

Comparing Net Present Value and Internal Rate of Return

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Executive Summary

- Net present value (NPV) and internal rate of return (IRR) are two very practical discounted cash flow (DCF) calculations used for making capital budgeting decisions.
- NPV and IRR lead to the same decisions with investments that are independent.
- With mutually exclusive investments, the NPV method is easier to use and more reliable.

Introduction

To this point neither of the two discounted cash flow procedures for evaluating an investment is obviously incorrect. In many situations, the internal rate of return (IRR) procedure will lead to the same decision as the net present value (NPV) procedure, but there are also times when the IRR may lead to different decisions from those obtained by using the net present value procedure. When the two methods lead to different decisions, the net present value method tends to give better decisions.

It is sometimes possible to use the IRR method in such a way that it gives the same results as the NPV method. For this to occur, it is necessary that the rate of discount at which it is appropriate to discount future cash proceeds be the same for all future years. If the appropriate rate of interest varies from year to year, then the two procedures may not give identical answers.

It is easy to use the NPV method correctly. It is much more difficult to use the IRR method correctly.

Accept or Reject Decisions

Frequently, the investment decision to be made is whether to accept or reject a project where the cash flows of the project do not affect the cash flows of other projects. We speak of this type of investment as being an independent investment. With the IRR procedure, the recommendation with conventional cash flows is to accept an independent investment if its IRR is greater than some minimum acceptable rate of discount. If the cash flow corresponding to the investment consists of one or more periods of cash outlays followed only by periods of cash proceeds, this method will give the same accept or reject decisions as the NPV method, using the same discount rate. Because most independent investments have cash flow patterns that meet the specifications described, it is fair to say that in practice, the IRR and NPV methods tend to give the same accept or reject recommendations for independent investments.

Mutually Exclusive Investment

If undertaking any one of a set of investments will change the profitability of the other investments, the investments are substitutes. An extreme case of substitution exists if undertaking one of the investments completely eliminates the expected proceeds of the other investments. Such investments are said to be mutually exclusive.

Frequently, a company will have two or more investments, any one of which would be acceptable, but because the investments are mutually exclusive, only one can be accepted. Mutually exclusive investment alternatives are common in industry. The situation frequently occurs in connection with the engineering design of a new installation. In the process of designing such an installation, the engineers are typically faced at a great many points with alternatives that are mutually exclusive. Thus, a measure of investment worth that does not lead to correct mutually exclusive choices will be seriously deficient.

Incremental Benefits: The Scale Problem

The IRR method's recommendations for mutually exclusive investments are less reliable than are those that result from the application of the NPV method because the former fail to consider the size of the investment. Let us assume that we must choose one of the following investments for a company whose discount rate is 10%: Investment A requires an outlay of \$10,000 this year and has cash proceeds of \$12,000 next year; investment B requires an outlay of \$15,000 this year and has cash proceeds of \$17,700 next year. The IRR of A is 20%, and that of B is 18%.

A quick answer would be that A is more desirable, based on the hypothesis that the higher the IRR, the better the investment. When only the IRR of the investment is considered, something significant is left out³and that is the size of the investment. The important difference between investments B and A is that B requires an additional outlay of \$5,000 and provides additional cash proceeds of \$5,700. Table 1 shows that the IRR of the incremental investment is 14%, which is clearly worthwhile for a company that can obtain additional funds at 10%. The \$5,000 saved by investing in A can earn \$5,500 (a 10% return). This is inferior to the \$5,700 earned by investing an additional \$5,000 in B.

Table 1. Two mutually exclusive investments, A and B

Investment	Cash flows		IRR (%)
	0	1	
A	#\$10,000	\$12,000	20
B	#\$15,000	17,700	18
Incremental (B#A)	#\$5,000	+\$5,000	14

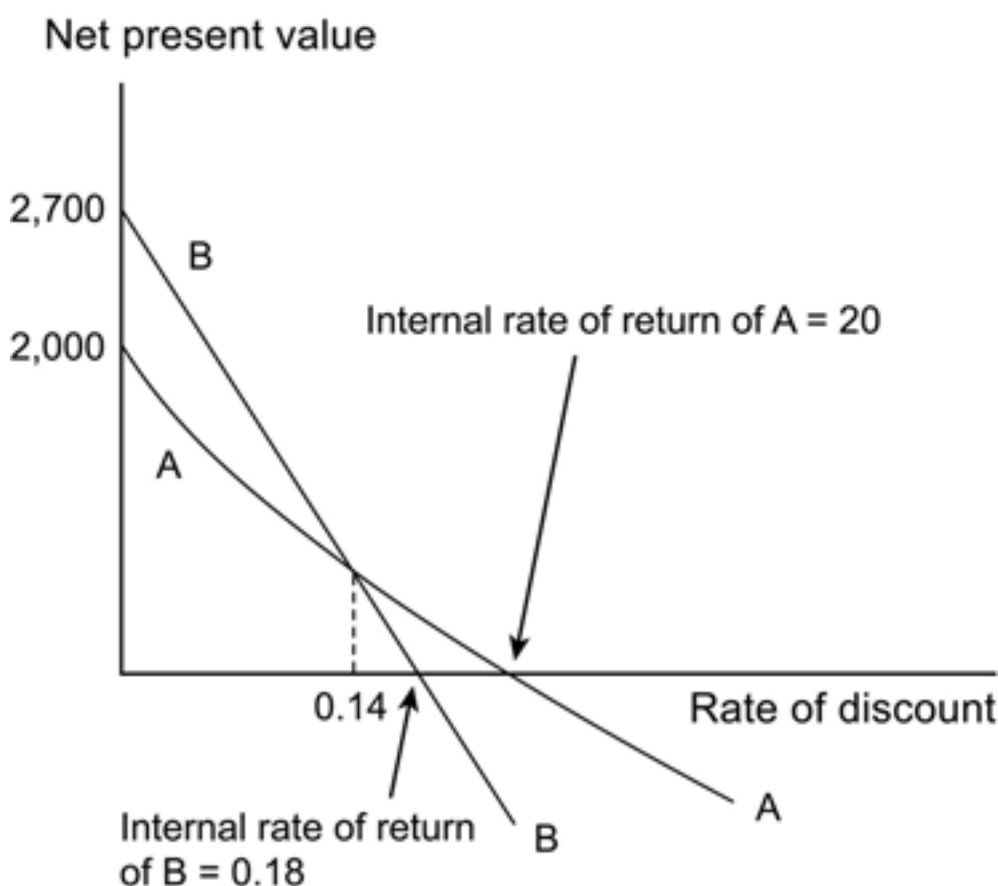


Figure 1. Two mutually exclusive investments, A and B

Figure 1 shows both investments. It can be seen that investment B is more desirable (has a higher present value) as long as the discount rate is less than 14%.

We can identify the difficulty just described as the scale or size problem that arises when the IRR method is used to evaluate mutually exclusive investments. Because the IRR is a percentage, the process of computation eliminates size; yet, size of the investment is important.

Timing

Assume that there are two mutually exclusive investments both requiring the same initial outlay. This case seems to be different from the one we have just discussed because there is no incremental investment. Actually, the difference is superficial. Consider investments Y and Z, described in Table 2. Suppose that Y and Z are mutually exclusive investments for a company whose cost of money is 5%. The IRR of Y is 20%, whereas that of Z is 25%. If we take the present value of each investment at 5%, however, we find that the ranking is in the opposite order. The present value of Z is less than the present value of Y.

Table 2. Cash flows for two investments, Y and Z

Cash flows for period	IRR (%)	NPV at 5%			
Investment	0	1	2		
Y	#\$100.00	\$20.00	\$1200.00	20	\$27.89
Z	#100.00	100.00	31.25	25	23.58

Table 3. Incremental comparison of cash flows for investments Y and Z

Period 0	0.00	Cash flows identical
Period 1	#\$80.00	Cash flow of Y is less than that of Z
Period 2	\$88.75	Cash flow of Y exceeds that of Z

Suppose that we attempt to make an incremental comparison, as shown in Table 3. We see that the cash flow of Y is \$80.00 less in year 1 and \$88.75 more than Z in year 2. As before, we can compute the IRR on the incremental cash flow. An outlay of \$80.00 that returns \$88.75 one year later has an IRR of 10.9%. An investment such as this would be desirable for a company whose cost of money is less than 10.9%. Again, we are really dealing with a problem of the scale of the investment, but in this case, the opportunity for the additional investment occurs one year later.

The same result can be reached by a somewhat different route if we ask how much cash the company would have on hand at the end of the second year if it accepted investment Y or if it accepted investment Z. Both investments give some cash proceeds at the end of the first year. The value of the investment at the end of the second year will depend on what is done with cash proceeds of the first year. Assume that the cash proceeds of the first year could be reinvested to yield 5%. Then investment Y would result in a total cash accumulation by the end of the year of \$141 (105% of \$20 plus \$120). Investment Z would result in a cash accumulation of only \$136.25 (105% of \$100 plus \$31.25).

Figure 2 shows that investment Y is to be preferred as long as the appropriate discount rate is less than 10.9%. If the rate is in excess of 10.9, then Z is to be preferred.

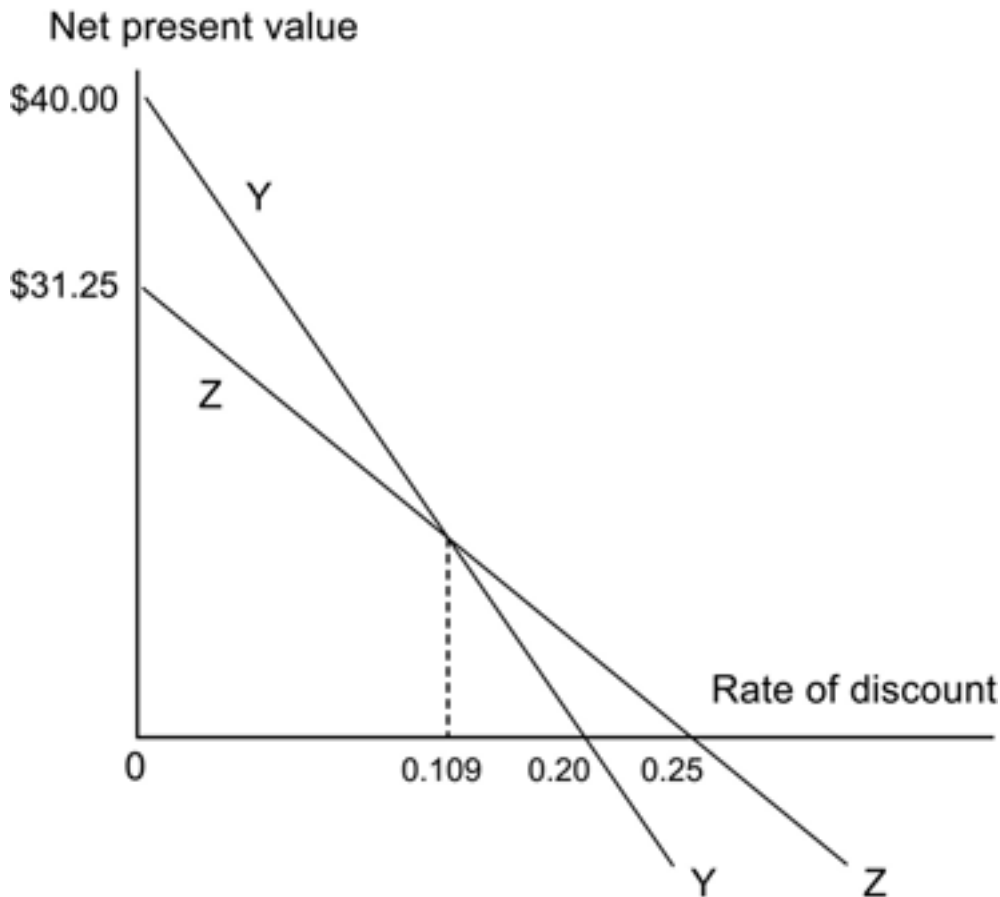


Figure 2. Two mutually exclusive investments, Y and Z

One disadvantage associated with the use of the IRR method is the necessity of computing the IRR on the incremental cash proceeds in order to determine which of a pair of mutually exclusive investments is preferable. If there are more than two mutually exclusive investments, we shall have to conduct an elimination tournament among the mutually exclusive investments. Taking any pair, we compute the IRR on the incremental cash flow and attempt to decide which of the two investments is preferable. The winner of this round would then be compared in the same manner with one of the remaining investments until the grand champion investment is discovered. If there are 151 investments being considered, there will have to be 150 computations, because 150 investments would have to be eliminated.

Why IRR Is Popular

Managers like the IRR method, since they consider it important to know the differential between the proposed investment's IRR and the required return. This is a measure of safety that allows an evaluation of the investment's return compared to its risk. If an investment has an IRR of 0.30 when the required return is 0.12, this is a large margin that allows for error. An NPV measure does not give the same type of information to management.

Case Study

A Decision in Mexico

A major Mexican steel corporation had a major decision. It could stand relatively pat (a marginal investment of \$50,000,000) with its present steel making facilities and earn indefinitely (after maintenance capital expenditures) \$8,000,000 per year. This is an IRR of 0.16. The pesos have been translated to dollars.

The alternative is to invest \$10,000,000,000 and earn \$1,500,000,000 per year indefinitely, an IRR of 0.15. What should the corporation do if it has a cost of capital of 0.10 for steel making facilities?

The solution is:

NPV (stand pat) = $8,000,000 \div 0.10 - 50,000,000 = 80,000,000 - 50,000,000 = \$30,000,000$

NPV (major investment) = $1,500,000,000 \div 0.10 - 10,000,000,000 = 15,000,000,000 - 10,000,000,000 = \$5,000,000,000$

IRR says stand pat (0.16 is larger than 0.15). NPV says rebuild (\$5 billion is larger than \$30 million).

Conclusion

An effective understanding of present value concepts is of great assistance in the understanding of a wide range of areas of business decision making. The concepts are especially important in managerial decision making, since many decisions made today affect the firm's cash flows over future time periods.

It should be stressed that I have only discussed how to take the timing of the cash flows into consideration. Risk and tax considerations must still be explained before the real-world decision maker has a tool that can be effectively applied. In addition, there may be qualitative factors that management wants to consider before accepting or rejecting an investment.

It is sometimes stated that refinements in capital budgeting techniques are a waste of effort because the basic information being used is so unreliable. It is claimed that the estimates of cash proceeds are only guesses and that to use anything except the simplest capital budget procedures is as futile as using complicated formulas or observations of past market levels to determine which way the stock market is going to move next. For example, in 1974 K. Larry Hastie published his classic paper, "One Businessman's View of Capital Budgeting." His position is that firms should avoid excessively complex measurement techniques. He states: "Investment decision making could be improved significantly if the emphasis were placed on asking the appropriate strategic questions and providing better assumptions rather than on increasing the sophistication of measurement techniques" (1974, p. 36).

It is true that in many situations reliable estimates of cash proceeds are difficult to make. Fortunately, there are a large number of investment decisions in which cash proceeds can be predicted with a fair degree of certainty. But even with an accurate, reliable estimate of cash proceeds, the wrong decision is frequently made because incorrect methods are used in evaluating this information.

While it is not possible to make a single estimate of cash proceeds that is certain to occur, it does not follow that incorrect methods of analysis are justified. When all the calculations are completed, judgmental insights may be included in the analysis to decide whether to accept or reject a project.

More Info

Books:

- Bierman, Harold, Jr. *Implementation of Capital Budgeting Techniques*. Financial Management Survey & Synthesis Series, FMA, Tampa, FL, 1986.
- Bierman, Harold, Jr, and Seymour Smidt. *Advanced Capital Budgeting*. New York and London: Routledge, 2007.
- Bierman, Harold, Jr, and Seymour Smidt. *The Capital Budgeting Decision*. 9th ed. New York and London: Routledge, 2007.

Article:

- Hastie, K. L. "One businessman's view of capital budgeting." *Financial Management* 3 (Winter 1974): 36–44.

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