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CENTRE FOR INDUSTRIAL DEVELOPMENT
ADMINISTRATIVE BUILDING

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The developing countries must rapidly industrialize their economies, and this on an efficient enough basis that the enterprises and industries so established can produce goods of a quality and price which have some chance in the longer run of becoming competitive internationally. This makes it of considerable importance to businessmen and officials alike in these countries to be able to make systematic and **objective** economic analyses of industrial investments. The expected economic return from a proposed investment is certainly not the only factor to be weighed in the decision making process, or necessarily the most important factor. Such additional considerations as national economic profitability, factor endowments, foreign exchange impact, choice of technology, interrelationships with other sectors, skill formation, and so on, must be evaluated as well. These additional considerations are being discussed during the course of the present symposium.^{1/} On the other hand, if efficient and truly competitive business enterprises and industries are to evolve in the developing countries, the economic costs and returns associated with major industrial investments cannot be lost sight of for long.

^{1/} See Department of Economic and Social Affairs, United Nations, "Syllabus for Inter-Regional Symposium on Industrial Project Evaluation," Mimeographed, 31 March 1965, p.4.

The focus of this paper is upon the discounted cash flow method of investment analysis as it might be applied in the developing countries. This method of analysis is one of a number of analytical techniques that have been developed to facilitate analysis of certain aspects of investment decisions. It must be well understood, however, that discounted cash flow is just a technique. As will be seen later, it is not always the most defensible investment analysis technique on either theoretical or practical grounds. And it is certainly no panacea for resolving knotty investment problems. Discounted cash flow can nevertheless be a quite useful technique when used in the proper circumstances, and when used with an element of common sense and judgement.

In the paragraphs and sections that follow, we will try to identify and evaluate what these so-called proper circumstances are in the context of the developing economies by discussing the following general questions :

1. What is the discounted cash flow technique and how does it relate to the overall capital or investment budgeting problem ?
2. How does the discounted cash flow technique differ from other investment analysis techniques ?
3. What assumptions are implicit in the discounted cash flow technique ?
4. What problems are encountered using the discounted cash flow approach in practice ?
5. What special implications can be drawn from this analysis for the developing countries ?

Analysis of Capital Expenditures

The starting point in any analysis of capital expenditures is the generation of investment ideas. If only poor investment projects are generated, only poor ones can be selected no matter how technically refined the method of analysis employed. Applying sophisticated analytical methods to less than the best investment alternatives simply leads to solving the wrong problem well. This important first step of assuring the best possible investment alternatives is largely an administrative task, involving the creation of an organizational atmosphere that is conducive to the generation and development of imaginative and soundly conceived investment possibilities. It would go beyond the scope of this paper to do more than highlight this fact at the beginning, and to note that it is assumed hereafter that the best investment alternatives have been assured.

Moving on from a statement of the investment alternatives to be analysed, the next general step in the economic analysis of an investment proposal is to determine the expected cash flow pattern associated with the proposal. A capital expenditure can be thought of as a cost or cash outflow incurred in the anticipation of future economic benefits. In this framework, a capital expenditure represents an outflow of funds and the hoped for revenues or cost reductions associated with the expenditure represent cash inflows. In practice, the determination of relevant cash flow patterns is extremely difficult to accomplish in a great many cases.

Assuming one is faced with the best alternatives,

and that the relevant cash flow patterns have been identified, the remaining step in an investment analysis is the purely technical problem of relating the cash inflows and outflows in some meaningful way that allows the decision maker to screen, rank, and select projects reliably. It is this technical problem that is at the heart of the present paper, for the discounted cash flow method is one of the techniques that have been developed to facilitate the analysis and comparison of different cash flow patterns.

As far as quantitative comparisons of this character are concerned, people have tried relating economic returns and investments in some ratio form since as far back in time as we have recorded economic and business history. In general, and up until the present day, these ratio comparisons have taken the form of either a simple return on investment or its algebraic inverse the so-called payback period. Numerous variants of these two general approaches can be found in use as well as in the literature. Investments or cash outflows are variously measured in terms of gross or net fixed assets, with or without either gross or net working capital requirements, and sometimes recognizing such things as future reinvestment requirements and terminal recovery values. Returns or cash inflows may reflect profits before or after taxes, sometimes adjusted to account for depreciation and other non-cash charges, and with other costs either fully or incrementally allocated. The number of combinations found in use of these simple rate of return and payback methods is virtually endless.

From a purely theoretical standpoint, clearly not all of these combinations can be correct. Beyond this, however, it is probably fair to say that none of the simple ratio approaches is entirely correct. All suffer from two serious short-comings over and above the problem the substantial variations one encounters in practice in the calculation of relevant cash flows:

(1) They do not adequately account for differences in the expected economic life of an investment. It is quite obvious that if two projects offer equal rates of return, but different economic life expectancies, the project or opportunity with the longer economic life should be preferred. It is not so obvious, on the other hand, whether it is better to take a five year project with an unadjusted 20 per cent return over a seven year project offering a 15 per cent return. Somehow differences in economic lives must be taken into account.

(2) They do not **adequately** account for situations where either the required investment is spread irregularly over a period of several years and/or the cash inflows are not absolutely level over time. Some way must be found to permit meaningful and correct **comparisons** despite cash flow irregularities.

What has come to be called the discounted cash flow method of analysis has evolved in response to these problems of uneven economic lives and irregular cash flow patterns that are inherent in the simpler ratio methods of investment analysis. The discounted cash flow method is based on the notion of present value, i.e. that the present value of

a sum of money to be received or paid in the future is less than its nominal future value. This difference between present value and nominal future value arises from the fact that there is an opportunity cost associated with receiving a sum of money later rather than sooner. In general, this investment opportunity rate can be considered to be the rate of return the same amount of money would earn if invested in the best alternative use. The implications of this statement are illustrated by the following figures :

Present Value of One Monetary Unit
Due or Received at the End of N Years

Number of Years into the Future	<u>Investment Opportunity Rate</u>		
	<u>5%</u>	<u>10%</u>	<u>15%</u>
0	1.0000	1.0000	1.0000
1	.9512	.9048	.8607
5	.7788	.6065	.4724
10	.6065	.3679	.2231
20	.3679	.1353	.0498

For example, if a person, business enterprise, or country has an investment opportunity rate of 10 per cent, then a payment to be made or an amount to be received at the end of year 20 has a present value in year 0 of just 0.1353 monetary units. Another way of saying the same thing is that this 0.1353 is the sum which if invested in year 0 at an opportunity rate of 10 per cent would grow to equal 1.000 monetary unit at the end of year 20. One

can see in addition from a quick inspection of the above table of figures that the present value of a sum decreases as the investment opportunity rate and period of years into the future increase and vice versa.

The calculation of present values and the intricacies of the discounted cash flow technique are well described in detail in a number of places.^{2/} It is not necessary to repeat this work. All that need be understood at this point is that the notion of present value accounts explicitly for the relevant investment opportunity rate and the expected economic life of an investment project. These are the two principle defects noted above in discussing the unadjusted or ratio methods of investment analysis. By this present value approach it is possible to reduce any pattern of present and/or future cash inflows and outflows into an equivalent and therefore directly comparable present value.

Two Variants : Internal Rate of Return versus Net Present Value

The discounted cash flow method can be employed in two different ways, each of which may indicate a different investment decision according to the cash flow pattern being discounted. These two variants of discounted cash flow are

^{2/} For example, see Bierman, Harold, Jr., and Seymour Smidt, The Capital Budgeting Decision. New York: Macmillan, 1960; Dean, Joel, Capital Budgeting. New York: Columbia University Press, 1951; Grant, Eugene, and William Ireson, Principles of Engineering Economy, 4th Ed. New York: Ronald Press, 1960.

Often called the internal rate of return and net present value methods respectively, although this terminology is not universally employed. The difference between these variants is subtle, but important and worth understanding at least conceptually.

What is called the internal rate of return method involves a series of trial and error iterations whereby the analyst seeks to determine the rate of discount that reduces a particular stream of cash inflows and outflows to zero. This rate of discount that exactly balances cash inflows and outflows is termed the internal rate of return of an investment. The resulting rate is the rate of return that is earned each period on the unamortized principal balance outstanding at the beginning of each discount period. For example, consider an investment of \$ 1,000.00 having annual earnings of \$ 250.00 for five years. As shown below, this project has an internal rate of return of eight per cent and this eight per cent is the annual return on the unamortized principle amount outstanding at the beginning of each year :

<u>Year</u>	<u>Outstanding Investment at Beginning of Year</u>	<u>Cash Flow</u>	<u>Return at 8% of Outstanding Investment</u>	<u>Amortization of Beginning Investment</u>	<u>Annual Rate of Return on Beginning Investment</u>
	(a)	(b)	(c)	(d)=(b)-(c)	(e)=(c) ÷ (a)
0	\$...	\$ (1,000.)*	\$...	\$ %
1	1,000	250	80	170	8.0
2	830	250	65	185	8.0
3	645	250	51	199	8.0
4	446	250	35	215	8.0
5	231	250	19	231	8.0

* Parentheses denote a cash outflow

Along with the internal rate of return method usually goes the notion of cost of capital. The basic concept behind this decisional framework is to accept projects with internal rates of return equal to or greater than what is called an organization's cost of capital. This approach has its roots deep in the field of microeconomic theory. It is part of and parallel to the idea that the optimum economic scale of an enterprise is achieved at the point where marginal costs equal marginal revenues. As important and hallowed as this proposition is in economic theory, it must be said that it is elusive and often impossible to handle in practice as applied in the capital budgeting domain. It is certainly beyond the scope of this discussion to enter into the question of cost of capital and how it should be defined and applied in practice. Suffice it to simply stress again that it is a very difficult notion to make operational, and this even in those of the developed economies that have the most sophisticated financial institutions and capital markets. If cost of capital cannot be operationally defined, on the other hand, the internal rate of return method loses much of its practical force as there remains no clear minimum acceptable cutoff rate of return against which to test proposed investments.

Another practical complication associated with internal rate of return is that the trial and error iterations necessarily involved can be time consuming and tiresome in the cases of projects with complex cash flow patterns or for organizations having to process more than a few projects at a time.

The net present value method is similar to the internal

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rate of return method just discussed, except that it involves discounting the cash flow stream associated with an investment project at a predetermined discount rate. This predetermined rate normally should reflect the enterprise's own expected investment opportunity rate. In the cases of nationalized firms, the opportunity rate selected is usually that of the economy as a whole. The preference or decision rule with this variant is that if the net present value that results from this calculation is greater than zero a project should be accepted. This is because a positive net present value indicates a project rate of return above the firm's or country's normal investment opportunity rate. A negative net present value, on the other hand, indicates a project rate of return of less than the relevant opportunity rate. In this case a project should be rejected. The greater the net present value of an investment the better the project under this system.

It should be noted that this second variant of discounted cash flow obviates the need for the cost of capital notion by substituting the conceptually and practically much easier concept of investment opportunity rate. A firm's investment opportunity rate cannot be determined with a high degree of accuracy, but the idea of opportunity rate is one familiar to businessman. Businessmen quite generally have a rough idea of the investment opportunity rate they expect to see on the average in their own businesses. Another point in favor of the net present value variant is that it avoids the trial and error iterations associated with internal rate of return.

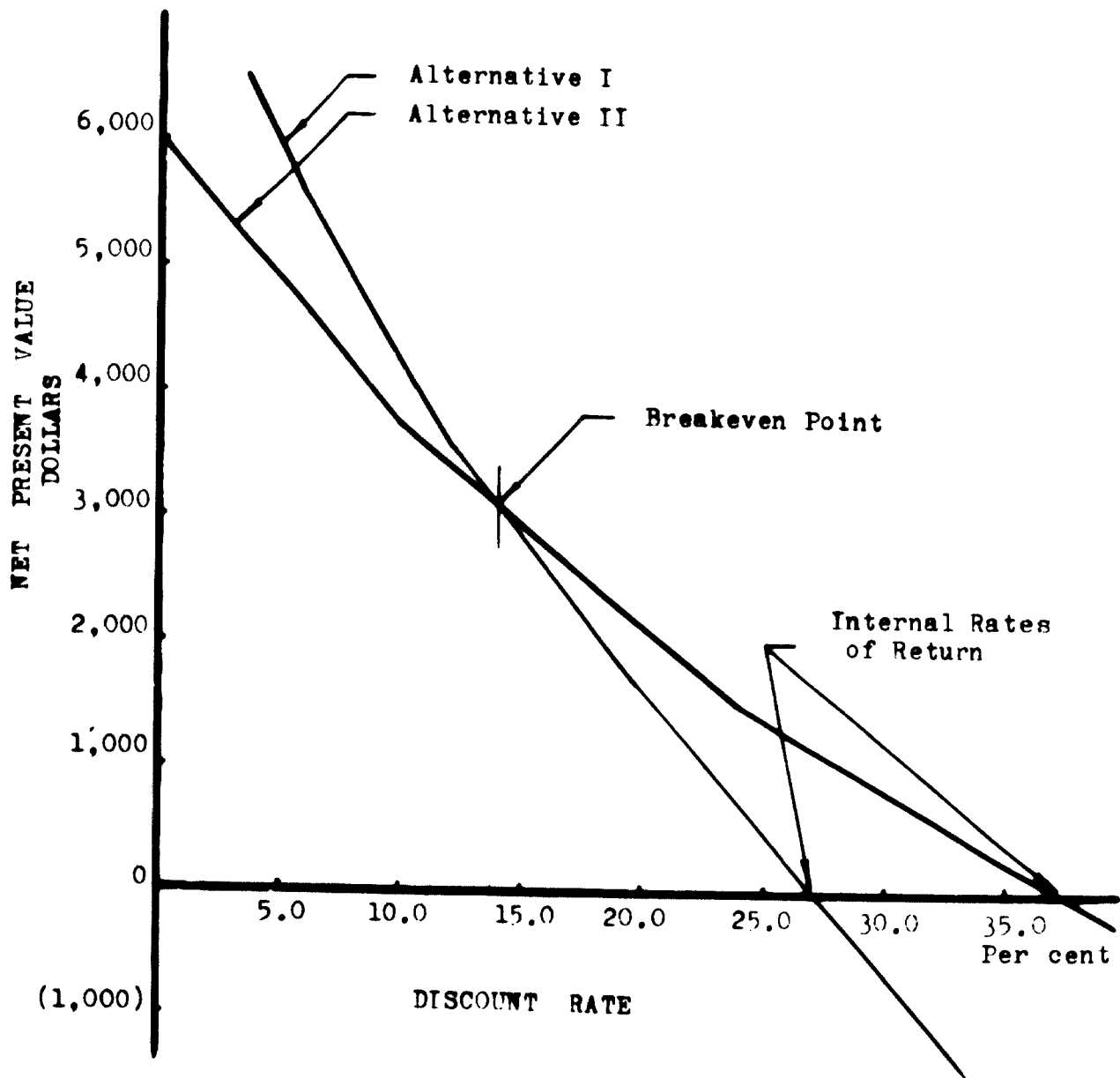
But the differences between the variants go beyond these

practical considerations. For certain kinds of decisions the two variants of discounted cash flow give identical results. This is true, for example, where the analytical problem is one of screening what can be called "go or accept" from "no-go or reject" investments. If the internal rate of return from a project is equal to or greater than a firm's investment opportunity rate, the project in question will appear acceptable whichever discounted cash flow variant is used. Stated another way, any project with an internal rate of return greater than its relevant opportunity rate of discount will also have a positive net present value and therefore appear acceptable whichever criterion is used. The same principle works in the opposite direction. In either set of circumstances, as a consequence, it is true that each of the two variants indicate the same go, no-go decision as far as screening investments is concerned.

It is often necessary to rank as well as screen investment alternatives. For example, it may have been decided for economic and other reasons to install a certain level of oil refining capacity within a country. Having decided this, it is also necessary to choose between the several alternative ways of accomplishing this result. This means it is necessary to have a reliable way of ranking as well as screening alternative uses of funds.

From the graph and numerical example attached beneath, it can be seen that the two variants of discounted cash flow do not yield the same result when it comes to ranking projects. In the example, the ranking of the two projects changes according to the investment opportunity rate that is selected. The lower the opportunity rate the greater the present value of the larger but later future payments associated with Alternative I. Just the opposite facts and result obtain

Graph Showing the Effect on Ranking Projects
Of Using the Internal Rate of Return and Net
Present Value Variants of the Discounted Cash Flow Method*



* Calculations for this graph are shown on previous page .

Example Showing the Effect on Ranking Projects of Using the Internal Rate
Of Return and Net Present Value Variants of the Discounted Cash Flow Method

	Required Initial Investment	Annual Cash Inflow		Net Present Value		Internal Rate of Return	
		Year 1	Year 2	0%	6%		30%
Alternative I	10,000	2,000	4,000	8,000	5,526	(634)*	27%
Alternative II	10,000	10,000	3,000	6,000	4,620	831	37%

* Parentheses denote a negative net present value.

with Alternative II. Up to an opportunity rate of about 14 per cent, in this particular example, Alternative I has a higher net present value than Alternative II and therefore would be preferred. Above this level of 14 per cent the opposite result is true, and Alternative II would be preferred because of the shrinking present value of the larger future cash flows associated with Alternative I.

To summarize, we have seen that the discounted cash flow technique was developed to deal with the problems presented by unequal economic lives and irregular cash flow patterns when the simpler unadjusted ratio methods of economic analysis are employed. Two variants of discounted cash flow have been presented - internal rate of return and net present value. Of these two, the net present value method has been suggested as giving the greatest degree of comparability between projects for screening and ranking purposes.

^{3/} In passing, one can also see from comparing the chart and graph that the intercepts on the horizontal axis of the graph represent the respective internal rates of return from the two alternatives. This should seem reasonable in that earlier we defined the internal rate of return from a project as that rate of discount that reduces a cash flow stream to zero. As indicated by the graph, the internal rates on these two alternatives do correspond to net present values of zero. It is also evident from the graph that the net present value of a cash flow stream discounted at zero per cent is the algebraic sum of the various inflows and outflows. This fact determines the vertical axis intercepts.

Problems Involved in Using the Discounted Cash Flow Methods

Although discounted cash flow represents a clear technical advance over all of the unadjusted ratio approaches, this greater technical sophistication offers no panacea to the problem of investment analysis and selection. As theory, discounted cash flow is not at all the ultimate in refinement or logical elegance. Much more critical, however, is that one almost always encounters very significant practical difficulties in trying to apply the discounted cash flow method.

It is easy to visualize these practical difficulties by simply making explicit some of the basic operating assumptions that are implicit in the discounted cash flow approach. As outlined by Dean[✓], these implicit assumptions include :

- (1) Perfect knowledge of all the opportunities for investing capital inside the company. Only by making such an assumption is it possible to conceive of a definitive demand schedule for capital expenditures, and only by anticipating future capital requirements is it possible to engage in the process of comparing investment opportunities that are inherent in the concept of capital expenditure budgeting.
- (2) That the prospective rate of return on each capital proposal can be projected with precision. Accurate forecasts must be made of the amount of investment as well as of the added profits from the added capital outlay. Only by assuming the measurability of capital productivity is it possible to set up a framework of economic analysis for this problem.

✓ Dean, op. cit., pp. 75-76

- (3) That the risks of all projects either are equal or have been accurately reduced to uniformity by a handicapping system that adjusts the rate of return for the proposal to a level that makes risks equal.
- (4) That the firm has free and unobstructed access to external as well as internal sources of funds and that the cost rates for each can be ascertained, so that, given the long run proportions of each source in overall capitalization, an average cost of capital can be derived.

It should be evident that even in the most professionally managed industrial organizations, and even for organizations operating in countries or economies where extensive and reliable economic, demographic, and market statistics are available, it is extremely difficult and often hazardous to attempt detailed forecasts very far into the future. Opportunities and market conditions can change almost overnight, particularly in the general manufacturing, service, and consumer oriented sectors of business. Thus even when the requisite professional skills and basic market and economic statistics are in evidence, it is often virtually impossible to make the kinds of forecasts anticipated above with any degree of confidence.

If it is sometimes difficult and hazardous to usefully forecast conditions in these relatively ideal circumstances, one can easily imagine that these difficulties compound where the necessary professional skills and/or basic statistical data do not exist. Notions based upon perfect knowledge of markets, long run investment demand schedules, investment opportunity rates, investment analyses adjusted for risk differentials, and so on, would seem utopian when viewed in this less ideal context. And this circumstance is

not changed at all by simply saying that the professional skills and data should be developed. Perhaps they should, but this is an entirely different problem and one that cannot be substantially changed except in the very long run.

Turning from these more or less technical reservations, it is also important to recognize that there are important organizational and human problems to be overcome in practice. To begin with, the subtleties of discounted cash flow are difficult to understand by a non-specialist. It seems to be fairly easy for many people to gain a broad grasp of the present value concept that underlies the discounted cash flow method, but not in enough depth to have what could be considered a meaningful operating or working grasp of the concept and its variants. As a consequence of its being difficult to understand, it is difficult to teach the discounted cash flow approach beyond imparting a broad conceptual grasp. This means that it is relatively difficult to propagate the faith, at least within a large decentralized kind of organization. And this is a field where a little knowledge can be worse than none at all.

Another practical consideration is that the more sophisticated analytical methods are often extremely time consuming in application. This can stem from a lack of basic quantitative data, a shortage of trained economists or technicians to do the work effectively and expeditiously, or simply from the scope and complexity of the decisions to be made.

The fact that the required analyses often are relatively difficult and time consuming to make, sometimes produces another entirely human reaction. It is quite typical that when individuals or groups of individuals have spent a great deal of time and emotional energy in preparing one particular approach - they lose objectivity and flexibility in their thinking about

other alternatives. This rigidity of thinking is very often much less acute in organizations where less sophisticated measures are employed -in part, it would seem, because people feel they have less **at stake** in what has already been done and because redoing things does not seem such an ordeal.

People are often deceived into thinking that the more sophisticated and elegant an analysis or **presentation**, the better the investment being discussed. That this is **so**, sometimes encourages those involved to rely more upon the persuasiveness of their analytical approach and presentation than in the basic facts of what they are proposing. This in the hope that those finally responsible for the particular decision will be persuaded by the form if not the content of what is being proposed. In part this is related to what was said at the beginning about not simply solving the wrong problem well, but it is also partly a question of people sometimes deliberately using a more sophisticated system to "snow" the boss.

This leads to one final observation along almost these same lines. In large organizations it often appears as though the extent and sophistication of organizational shenanigans behind investment analyses closely parallels the sophistication of the analytical methods employed. This **tendency** seems particularly marked in cases where the organization imposes a particular analytical system upon its members. People may not fully understand the intricacies of the analytical methods they are required to use, and they may be quite incapable for just reason of generating the required investment, cost, and revenue data, but typically they find a way "to get their work done". They rapidly learn to play the game, i.e. as rapidly as they develop an understanding of the rules of the game.

None of these organizational characteristics is necessarily good or bad in itself, although it would certainly be outside the scope of what we are doing here to enter into this polemic. What is important to appreciate in the present context is that there are some human and organizational characteristics that seem to appear over and over again in business organizations and that strongly influence any capital budgeting system. And this without regard to the social and political system in which these organizations find themselves. The only important point in this is that if these are common organizational uniformities as regards investment analysis and capital budgeting, they must be taken into account by those thinking about or interested in installing one approach or another.

Implications for Action in Developing Countries

In this final section we will turn to what seem to be the most important implications for developing countries of what has been said so far about discounted cash flow. We have seen that the discounted cash flow methods are technically more correct than the unadjusted ratio methods; that the net present value variant of discounted cash flow is generally more reliable than the internal rate of return variant; and that the greater technical finesse and sophistication of the present value methods is probably gained at the expense of important practical limitations. The thinking presented so far is based upon direct experience in a number of highly developed economies. Although it is undoubtedly risky to extrapolate too much from this experience in developed economies, one would seem justified in observing that the practical limitations of discounted cash flow are likely to be even more constraining in the developing economies than they are

in the economically developed nations. The same base of professional skills and necessary statistical and other information just does not exist in the developing nations, and it is not likely to for some time to come. If this is true, what if any practical value is there in the discounted cash flow technique for the developing countries ?

Perhaps we can approach this question from two levels. At the most general or conceptual level, the basic notions of present value and discounted cash flow are relatively easily understood and of some value to managers even if understood in just general terms. The concept of present value provides an analytical and decisional framework that is meaningful and useful in practice where people are responsible for major industrial investment projects and programs involving long term capital commitments and complex cash flow patterns. Even a general conceptual awareness of the idea behind present value ought to alert people to the need to consider as objectively as possible the questions of relevant cash flows and the timing of cash flows. An appreciation of this kind seems doubly important in the developing economies because of the relatively higher investment opportunity rates that prevail. Stated in other terms, when a company or country can invest limited amounts of capital at high rates of return it makes a bigger present value difference to ignore the timing of cash flows than when the lower rates of return found in the more mature, capital abundant economies are involved. Simply general awareness of the present value concept ought to be enough to alert the key people in an organization to these questions. The required level of general acquaintance with the underlying concepts can be both taught and learned quite easily.

Beyond this possibility of providing a helpful conceptual framework at the top policy and decision making levels of an organization, the discounted cash flow technique has potential value at the level of the professional investment analyst. The job of the few professional analysts in enterprises and countries alike that are short on the requisite skills and statistical information that might permit widespread use of the most sophisticated techniques should be regarded quite differently than it is typically in more developed companies and economies. The philosophy and objectives governing the thinking of the technical specialist in the less developed situations should include the following elements :

- (1) To reduce wrong investment decisions within an enterprise or economy to a tolerable level considering the costs of doing so.
- (2) To focus management attention as quickly as possible upon determining whether or not investment alternatives are clearly attractive, marginal, or plainly unattractive. This initial screening should be accomplished as expeditiously and simply as possible.
- (3) To develop a combination of analytical methods tailored to the decision making requirements and the analytical abilities of the people working in the particular organization.

Although the professional urge is often understandably strong to do so, the technical specialist should not allow himself to fall into the trap of seeking to increase the precision and elegance of the analytical methods being employed as an objective in itself. While the above guidelines are

clearly not relevant in the context of someone preoccupied with the development and extension of theory cum theory, in business and economic development the real practical problem faced by decision makers is to make decisions as effectively and rapidly as possible given the existing information and organizational constraints they have to contend with. The job of the investment analyst should be to facilitate - not complicate - this process.

Thus discounted cash flow or any other method of analysis should not be accorded the imprimatur to the exclusion of all other methods. Initial screening of projects can often be done by using one of the simple ratio methods of comparison tentatively rejected earlier. Often only questionable or marginal opportunities require further analysis of a go, no-go character, and then only enough to clarify the issue. Sometimes discounted cash flow is absolutely required to enable a correct economic analysis of an investment choice. Where this is the **case**, discounted cash flow should be **employed but**, by someone with enough understanding of the method to really know what he is doing and assuming. Even in those instances where present value probably ought to be employed, it is often possible for the specialist to fashion special payback tables, nomograms, and graphs to facilitate quick and rough but accurate enough approximations of present value analyses by people who do not themselves fully understand the internal workings of present value.

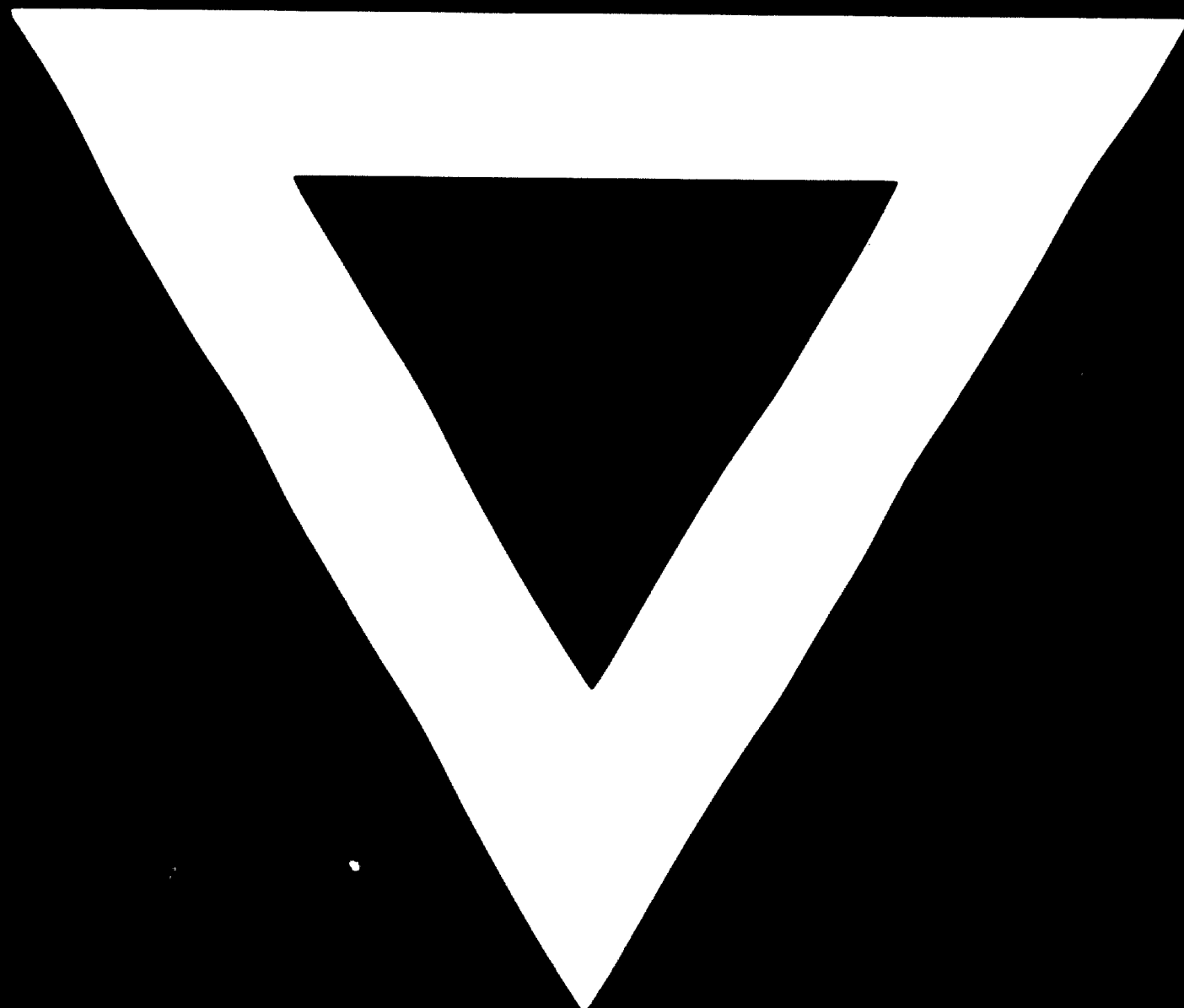
Despite the practical limitations outlined earlier, the discounted cash flow technique is seen to have at least some positive **value** for the developing countries. It is important for these countries to industrialize their economies rapidly

and efficiently and present value does impose a conceptual framework for thinking systematically and **objectively** about the economic aspects of investment decisions. It may be, as has been suggested, that the present value notion can work its influence in different ways on at least two levels. One must caution, however, that adoption or not of the discounted cash flow technique is not in itself going to seriously influence the rate or quality of industrial development in the developing nations. More or less refined technical analysis will not really alter the industrial management problems facing these countries. Long term business success or failure revolve around such general management activities as goal setting, strategy formulation, and effective long range planning - not to mention the important practical problem of assuring satisfactory short and medium term operating results. Seen in this broader context, the really important allocations of strategic resources within an enterprise involve trade-offs between such things as investment in productive plant versus in distribution and service networks, product and market development versus research and the introduction of entirely new products, advertising versus price reductions, local versus national and international distribution, and so on. In all of these trade-offs, the basic problem is to evaluate alternative corporate strategies, and the capital and other resources required to support them, in terms of the extent to which they are thought to contribute to the achievement of the organization's long term goals. Discounted cash flow and other analytical methods have a place in this framework, as it is important to be able to evaluate projects correctly when the occasion arrives. But the really critical matter is to generate an abundance of sound investment projects

that fall into a rationally conceived strategic pattern of development. There is a very great risk that the devotion of undue attention by an organization to questions of analytical methodology will lead to confusion and the misdirection of planning effort from where it can be most effectively placed.



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