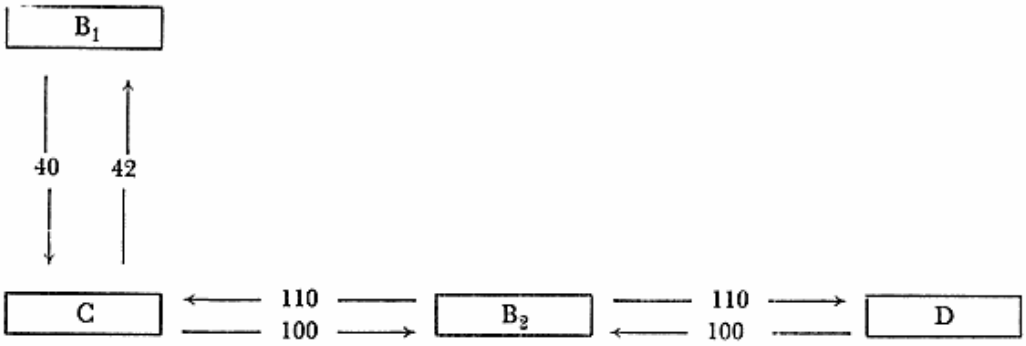
Some Remarks on Capital Investment Analysis.

By J. T. Ross Jackson*)

Return on Investment.

The concept of return on investment is at once both apparently simple and actually quite complex, involving fundamental philosophical concepts and computational variations. There are at least a dozen different methods, all quite acceptable and in current use, of handling any particular investment problem. By way of example, consider how an apparently simple investment situation can lead to quite different interpretations.



Time	B_1's Capital	C's Capital	D's Capital
Jan. 1, 1966	40	60	100
Jan. 1, 1967	42	68	110

Fig. 1

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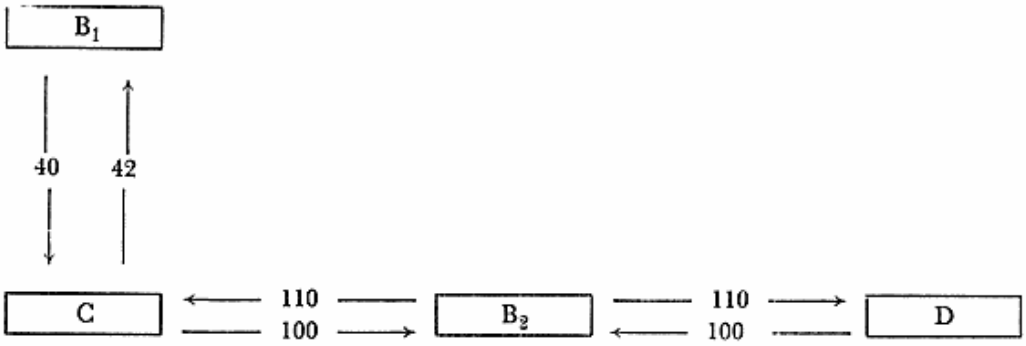

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Bank B_2 offers a 10.0 % reurn to any company which deposits 100 money units. (100 now garners 110 one year from now – simple). Company D, having an excess of capital invests 100. Company C, having only 60, borrows the other 40 from bank B_1 at a 5.0 % interest rate for one year, and also invests with B_2. The net changes in capital and money flow are illustrated. Question: What is C's return on investment? A panel of three capital investment experts might well respond as follows:

Analyst 1: »My criterion is simple enough. C began with 60, ended with 68. His return was 8/60 or 13.4 %. The amount of money he had to borrow to make this profit is irrelevant. The only effect it has is the creation of a 2 unit interest charge which is treated as an operating expense.«

Analyst 2: »I disagree. The value of a particular investment must be independent of the financial problems of the investor. Thus both C and D made the same investment. This investment has a return of 10/100 or 10.0 % no matter who makes it. Of course the question of whether or not C *ought* to make the investment will depend on the rate at which he can borrow capital and other investment possibilities.«

Analyst 3: »I maintain that C's and D's return on investment need not be the same. The return should in fact be different and reflect their different capital situations. I ask only two questions. What was C's net profit? What was his total capital outlay? I disagree also with analyst 1 who says that the capital outlay is 60. For by his definition if all the capital were borrowed, the outlay would be zero and the return infinite. The latter concept has no real meaning for me. C's investment was 100, not 60, and his return should be computed on the basis of his original capital plus borrowing capability. His return is thus 8/100 or 8.0 %.«

With which analyst do you agree? Why? Be careful!

Note that by all definitions, D's return was 10.0 % and bank B1's return var 5 %. The problem arises over the case where some borrowing is involved.

The basic reason for difference of opinion is that no one has adequately defined quantitatively what an investment really is. Consequently the concept has different meanings to different people and is the cause for much misunderstanding. There are dozens of other problems of definition and treatment, such as:

1) Should additional capital needs be considered as part of the investment or should we treat this cost as an interest expense?
2) What rate should we charge for additional capital; the rate at which we can borrow? the rate of return of our next best investment from which funds are diverted? or a weighted average of debt financing and stock issue costs? Should this rate be the same for all investment decisions?
3) Should taxation be considered or should we look at before-tax profit only?
4) What assumptions should be made concerning depreciation expenses?
5) Should we consider the possibility of reinvesting capital as it is generated?
6) When will the investment terminate? Should we introduce the ideas of probability theory? What about obsolescence due to technological improvement? What about assuming or computing an optimal replacement interval as a basis for our calculation?
7) Should we be using the criterion of return on investment in the first place as our basis of decision making? What about the risks involved? Surely a low risk 10.0 % return is better than a high risk 11.0 % return. Or is it? (And what do we mean by risk? By this time we should be wary if introducing vague terms which have not been operationally defined!).

Developing a Plan of Analysis.

We have raised a few important questions – there are many more – and offered no answers. Where do we go from here? First of all, there is no such thing as a uniformly best answer for all companies or even for all investment decisions within the same company. Without attempting to answer all of these questions now, consider as a starting point a real hard look at two Basic questions – and this thinking applies to any problem of management, not just capital investment decisions:

1) What are we trying to do?
2) How do we measure how well are doing it?

The key to effective operation analysis is to answer these two questions in terms of operationally defined, measureable quantities. Don't say maximize »return on investment« or maximize »profit« until the exact meaning of these terms has been spelled out – in detail. The computer is a very powerful tool, but very simple-minded. It cannot think in the abstract. Furthermore, the process of transforming management's objectives into a mathematical language understandable to the computer can

be a very enlightening experience, for it forces one to consider some very basic questions and often turns up fresh new ways of looking at old problems.

Returning to the capital investment problem, the answer to question 1) is typically of the form. »We wish to selct a course of action from the following list of alternatives, 1, 2, 3, ...« The answer to question 2) involves the selection of a well defined criterion to be used as a basis for evaluating each of the courses of action. Return on investment is one such criterion. There are others. The third step is to select the course of action which maximizes the criterion function. In this case, once the problem has been defined correctly, it is a simple matter of computation and enumeration. In many problems, such enumeration is not possible and other methods must be used which typically might involve differential calculus or linear programming.

Note that structuring the problem in terms of a choice between courses of action deemphasizes the problem of definition of return on investment, for most reasonable definitions would likely lead to the same optimal choice.

Furthermore, thinking along these lines should help any manager see his problem in the right perspective and remove a lot of the fuzziness which surrounds capital investment decisions.

Example 1:

A manager has two alternatives to consider.

Alternative	Required outlay	Expected return
A	100.000	6 %
B	60.000	7 %

Table 1.

Question: Which alternative should he select?

Answers: Who knows? The problem has not been formulated correctly! Clearly he has access to 100000 money units – whether loaned or not is irrelevant. The unanswered question is – what will he do with the other 40000 under alternative B? If his »next best« investment earns less than 4½ %, A is preferred[1]). Otherwise B is preferred. It is the return on his total *potential* investment that should be used, and this base must be the same for all alternatives. This »poten-

[1]) Solve $7\,(60) + (40)\,x = 6\,(100)$; $x = 4\frac{1}{2}$

tial« should in general include borrowing capabilities. (Even for the largest firms, this has an upper limit and can be estimated).

Methodologically, this line of argument agrees with analyst 3, who considers borrowed money as part of the investment and treats interest on this loan as an operating expense. According to this way af thinking there is no such thing as an investment having a »10 % return« inpendent of who makes it (unless it be understood that no borrowing is allowed). The logic behind including borrowed money as part of the investment is that funds are being diverted from other future investments by reducing the future loan potential.

Example 2:

A manager has several investments to consider. Having accepted the previous argument, he has computed all the returns on the basis of the largest outlay (100), considering the return possible from the »next best« investment in each case to bring all outlays up to 100. The returns are now directly comparable. However, he notes that there exist considerable differences in »risk« among the investments. All the actual returns include some amount of uncertainty. He is able to describe this »risk« in terms of a probability function for outcomes. (This may be a subjective estimate or a statistically derived one if the underlying process is understood).

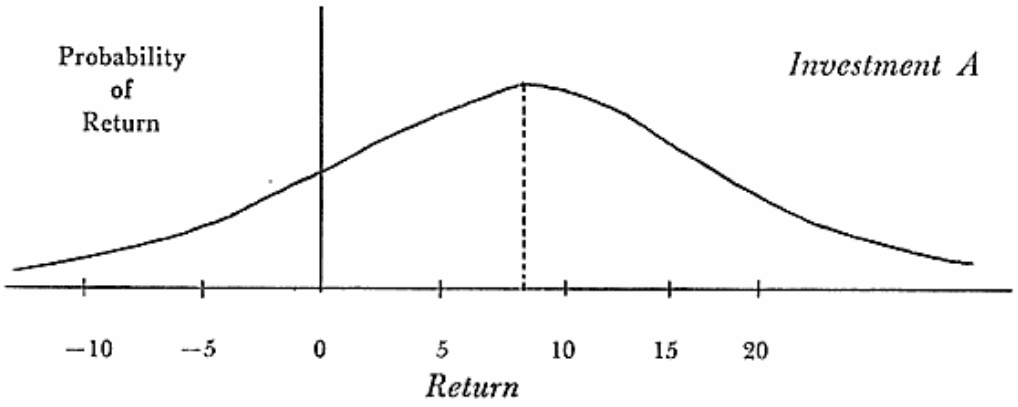

Fig. 2.

Our man decides to define »risk« as the statistical standard deviation σ. Roughly this means the following: if the expected return is μ, then he is 95 % sure of an actual return lying between $(\mu-2\sigma)$ and $(\mu+2\sigma)$.

His decision table appears as follows:

Alternative	Expected return (%)	Risk (%)
A	7	10
B	4	7
C	8	20
D	10	15
E	15	40
F	9	12
G	3	0
H	13	23

Table 2.

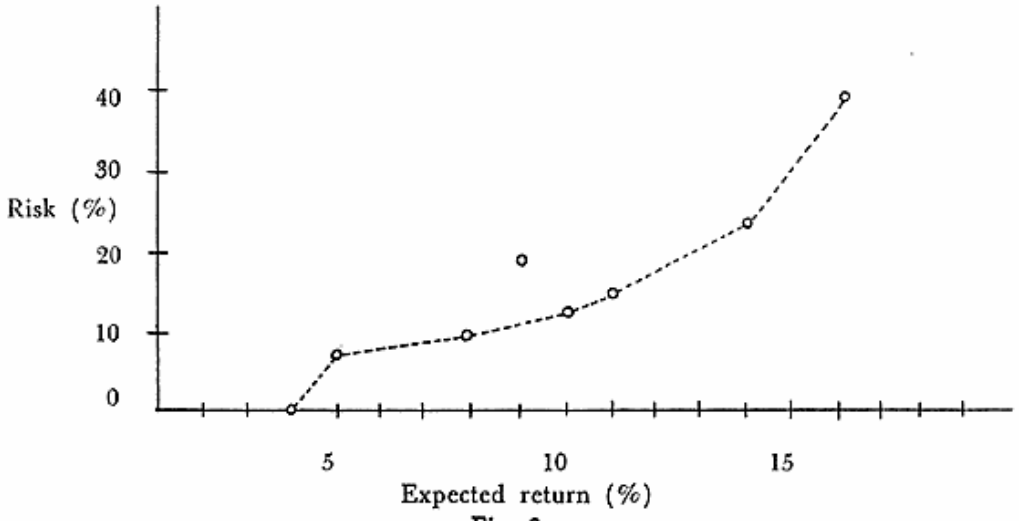

Fig. 3.

We cannot say which of these alternatives he »ought« to take without knowing more about his attitude toward risk. A diagram such as that in fig. 3 is often helpful. The main point of the example is that expected return is not necessarily the right criterion. There may be several other factors of importance, such as risk.

A Note on Taxation and Depreciation.

There is some justification for a company which is consistently showing a loss to consider before-tax cash flow in computing return on investment, or equivalently, to assume that the tax rate is zero. This assumption makes the choice of depreciation method irrelevant since the only effect of depreciation expense on cash flow is to reduce taxation. It should be used only when the profit before taxes for the whole company will be negative each year no matter which method of depreciation

is used on the investment considered. However, if any legally acceptable depreciation method would allow a positive before-tax profit at any time during the course of the investment, the normal tax rate should be assumed, and a method of depreciation chosen that will minimize the discounted sum of all future tax payments.

Note that we are speaking of the overall profitability of the firm here, not the profitability of the particular investment. Obviously, the optimal strategy of depreciation for the single investment considered alone would be to set depreciation expense exactly equal to profit before depreciation (if legally permissible) until the book value was zero. Such a policy would not in general be optimal for the whole firm however unless all investments were depreciated according to this rule.

However, there are two reasons why this criterion alone should not be used indiscriminately. The first is a legal question. There may be limitations in the frequency at which the method of depreciation can be changed. If so, the firm may find itself committed to a policy which is no longer desirable. The second is a principle of accounting that the balance sheet should be a fair statement of the firm's value, hence book value should be at least a reasonable approximation of real worth.

Concluding Remarks.

Many words have been written on some of the questions raised here, particularly regarding various computational techniques such as »»discounted present value« and »internal rate of return«. Attention has been directed here away from the »trees« in order to get a look at the »»forest«. Too often, the very use of any return on investment criterion is accepted too readily, as is the understanding of the meaning of an investment. The key to successful analysis is to spend a little more time in the problem formulation stage in view of the power of the decision theory approach and the resultant clarification of the whole problem.