Chapter 8: Investment decision rules

The NPV decision rule

Most companies prefer to measure values in terms of cash today: the present value. The net present value (NPV) of a project or investment is the difference between the present value of the benefits and the present value of the costs.

Net present value (NPV) = PV (benefits) – PV (costs).

The present value is the amount you need to put in the bank today (at the current interest rate) to recreate the cash flow. If the NPV is positive, the decision is a good decision regardless of your current cash needs or preferences regarding when to spend the money. This decision will increase the value of the firm.

The NPV decision rule states: when choosing among investment alternatives, take the alternative with the highest NPV. Choosing this alternative is equivalent to receiving its NPV in cash today.

The NPV decision rule can help by accepting or rejecting a project. According to the NPV decision rule we should accept positive-NPV projects and reject negative-NPV projects. Furthermore, you can use the NPV decision rule to choose among alternatives. You will generally choose the alternative with the highest NPV.

Maximizing NPV should always be the first priority, regardless of the preferences for cash today versus cash in the future. When you maximize the NPV, you can borrow or lend to shift cash flows through time. By doing this, you can find the most preferred pattern of cash flows.

You can compute the future value of a stream of cash flows directly (compute the bank balance each year) or you can compute the present value and move this value to the future.

NPV of a stream

To evaluate an investment decision, the central goal is calculating the NPV of future cash flows. Earlier we defined the NPV as: NPV = PV (benefits) – PV (costs). The benefits are the cash inflows (positive cash flows) and the costs are the cash outflows (negative cash flows).
NPV = PV (benefits) – PV (costs) = PV (benefits – costs).
The NPV of an investment opportunity, is the present value of the stream of cash flows of the opportunity.

Using the NPV rule

The NPV of the project depends on its appropriate cost of capital. When there is some uncertainty regarding the project's cost of capital it may be helpful to compute the NPV profile, a graph of a project's NPV over a range of discount rates. You can also determine the IIR of an investment by constructing the NPV profile. The appropriate cost of capital is very important in the NPV decision. The difference between the cost of capital and the IRR of an investment makes clear the amount of estimation error in the cost of capital estimate that can exist without altering the investment decision.

Alternative decision rules

The NPV is the most accurate and reliable investment decision rule but in practice also other rules are applied. Alternative decision rules may conflict or agree with the NPV decision. When the rules conflict, always base the decision on the NPV. We will focus on two alternative decision rules for single, stand-alone projects within the firm; the payback rule and the IRR rule.

1. The payback investment rule says that only projects that pay back their initial investment within the payback period are undertaken. This is the simplest investment rule. To apply the rule the following steps are undertaken:

- Calculate the payback period: the amount of time until the cash flows from a project offset the initial investment. The time it takes to pay back the initial investment.
- If this period is less than a prespecified length of time, accept the project.
- If this period is greater than the prespecified length of time, reject the project.

The payback investment rule doesn't care about the time value of money, it ignores the cash-flows after the payback period and the rule has no decision criterion which is grounded in economics. Some economics addressed the first failing of the rule by computing the payback period using discounted cash flows. It is called the discounted payback rule; only accept projects where the sum of the discounted cash flows within the payback period is greater than or equal to the initial investment.

2. The internal rate of return (IRR) investment rule is a decision rule that accepts any investment opportunity where the IRR exceeds the opportunity cost of capital and otherwise rejects the opportunity. The IRR shows the sensitivity of the investment decision to uncertainty in the estimation of the cost of capital.

This rule will give the correct answer in many but not in all situations. The IRR is hard to compute. Multiple IRRs can occur, this lead to ambiguity. The IRR cannot be used to choose among projects. If project has got future liabilities, the IRR can be incorrect.

There is a 'solution' for the great disadvantage of multiple IRRs: the modified internal rate of return (MIRR): the discount rate sets the NPV of modified cash flows of a project equal to zero. Cash flows are modified so there is only one negative cash flow (and one sign-change) to ensure that only one IRR exists.

Two other approaches to solve the multiple IRR problem are:

1. Discount all negative cash flows to time 0 and leave the positive cash flows alone.
2. Leave the initial cash flow alone and compound all the remaining cash flows to the final period of the project. In this approach, you are implicitly reinvesting all the cash flows from the project at your compound rate until the project is complete.

Choosing between projects

Managers often have to choose between different investment options. They are facing mutually exclusive projects: projects that compete with one another; by accepting one, you exclude the others. The manager wants to choose only the best one by ranking the projects. In this case, only computing the NPVs isn't

enough. Besides, only computing the IRR can also lead to mistakes: problems will arise when the projects have got differences in scale and differences in the timing of cash flows. In this situation you should always rely on the NPV.

Projects with different lives

When you have to choose among projects with different lives, you need a standard basis of comparison. One method to evaluate project with different lives is the equivalent annual annuity: the level annual cash flows that has the same present value as the cash flow of a project.

- Step one: compute an annuity with an equivalent PV to the NPV of each project

$$Cash\ flow = \frac{PV}{\frac{1}{r}\left[1 - \frac{1}{(1+r)^N}\right]}.$$

- Step two: compare the projects on their cost or value created per year.

When using the equivalent annual annuity you have to think about the: required life and the replacement costs over time.

Choosing among projects when resources are limited

Before, we compared projects with identical resource needs. Now, we will discuss projects with different resource needs (e.g. budgets or max. hour labor). We usually assume that you will be able to finance all positive NPV projects that you have. In reality, managers deal with the constraint of a budget that restricts the amount of capital they may invest in a given period.

In this situation, managers often use the profitability index to help identify the optimal combination of projects to undertake. The *profitability index* measures the NPV per unit of resource consumed.

$$Profitability\ index = \frac{value\ created}{resource\ consumed} = \frac{NPV}{resource\ consumed}$$

Managers choose the set of projects with the highest profitability indices that can still be undertaken given the limited resource. A critic is that the index breaks down when there's more than one resource constraint.