ECON2103: Financial Economics Lecture 7

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This week's topics

- Cash flow risk
- Sales risk
- Operating risk
- Investment and the firm's value
- Independent projects
- Contingent projects
- Complementary projects
- A project's incremental cash flows
- Operating cash flow
- Investment cash flow
- The effect on the value of the company
- Net present value (NPV)
- Economic independence
- Value additivity principle
- Internal rate of return (IRR)
- Required rate of return (RRR)

Investment decisions and owners' wealth maximization

- According to the market value rule, management's goals should be to maximize the market value of the firm in order to maximize the owners' current wealth.
- Not only does the manager need to estimate how much the firm's future cash flows will change if it invests in a project, but the manager must also evaluate the risk associated with these future cash flows.
- We need to understand where these future cash flows come from.
- Their sources are both assets that have been accumulated as a result of all past investment decisions and future investment opportunities.

Cash flow risk

- The firm's value is the present value of all the firm's future cash flows, where the expected values of the future cash flows are discounted at a rate that represents investors' assessments of the risk involved.
- We need to evaluate the risk of these future cash flows, referred to as *cash flow risk*, in order to understand the risk of any investment opportunity on the value of the company.

Two basic risks

- Sales risk: The risk related to the firm's output that will be sold and the price of the goods or services; and
- Operating risk: The risk concerning operating cash flows that arises from the particular mix of fixed and variable operating costs.

How does the investment affect the firm's value?

- Suppose a firm invests in a new project, Project *X*.
- If Project *X* generates cash flows that just compensate the suppliers of capital for the risk they bear on this project, the firm's value does not change.
- If Project *X* generates cash flows greater than the amounts needed to compensate investors for the risk they take on, it earns more than the cost of capital, increasing the firm's value.
- If Project *X* generates cash flows less than needed, it earns less than the cost of capital, decreasing the value of the company.

Capital budgeting

- If the expected change in the value of the company from an investment is:
  - Positive, the project returns more than the cost of capital.
  - Negative, the project returns less than the cost of capital.
  - Zero, the project returns the cost of capital.
- Capital budgeting is the process of identifying and selecting investments in long- lived assets, that is, assets expected to produce benefits over more than one year.

Independent projects

- An independent project is one whose cash flows are not related to the cash flows of any other project.
- Projects are mutually exclusive if the acceptance of one precludes the acceptance of other projects.

Example: decision by a firm

- For example, suppose a manufacturer is considering whether to replace its production facilities with more modern equipment.
- The company may solicit bids among the different manufacturers of this equipment.
- The decision consists of comparing two choices, either keeping its existing production facilities or replacing the facilities with the modern equipment of one manufacturer.
- Because the company cannot use more than one production facility, it must evaluate each bid and choose the most attractive one.

Contingent projects

- Contingent projects are dependent on the acceptance of another project.
- Suppose a greeting card company develops a new character, Pippy, and is considering starting a line of Pippy cards.
- If Pippy catches on, the company will consider producing a line of Pippy T-shirts—but only if the Pippy character becomes popular.
- The T-shirt project is a contingent project.

Complementary projects

- Another form of dependence is found in complementary projects, where the investment in one enhances the cash flows of one or more other projects.
- Consider a manufacturer of personal computer equipment and software.
- If it develops new software that enhances the abilities of a computer mouse, the introduction of this new software may enhance its mouse sales as well.

A project's incremental cash flow

- When a firm invests in new assets, it expects the future cash flows to be greater than without this new investment.
- The difference between the cash flows of the company with the investment project, compared over the same period of time to the cash flows of the company without the investment project, is referred to as the project's incremental cash flows.
- The change in a company's value is the difference between project benefits and costs:

Project's change in the firm's value

= Project's benefits - Project's costs

Another way to evaluate the change

- A second way of evaluating the change in the value of the company is to break down the project's cash flows into two components:

1. The cash flows from the project's operating activities (revenues and operating expenses), referred to as the project's operating cash flows (OCF);
2. The investment cash flows, that is, the expenditures needed to acquire the project's assets and any cash flows from disposing the project's asset.

The effect on the value of the company

The effect on the value of the company can then be expressed as:

Change in the value of the firm

= Present value of the change in operating cash flows provided by the project

+

Present value of investment cash flows

Applying the market value rule to independent projects

- The market value criterion deals with the totality of the firm's investments, not with particular projects comprising it.
- But it is often convenient to assess increments to the firm's assets, and for this purpose we need to understand how incremental investments can contribute to market value.
- By "economic independence" we mean that the net cash flows of an opportunity are not affected by the level of operation of any other opportunities.
- The fact that economically independent projects' values add to the market value of the firm is sometimes referred to as the value additivity principle.

Net present value (NPV)

NPV =

PV of net cash flows from operations over the project's life

—

PV of investment cash outflows over the project's life where PV denotes the present value.

Alternatively, if one computes the net cash flows for each period, the NPV is defined as:

NPV = PV of net cash flows over the project's life.

NPV continued

- We can also break out the initial cash investment outlay and subtract that amount from the present value of the subsequent net cash flows.
- This can be expressed as:

NPV

= PV of net cash flows over the project0s life after the initial investment outlay

—

Initial investment outlay.

A general formulation

Mathematically, the NPV is calculated as:

$$NPV = \sum_{t=1}^{N} CF_t (1+r)^{-t} - I$$

where

$$CF_t = net\ cash\ flow\ for\ period\ t$$

$$I = initial\ investment\ outlay$$

$$N = number\ of\ periods$$

$$r = one - period\ required\ rate\ of\ return\ for\ the\ project$$

Numerical example

Year	*Net cash flow* (CF_t)	*Present value of net cash flow at 10%* $[CF_t (1 + r)^{-t}]$
1	$ 0	$ 0
2	2,000,000	1,652,893
3	3,000,000	2,253,944
4	9,000,000	6,147,121

Numerical example: Calculation

- When I = \$10,000,000 and N = 4,

$$\sum_{t=1}^{4} CF_t (1+r)^{-t} = \$10,053,958$$

- Thus we obtain

NPV = \$10,053,958 - \$10,000,000

= \$53,958

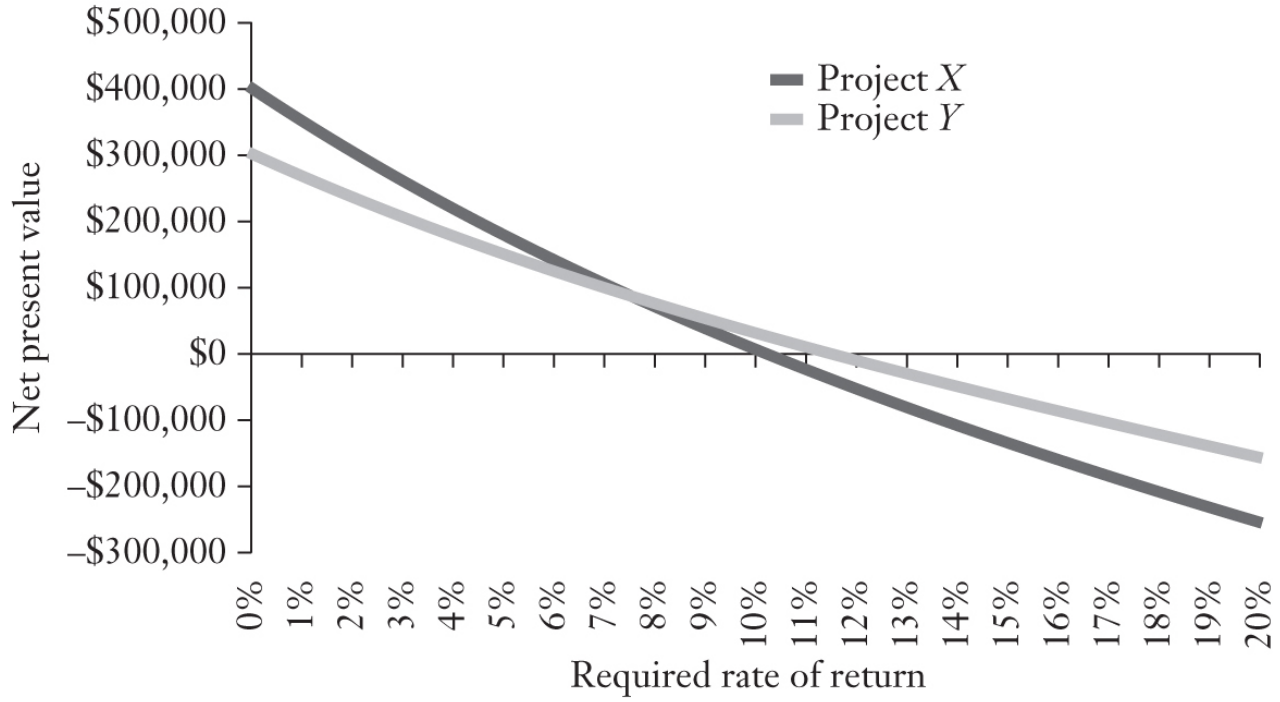
Based on the NPV criterion

If . . .	*then shareholder wealth is expected to . . .*	*and management should . . .*
NPV > $0	project expected to increase shareholder wealth	accept project
NPV < $0	project expected to decrease shareholder wealth	reject project
NPV = $0	keep shareholder wealth unchanged	be indifferent to project

The investment profile

- The investment profile (also known as the net present value profile) is a depiction of the NPVs for different required rates of return, which allows an examination of the sensitivity in how a project's NPV changes as the rate changes.
- The investment profile is a graphical depiction of the relation between the NPV of a project and the discount rate.
- The profile shows the NPV of a project for each rate, within some range.

FIGURE 6.1
INVESTMENT PROFILES OF INVESTMENTS *X* AND *Y*



Internal rate of return

- Another criterion used for selecting investment projects is the internal rate of return (IRR).
- The IRR is the discount rate that makes the sum of the present value of the net cash flows equal to zero.
- Or equivalently, it is the discount rate that makes the NPV equal to zero.
- We can represent the IRR as the discount rate that solves:

$$0 = \sum_{t=1}^{4} CF_t (1+r)^{-t} - I.$$

Alternative definition: interest rate of return

- The IRR for this project is the discount rate that solves:

$$0 = \frac{\$0}{1+IRR} + \frac{\$2m}{(1+IRR)^2} + \frac{\$3m}{(1+IRR)^3} + \frac{\$9m}{(1+IRR)^4} - \$10m$$

- Using a calculator or a computer, we get the answer of *10.172%* per year for Project *X*.
- For Project *Y*, the IRR is equal to *11.388%*.

IRR vs RRR criterion

- A hurdle rate is the minimum acceptable rate of return.
- The required rate of return (RRR), in the context of the IRR, is a hurdle rate.

If ...	*then shareholder wealth is expected to ...*	*and management should ...*
IRR > RRR	project expected to increase shareholder wealth	accept project
IRR < RRR	project expected to decrease shareholder wealth	reject project
IRR = RRR	keep shareholder wealth unchanged	be indifferent to project

The IRR Criterion and Mutually Exclusive Projects

- When evaluating mutually exclusive projects, the project with the highest IRR may not be the one with the largest NPV as we have just shown.
- The IRR method assumes cash flows may be reinvested at the IRR, while the NPV method assumes cash flows may be reinvested at the required rate of return.
- If the reinvestment rate is assumed to be the required rate of return, then evaluating projects on the basis of the NPV means selecting projects that maximize owners' wealth.

Multiple interest rate of return

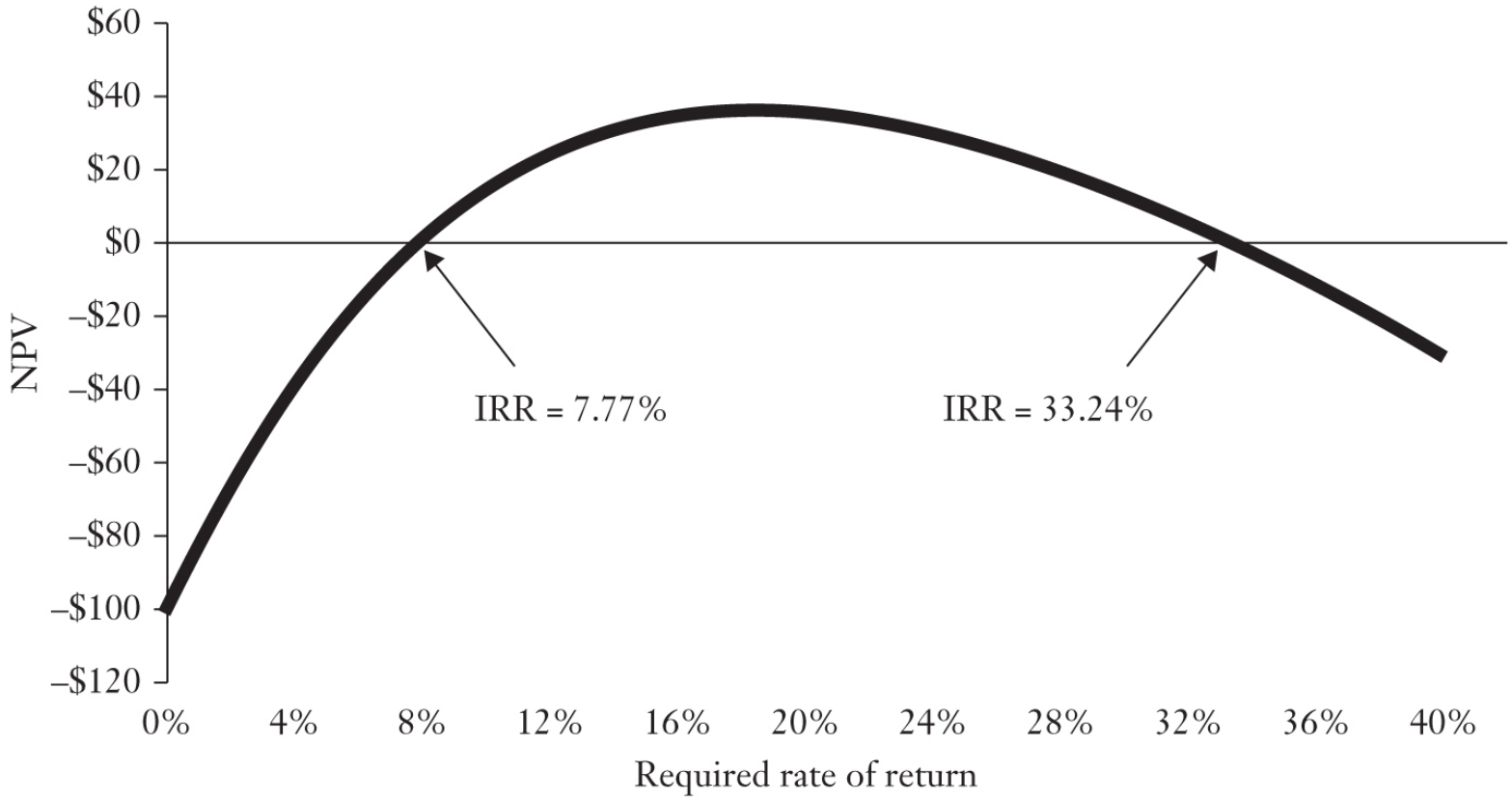
- The typical project usually involves only one large negative cash flow initially, followed by a series of future positive cash flows. But that's not always the case.
- Suppose management is considering a project that uses environmentally sensitive chemicals.
- Suppose we are considering a three-year project requiring an initial investment outlay of $100 million that has net cash flows:

Year	*Net Cash Flow ($)*
1	+100 million
2	+ 50 million
3	−210 million

What is this project's IRR?

- One possible solution is IRR = 7.77%, yet another possible solution is IRR = 33.24%.
- Both IRRs will make the NPV equal to zero.
- The IRR is the discount rate that causes the NPV to be zero.
- In Figure 6.2, the IRR is the discount rate where the NPV is zero, the point at which the present value changes sign—from positive to negative or from negative to positive.
- In the case of this project, the present value changes from negative to positive at 7.77% and from positive to negative at 33.24%

FIGURE 6.2
THE CASE OF MULTIPLE IRRS



Key points 1

- One of the most important strategic functions in managing a firm is the evaluation of capital projects.
- Decisions relating to a firm's capital projects are known as capital budgeting decisions.
- Capital budgeting decisions commit funds for a time period longer than one year and may have an impact on a firm's strategic position within its industry.
- In making firms' investment decisions, management should seek to maximize the market value of the firm in order to maximize the owners' current wealth.

Key points 2

- Classifying capital projects along different dimensions (that is, economic life, risk, and dependence on other projects) is helpful because these characteristics affect the analysis of the projects.
- Investment projects can be classified according to their degree of dependence as independent projects, mutually exclusive projects, contingent projects, and complementary projects.
- The net present value method calculates the present value of the project's expected cash flows.
- The internal rate of return is the yield on the investment.