-output ratio for the First Plan period is 2.6.

$$S = Sw\,(wL) + s_p\,(rpK) \tag{3}$$

$$S = Sw\,(Y - rpK) + s_p\,(rpK) \tag{4}$$

if we divide both sides of the equation by rpK, we obtain;

$$\frac{S}{rpK} = Sw\left(\frac{Y}{rpK}\right) - Sw + S_p \tag{5}$$

In equation (5), $\frac{Y}{rpK}$ is nothing but the reverse of the share of profit incomes in total income. Thus if we write,

$$\frac{rpK}{Y} = D, \text{ then,}$$

$$\frac{S}{rpK} = \frac{Sw}{D} - Sw + Sp \tag{6}$$

Since in a state of steady growth, the rate of growth of income is equal to the rate of growth of capital stock[1] we can write the following identity,

$$\frac{\triangle K}{K} = \frac{\triangle Y}{Y} = g$$

From this identity we can also write,

$$S = I = \triangle K = gK \tag{7}$$

Assuming that the relative price of capital p = 1, we can write :

$$\frac{S}{rpK} = \frac{gK}{rK} = \frac{g}{K} \tag{8}$$

From equation (6) and (8), we can obtain :

$$\frac{g}{r} = \frac{Sw}{D} - Sw + Sp \tag{9}$$

(1) Both Harrod and Domar models show that to maintain full employment, desired savings out of a full employment level of income must be offset by an equal amount of desired investment. In addition, for maintaining a continious state of full employment the investment and real income must grow at a constant annual percentage rate equal to the product of the propensity to save and the average productivity of investment.

If we multiply both sides by D, and solve the equation we shall get :

$$\frac{gD}{r} = Sw - SwD + SpD \quad (10)$$

$$r = \frac{gD}{Sw - SwD + SpD} \quad (11)$$

$$r = \frac{gD}{Sw\,(1-D) + SpD} \quad (12)$$

Dividing the numerator and the demominator by D, we can write:

$$r = \frac{g}{\left(\frac{1-D}{D}\right) Sw + Sp} \quad (13)$$

It is clear from the formula that $r \geq g$ will be sustained if the denominator is ≤ 1. The denominator can also be written as

$$\frac{DSp + (1-D)\,Sw}{D},$$

and the expression Dsp + (1-D) Sw is nothing other than the weighted average of the savings coefficients or the saving coefficients for the economy as a whole. Thus we may reduce the formula to,

$r = \frac{g}{S/D}$, where S is the global savings ratio. On the assumption that Sp = 1 and Sw = 0, the above formula becomes r = g. Despite the fact that the formula indicates theoretical possibility that the rate of interest may be lower than the rate of growth, the empirical evidence we have, rules out this as a realistic case. Therefore, the above equality could be considered to be the limiting case.

If we assume that the S/D ratio in Turkey lie somewhere between .5 and .3, this, depending of course on how one classifies income in the household sectors, and also if we assume a maximal rate of steady growth of income at 7 %, the rate of interest will lie between 14 % and 23 %. As can be seen from the formula with a

larger rate of growth the equilibrium values of the interest goes up and with a higher rate of savings it falls.

Clearly, the above formula may enable us to calculate limits for the shadow rate of interest in case of our a priori knowledge strongly indicates that the real scarcity of capital is greater than would be represented by the current rate of interest. In this simple model the limits are given by the current rate and by the formula connecting the rate of interest with the maximal rate of steady growth.

However, all these methods we have mentioned above have been largely criticized for being incomplete, misleading and impracticable. Clearly the method of financing the project (i.e. borrowing, taxation or by monetary policy) will have a considerable effect on the type of social opportunity cost and the appropriate way of measuring it.

Another conclusion which emerges from the above arguments is that both social time preference rates and social opportunity cost methods do not cut very much ice in most empirical works and there has not been a successful and fully convincing application of these notions in cost-benefit analysis. Nor do the ideas about allowing for future changes in interest rates seem to receive much attention[1].

Generally speaking, the rule in practice has been to choose an interest rate or rates on the basis of observed rates ruling at the time for calculating present values. Thus the choice of discount rates, in view of all these ambiguities may still remain a matter of value judgement as Eckstein (1961 : 460) has pointed out.

V. DISCOUNT RATES IN DEVELOPING COUNTRIES

When developing countries are concerned the question of determining social discount rate becomes even more difficult. The market interest rate is not an appropriate representative of the value of capital in developing countries. A problem of calculating the cost capital may arise since they are usually fixed by special government regulations. Owing to the shortage of capital and the implicit imperfection of the market in developing countries the real cost of capital

(1) Discount rates in appraising public investment projects need not remain constant. Feldstein, for instance, states that the STP rate may vary through time, if society's location in the consumption space changes or, if the shapes or positions of the indifference curves do not remain constant. See, Feldstein. [1964 : 376].

will most probably exceed the maximum cost authorised by the law or other regulations. Thus shortage of capital will lead to a rate of interest higher than the market one. The re-evaluation of the capital cost becomes even more urgent where the government intervenes in capital markets and there also exists a notorious disorganized capital market. Although it is extremely difficult to determine the real social discount rate in these countries, the following points should be borne in mind in determining the discount rate.

(i) The developing countries should use a social discount rate since market rate of interest does not reflect the "intrinsic" value of capital. In other words, the actual capital cost does not represent an equilibrium rate of interest which would be prevailing under a free and competitive capital market[1]. If the capital is underpriced and no "shadow" price is used, capital-intensive projects will be favoured. If on the other hand, higher (social) discount rates are used, many of the investment projects may not appear profitable and this can hamper efficient resource utilisation. Nonetheless, it can be argued that a discount rate higher than market rate will at least have the advantage of rejecting projects with a rather low rate of return i.e., luxury housing and transport projects[2].

(ii) Developing countries should apply a rate of discount which is much higher than the discount rate used in developed countries. It can be argued that developing countries by using a higher rate will be able to pass projects with a high rate of profitability which, in turn, achieve higher rates of growth of income and thus a highest level of welfare for future generations.

The developed countries can forego the risk of applying a lower social discount rate which would ultimately give priority to projects with higher capital-intensity and with long durability. But this is what an underdeveloped country cannot afford. Advanced countries

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(1) The SPO in Turkey has applied a social discount rate of 12 % in the appraisal of projects. But in view of the acute shortage of capital in Turkey, the argument for adopting the social opporunity cost of capital becomes a strong one. Therefore, it is fair to claim that the social apportunity cost of capital should be higher than 12 % and it should be raised to 14 % or even 16 %. This makes sense as the borrowing rate of interest now varies between 10 % and 24 % depending on the terms and duration of the loans.

(2) It is often argued that different discount rates for different sectors or projects may be needed, but opinions on that are divided on the grounds that such differentiation would be technically very difficult and probably incorrect.

with their abundant capital resources are able to consider the social time preference rate as well as the social opportunity cost of capital. In other words, they can take care of present and future generations simultaneously, but the government in developing countries should first be concerned about the present generation which happens to be poorer rather than the future generation which would be better off anyhow[1].

VI. CONCLUDING REMARKS

From the foregoing discussions, it can be seen that the present value rule is more operational and reliable than the internal rate of return rule. As we have pointed out earlier, the present value approach can give a clear expression of the total net benefit expected from a project and does so in a manner which involves consistent time weighting for all projects. Whereas the IRR rule does not tell us much about the present value of cash flows nor the scale of benefits, the latter method only tells us whot is the average rate of return on the capital invested.

Furthermore, the present value rule has more advantages than the internal rate of return method on the grounds that use of a specific centrally determined social discount rate may be very significant and on the grounds that it is much simpler to apply. As mentioned elsewhere, when the IRR rule is applied there will be the complex problem of non-uniqueness (even negative values) which has been considered to be a fatal objection to its full use. No doubt this is a disadvantage from which the present value rule is completely free. On the other hand, even if cost flows of some years happen to be negative, the present value rule can give positive results.

These objections, however, do not imply that the rate of return should be rejected entirely, on the contrary the IRR of compatible projects should always be calculated. The IRR is nothing but a precise definition of "yield" and this can be useful to know before-

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(1) W. Baumol states that "The rate of interest should be set by the market and the needs of public... and no attempt should be made to subsidise the future by artificial reductions in discount rates designed only for that purpose". He also persist than "an appropriate instrument would be a set of selective subsidies rather than a low general discount rate that encourages indiscriminately all sorts of investment programmes whether or not they are relevant". See, Baumol [1968 : 801-802]

hand both for public and private evaluation[1]. Moreover, the present value computations depend on a proper choice of the rate of discount and this could be determined in the light of the IRR of the marginal project. If only for this reason, the IRR should always be calculated.

By and large, the choice between the two rules may be affected by a judgement on the prevalance of capital rationing and on the best way of selecting projects under these conditions. Therefore, the choice of criterion will mainly depend on what budget is considered, what aims are adopted when the capital rationing is the case and also on the pattern of time preferences.

It is therefore, necessary that the government should see to what extent and in what ways arbitrary forms of financial rationing are inforced. This is important not only that where such constraints exist they can be eliminated, but also in order that so long as capital rationing is unavoidable in particular cases, the investment agencies concerned are using the appropriate decision rule for ranking pprojects[2].

Whether IRR or present value rule is used the analyst is faced with some difficulties. In former case, it is necessary to specify a minimum acceptable rate of return which projects must reach in order to qualify for selection. In the latter case, a pre-determined rate of interest has to be used in discounting net benefits.

The choice of a rate of interest is very important, particularly when the present value rule is applied. The higher the rate chosen the greater the bias in favour of projects with relatively low initial expenditure and benefits which accrue earlier rather than later. Thus,

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(1) However, in the appraisal of projects, the World Bank strongly recommends the application of **"economic rate of return"** which requires the use of social prices for the firm's sales, and purchase of factor inputs, and which includes direct and indirect taxes in annual cash flows and values the internationally traded commodities at border prices. When such adjustments are carried out on benefits and costs the IRR will represent the social (or economic) yield. For the application of this rule, see, The World Bank's working paper : Guidelines For Calculation of Economic Rates of Return on DFC Sub-Projects. (Draft), 7/30/1973.

(2) Henderson (1965 : 76-77) argues that "imposition of arbitrary constraints on public expenditure simplifies the task of decision-making, but it does so only at the cost of ensuring that decision model will be worse than they need have been". He also argues that for a sound decision making the government should eliminate all kinds of rationing.

whenever alternative projects exist which differ in time profiles of their prospective net benefits, the rate of interest used for discounting may have a decisive influence on the choice. If the discount rate is low, projects with high capital investment and with a lower annual operating cost are preferable to those projects with a smaller capital outlay but with a high annual operating cost. If discount rate goes up progressively those projects with a larger investment outlay lose their relative superiority.

If the discount rate is higher than the marginal rate of return, many projects with positive present values could hardly qualify for selection. Thus it is more reasonable to use a rate that is consistent with the degree of capital rationing imposed at higher levels and also consistent with attitude towards the future that is implied by higher level-decisions[1].

In project appraisal it is a common practice to assume that the discount rate will remain constant during the economic life of investment projects. But as we have pointed out elsewhere, the STP rate need not be constant as it may vary according to changes in the growth rates and level of consumption, the rate of population growth and the pure time preference rate[2]. Similarly a social discount rate based upon the social opportunity cost of capital may depend on factors which will affect the marginal productivity of capital. According to **Harberger** (1967 : 136) these factors will include the rate of capital formation, the rate of labour force growth, the degree of "neutrality" of technical advance, the nature and changes in the pattern of demand and the relative shifts toward or away from capital intensive industries. Undoubtedly, some of these factors might cause a secularly rising rate of marginal productivity while others might cause a secularly declining rate.

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(1) A discount rate different from the marginal rate of return is sometimes appropriate because policy-makers may have time preferences or subjective rate of return that differ from the marginal rate of return. For instance, if policy makers have pessimistic views about long-run prospects and attach a great weight to the near future, they can discount the future at a high rate-higher than the marginal IRR or vice versa if the policymakers are optimistic.

(2) In this connection Feldstein suggests that "raising slowly but continuously the pure time discount rate may seem to be the best compromise between those who would not have society look endlessly into the future and those who can see normal justification for not doing so. See, Feldstein [1964 : 378-79].

There are strong reasons to believe that, marginal productivity of capital will change in the long-term future and the factors causing this change have got to be taken into account when a social discount rate is to be determined. For instance, the discount rate should be modified for the present and near future years, when there is evidence of an abnormal scarcity or glut of investible funds.

In view of acute shortage of capital and market imperfections the social opportunity cost of capital would be more relevant to the conditions of developing countries. After all it can be claimed that a high discount rate is more advantageous than the lower one since at least the former rate will preclude misallocation of scarce factors by rejecting the inferior projects. It must also be noted that in a mixed-economy with market imperfections and multiple interest rates, no single discount rate can be taken as a measure of both time preference rate and the productivity of capital. Therefore we feel that at least two rates of social discount should be applied to see how far the final decision and priority ranking is sensitive to the discount rate.

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ÖZET

BUGÜNKÜ DEĞER KRİTERİ VE SOSYAL İSKONTO HADDİ

Makalenin ilk bölümünde, yatırım projelerinin değerlendirilmesinde izlenen çok önemli iki kriter olan "bugünkü değer" ve "iç kârlılık" (internal rate of return) ölçütlerinin mukayesesi yapılarak, her iki kriterin geçerliliği teorik ve pratik açıdan tartışılmıştır. Yazıda, bugünkü değer kriterinin üstün yönleri, bazı örneklerle ayrıntılı olarak belirtilmiştir. İkinci bölümde ise, birinci kriter ile yakından ilgili olan "sosyal iskonto haddi"ne ilişik teorik görüşler tartışılmış ve uygulamada bu oranın nasıl saptandığı kısaca açıklanmıştır.

İskonto haddi sorunu, yalnız sermaye piyasasının eksik rekabet niteliği göstermesinden değil, ayrıca bireyler ile toplumun beklemeyi tercih oranlarının (time preference rates) farklılık göstermesinden doğmaktadır. Bilindiği gibi,, iskonto haddi oranının seçiminde, birbirine zıt iki önemli görüş ortaya çıkmıştır. İskonto haddinin saptanmasında, ya sosyal beklemeyi tercih oranı (STR) veya sermayenin sosyal fırsat maliyeti (SOC) temel tez olarak göz önünde tutulur.

Sosyal beklemeyi tercih oranını içeren görüşe göre, tüketicinin kararlarına göre belirlenen beklemeyi tercih oranı, zaman boyutu içinde değerlendirmenin ölçütü olamaz. Bireyler bugünkü tüketimi tercih ettikleri için, gelecek nesillerin tüketimlerine çok az bir değer atfederler. Şüphesiz, bireyler olsun, toplum olsun bugünkü tüketimi gelecekteki tüketime tercih ederler, fakat her ikisinin "beklemeyi tercih oranlarını" (time preference rates) etkileyen faktörlerin önemi de farklıdır. Bu görüşü savunanlara göre, (Pigou, Dobb, Sen...) devlet "toplumun beklemeyi tercih oranını" saptamalı ve bunu yatırım kararlarında empoze etmelidir. Bu yazarlar, gelecek nesillerin refahını gözeten ve bunu temsil eden bir "beklemeyi tercih oranını" ileri sürmekte ve toplumun bunu kabullenme sorumluluğunu göstermesi gerektiği tezini ileri sürmektedirler.

Öteki görüşe göre, kamu projesinde kullanılan yatırım fonlarının "sosyal fırsat maliyeti (social opportunity cost of capital), bugünkü değer kriterinde iskonto haddi olarak kullanılmalıdır. Diğer bir deyimle, sermayenin fırsat maliyeti, asıl projenin alternatifi olan yatırımın fayda akımlarının bugünkü değerini gösteren parasal bir değer veya o alternatifin iç kârlılık oranı olarak tanımlanabilir. Bazı eko-

nomistlere göre, eğer sermaye piyasası eksik rekabet özeliiği taşıyorsa ve sınırlı bir bütçe sözkonusu ise, bu durumda marjinai projenin "sosyal iç kârlılık oranı" (internal rate of return), asıl projenin bugünkü değerinin hesaplanmasında iskonto haddi olarak kullanılabilir.

Sermaye piyasasının gelişmemiş olduğu ve tam rekabet koşullarının mevcut olmadığı az gelişmiş ülkelerde, piyasa faiz haddi sermayenin gerçek değerini (intrinsic) yansıtmaktan uzaktır. Bu nedenle, sermayenin gerçek değeri düşük tutulur ve hiçbir gölge fiyat kullanılmazsa, sermaye-yoğun projeler tercih edilmiş olur. Öte yandan, sosyal iskonto haddi yüksek tutulursa, birçok yatırım projesi kârlılık testini geçemiyecek ve bu da rasyonel bir kaynak dağılımını önleyecektir.

Sermayenin çok kıt olduğu ve sermaye piyasasının tam rekabet koşullarından uzak olduğu ülkelerde, sosyal fırsat maliyetini içeren bir iskonto haddinin proje değerlendirmesinde kullanılması daha rasyonel bir tutumdur. Ancak, sermaye piyasasının eksik rekabet koşullarını taşıdığı ve çeşitli faiz hadlerinin var olduğu bir ekonomide, tek bir faiz haddinin sermayenin sosyal fırsat maliyetini yansıtması olanaksızdır. Bu nedenle proje değerlendirmerlerinde hiç değilse birden fazla iskonto haddinin uygulanması yoluna gidilmeli ve özellikle proje seçiminin iskonto haddindeki değişmelere ne ölçüde bağımlı olduğu gözetilmelidir.