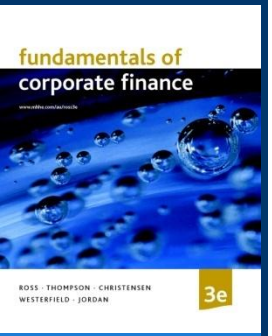
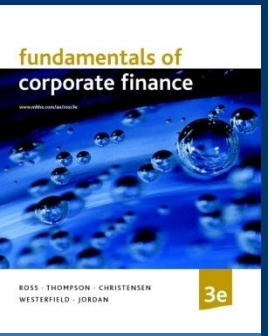


Chapter Seven

Capital Budgeting techniques



Chapter Organization

7.1 capital budgeting: definition & process

7.2 Classification of investment projects

7.3 Net Present Value

7.4 The Payback Rule

7.5 The Discounted Payback Rule

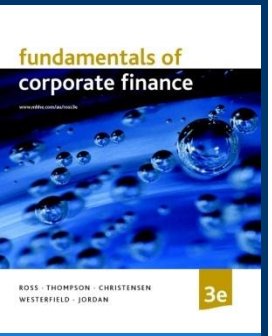
7.6 The Accounting Rate of Return

7.6 The Internal Rate of Return

7.7 The Present Value Index

7.8 The Practice of Capital Budgeting

7.9 Test Questions and True/False Questions

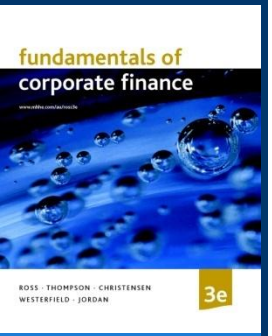


Chapter Objectives

- define the capital budgeting decision within the broader perspective of financial management.
- classify investment projects on the basis of how they influence the investment decision process
- Discuss the various investment evaluation techniques, including their advantages and disadvantages.
- Apply these techniques to the evaluation of projects.
- Interpret the results of the application of these techniques in accordance with their respective decision rules.
- Understand the importance of net present value.

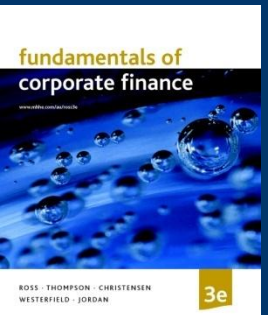
Capital budgeting: an overview

- Financial management is largely concerned with financing, dividend and investment decisions of the firm with some overall goal in mind.
- Corporate finance theory has developed around a goal of maximizing the market value of the firm to its shareholders. This is also known as shareholder wealth maximization.
- Financing decisions deal with the firm's optimal capital structure in terms of debt and equity.
- Dividend decisions relate to the form in which returns generated by the firm are passed on to equity-holders.
- Investment decisions deal with the way funds raised in financial markets are employed in productive activities to achieve the firm's overall goal; in other words, how much should be invested and what assets should be invested in

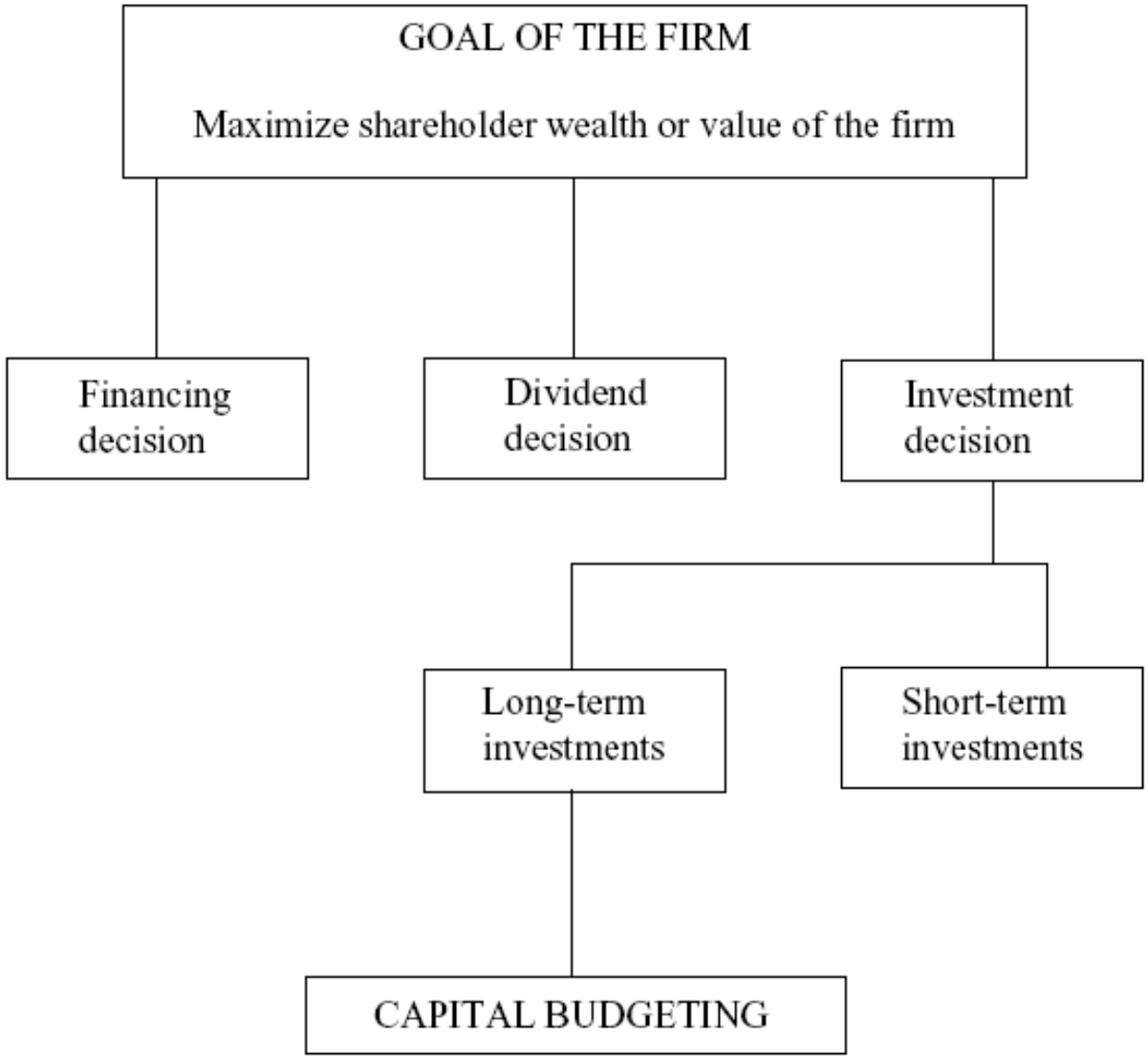


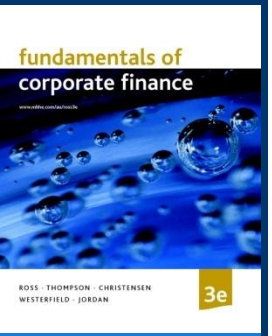
Capital budgeting: an overview

- Funds are invested in both short-term and long-term assets. Capital budgeting is primarily concerned with sizable investments in long-term assets.
- a capital investment project can be distinguished from recurrent expenditures by two features. One is that such projects are significantly **large**. The other is that they are generally **long-lived** projects with their benefits or cash flows spreading over many years. **Sizable**, **long-term investments** in tangible or intangible assets have long-term consequences.
- Capital budgeting decisions thus have a long range impact on the firm's performance and they are critical to the firm's success or failure



Capital budgeting: an overview



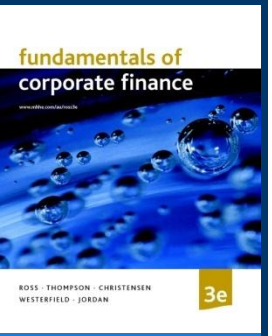


What is capital budgeting?

- Analysis of potential projects.
- Deciding which one is more important
- Adds to the firm value

Importance of capital budgeting:

- Strategic direction
- Long term decision and effects last longtime
- It might have serious financial consequences



Classification of investment projects

1. independent projects

independent project is one the acceptance or rejection of which does not directly eliminate other projects from consideration or affect the likelihood of their selection.

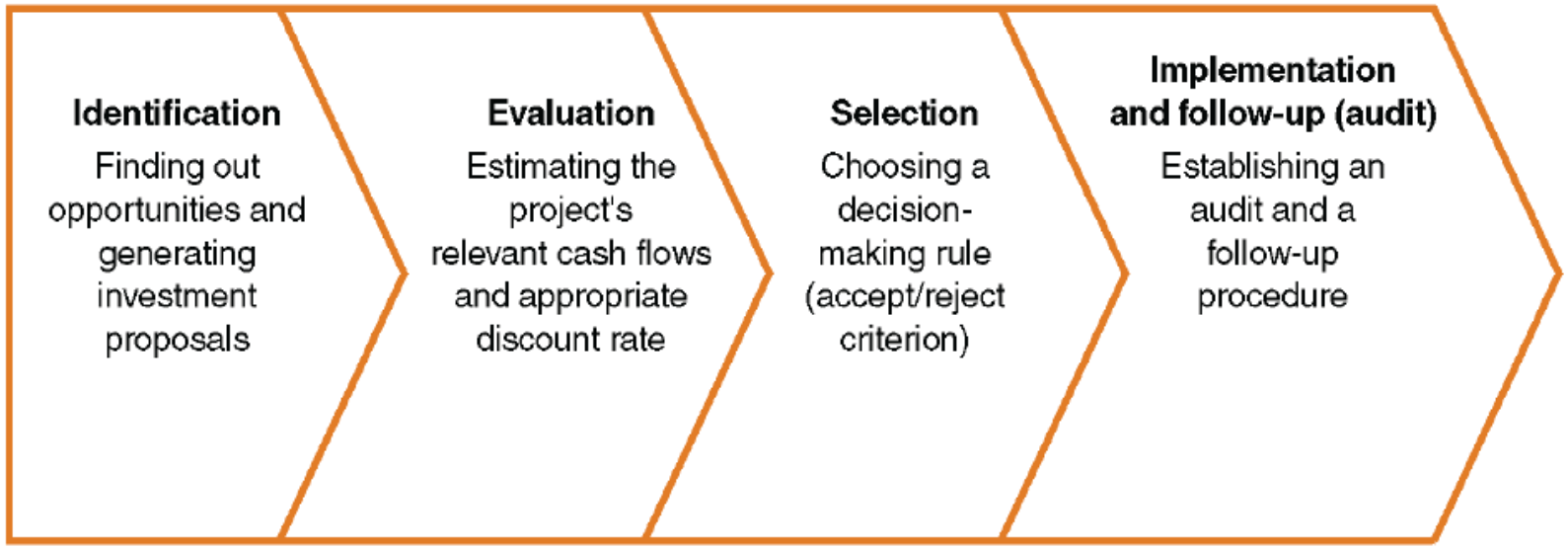
2. mutually exclusive projects

Two or more projects that cannot be pursued simultaneously are called mutually exclusive projects – the acceptance of one prevents the acceptance of the alternative proposal.

2. contingent projects

A contingent project is one the acceptance or rejection of which is dependent on the decision to accept or reject one or more other projects. For example, the decision to start a pharmacy may be contingent upon a decision to establish a doctors' surgery in an adjacent building

The Capital Investment Process



Type of investment

- Required investment
- Replacement investment
- Expansion investment
- Diversification investment

Input

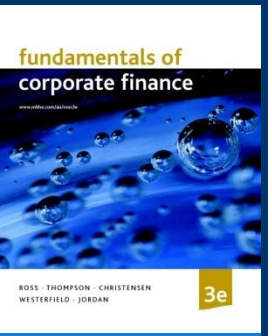
- Expected cash-flow stream
- Discount rate

Decision rule

- Net present value
- Profitability index
- Internal rate of return
- Payback period

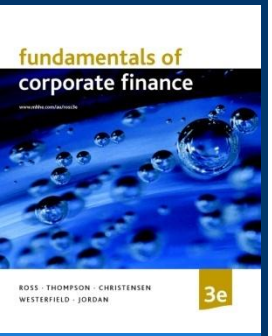
Performance evaluation

- Monitor the magnitude and timing of cash flows
- Check if the project still meets the selection criterion
- Decide on continuation or abandonment
- Review previous steps if failure rate is high



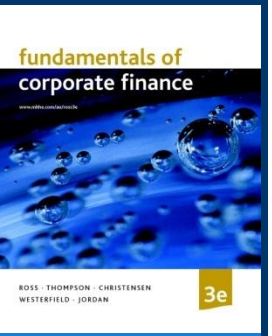
investment evaluation techniques
(Capital budgeting decision rules)

- **Net Present Value (NPV)**
- **Payback period**
- **Discounted payback period**
- **Accounting Rate of Return**
- **Internal Rate of Return(IRR)**
- **• Profitability index**



Net Present Value (NPV)

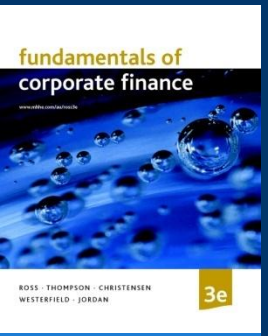
- Net present value is the difference between an investment's market value (in today's dollars) and its cost (also in today's dollars).
- Net present value is a measure of how much value is created by undertaking an investment.
- Estimation of the future cash flows and the discount rate are important in the calculation of the NPV.



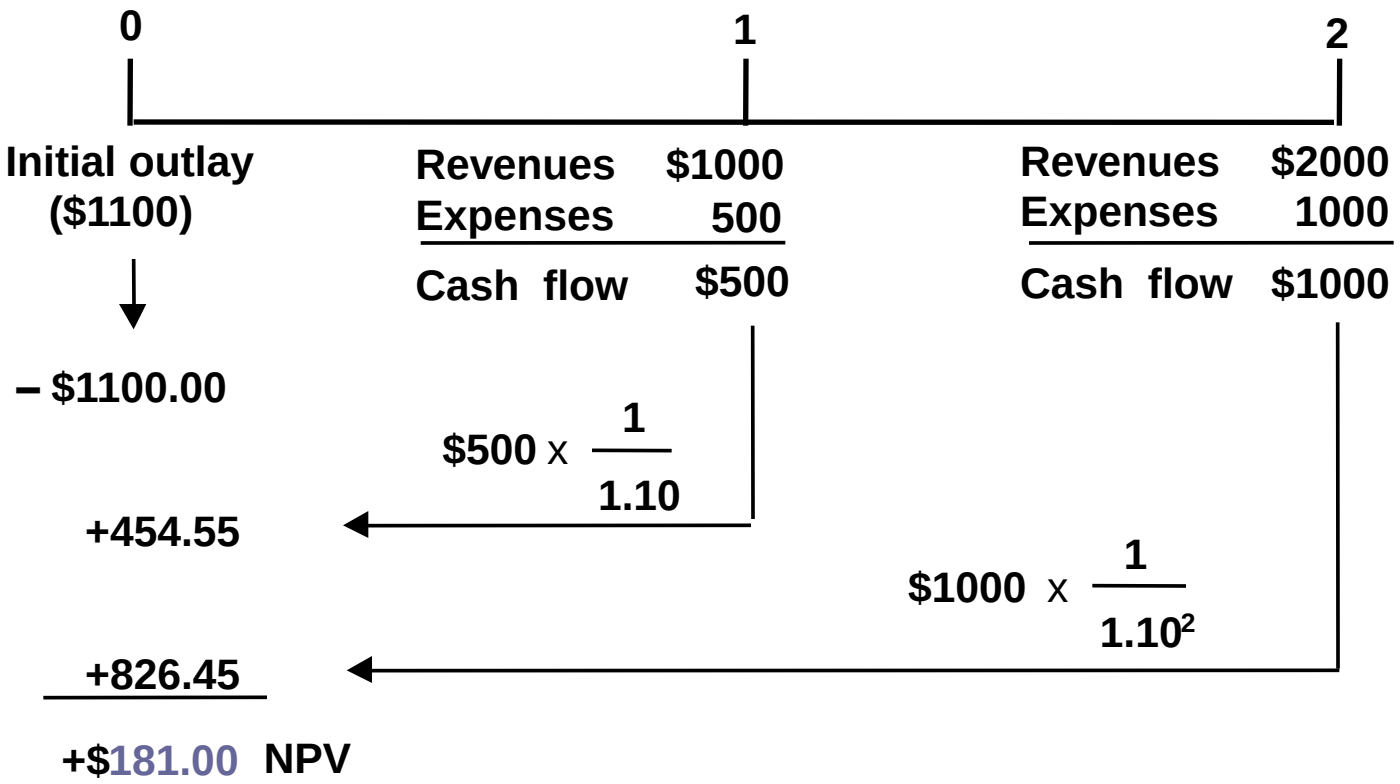
Net Present Value

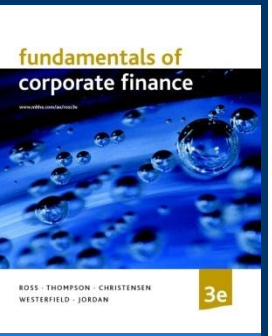
Steps in calculating NPV:

- The first step is to estimate the expected future cash flows.
- The second step is to estimate the required return for projects of this risk level.
- The third step is to find the present value of the cash flows and subtract the initial investment.



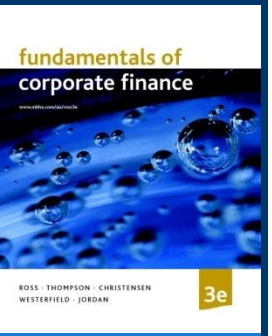
NPV Illustrated





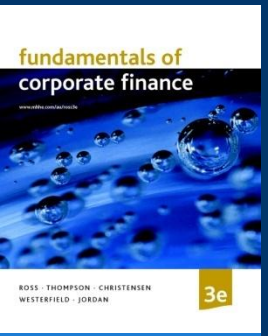
NPV

- An investment should be accepted if the NPV is positive and rejected if it is negative.
- NPV is a direct measure of how well the investment meets the goal of financial management—to increase owners' wealth.
- A positive NPV means that the investment is expected to add value to the firm.



Payback Period

- The amount of time required for an investment to generate cash flows to recover its initial cost.
- Accumulate the future cash flows until they equal the initial investment.
- The length of time for this to happen is the payback period.
- An investment is acceptable if its calculated payback is less than some prescribed number of years.



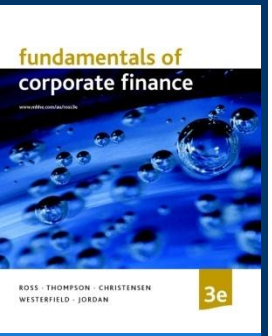
Payback Period Illustrated

Initial investment = –$1000

Year	Cash flow
1	$200
2	400
3	400

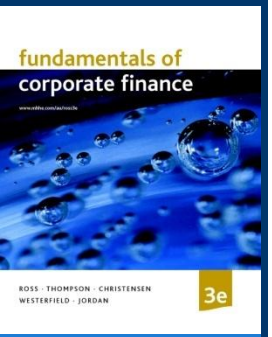
Year	Accumulated Cash flow
1	$200
2	600
3	1000

Payback period = 2 years



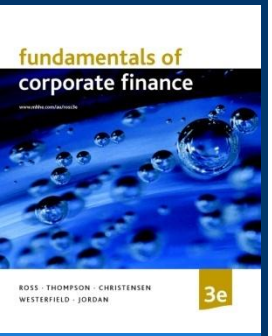
Advantages & Disadvantages of Payback Period

Advantages	Disadvantages
1. Easy to understand. 2. Adjusts for uncertainty of later cash flows. 3. Biased towards liquidity.	1. Ignores the time value of money. 2. Requires an arbitrary cutoff point. 3. Ignores cash flows beyond the cutoff date. 4. Biased against long-term projects, such as research and development, and new projects.



Discounted Payback Period

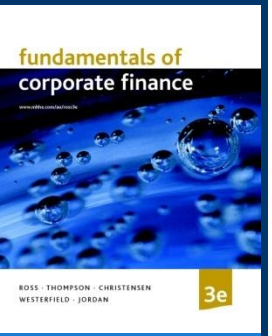
- The length of time required for an investment's discounted cash flows to equal its initial cost.
- Takes into account the time value of money.
- More difficult to calculate.
- An investment is acceptable if its discounted payback is less than some prescribed number of years.



Example—Discounted Payback

Initial investment = —$1000
R = 10%

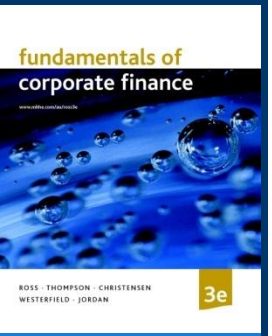
Year	Cash flow	PV of Cash flow
1	$200	$182
2	400	331
3	700	526
4	300	205



Example—Discounted Payback (*continued*)

Year	Accumulated *discounted* cash flow
1	$182
2	513
3	1039
4	1244

Discounted payback period is just under three years



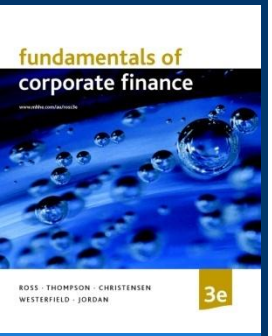
Advantages and Disadvantages of Discounted Payback

Advantages

- Includes time value of money
- Easy to understand
- Does not accept negative estimated NPV investments
- Biased towards liquidity

Disadvantages

- May reject positive NPV investments
- Arbitrary determination of acceptable payback period
- Ignores cash flows beyond the cutoff date
- Biased against long-term and new products

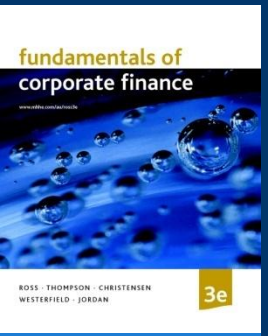


Accounting Rate of Return (ARR)

- Measure of an investment's profitability.

$$\text{ARR} = \frac{\text{average net profit}}{\text{average book value}}$$

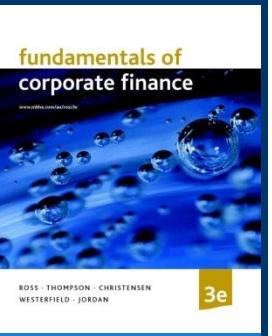
- A project is accepted if ARR > target average accounting return.



Example—ARR

	Year 1	Year 2	Year 3
Sales	$440	$240	$160
Expenses	220	120	80
Gross profit	220	120	80
Depreciation	80	80	80
Taxable income	140	40	0
Taxes (25%)	35	10	0
Net profit	$105	$30	$0

Assume initial investment = $240



Example—ARR (*continued*)

$$\text{Average net profit} = \frac{\$105 + \$30 + \$0}{3}$$

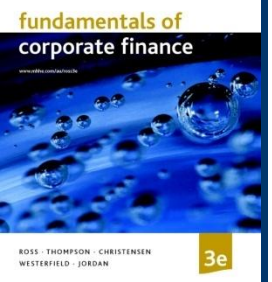
$$= \$45$$

$$\text{Average book value} = \frac{\text{Initial investment} + \text{Salvage value}}{2}$$

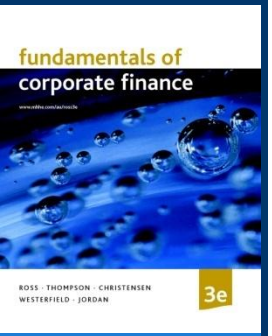
$$= \frac{\$240 + \$0}{2} = \$120$$

$$\text{ARR} = \frac{\text{Average net profit}}{\text{Average book value}} = \frac{\$45}{\$120} = 37.5\%$$

Advantages and Disadvantages of ARR

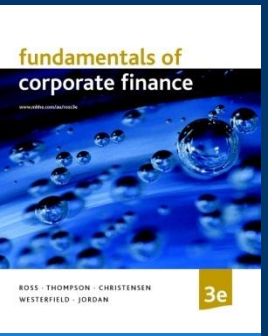


Advantages	Disadvantages
1. Easy to calculate. 2. Needed information will usually be available.	1. Not a true rate of return; time value of money is ignored. 2. Uses an arbitrary benchmark cutoff rate 3. Based on accounting (book) values, not cash flows and market values.



Internal Rate of Return (IRR)

- The discount rate that equates the present value of the future cash flows with the initial cost.
- Generally found by trial and error.
- A project is accepted if its IRR is > the required rate of return.
- The IRR on an investment is the required return that results in a zero NPV when it is used as the discount rate.



Example—IRR

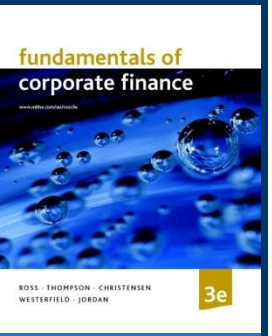
Initial investment = –$200

Year	Cash flow
1	$ 50
2	100
3	150

- Find the IRR such that NPV = 0

$$0 = -200 + \frac{50}{(1+IRR)^1} + \frac{100}{(1+IRR)^2} + \frac{150}{(1+IRR)^3}$$

$$200 = \frac{50}{(1+IRR)^1} + \frac{100}{(1+IRR)^2} + \frac{150}{(1+IRR)^3}$$

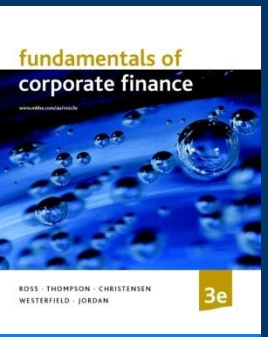


Example—IRR (*continued*)

Trial and Error

Discount rates	NPV
0%	$100
5%	68
10%	41
15%	18
→ 20%	–2

IRR is just under 20%—about 19.44%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corporate finance
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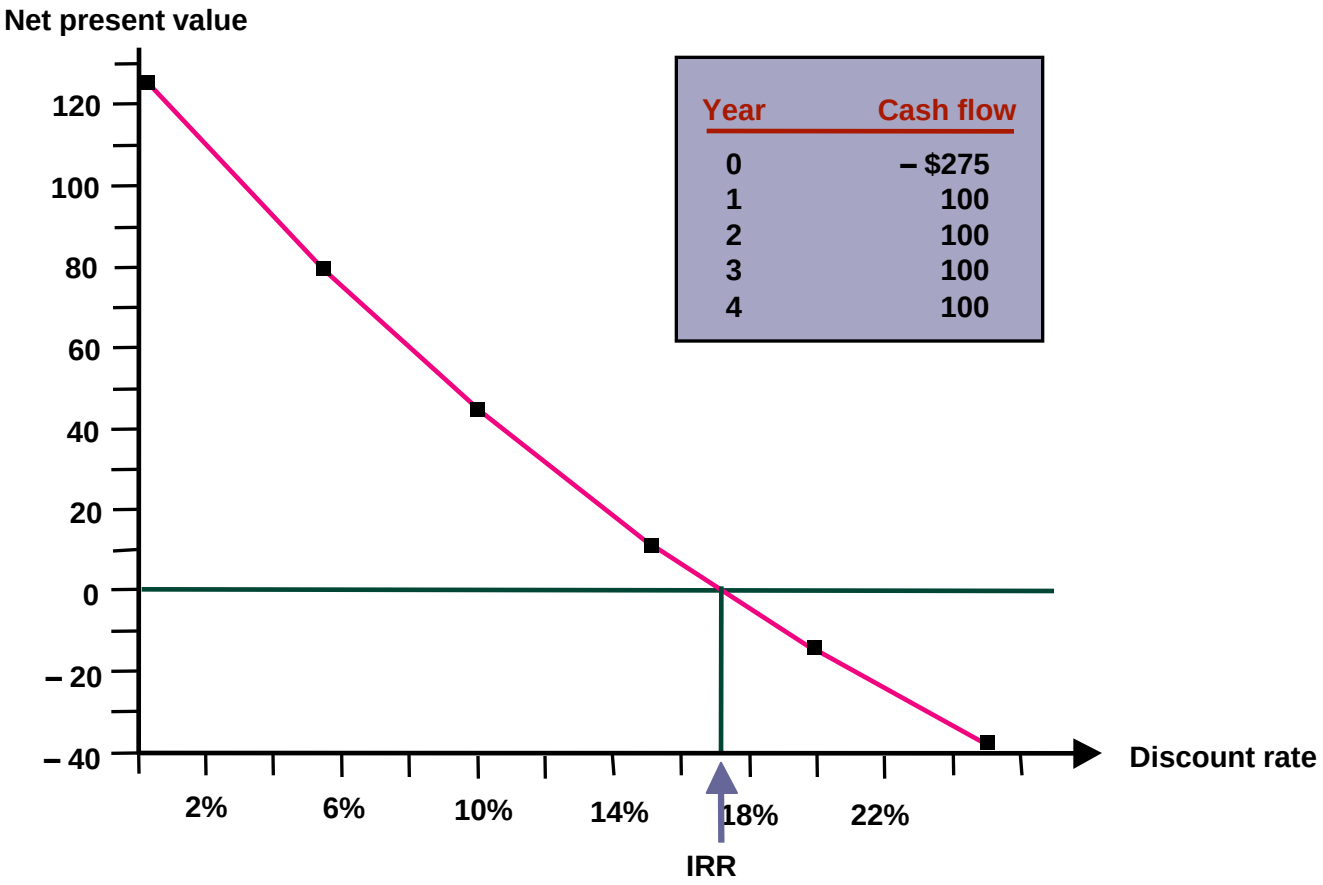
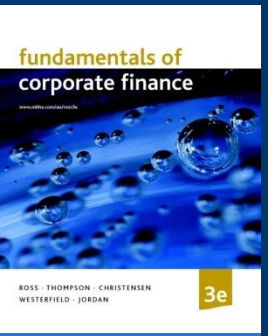
NPV Profile


Net present value
120
100
80
60
40
20
0
– 20
– 40
2%
6%
10%
14%
18%
22%
IRR
Discount rate
Year
Cash flow
0
– $275
1
100
2
100
3
100
4
100

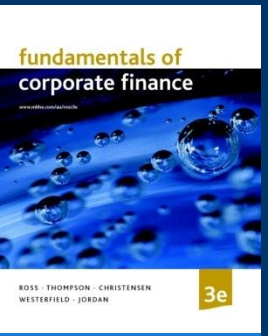


Problems with IRR

- More than one negative cash flow → multiple rates of return.
- Project is not independent → mutually exclusive investments. Highest IRR does not indicate the best project.

Advantages of IRR

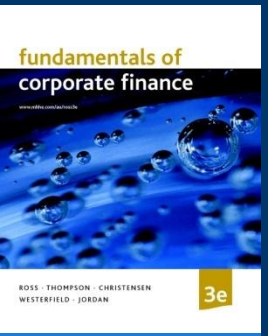
- Popular in practice
- Does not require a discount rate



Multiple Rates of Return

Assume you are considering a project for which the cash flows are as follows:

Year	Cash flows
0	–$252
1	1431
2	–3035
3	2850
4	–1000



Multiple Rates of Return

- What's the IRR? Find the rate at which the computed NPV = 0:

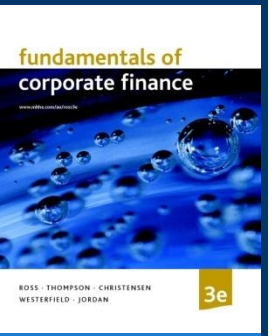
  at 25.00%: NPV = 0

  at 33.33%: NPV = 0

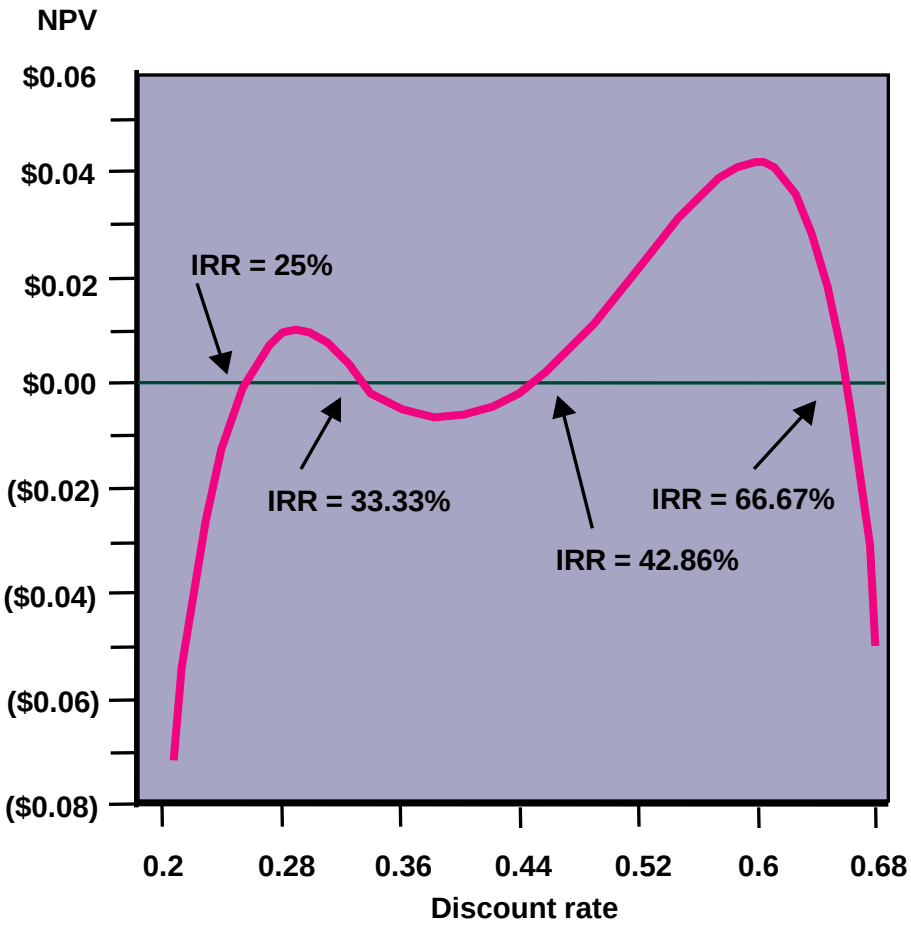
  at 42.86%: NPV = 0

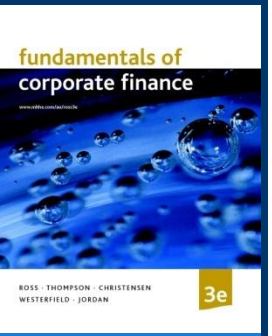
  at 66.67%: NPV = 0

- Two questions:
  1. What's going on here?
  2. How many IRRs can there be?



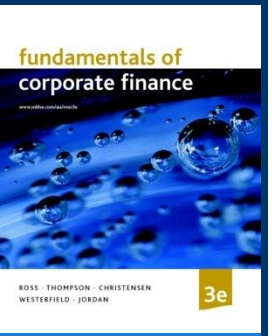
Multiple Rates of Return



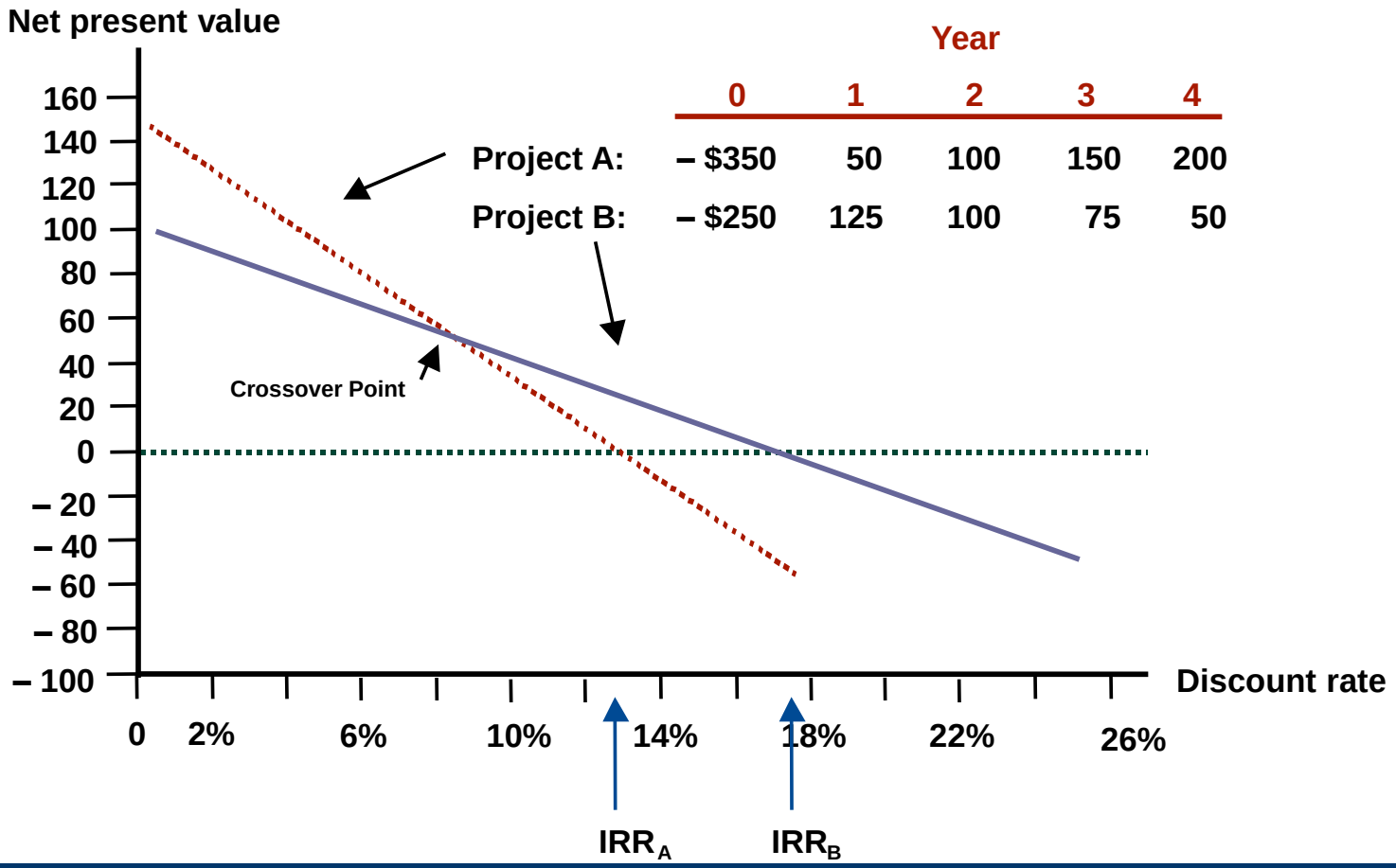


IRR and Non-conventional Cash Flows

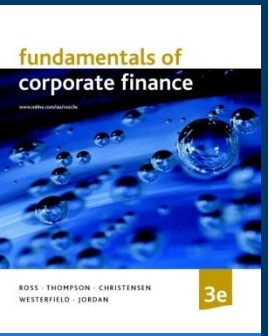
- When the cash flows change sign more than once, there is more than one IRR.
- When you solve for IRR you are solving for the root of an equation and when you cross the *x* axis more than once, there will be more than one return that solves the equation.
- If you have more than one IRR, you cannot use any of them to make your decision.



IRR, NPV and Mutually-exclusive Projects



	Year 0	1	2	3	4
Project A:	– $350	50	100	150	200
Project B:	– $250	125	100	75	50

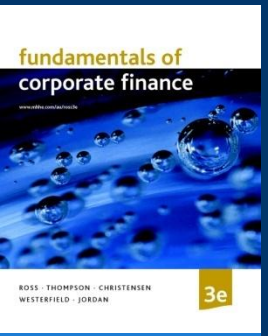


Present Value Index (PVI)

- Expresses a project's benefits relative to its initial cost.

$$\text{PVI} = \frac{\text{PV of inflows}}{\text{Initial cost}}$$

- Accept a project with a PVI > 1.0.



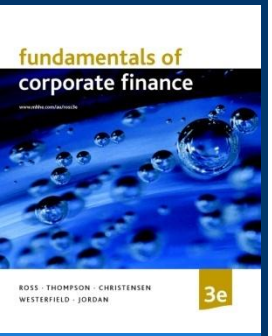
Example—PVI

Assume you have the following information on Project X:

Initial investment = –$1100 Required return = 10%

Annual cash revenues and expenses are as follows:

Year	cash flow
1	$500
2	1000

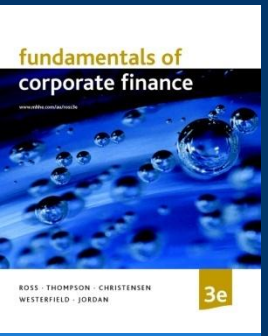


Example—PVI (*continued*)

$$NPV = \frac{500}{1.10} + \frac{1000}{(1.10)^2} - 1100$$
$$= \$181$$

$$PVI = \frac{181 + 1100}{1100}$$
$$= 1.1645$$

Net Present Value Index = 0.1645



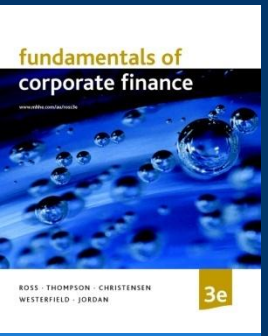
Advantages and Disadvantages of PVI (and NPVI)

Advantages

- Closely related to NPV, generally leading to identical decisions.
- Easy to understand.
- May be useful when available investment funds are limited.

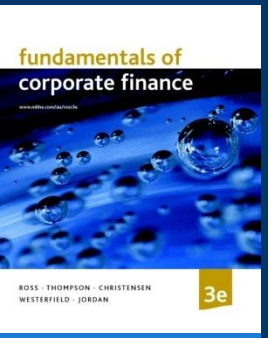
Disadvantages

- May lead to incorrect decisions in comparisons of mutually exclusive investments.



Capital Budgeting in Practice

- We should consider several investment criteria when making decisions.
- NPV and IRR are the most commonly used primary investment criteria.
- Payback is a commonly used secondary investment criteria.



Test Questions

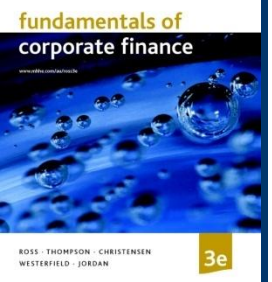
1. Capital budgeting is defined as the:

1. management of a firm's net working capital.
2. management of a firm's long-term investments.
3. determination of the total amount of money which a firm should borrow.
4. mix of debt and equity used by a firm to finance its operations.

2. Which one of the following is a capital budgeting decision?

1. determining how much debt should be borrowed from a particular lender
2. determining how much inventory to keep on hand
3. determining how much money should be kept in the checking account
4. deciding whether or not to open a new store

Test Questions

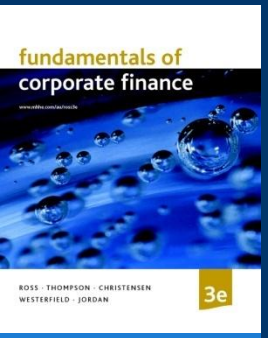


3. The process of planning and managing a firm's long-term investments is called:

1. Capital structure.
2. Working capital management.
3. Agency cost analysis.
4. Capital budgeting

4. The primary purpose of capital budgeting is to:

1. Determine the amount of cash and inventory to keep on hand.
2. Estimate the initial cost of a project.
3. Identify projects that produce cash flows that exceed the cost of the project.
4. Determine the risk level of a project.



Test Questions

5. A profitability index of .85 for a project means that:

1. the present value of benefits is 85% greater than the project's costs.
2. the project's NPV is greater than zero.
3. the project returns 85 cents in present value for each current dollar invested.
4. the payback period is less than one year.

6.The net present value (NPV) rule can be best stated as:

1. An investment should be accepted if, and only if, the NPV is exactly equal to zero.
2. An investment should be rejected if the NPV is positive and accepted if it is negative.
3. An investment should be accepted if the NPV is positive and rejected if it is negative.
4. An investment with greater cash inflows than cash outflows, regardless of when the cash flows occur

Test Questions

7. The discount rate that makes the net present value of investment exactly equal to zero is the:

1. Payback period.
2. Internal rate of return.
3. Profitability index.
4. Discounted payback period.

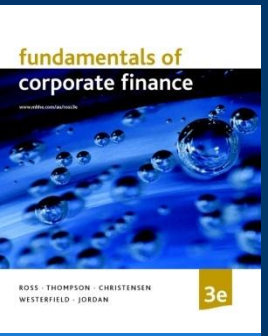
8. Net present value :

a. is equal to the initial investment in a project

b. is equal to the present value of the project returns

c. is equal to zero when the interest rate used to discount cash flows equals the IRR

d. is simplified by the fact that future cash flows are easy to estimate



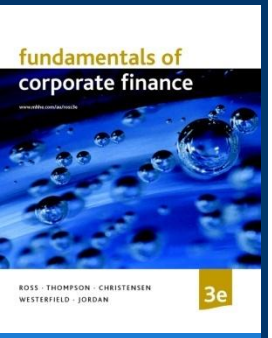
Test Questions

9. An NPV of zero implies that an investment:

1. has no initial cost
2. has the sum of the total cash flows equal to zero
3. destroys shareholder wealth
4. is immaterial to the shareholder

10. All of the capital budgeting methods use cash flow numbers except the

1. payback period technique.
2. internal rate of return (IRR) method.
3. net present value (NPV) method
4. annual rate of return method.



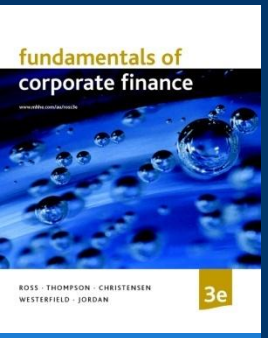
Test Questions

11. The time value of money is considered by each of the following except the:

1. profitability index.
2. net present value method.
3. internal rate of return method.
4. cash payback technique.

12. The payback period is expressed"

1. as a percentage.
2. as a dollar amount.
3. in years
4. none of the above



Test Questions

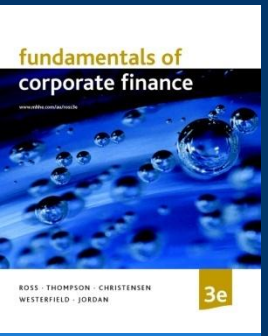
13. Which one of the following is the preferred method of analyzing a proposed investment?

a. payback
b. profitability index
d. internal rate of return
E. net present value

14. Which of the following consider the time value of money in their computation?

1. payback
2. average accounting return
3. profitability index
4. none of the above

Test Questions

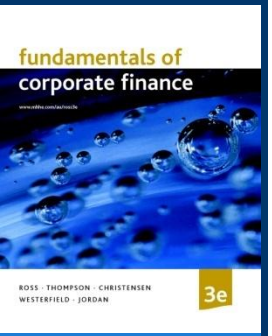


15. The average accounting return (AAR) decision rule states that a project should be accepted whenever the AAR:

1. is positive
2. exceeds the internal rate of return (IRR).
3. exceeds the target AAR.
4. is less than the IRR.

16. When evaluating capital budgeting projects, which of the following would NOT necessarily be an indicator of an acceptable project?

1. an NPV > $0
2. an IRR > the project's required rate of return
3. an IRR > $0
4. All of the above are correct indicators.



True or False Questions

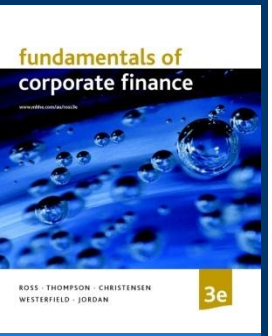
Are the following statements true or false?

1. In capital budgeting, the financial manager tries to identify investment opportunities that are worth more to the firm than they cost to acquire.

   a. True b. False

2. The profitability index is calculated by dividing the initial investment by the present value of cash flows.

   a. True b. False



True or False Questions

Are the following statements true or false?

3. The profitability index is computed using accounting income and accounting book values

a. True b. False

4. The profitability index is calculated by dividing the initial investment by the present value of cash flows.

a. True b. False