NPV and IRR

Should a company buy a new machine, open a shop or launch a project? To decide, it must compare money spent today with money received in the future. Net present value, or NPV, and internal rate of return, or IRR, are the two most common tools for this, explained in textbooks such as Principles of Corporate Finance by Brealey, Myers and Allen. Both rest on one idea: money today is worth more than the same money later. In this lesson, Huda, a finance analyst at a bakery chain, uses them to choose between two expansions, and she learns why the two tools can disagree. This video is a teaching aid, so facts and figures should be checked before they are used.

1. The Time Value of Money

A dollar today is worth more than a dollar next year. Money that we have today can be saved or invested to earn a return, and money that arrives sooner can start earning sooner. This idea is called the time value of money. Discounting turns a future amount into its present value: we divide the amount by one plus the discount rate, once for every year of waiting. The discount rate is the return that we could earn elsewhere with similar risk, and it is often the company's cost of capital. The higher the rate, or the longer the wait, the smaller the present value.

Example: At ten percent a year, a saver's one hundred dollars grows to one hundred and ten dollars in a year, and the saver can spend or invest the extra ten dollars. Discounting works backward: one hundred and ten dollars promised next year is worth one hundred dollars today, because that sum would grow into the promised amount. That is exactly what the time value of money means.

At work: Huda must advise the chain on its central bakery. The small oven line costs fifty thousand dollars and returns twenty-five thousand dollars at the end of each of three years. The automated line costs two hundred thousand dollars and returns ninety thousand dollars at the end of each of three years. The chain's cost of capital is ten percent. Huda discounts the three payments of the small line, and they are worth about twenty-two thousand seven hundred, twenty thousand seven hundred and eighteen thousand eight hundred dollars in today's money.

2. Net Present Value

Net present value is the present value of all future cash flows, minus the money invested today. A positive NPV means that the project earns more than the cost of capital, so it adds value. A negative NPV means that the money would do better elsewhere, and a zero NPV means that the project earns only the required return. The cash flows used should be extra cash flows caused by the project, after tax, and money already spent that cannot be recovered is left out.

Example: A family looks at solar panels that cost two thousand dollars and save eleven hundred dollars a year for two years. The savings add up to more than the cost, but at ten percent the NPV is about ninety dollars below zero, so the panels do not earn that rate.

At work: For the small line, the present values add up to about sixty-two thousand two hundred dollars. After taking away the price, the NPV is about twelve thousand two hundred dollars. For the automated line, the present values add up to about two hundred and twenty-three thousand eight hundred, so the NPV is about twenty-three thousand eight hundred dollars. Both lines add value, and the automated line adds almost twice as much.

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3. Internal Rate of Return

The internal rate of return is the discount rate at which the NPV is exactly zero. It is the project's own yearly return, shown as a percentage, and it is found by trial and error or with a spreadsheet function. If the IRR is higher than the cost of capital, the project is usually worth doing. The gap is a margin of safety, because it shows how far the cost of capital can rise before the project stops adding value.

Example: The solar panels from the last example have an IRR of about six and a half percent, so the savings earn only about six and a half percent a year on the money spent, which is two thousand dollars. This is below the ten percent rate that the family could earn elsewhere, so the IRR gives the same answer as the NPV: the panels are not worth buying. That is exactly what the internal rate of return tells us.

At work: A spreadsheet function gives Huda an IRR of about twenty-three percent for the small line and about sixteen and a half percent for the automated line. Her manager looks at the two percentages and says that the small line is clearly better. Huda notes that both percentages are correct as arithmetic, but they do not answer the question that the decision needs.

4. When They Disagree

For one stand-alone project, NPV and IRR give the same answer, but they can disagree when we must choose between projects. IRR is a percentage, so it ignores size: a small project can have a high rate and add little money. IRR also assumes that the cash received along the way is reinvested at the IRR itself, which is often too hopeful, while NPV assumes reinvestment at the cost of capital. When projects exclude each other, NPV is the safer guide, and we can also test the extra investment: the additional money in the bigger project is compared with the cost of capital.

Example: A hotel can renovate one floor, with a very high IRR, or the whole building, with a lower IRR. The floor costs little, so even its high rate earns only a small amount of money. The whole building earns the lower rate on much more money, so it adds more total value. That is exactly why IRR alone can mislead when projects differ in size.

At work: Huda shows that the automated line needs one hundred and fifty thousand dollars more than the small line and brings sixty-five thousand dollars more each year. That extra investment earns about fourteen percent, above the cost of capital of ten percent, so it is worth making. The NPV agrees: the automated line adds about eleven thousand six hundred dollars more. She also tests the rate: the automated line keeps a positive NPV at fifteen percent, but it turns negative if the cost of capital rises above about sixteen and a half percent, which is its IRR. Her manager chooses the automated line and records that the choice depends on the rate staying below that level. These figures are an invented illustration.

Conclusion

NPV and IRR both rest on the time value of money and on discounting. NPV shows how much value a project adds in today's money, while IRR shows its return as a percentage and its margin over the cost of capital. When projects differ in size, NPV is the safer guide, and a test at different rates shows how much the decision depends on forecasts. The examples here are illustrations, so facts and figures should be checked before they are applied.

Sources

• Brealey, R. A., Myers, S. C. and Allen, F., Principles of Corporate Finance, McGraw Hill (chapters on net present value and investment criteria). Book without a link; not opened.

• Corporate Finance Institute: Net Present Value (NPV) (formula variables, decision rule) – https://corporatefinanceinstitute.com/resources/valuation/net-present-value-npv/

• Corporate Finance Institute: Internal Rate of Return (IRR) (definition, hurdle rate, scale, duration and reinvestment limits) – https://corporatefinanceinstitute.com/resources/valuation/internal-rate-return-irr/

• The bakery chain, the two lines and all figures are invented for teaching. Present values and IRRs were calculated by us at a ten percent rate.

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