

Course: Corporate Finance.

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## *Session 4*

# Investment Decision Tools

## Measuring investment worth

Several methods of evaluating investment projects are used by financial managers, including:

1. Payback period,
  2. Net Present Value (NPV),
  3. Internal Rate of Return (IRR),
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# 1. Payback period

- The length of time it will take the company to recover its initial investment.
- When cash inflows are equal, the payback period is computed by dividing the initial investment by the cash inflows generated by the project.
- When cash inflows are not even, you must find the payback period by trial and error.

**Example 1:** Assume: Cost of investment = €18,000

Annual cash flows = €3,000

Payback period?

Payback period =  $18,000 / 3,000 = 6$  years.

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**Example 2:** Consider to projects with uneven after-tax cash inflows. Assume each project costs €1,000

	Cash Inflow	
Year	A(€)	B(€)
1	100	500
2	200	400
3	300	300
4	400	100
5	500	
6	600	

Payback period of each project?

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Project A:  $1,000 = 100 + 200 + 300 + 400 \square 4 \text{ years}$

Project B:  $1,000 = 500 + 400 + 100 \square 2 \text{ years} + 100/(300/12)$   
 $= 2 \text{ years and } 4 \text{ months}$

Payback period B < Payback period A  $\square$  Project B is the project of choice in this case.

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## 2. Net present Value (NPV)

- The NPV is the excess of the present value (PV) of future cash inflows to be generated by the project over the amount of the initial investment (I):

$$\text{NPV} = \text{PV} - \text{I}$$

- The NPV is computed using the so called the discount rate.
  - If NPV is *positive*, you should *accept* the project.
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**Example 3:** Consider the following investment:

Initial investment = €12,950

Estimated life = 10 years,

Annual cash inflows = €3,000

Cost of capital = 12%

NPV?

$PV = € 16,950$

□  $NPV = PV - I = €4,000$

□ Since the NPV is positive, the investment should be accepted.

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### 3. Internal rate of return (IRR)

- The IRR is defined as the rate that equates the initial investment  $I$  with the present value (PV) of future cash inflows. In other words, at IRR,  $I = PV$  or  $NPV = 0$ .
- Generally you should accept the project if the IRR exceeds the cost of capital.

**Example 4:** Consider the following investment:

Initial investment = €12,950

Estimated life = 10 years,

Annual cash inflows = €3,000

Cost of capital = 12%

IRR?

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For  $r = 12\% \rightarrow NPV = 4,000$

For IRR  $\rightarrow NPV = 0$

$\rightarrow$  Try to find a rate that results in a negative NPV (trial and error).

For example, for  $r = 20\% \rightarrow NPV = -372.58$

$\rightarrow$  Linear interpolation:  $\frac{12\% - IRR}{12\% - 20\%} = \frac{4,000 - 0}{4000 - (-372.58)} \rightarrow IRR \approx 19.31\% \rightarrow$  Not providing a precise IRR.

$\rightarrow$  A computer can help.

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### 3.1. Applying the IRR rule

- The IRR investment rule will give the correct answer (that is, the same answer as the NPV rule) in many—but not all—situations.
  - In fact, *the IRR rule is only guaranteed to work for a stand-alone project if all of the project's negative cash flows precede its positive cash flows.*
  - If this is not the case, the IRR rule can lead to incorrect decisions.
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### 3.1.1. Pitfall 1

John Star, the founder of SuperTech, a successful company in the last 20 year, has just retired as CEO. A major publisher has offered to pay Star \$1 million upfront if he agrees to write a book about his experiences. He estimates that it will take him three years to write the book. The time that he spends writing will cause him to forgo alternative sources of income amounting to \$500,000 per year. Considering the risk of his alternative income sources and available investment opportunities, Star estimates his opportunity cost of capital to be 10%.

- 1) What is the NPV of the book deal? Should Star sign the book deal?
- 2) What is the IRR (use linear interpolation)? Should Star sign the book deal?

### Answer



### 3.1.1. Pitfall 1

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- 1) What is the NPV of the book deal? Should Star sign the book deal?
- 2) What is the IRR (use linear interpolation)? Should Star sign the book deal?

### Answer

1)

$$NPV = 1,000,000 - \frac{500,000}{1.1} - \frac{500,000}{1.1^2} - \frac{500,000}{1.1^3} = -\$243,426$$

☐ He should not sign the book deal.

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- 1) What is the NPV of the book deal? Should Star sign the book deal?
- 2) What is the IRR (use linear interpolation)? Should Star sign the book deal?

### Answer

- 2)  $IRR \approx 23.38\%$



**The IRR rule fails!**

- ☐ He should sign the book deal.

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### Answer

**One possible explanation:** Generally, the IRR can be viewed as the return from the investment opportunity. In Star's case, he gets cash upfront and incurs the costs of producing the book later.

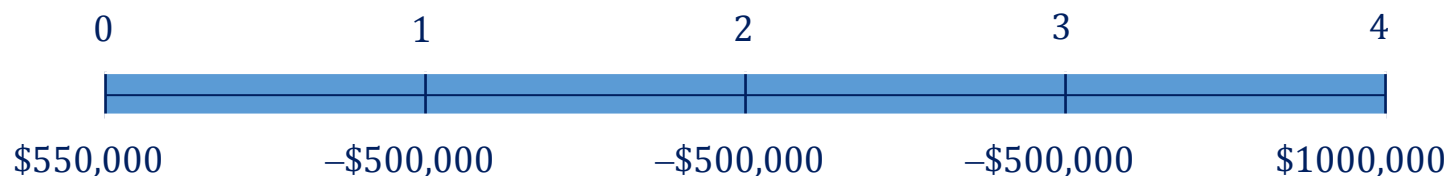
- It is if Star borrowed money—receiving cash today in exchange for a future liability—and when you borrow money you prefer as **low** a rate as possible.
  - In this case, the IRR is best interpreted as the rate Star is paying rather than earning.
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### 3.1.2. Pitfall 2

Star has informed the publisher that it needs to sweeten the deal before he will accept it. In response, the publisher offers to give him a royalty payment when the book is published in exchange for taking a smaller upfront payment. Specifically, Star will receive \$1 million when the book is published and sold *four years from now*, together with an upfront payment of \$550,000.

- 1) What is the NPV of the new offer if  $r = 7.164\%$  and if  $r = 33.673\%$ ?
- 2) Can we apply the IRR rule in this example?

### Answer



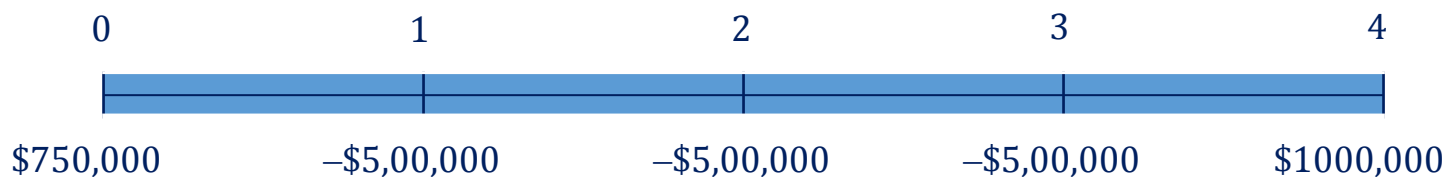
- 1) There are two IRRs!
  - 2) We cannot apply the IRR rule.
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- There are situations in which more than two IRRs exist.
- When multiple IRRs exist, our only choice is to rely on the NPV rule.

### 3.1.3. Pitfall 3

After protracted negotiations, Star is able to get the publisher to increase his initial payment to \$750,000, in addition to his \$1 million royalty payment when the book is published in four years. What is the IRR?

### Answer



With these cash flows, no IRR exists! □ There is no discount rate that makes the NPV equal to zero!

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## Exercise 1

You are considering investing in a project at a cost of \$350,000. You expect the project to return equal cash flows of \$45,000 per year over the next nine years. What is the project's payback period (in years, months and days)?

## Exercise 2

Consider the following project (a machine):

Cost of the project today: € 700,000

Year 1 Cash Flow: € 100,000

Year 2 Cash Flow: € 110,000

Year 3 Cash Flow: € 230,000

Year 4 Cash Flow: € 280,000

Year 5 Cash Flow: € 190,000

- 1) If the current interest rate is 8.00%, and you will sell the machine at €20,000 at the end of year 5, what is the NPV of this project?
  - 2) If the current interest rate is 8.00%, and instead of paying 700,000 today (year 0), you pay 400,000 at the end of years 4 and 5, what is the NPV of this project?
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## Exercise 3

Consider a project that will require a payment of €2,500,000 today, and will generate €400,000 at the end of each of the next 10 years. The project cannot be sold at the end of the last year. The discount rate is 7.50%. *Consider only two decimals.*

- a)** What is the project's Net Present Value (NPV)?
  - b)** What is the project's Payback Period (in years, months and days, assuming 30 days for each month)?
  - c)** What is the project's Internal Rate of Return (IRR)?
  - d)** Based on the NPV and the IRR, will you accept this project?
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## Exercise 4

You are considering investing in a start up project at a cost of \$400,000. You expect the project to return \$1,500,000 to you in five years (which means ONE cash flow of \$1,500,000 at the end of year 5). Given the risk of this project, your cost of capital is 20%.

- a) What is the project's Net Present Value (NPV)? Show calculation steps and consider only two decimals.
  - b) What is the project's Internal Rate of Return (IRR)?
  - c) What is the decision you should take regarding this project?
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