CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II
FINANCE AND BANKING

Introduction to Corporate Finance: Net Present Value and Other Investment Rules

Readings:

Hillier et al., Chapter 6

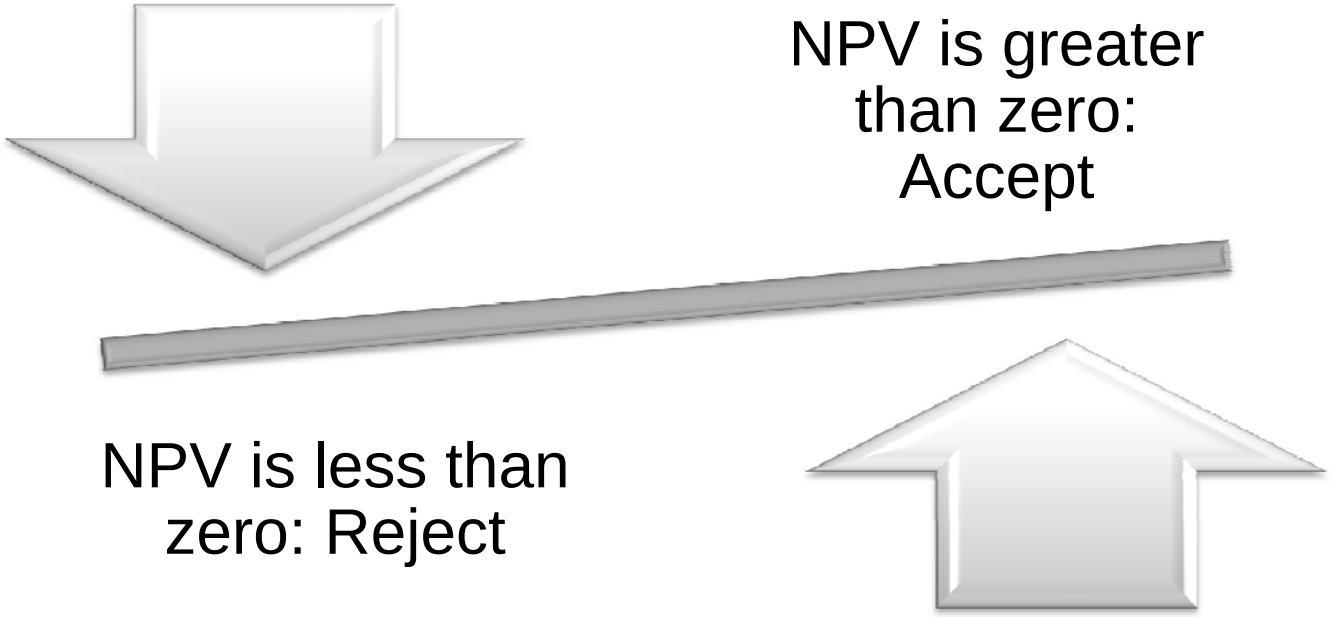
Overview of Lecture

- Why Use NPV?
- The Payback Period Method
- The Discounted Payback Period
- The Average Accounting Return Method
- The Internal Rate of Return
- Problems with the IRR Approach
- The Profitability Index
- The Practice of Capital Budgeting

Capital Budgeting

- The process of deciding whether to accept or reject a project is called capital budgeting.
- In this chapter, we will discuss several capital budgeting techniques used in practice, and compare them to the NPV rule.

NPV Investment Rule



Example 6.1: Net Present Value

- Alpha Corporation is considering investing in a riskless project costing £100. The project receives £107 in one year and has no other cash flows. The discount rate is 6 percent.
- What is the NPV of the project?

$$£.94 = -£100 + \frac{£107}{1.06} \qquad \textbf{(6.1)}$$

Strengths of NPV

CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II
FINANCE AND BANKING

Uses Cash Flows

- Cash Flows are better than Earnings

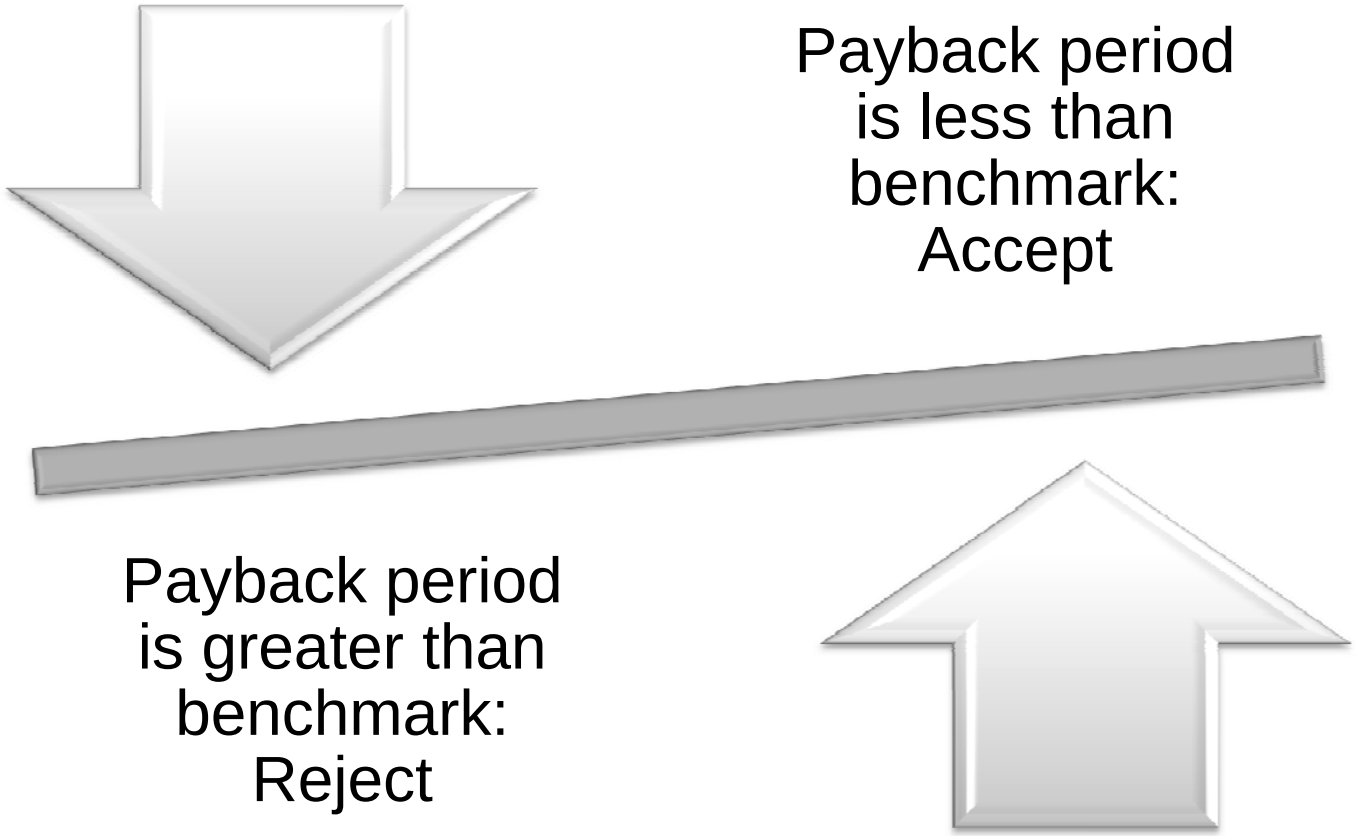
Uses all Cash Flows

- Other approaches ignore cash flows beyond a certain date

Discounts Cash Flows

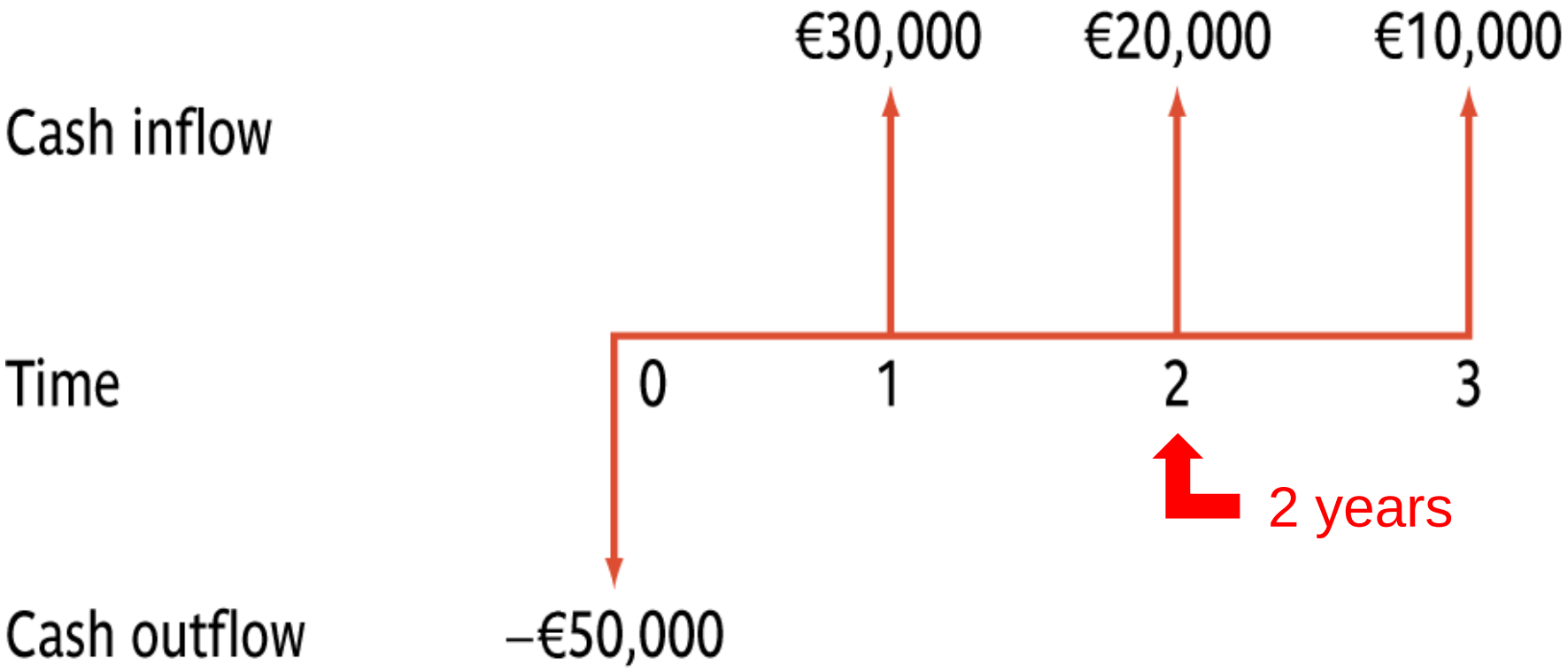
- Fully incorporates the time value of money

The Payback Period Method



Payback Period Example

What is the payback period of the following cash flow stream?



Problems with the Payback Period

CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II
FINANCE AND BANKING

Timing of cash flows

Payments after the payback period

Arbitrary standard for the payback period

Problems with the Payback Period

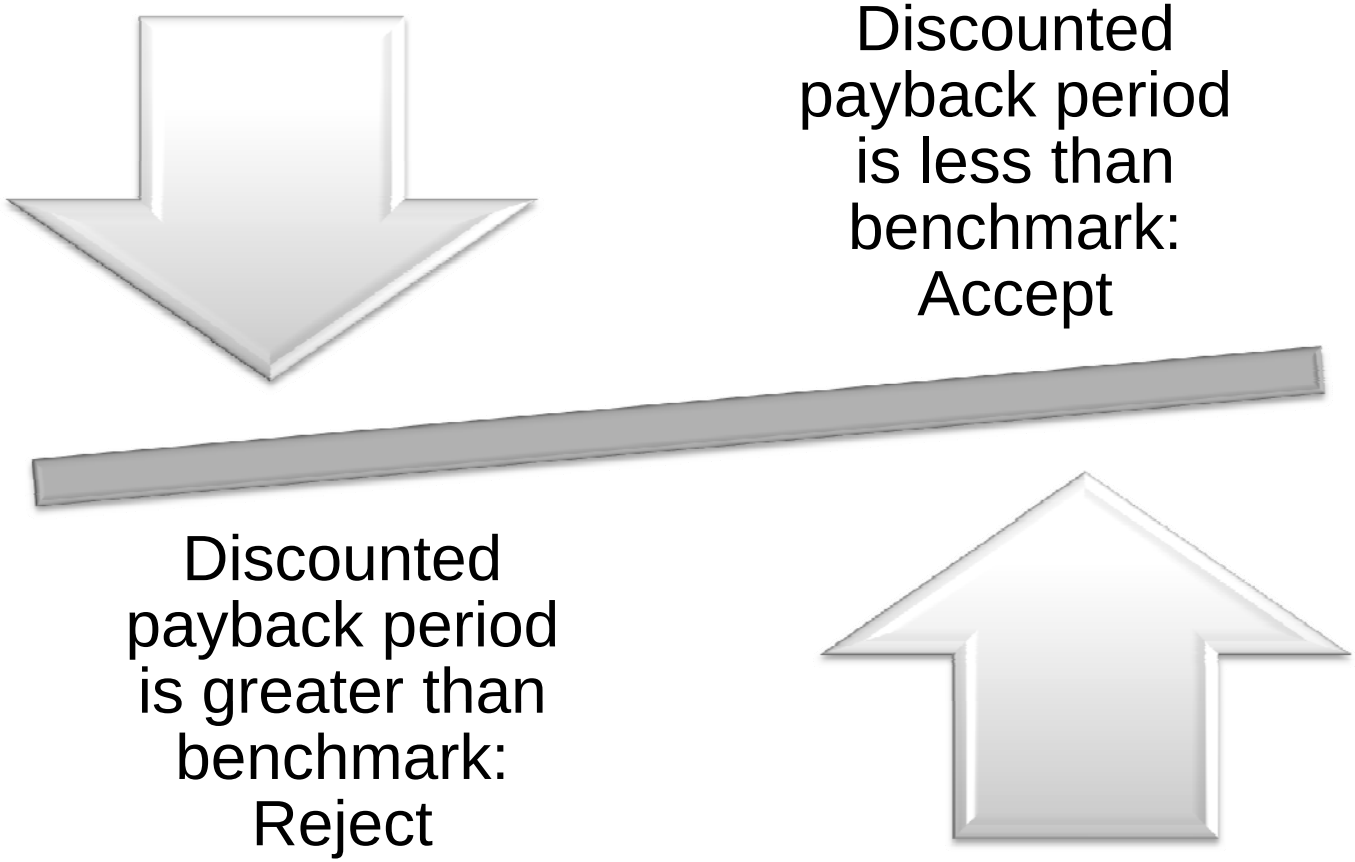
CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II
FINANCE AND BANKING

Year	*A*	*B*	*C*
0	–£100	–£100	–£100
1	20	50	50
2	30	30	30
3	50	20	20
4	60	60	60,000
Payback period (years)	3	3	3

Summary of Payback Period

- Simple to understand
- Easy to use
- May sometimes be acceptable as a heuristic
  - for (very) small scale investments, or
  - in firms with severe capital rationing
- Can, however, lead to decisions that do not maximise shareholder wealth

Discounted Payback Period



Idea, Strengths and Weaknesses of Discounted Payback Period

CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II FINANCE AND BANKING

Idea

- Same as payback method, but we use discounted cash flows to calculate payback period

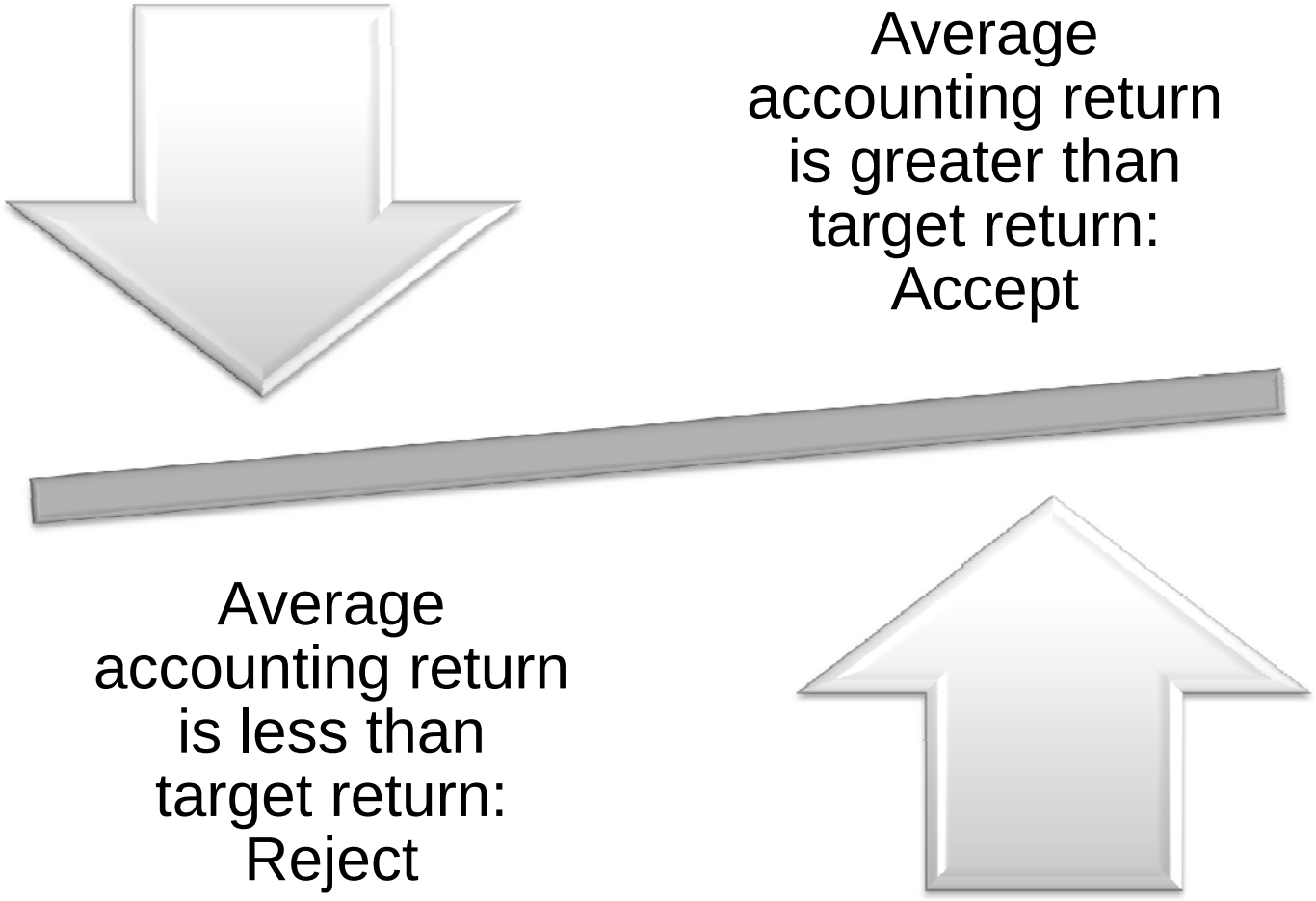
Strengths

- Simple
- Uses time value of money

Weaknesses

- Ignores cash flows beyond benchmark
- Arbitrary benchmark

The Average Accounting Return Method (AAR)



Example 6.2: Average Accounting Return

- Consider a company that is evaluating whether to buy a store in a new shopping centre. The purchase price is £500,000.
- We will assume that the store has an estimated life of five years and will need to be completely scrapped or rebuilt at the end of that time.
- For simplicity sake, we assume that the asset will be depreciated using straight-line depreciation.
- The target return on new investments is 15 percent.

Example 6.2: Average Accounting Return

	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue	£433,333	£450,000	£266,667	£200,000	£133,333
Expenses	200,000	150,000	100,000	100,000	100,000
Before-tax cash flow	233,333	300,000	166,667	100,000	33,333
Depreciation	100,000	100,000	100,000	100,000	100,000
Profit before taxes	133,333	200,000	66,667	0	– 66,667
Taxes (t_c=. 25)*	33,333	50,000	16,667	0	– 16,667
Net income	£100,000	£150,000	£ 50,000	£ 0	–£ 50,000

*Corporate tax rate $= t_c$. The tax rebate in year 5 of – £16,667 occurs if the rest of the firm is profitable. Here the loss in the project reduces the taxes of the entire firm.

Example 6.2: Average Accounting Return

CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II
FINANCE AND BANKING

Step 1

- Determine average net income

Step 2

- Determine average investment

Step 3

- Determine average accounting return

Example 6.2: Average Accounting Return

CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II
FINANCE AND BANKING

Step 1: Determine average net income

(£100,000 + 150,000 + 50,000 + 0 –50,000)/5 = £50,000

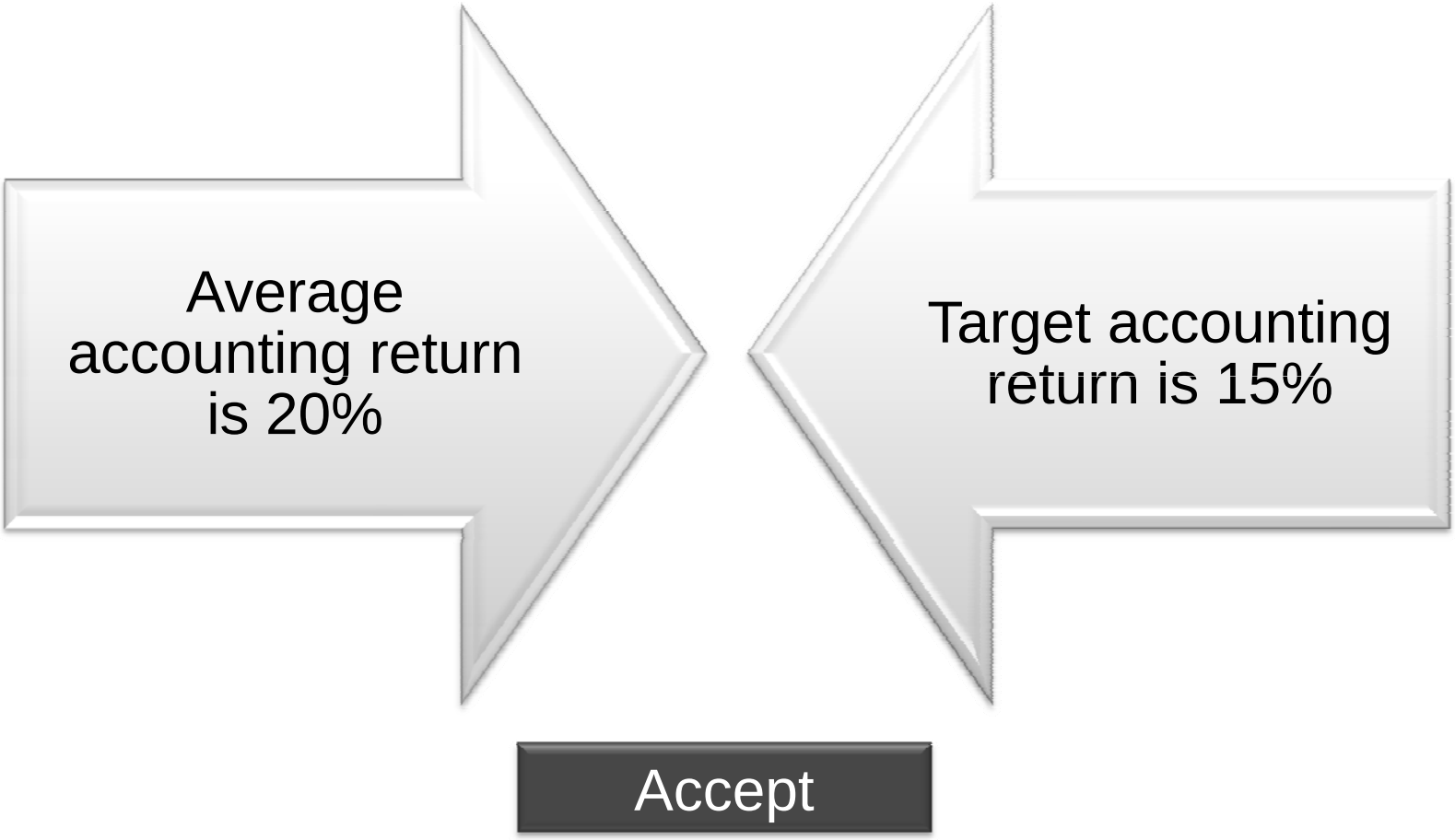
Step 2: Determine average investment

(£500,000 + 400,000 + 300,000 + 200,000 + 100,000 + 0) / 6 = £250,000

Step 3: Determine average accounting return

AAR = £50,000 / £250,000 = 20%

Example 6.2: Average Accounting Return



Strengths and Weaknesses of the Average Accounting Return

CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II
FINANCE AND BANKING

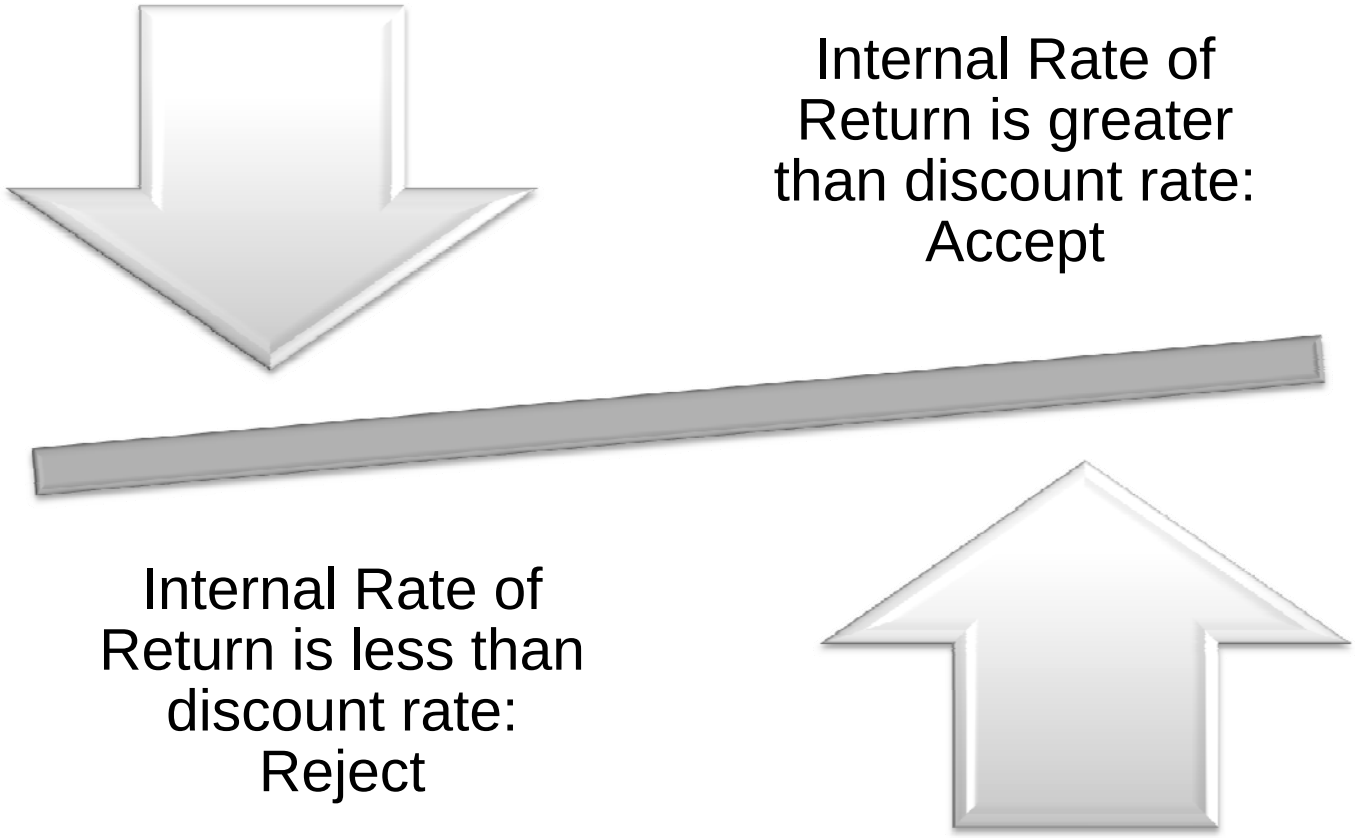
Strengths

- Simple return based measure

Weaknesses

- Does not use cash flows
- Does not use time value of money
- Arbitrary target rate

The Internal Rate of Return (IRR)



The Internal Rate of Return Rule

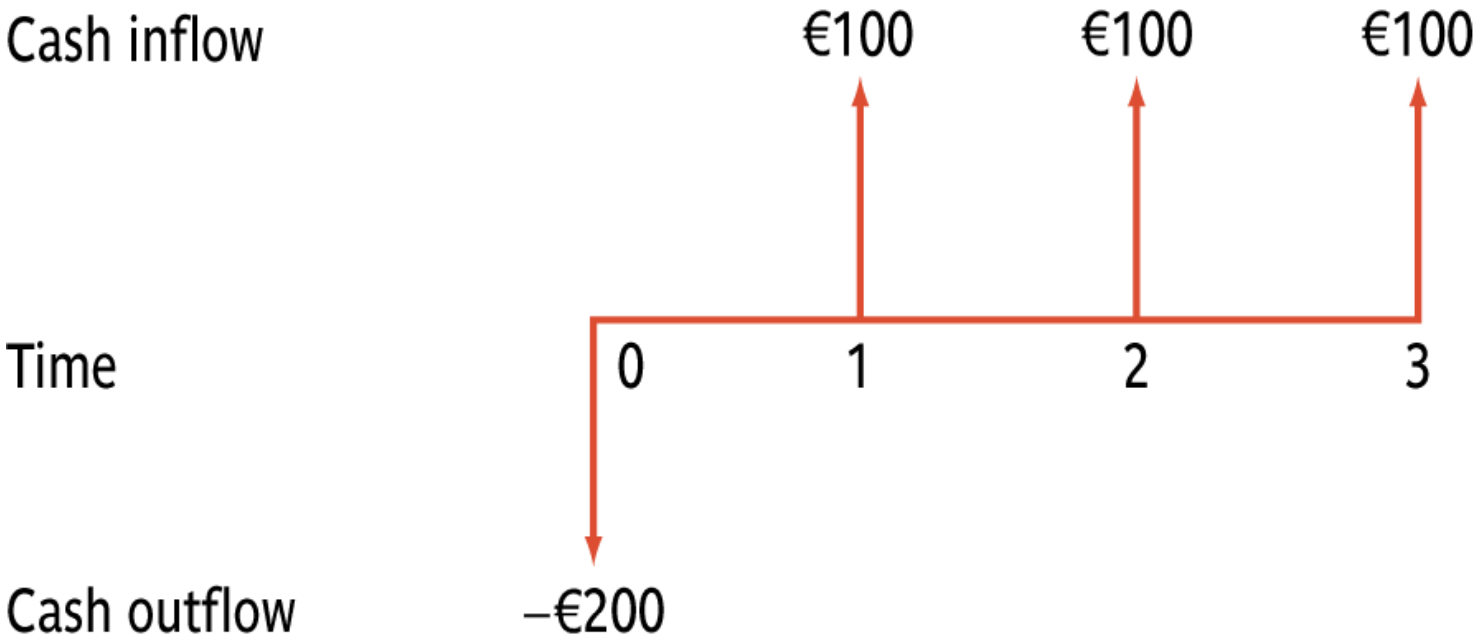
Consider the simple project (–£100, £110)

Task:
Find IRR that sets NPV equal to zero

$$\text{NPV} = -£100 + \frac{£110}{1+R}$$

$$0 = -£100 + \frac{£110}{1.10}$$

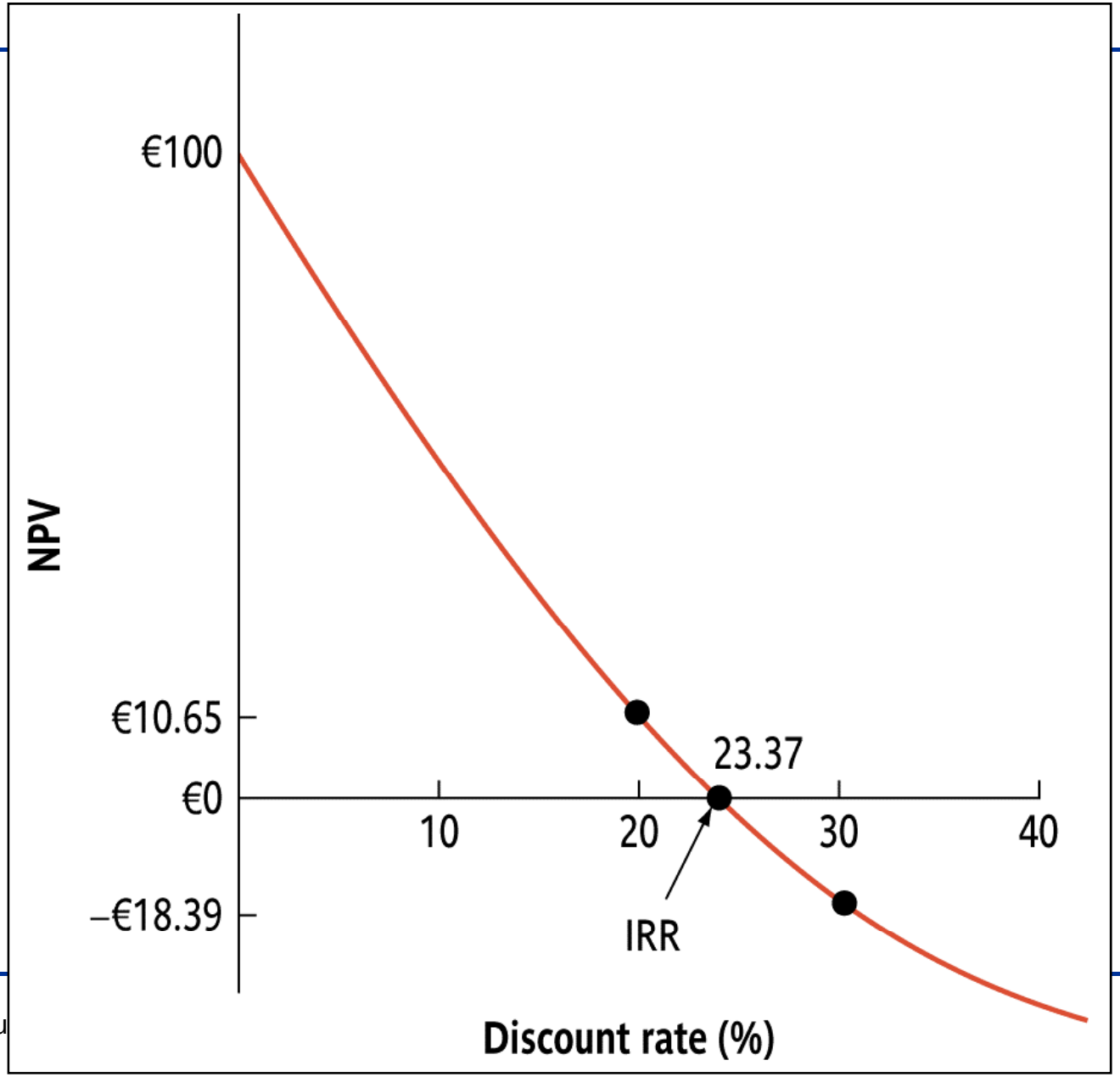
IRR: A More Complex Example



$$0 = -€200 + \frac{€100}{1+\text{IRR}} + \frac{€100}{(1+\text{IRR})^2} + \frac{€100}{(1+\text{IRR})^3}$$

⇨ Use “Trial and Error”

IRR: A More Complex Example



Some Important Definitions

Independent Project

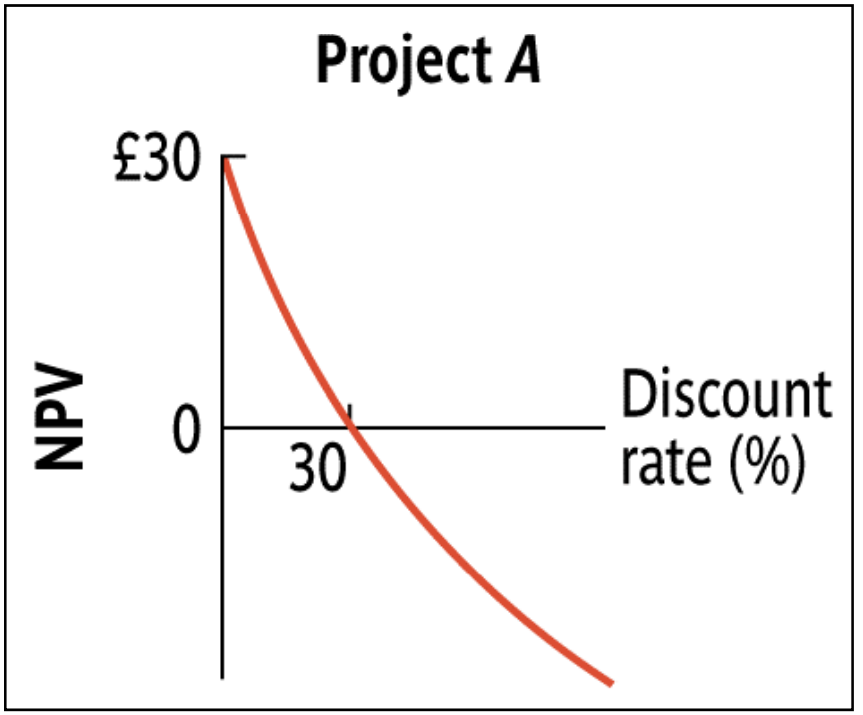
- An independent project is one whose acceptance or rejection is independent of the acceptance or rejection of other projects.

Mutually Exclusive Projects

- With mutually exclusive projects, you can accept *A* or you can accept *B* or you can reject both of them, but you cannot accept both of them.

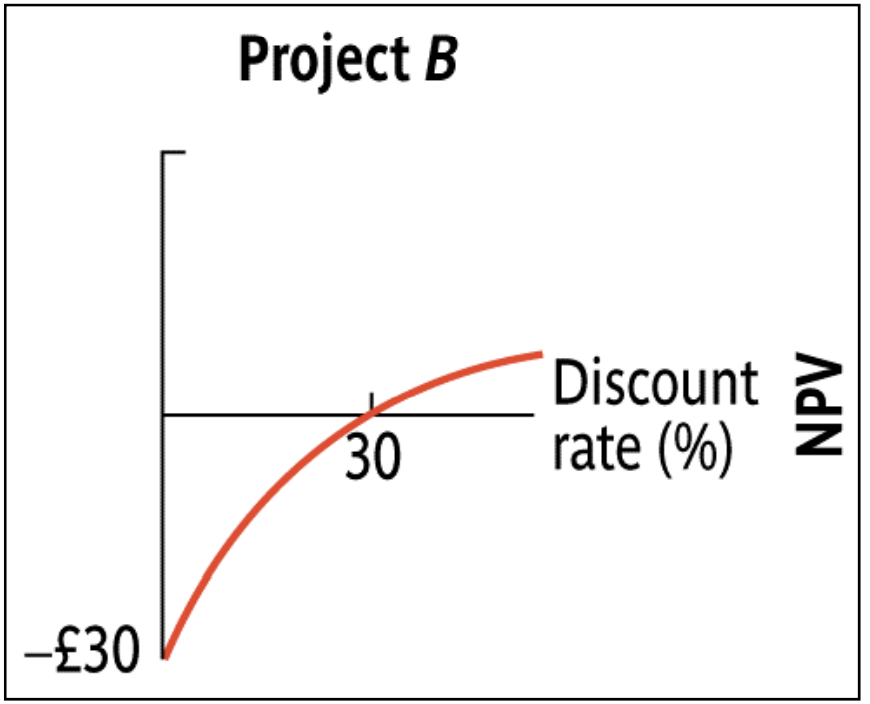
Some Problems with IRR: Investment

	Project *A*		
Dates:	**0**	**1**	**2**
Cash flows	–£100	£130	
IRR		30%	
NPV @10%		£18.2	
Accept if market rate		<30%	
Financing or investing		Investing	



Some Problems with IRR: Financing

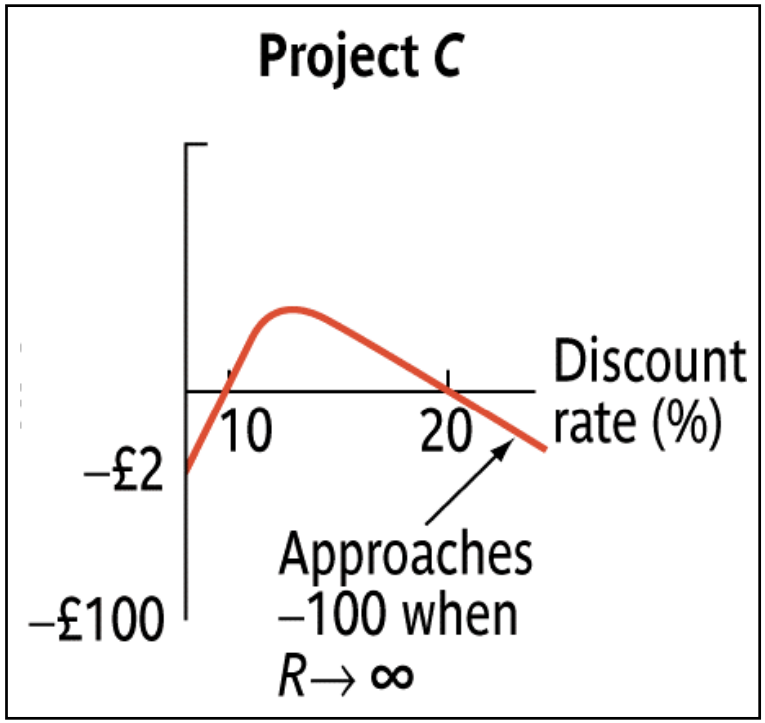
	Project *B*		
Dates:	**0**	**1**	**2**
Cash flows	£100	–£130	
IRR		30%	
NPV @10%		–£18.2	
Accept if market rate		>30%	
Financing or investing		Financing	



Some Problems with IRR: Mixed Cash Flows

CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II
FINANCE AND BANKING

	Project *C*		
Dates:	**0**	**1**	**2**
Cash flows	–£100	£230	–£132
IRR	10%	and	20%
NPV @10%		0	
Accept if market rate	>10%	but	<20%
Financing or investing		Mixture	



General Investment Rules: IRR and NPV

1st cash flow negative; remaining cash flows positive	• Number of IRRs: 1 • Accept if IRR > R; reject if IRR < R • Accept if NPV > 0; reject if NPV < 0
1st cash flow positive; remaining cash flows negative	• Number of IRRs: 1 • Accept if IRR < R; reject if IRR > R • Accept if NPV > 0; reject if NPV < 0
Mixture of positive and negative cash flows	• Number of IRRs: May be more than 1 • No valid IRR • Accept if NPV > 0; reject if NPV < 0

IRR Problems Specific to Mutually Exclusive Projects

CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II
FINANCE AND BANKING

Scale of cash flows

- IRR ignores scale of cash flows

Timing of cash flows

- IRR ignores timing of cash flows

Example 6.3: NPV versus IRR in Case of Differences in Scale

CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II
FINANCE AND BANKING

- Stanley Jaffe and Sherry Lansing have just purchased the rights to *Corporate Finance: The Motion Picture*. They will produce this major motion picture on either a small budget or a big budget. Here are the estimated cash flows:

	Cash flow at date 0	**Cash flow at date 1**	**NPV @25%**	**IRR**
Small budget	–$10 million	$40 million	$22 million	300%
Large budget	– 25 million	65 million	27 million	160

- Because of high risk, a 25 percent discount rate is considered appropriate. Sherry wants to adopt the large budget because the NPV is higher. Stanley wants to adopt the small budget because the IRR is higher. Who is right?

Incremental IRR

- When scale is an issue, calculate the incremental cash flows and determine IRR from them:

	Cash flow at date 0 (in $ millions)	Cash flow at date 1 (in $ millions)
Incremental cash flows from choosing large budget instead of small budget	–$25 – (– 10) = –$15	$65 – 40 = $25

$$0 = -\$15 \text{ million} + \frac{\$25 \text{ million}}{1+IRR} \quad \Rightarrow IRR = 66.67\%$$

⇨ I.e., IRR > 25%, so the large-budget movie should be made

Example 6.4: NPV versus IRR in Case of Differences in Cash Flow Timing

CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II FINANCE AND BANKING

Year:	0	1	2	3
Investment *A*	–£10,000	£10,000	£1,000	£1,000
Investment *B*	-10,000	1,000	1,000	12,000

	NPV			
Year:	**@0%**	**@10%**	**@15%**	**IRR**
Investment *A*	£2,000	£669	£109	16.04%
Investment *B*	4,000	751	–484	12.94

						Incremental NPV		
Year:	**0**	**1**	**2**	**3**	**Incremen-tal IRR**	**@0%**	**@10%**	**@15%**
B – *A*	£0	-£9,000	£0	£11,000	10.55%	£2,000	£83	–£593

A General Rule with Mutually Exclusive Investments

CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II
FINANCE AND BANKING

- To avoid issues such as timing and scale, use
  - NPV
  - Incremental NPV or
  - Incremental IRR

- I.e., do not use standard IRR

The Profitability Index

Definition of profitability index (PI):

$$PI = \frac{\text{PV of cash flows } \textit{subsequent to} \text{ initial investment}}{\text{Initial investment}}$$

Example 6.5: Profitability Index

- Hiram Finnegan Int. (HFI) applies a 12 percent discount rate to two investment opportunities.

Project	Cash flows (€000,000) C_0	C_1	C_2	PV @ 12% of cash flows sub-sequent to initial investment (€000,000)	PI	NPV @12% (€000,000)
1	–€20	€70	€10	€70.5	3.53	€50.5
2	– 10	15	40	45.3	4.53	35.3

Application of the Profitability Index

CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT II
FINANCE AND BANKING

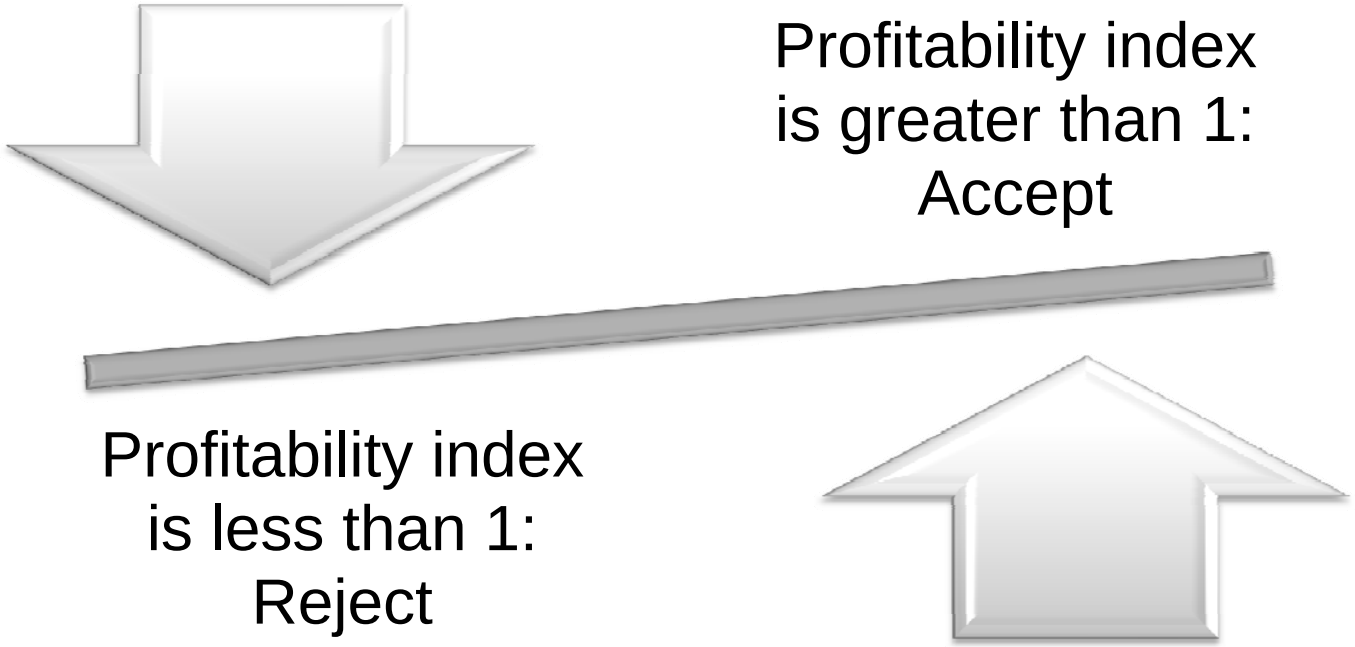
Independent Projects

Mutually Exclusive Projects

Capital Rationing

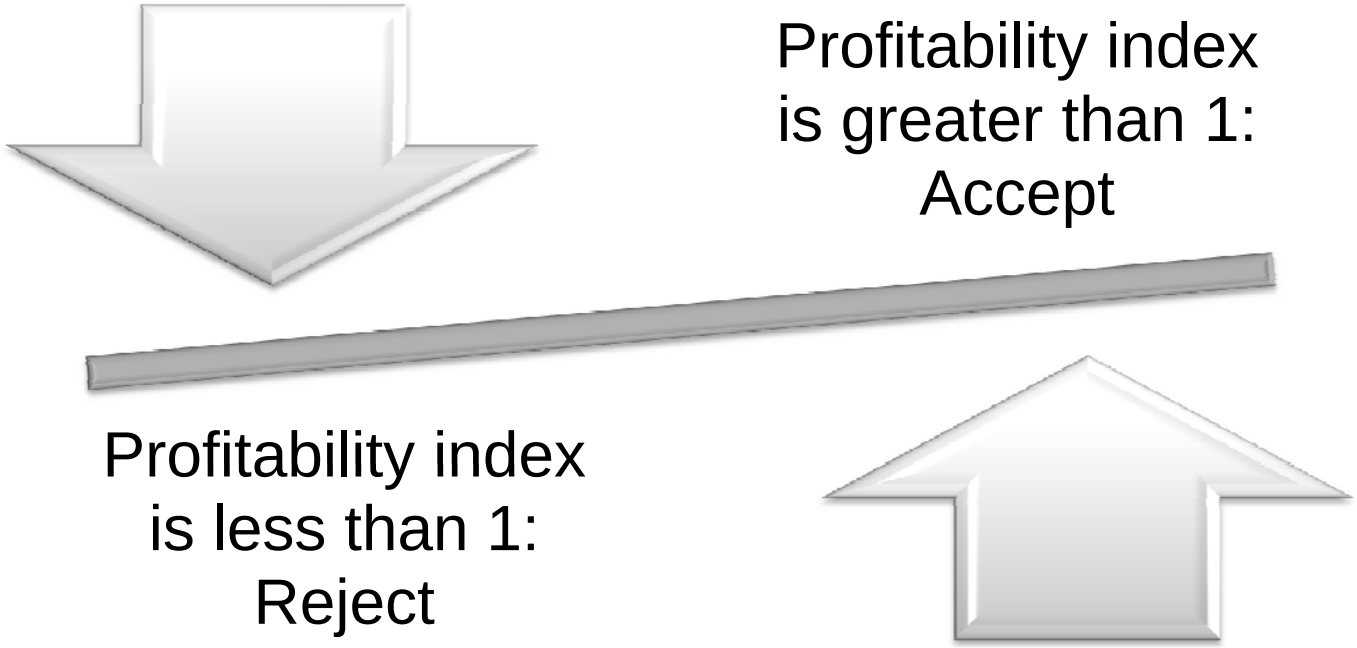
Profitability Index: Independent Projects

- Decision rule in case of independent projects:



Profitability Index: Mutually Exclusive Projects

- Like IRR, the PI approach ignores scale. Thus, if projects are mutually exclusive, use **incremental cash flows**
- Decision rule based on incremental cash flows:



Profitability Index: Capital Rationing

Capital rationing occurs when there is not enough cash to invest in all positive NPV projects

Under capital rationing you cannot rank projects according to NPV

Should use profitability index or incremental NPV

Example 6.5 Continued: Capital Rationing Example

- You only have €20 million to invest:

Project	Cash Flows (€000,000) C_0	C_1	C_2	Profitability Index	NPV @12% (€000,000)
1	–€20	€70	€10	3.53	€50.5
2	–10	15	40	4.53	€35.3
3	–10	–5	60	4.34	€33.4

- Can invest in 1, 2, 3, (2 + 3).

The Practice of Capital Budgeting

	US	UK	The Netherlands	Germany	France
Net present value	74.93	46.97	70.00	47.58	35.09
Internal rate of return	75.61	53.13	56.00	42.15	44.07
Accounting rate of return	20.29	38.10	25.00	32.17	16.07
Profitability index	11.87	15.87	8.16	16.07	37.74
Payback period	56.74	69.23	64.71	50.00	50.88
Discounted payback	29.45	25.40	25.00	30.51	11.32
Hurdle rate	56.94	26.98	41.67	28.81	3.85
Sensitivity analysis	51.54	42.86	36.73	28.07	10.42
Real options	26.56	29.03	34.69	44.04	53.06

Source: Table 2 from D. Brounen, A. de Jong and K. Koedijk, 'Corporate finance in Europe: confronting theory and practice', *Journal of Banking and Finance* (2006), vol. 30, no. 5, 1409 – 1442.

Overview of Lecture

- Why Use NPV?
- The Payback Period Method
- The Discounted Payback Period
- The Average Accounting Return Method
- The Internal Rate of Return
- Problems with the IRR Approach
- The Profitability Index
- The Practice of Capital Budgeting