

1. INTRODUCTION

- **Capital budgeting** is the allocation of funds to long-lived capital projects.
- A **capital project** is a long-term investment in tangible assets.
- The principles and tools of capital budgeting are applied in many different aspects of a business entity's decision making and in security valuation and portfolio management.
- A company's capital budgeting process and prowess are important in valuing a company.

2. THE CAPITAL BUDGETING PROCESS

Step 1 Generating Ideas

- Generate ideas from inside or outside of the company

Step 2 Analyzing Individual Proposals

- Collect information and analyze the profitability of alternative projects

Step 3 Planning the Capital Budget

- Analyze the fit of the proposed projects with the company's strategy

Step 4 Monitoring and Post Auditing

- Compare expected and realized results and explain any deviations

CLASSIFYING PROJECTS

Replacement
Projects

Expansion
Projects

New Products
and Services

Regulatory,
Safety, and
Environmental
Projects

Other

3. BASIC PRINCIPLES OF CAPITAL BUDGETING



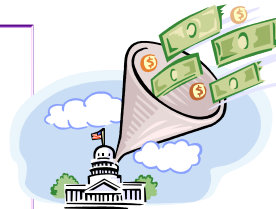
Decisions are based on cash flows.



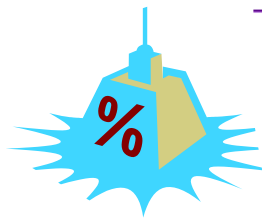
The timing of cash flows is crucial.



Cash flows are incremental.



Cash flows are on an after-tax basis.



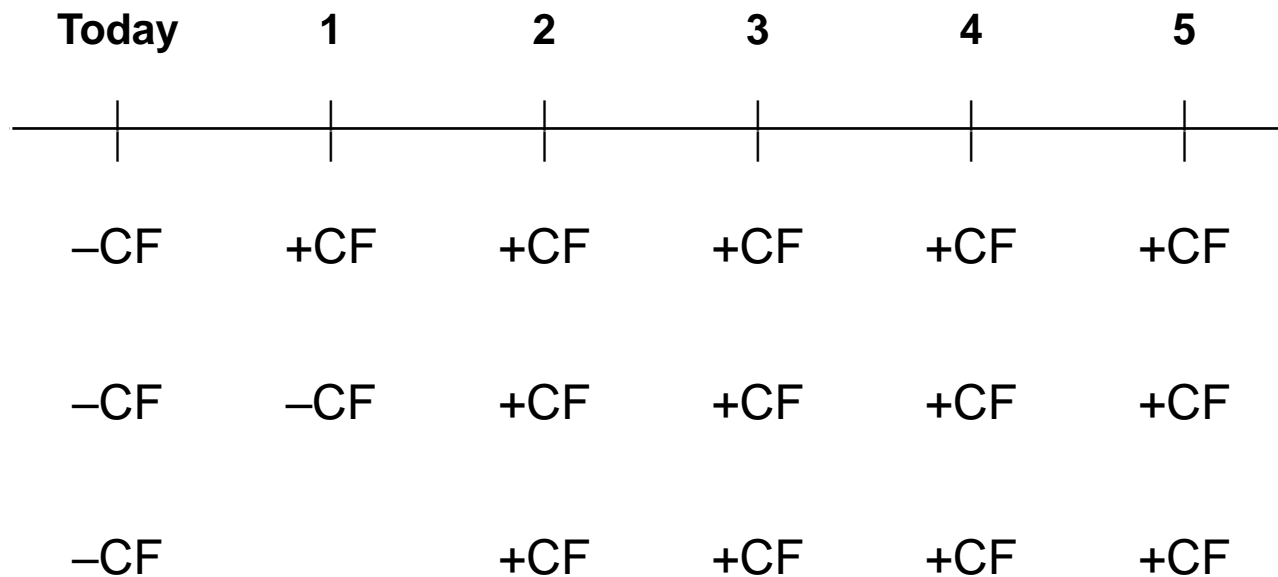
Financing costs are ignored.

COSTS: INCLUDE OR EXCLUDE?

- A **sunk cost** is a cost that has already occurred, so it cannot be part of the incremental cash flows of a capital budgeting analysis.
- An **opportunity cost** is what would be earned on the next-best use of the assets.
- An **incremental cash flow** is the difference in a company's cash flows with and without the project.
- An **externality** is an effect that the investment project has on something else, whether inside or outside of the company.
 - **Cannibalization** is an externality in which the investment reduces cash flows elsewhere in the company (e.g., takes sales from an existing company project).

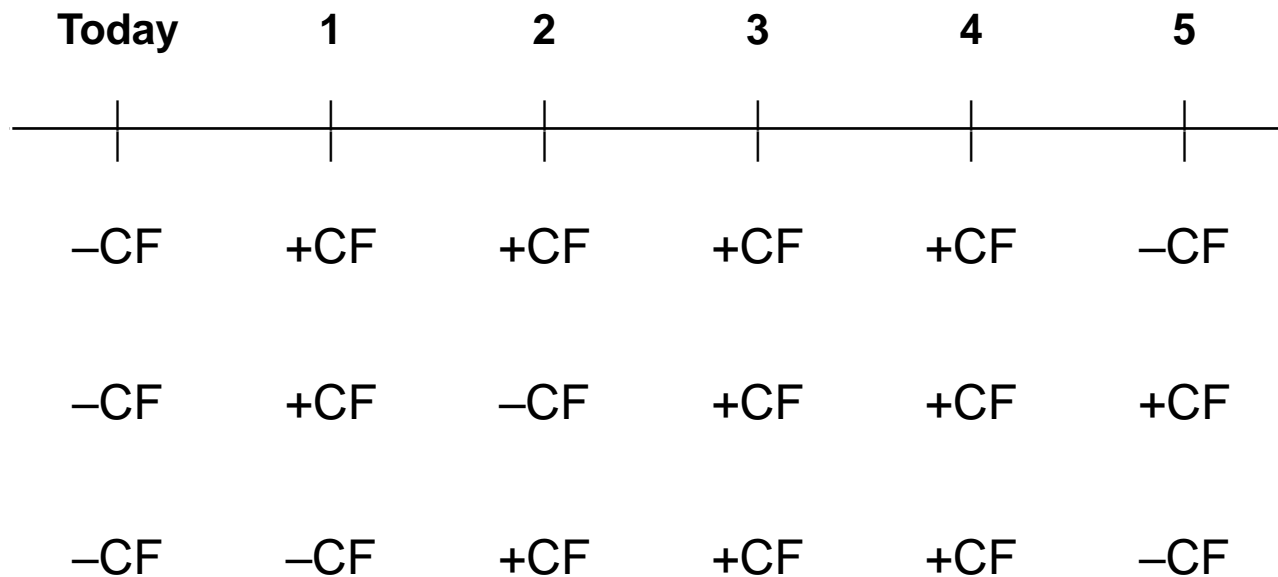
CONVENTIONAL AND NONCONVENTIONAL CASH FLOWS

Conventional Cash Flow (CF) Patterns



CONVENTIONAL AND NONCONVENTIONAL CASH FLOWS

Nonconventional Cash Flow Patterns



INDEPENDENT VS. MUTUALLY EXCLUSIVE PROJECTS

- When evaluating more than one project at a time, it is important to identify whether the projects are independent or mutually exclusive
 - This makes a difference when selecting the tools to evaluate the projects.
- **Independent projects** are projects in which the acceptance of one project does not preclude the acceptance of the other(s).
- **Mutually exclusive projects** are projects in which the acceptance of one project precludes the acceptance of another or others.

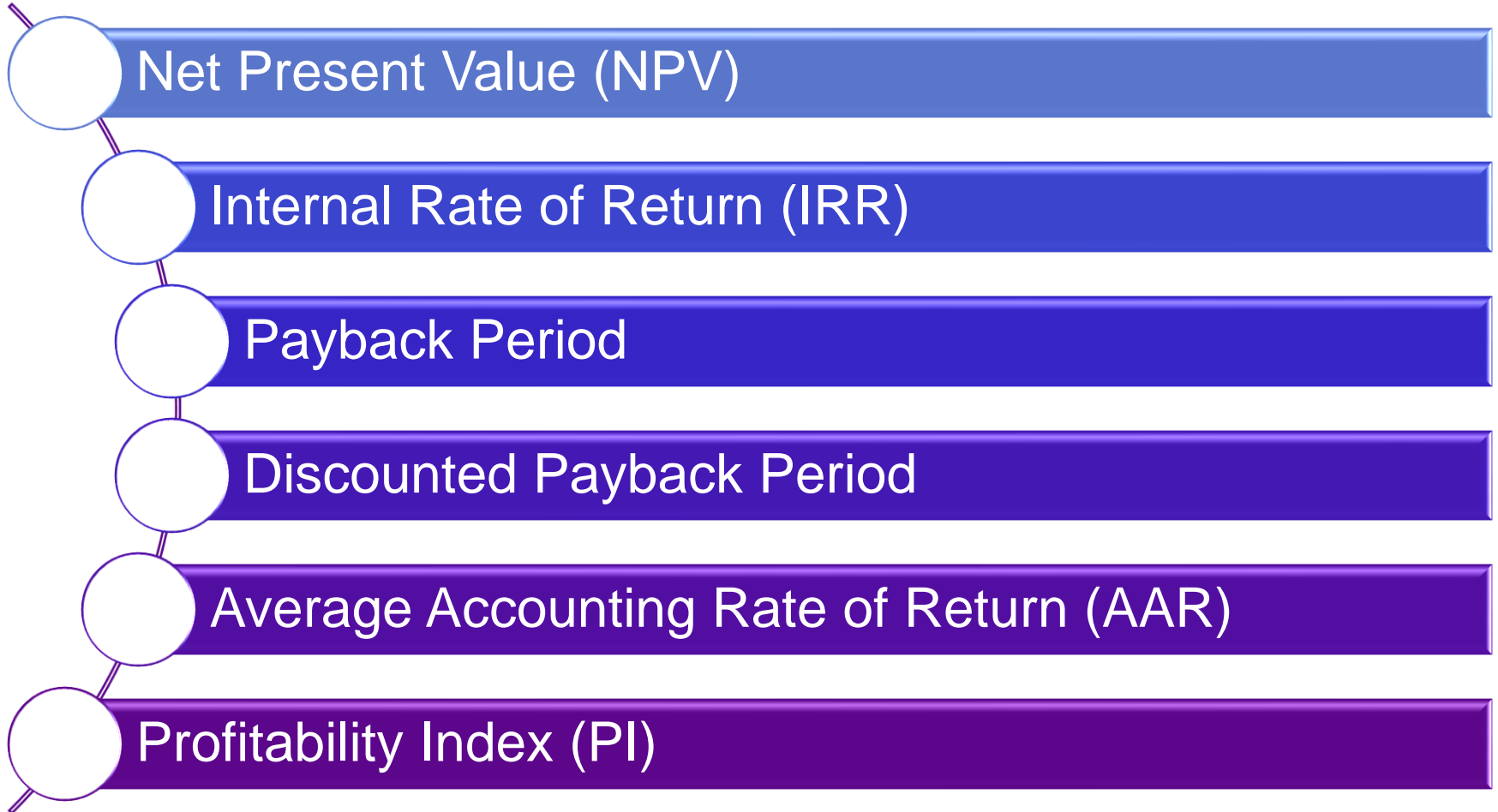
PROJECT SEQUENCING

- Capital projects may be sequenced, which means a project contains an option to invest in another project.
 - Projects often have **real options** associated with them; so the company can choose to expand or abandon the project, for example, after reviewing the performance of the initial capital project.

CAPITAL RATIONING

- **Capital rationing** is when the amount of expenditure for capital projects in a given period is limited.
- If the company has so many profitable projects that the initial expenditures in total would exceed the budget for capital projects for the period, the company's management must determine which of the projects to select.
- The objective is to maximize owners' wealth, subject to the constraint on the capital budget.
 - Capital rationing may result in the rejection of profitable projects.

4. INVESTMENT DECISION CRITERIA



NET PRESENT VALUE

The **net present value** is the present value of all incremental cash flows, discounted to the present, less the initial outlay:

$$NPV = \sum_{t=1}^n \frac{CF_t}{(1+r)^t} - \text{Outlay} \quad (2-1)$$

Or, reflecting the outlay as CF_0 ,

$$NPV = \sum_{t=0}^n \frac{CF_t}{(1+r)^t} \quad (2-2)$$

where

CF_t

= After-tax cash flow at time t

r

= Required rate of return for the investment

Outlay

= Investment cash flow at time zero

If $NPV > 0$:

- Invest: Capital project adds value

If $NPV < 0$:

- Do not invest: Capital project destroys value

EXAMPLE: NPV

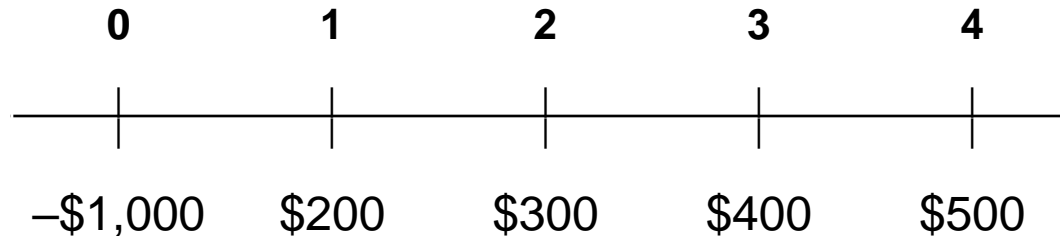
Consider the Hoofdstad Project, which requires an investment of \$1 billion initially, with subsequent cash flows of \$200 million, \$300 million, \$400 million, and \$500 million. We can characterize the project with the following end-of-year cash flows:

Period	Cash Flow (millions)
0	-\$1,000
1	200
2	300
3	400
4	500

What is the net present value of the Hoofdstad Project if the required rate of return of this project is 5%?

EXAMPLE: NPV

Time Line



Solving for the NPV:

$$\text{NPV} = -\$1,000 + \frac{\$200}{(1 + 0.05)^1} + \frac{\$300}{(1 + 0.05)^2} + \frac{\$400}{(1 + 0.05)^3} + \frac{\$500}{(1 + 0.05)^4}$$

$$\text{NPV} = -\$1,000 + \$190.48 + \$272.11 + \$345.54 + \$411.35$$

$$\text{NPV} = \$219.47 \text{ million}$$

INTERNAL RATE OF RETURN

The **internal rate of return** is the rate of return on a project.

- The internal rate of return is the rate of return that results in NPV = 0.

$$\sum_{t=1}^n \frac{CF_t}{(1 + IRR)^t} - \text{Outlay} = 0 \quad (2-3)$$

Or, reflecting the outlay as CF_0 ,

$$\sum_{t=0}^n \frac{CF_t}{(1 + IRR)^t} = 0 \quad (2-4)$$

If $IRR > r$ (*required rate of return*):

- Invest: Capital project adds value

If $IRR < r$:

- Do not invest: Capital project destroys value

EXAMPLE: IRR

Consider the Hoofdstad Project that we used to demonstrate the NPV calculation:

Period	Cash Flow (millions)
0	-\$1,000
1	200
2	300
3	400
4	500

The IRR is the rate that solves the following:

$$\$0 = -\$1,000 + \frac{\$200}{(1 + \text{IRR})^1} + \frac{\$300}{(1 + \text{IRR})^2} + \frac{\$400}{(1 + \text{IRR})^3} + \frac{\$500}{(1 + \text{IRR})^4}$$

A NOTE ON SOLVING FOR IRR

- The IRR is the rate that causes the NPV to be equal to zero.
- The problem is that we cannot solve directly for IRR, but rather must either iterate (trying different values of IRR until the NPV is zero) or use a financial calculator or spreadsheet program to solve for IRR.
- In this example, IRR = 12.826%:

$$\$0 = -\$1,000 + \frac{\$200}{(1 + 0.12826)^1} + \frac{\$300}{(1 + 0.12826)^2} + \frac{\$400}{(1 + 0.12826)^3} + \frac{\$500}{(1 + 0.12826)^4}$$

PAYBACK PERIOD

- The **payback period** is the length of time it takes to recover the initial cash outlay of a project from future incremental cash flows.
- In the Hoofdstad Project example, the payback occurs in the last year, Year 4:

Period	Cash Flow (millions)	Accumulated Cash flows
0	-\$1,000	-\$1,000
1	200	-\$800
2	300	-\$500
3	400	-\$100
4	500	+400

PAYBACK PERIOD: IGNORING CASH FLOWS

For example, the payback period for both Project X and Project Y is three years, even though Project X provides more value through its Year 4 cash flow:

Year	Project X Cash Flows	Project Y Cash Flows
0	-£100	-£100
1	£20	£20
2	£50	£50
3	£45	£45
4	£60	£0

DISCOUNTED PAYBACK PERIOD

- The **discounted payback period** is the length of time it takes for the cumulative discounted cash flows to equal the initial outlay.
 - In other words, it is the length of time for the project to reach $NPV = 0$.

EXAMPLE: DISCOUNTED PAYBACK PERIOD

Consider the example of Projects X and Y. Both projects have a discounted payback period close to three years. Project X actually adds more value but is not distinguished from Project Y using this approach.

Year	Cash Flows		Discounted Cash Flows		Accumulated Discounted Cash Flows	
	Project X	Project Y	Project X	Project Y	Project X	Project Y
0	-£100.00	-£100.00	-£100.00	-£100.00	-£100.00	-£100.00
1	20.00	20.00	19.05	19.05	-80.95	-80.95
2	50.00	50.00	45.35	45.35	-35.60	-35.60
3	45.00	45.00	38.87	38.87	3.27	3.27
4	60.00	0.00	49.36	0.00	52.63	3.27

AVERAGE ACCOUNTING RATE OF RETURN

- The **average accounting rate of return (AAR)** is the ratio of the average net income from the project to the average book value of assets in the project:

$$\text{AAR} = \frac{\text{Average net income}}{\text{Average book value}}$$

PROFITABILITY INDEX

The **profitability index (PI)** is the ratio of the present value of future cash flows to the initial outlay:

$$PI = \frac{\text{Present value of future cash flows}}{\text{Initial investment}} = 1 + \frac{\text{NPV}}{\text{Initial investment}} \quad (2-5)$$

If $PI > 1.0$:

- Invest
- Capital project adds value

If $PI < 0$:

- Do not invest
- Capital project destroys value

EXAMPLE: PI

In the Hoofdstad Project, with a required rate of return of 5%,

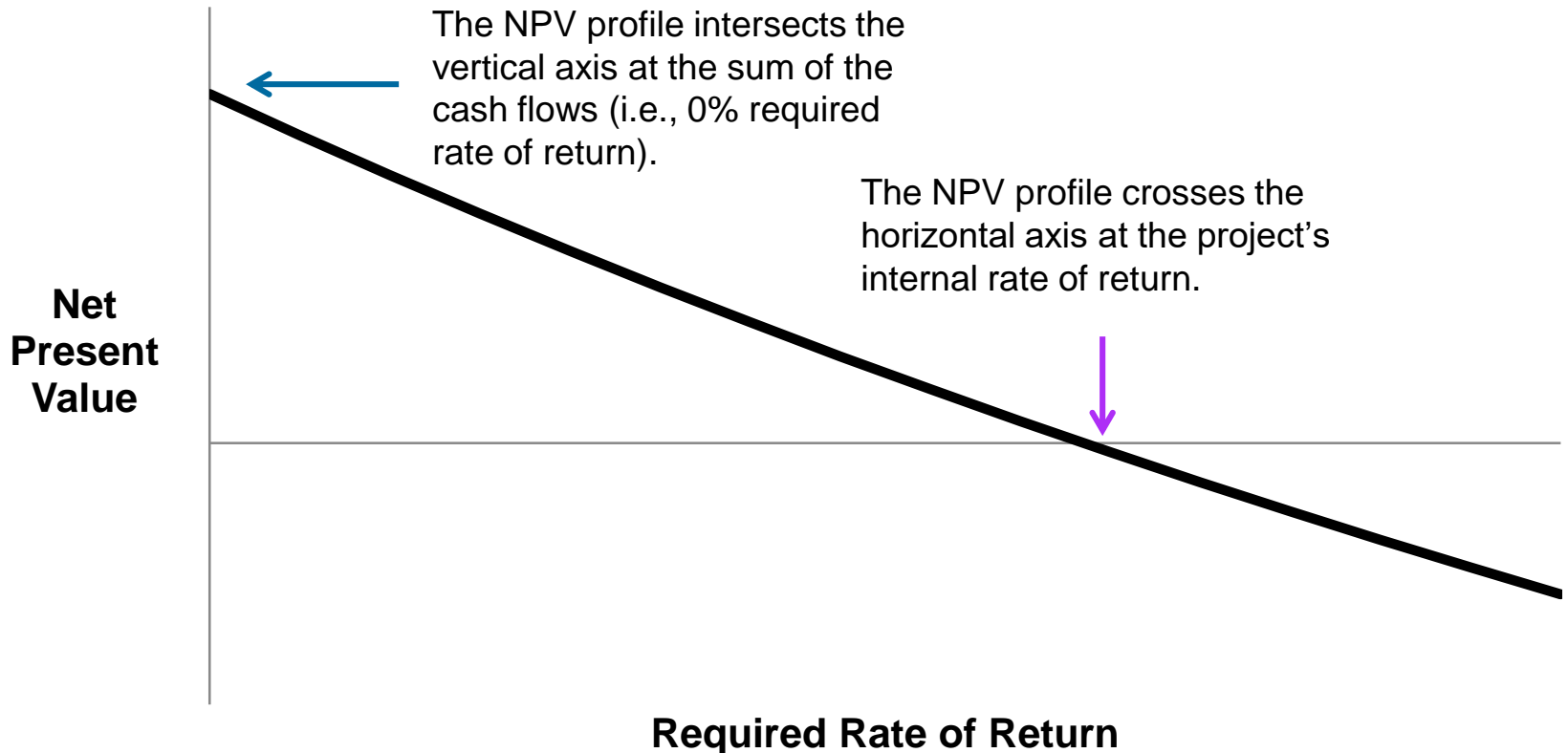
Period	Cash Flow (millions)
0	-\$1,000
1	200
2	300
3	400
4	500

the present value of the future cash flows is \$1,219.47. Therefore, the PI is:

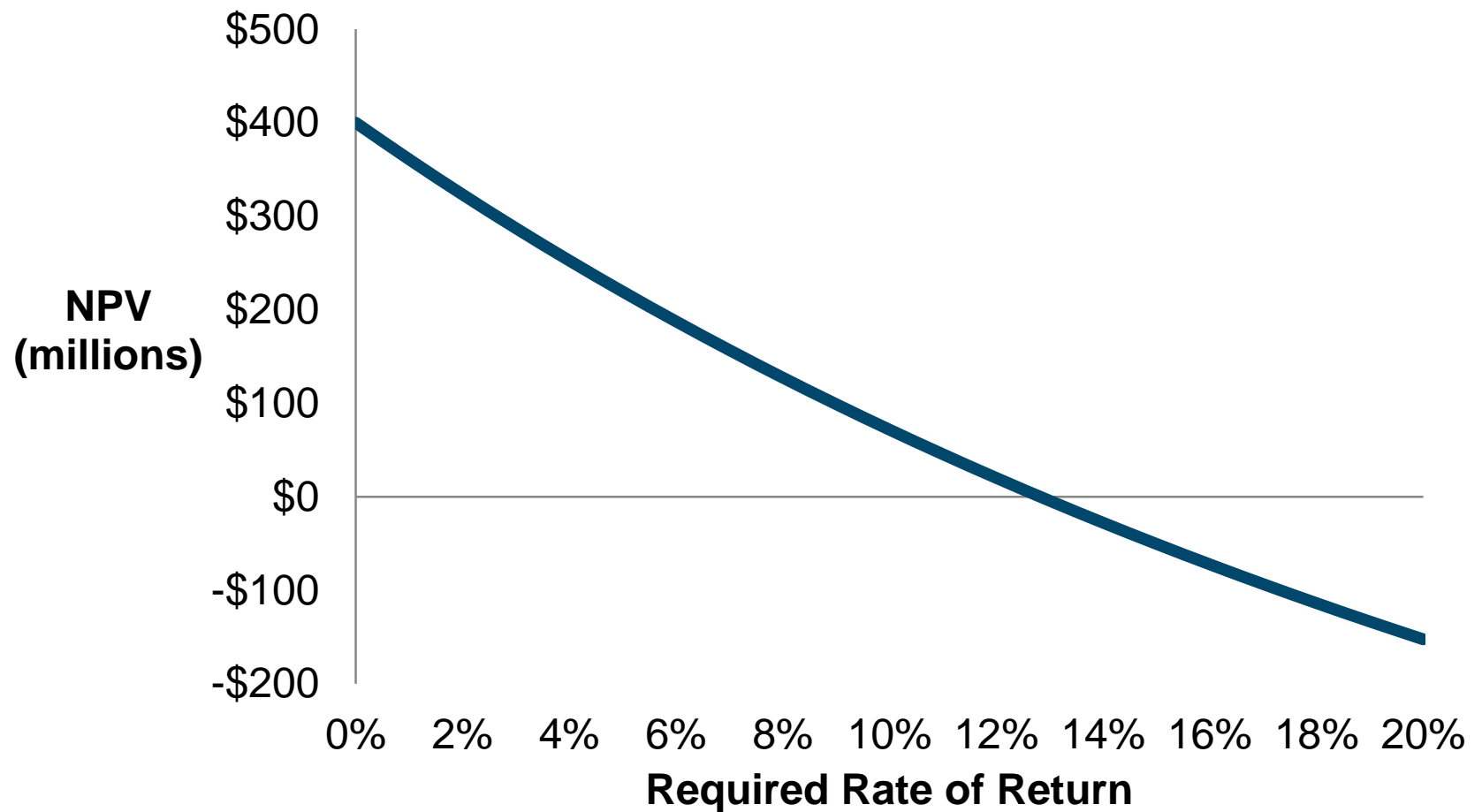
$$PI = \frac{\$1,219.47}{\$1,000.00} = 1.219$$

NET PRESENT VALUE PROFILE

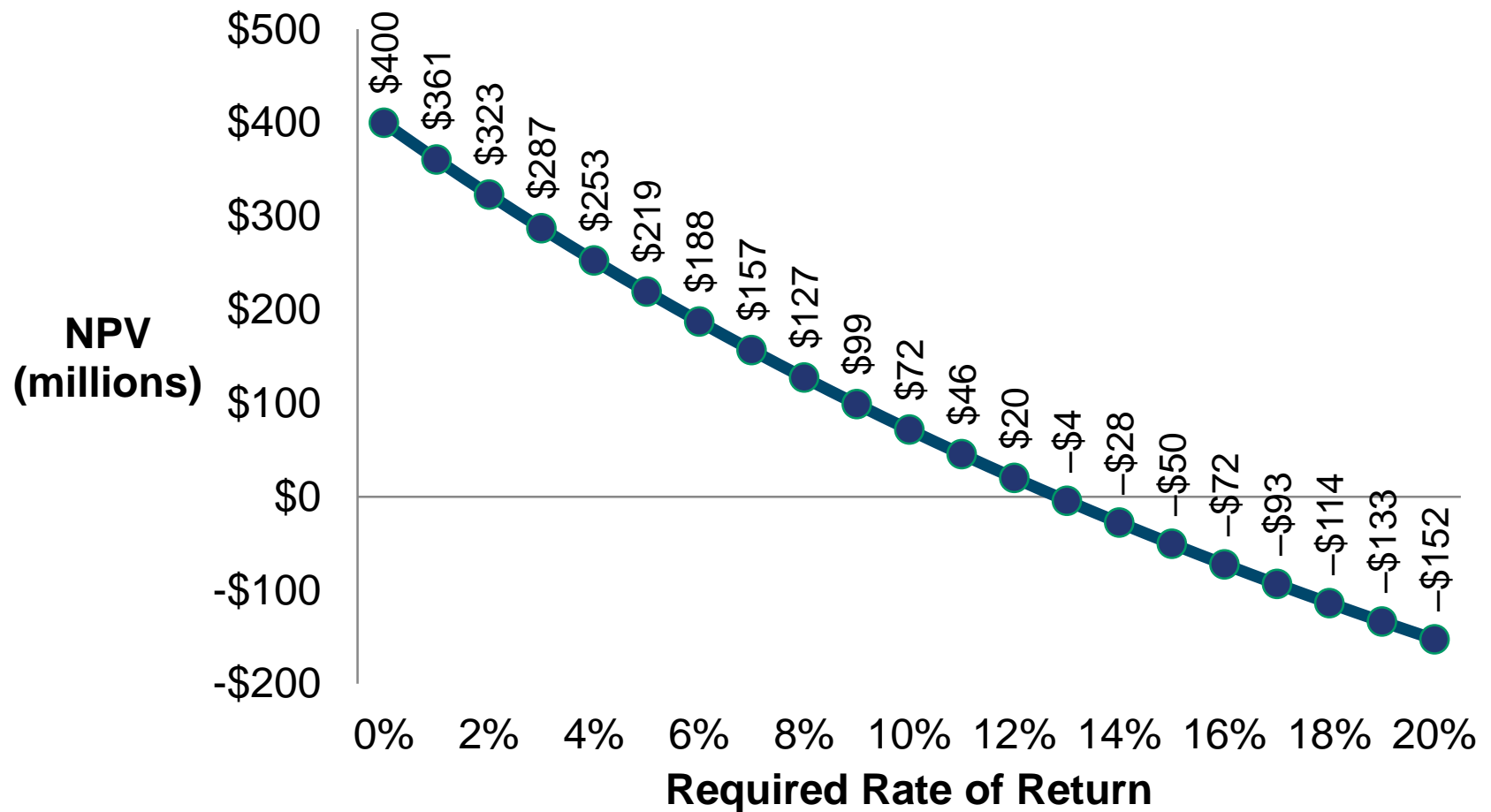
The **net present value profile** is the graphical illustration of the NPV of a project at different required rates of return.



NPV PROFILE: HOOFDSTAD CAPITAL PROJECT



NPV PROFILE: HOOFDSTAD CAPITAL PROJECT



RANKING CONFLICTS: NPV VS. IRR

- The NPV and IRR methods may rank projects differently.
 - If projects are independent, accept if $NPV > 0$ produces the same result as when $IRR > r$.
 - If projects are mutually exclusive, accept if $NPV > 0$ may produce a different result than when $IRR > r$.
- The source of the problem is different reinvestment rate assumptions
 - Net present value: Reinvest cash flows at the required rate of return
 - Internal rate of return: Reinvest cash flows at the internal rate of return
- The problem is evident when there are different patterns of cash flows or different scales of cash flows.

EXAMPLE: RANKING CONFLICTS

Consider two mutually exclusive projects, Project P and Project Q:

Year	End of Year Cash Flows	
	Project P	Project Q
0	-100	-100
1	0	33
2	0	33
3	0	33
4	142	33

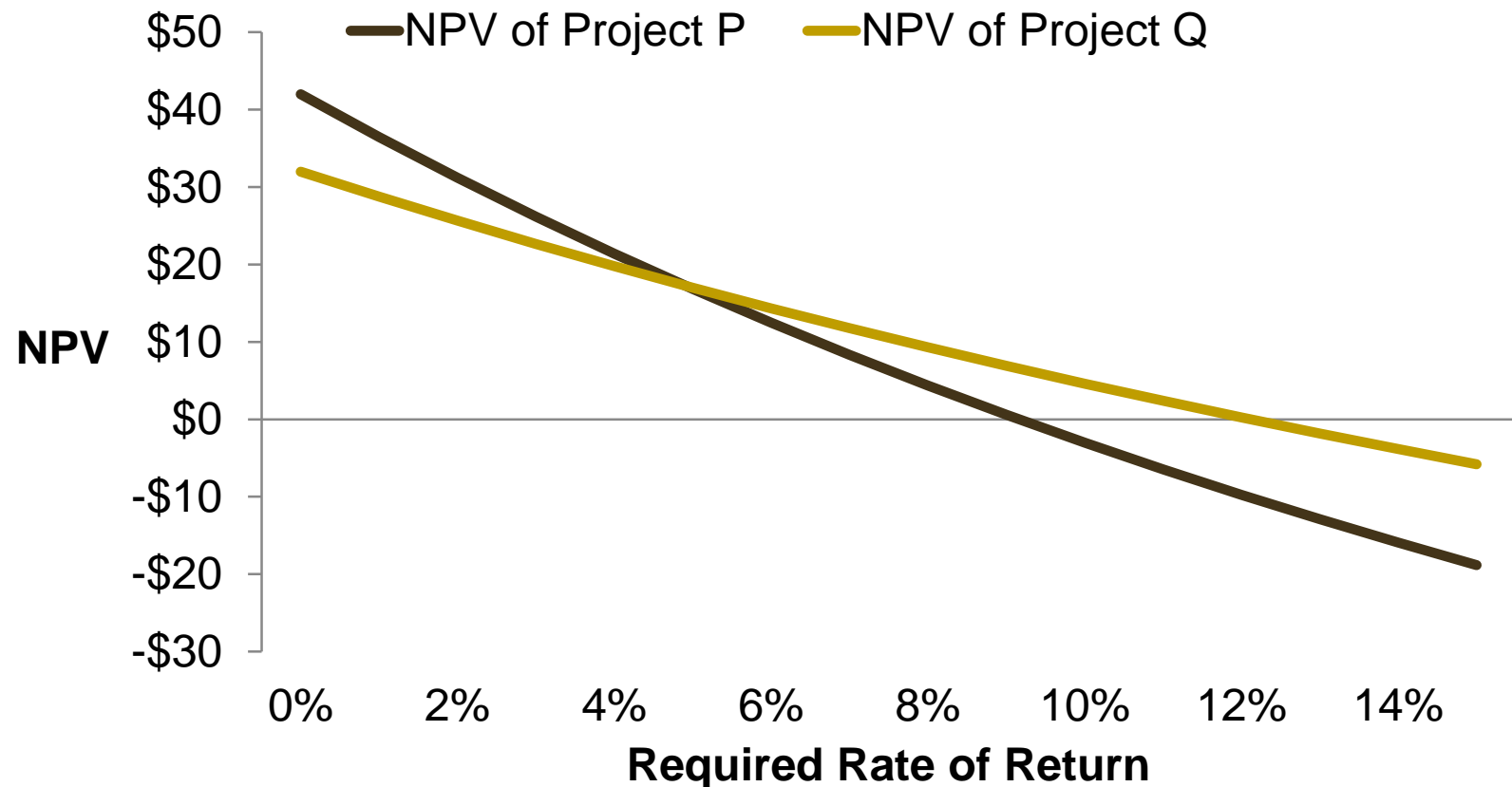
Which project is preferred and why?

Hint: It depends on the projects' required rates of return.

DECISION AT VARIOUS REQUIRED RATES OF RETURN

	Project P	Project Q	Decision
NPV @ 0%	\$42	\$32	Accept P, Reject Q
NPV @ 4%	\$21	\$20	Accept P, Reject Q
NPV @ 6%	\$12	\$14	Reject P, Accept Q
NPV @ 10%	-\$3	\$5	Reject P, Accept Q
NPV @ 14%	-\$16	-\$4	Reject P, Reject Q
IRR	9.16%	12.11%	

NPV PROFILES: PROJECT P AND PROJECT Q



THE MULTIPLE IRR PROBLEM

- If cash flows change sign more than once during the life of the project, there may be more than one rate that can force the present value of the cash flows to be equal to zero.
 - This scenario is called the “multiple IRR problem.”
 - In other words, there is no unique IRR if the cash flows are nonconventional.

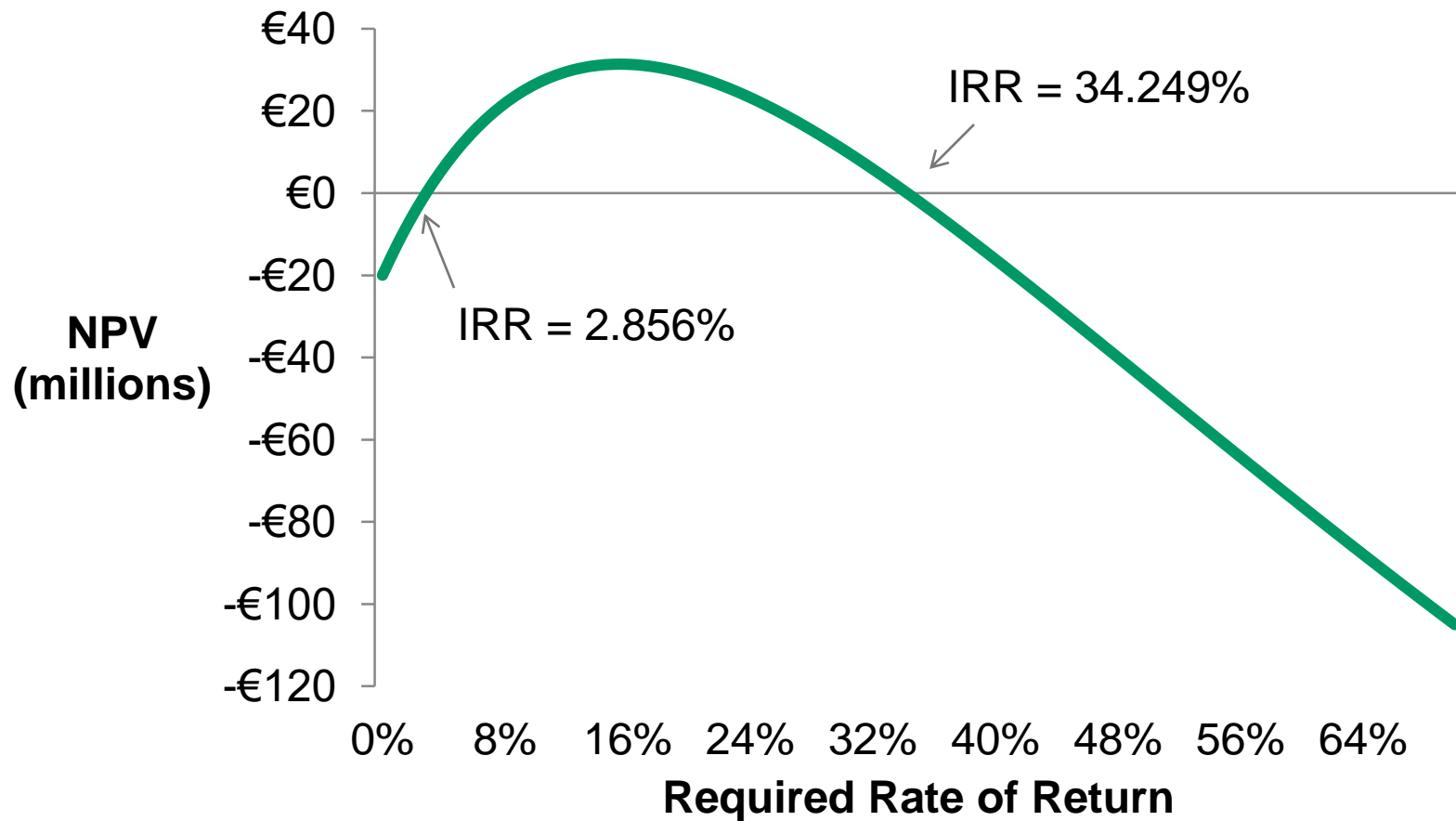
EXAMPLE: THE MULTIPLE IRR PROBLEM

Consider the fluctuating capital project with the following end of year cash flows, in millions:

Year	Cash Flow
0	-€550
1	€490
2	€490
3	€490
4	-€940

What is the IRR of this project?

EXAMPLE: THE MULTIPLE IRR PROBLEM

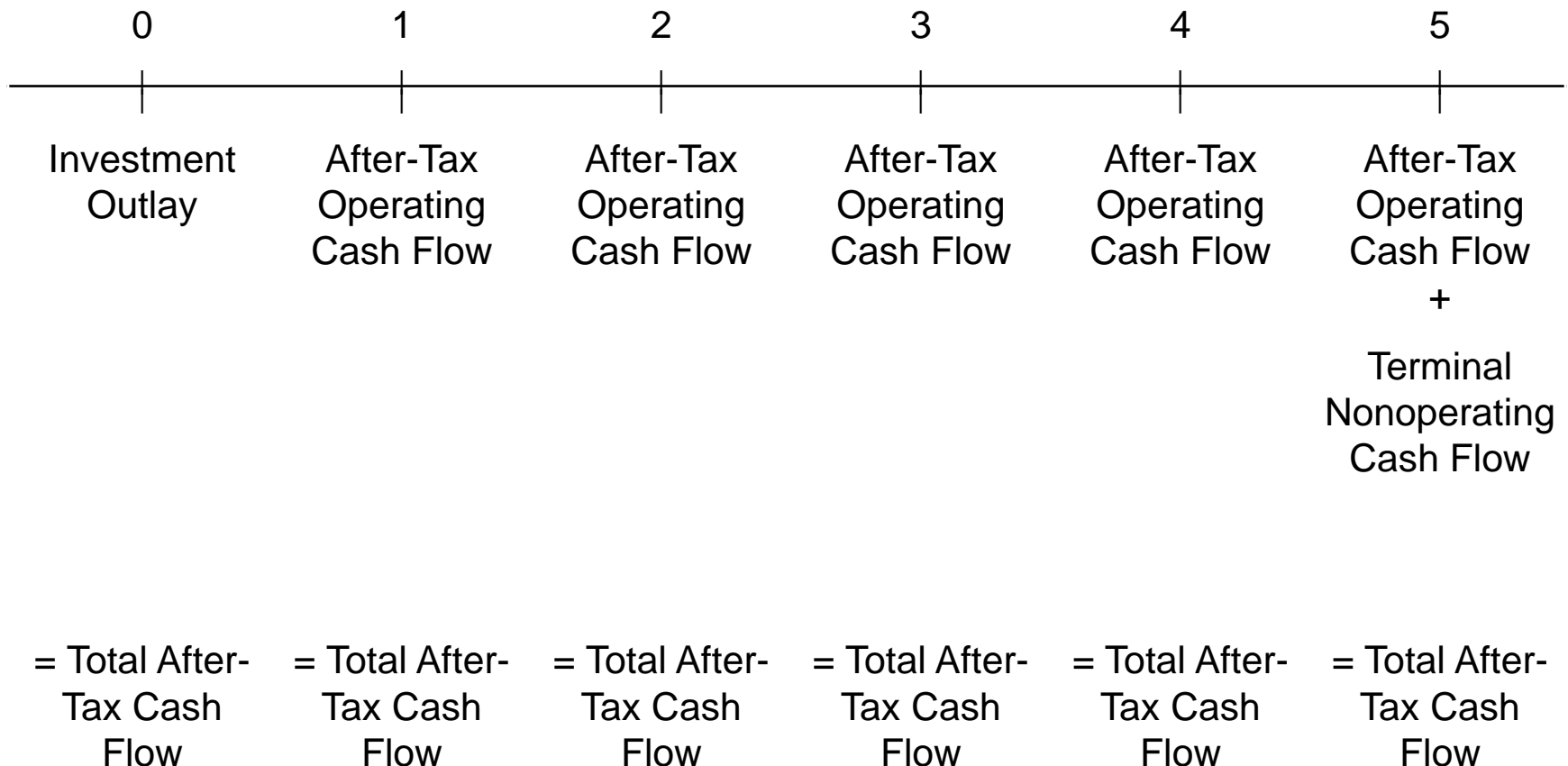


POPULARITY AND USAGE OF CAPITAL BUDGETING METHODS

- In terms of consistency with owners' wealth maximization, NPV and IRR are preferred over other methods.
- Larger companies tend to prefer NPV and IRR over the payback period method.
- The payback period is still used, despite its failings.
- The NPV is the estimated added value from investing in the project; therefore, this added value should be reflected in the company's stock price.

5. CASH FLOW PROJECTIONS

The goal is to estimate the incremental cash flows of the firm for each year in the project's useful life.



INVESTMENT OUTLAY

<i>Start with</i>	Capital expenditure
<i>Subtract</i>	Increase in working capital
<i>Equals</i>	<hr/> Initial outlay

AFTER-TAX OPERATING CASH FLOW

<i>Start with</i>	Sales
<i>Subtract</i>	Cash operating expenses
<i>Subtract</i>	Depreciation
<i>Equals</i>	<hr/> Operating income before taxes
<i>Subtract</i>	Taxes on operating income
<i>Equals</i>	<hr/> Operating income after taxes
<i>Plus</i>	Depreciation
<i>Equals</i>	<hr/> After-tax operating cash flow

TERMINAL YEAR AFTER-TAX NONOPERATING CASH FLOW

<i>Start with</i>	After-tax salvage value
<i>Add</i>	Return of net working capital
	<hr/>
<i>Equals</i>	Nonoperating cash flow

FORMULA APPROACH

Initial outlay $\text{Outlay} = \text{FCInv} + \text{NWCInv} - \text{Sal}_0 + T(\text{Sal}_0 - B_0)$ (6)

After-tax operating cash flow $\text{CF} = (\text{S} - \text{C} - \text{D})(1 - T) + \text{D}$ (7)

$$\text{CF} = (\text{S} - \text{C})(1 - T) + \text{TD}$$
 (8)

Terminal year after-tax nonoperating cash flow (TNOCF) $\text{TNOCF} = \text{Sal}_T + \text{NWCInv} - T(\text{Sal}_T - B_T)$ (9)

FCINV = Investment in new fixed capital

S = Sales

NWCInv = Investment in working capital

C = Cash operating expenses

Sal₀ = Cash proceeds

D = Depreciation

B₀ = Book value of capital

T = Tax rate

EXAMPLE: CASH FLOW ANALYSIS

Suppose a company has the opportunity to bring out a new product, the Vitamin-Burger. The initial cost of the assets is \$100 million, and the company's working capital would increase by \$10 million during the life of the new product. The new product is estimated to have a useful life of four years, at which time the assets would be sold for \$5 million.

Management expects company sales to increase by \$120 million the first year, \$160 million the second year, \$140 million the third year, and then trailing to \$50 million by the fourth year because competitors have fully launched competitive products. Operating expenses are expected to be 70% of sales, and depreciation is based on an asset life of three years under MACRS (modified accelerated cost recovery system).

If the required rate of return on the Vitamin-Burger project is 8% and the company's tax rate is 35%, should the company invest in this new product? Why or why not?

EXAMPLE: CASH FLOW ANALYSIS

Pieces:

- Investment outlay = $-\$100 - \$10 = -\$110$ million.
- Book value of assets at end of four years = \$0.
 - Therefore, the \$5 salvage represents a taxable gain of \$5 million.
 - Cash flow upon salvage = $\$5 - (\$5 \times 0.35) = \$5 - 1.75 = \3.25 million.

EXAMPLE: CASH FLOW ANALYSIS

Year	0
<i>Investment outlays</i>	
Fixed capital	-\$100.00
Net working capital	<u>-10.00</u>
Total	-\$110.00

EXAMPLE: CASH FLOW ANALYSIS

Year	1	2	3	4
<i>Annual after-tax operating cash flows</i>				
Sales	\$120.00	\$160.00	\$140.00	\$50.00
Cash operating expenses	84.00	112.00	98.00	35.00
Depreciation	<u>33.33</u>	<u>44.45</u>	<u>14.81</u>	<u>7.41</u>
Operating income before taxes	\$2.67	\$3.55	\$27.19	\$7.59
Taxes on operating income	<u>0.93</u>	<u>1.24</u>	<u>9.52</u>	<u>2.66</u>
Operating income after taxes	\$1.74	\$2.31	\$17.67	\$4.93
Add back depreciation	<u>33.33</u>	<u>44.45</u>	<u>14.81</u>	<u>7.41</u>
After-tax operating cash flow	\$35.07	\$46.76	\$32.48	\$12.34

EXAMPLE: CASH FLOW ANALYSIS

Year

4

Terminal year after-tax nonoperating cash flows

After-tax salvage value

\$3.25

Return of net working capital

10.00

Total terminal after-tax non-operating cash flows

\$13.25

EXAMPLE: CASH FLOW ANALYSIS

Year	0	1	2	3	4
Total after-tax cash flow	-\$110.00	\$35.07	\$46.76	\$32.48	\$25.59
Discounted value, at 8%	-\$110.00	\$32.47	\$40.09	\$25.79	\$18.81
Net present value	\$7.15				
Internal rate of return	11.068%				

6. MORE ON CASH FLOW PROJECTIONS

Depreciation Issues

Replacement
Decisions

Inflation

RELEVANT DEPRECIATION

- The relevant depreciation expense to use is the expense allowed for tax purposes.
 - In the United States, the relevant depreciation is MACRS, which is a set of prescribed rates for prescribed classes (e.g., 3-year, 5-year, 7-year, and 10-year).
 - MACRS is based on the declining balance method, with an optimal switch to straight-line and half of a year of depreciation in the first year.

EXAMPLE: MACRS

Suppose a U.S. company is investing in an asset that costs \$200 million and is depreciated for tax purposes as a five-year asset. The depreciation for tax purposes is (in millions):

Year	MACRS Rate	Depreciation
1	20.00%	\$40.00
2	32.00%	64.00
3	19.20%	38.40
4	11.52%	23.04
5	11.52%	23.04
6	<u>5.76%</u>	<u>11.52</u>
Total	100.00%	\$200.00

PRESENT VALUE OF DEPRECIATION TAX SAVINGS

- The cash flow generated from the deductibility of depreciation (which itself is a noncash expense) is the product of the tax rate and the depreciation expense.
 - If the depreciation expense is \$40 million, the cash flow from this expense is \$40 million \times Tax rate.
 - The present value of these cash flows over the life of the project is the **present value of tax savings from depreciation.**

PRESENT VALUE OF DEPRECIATION TAX SAVINGS

Continuing the example with the five-year asset, the company's tax rate is 35% and the appropriate required rate of return is 10%. Therefore, the present value of the tax savings is \$55.89 million.

(in millions)

<i>Year</i>	<i>MACRS Rate</i>	<i>Depreciation</i>	<i>Tax Savings</i>	<i>Present Value of Depreciation Tax Savings</i>
1	20.00%	\$40.00	\$14.00	\$12.73
2	32.00%	64.00	22.40	18.51
3	19.20%	38.40	13.44	10.10
4	11.52%	23.04	8.06	5.51
5	11.52%	23.04	8.06	5.01
6	5.76%	<u>11.52</u>	<u>4.03</u>	<u>4.03</u>
		\$200.00	\$69.99	\$55.89

CASH FLOWS FOR A REPLACEMENT PROJECT

- When there is a replacement decision, the relevant cash flows expand to consider the disposition of the replaced assets:
 - Incremental depreciation expense (old versus new depreciation)
 - Other incremental operating expenses
 - Nonoperating expenses
- Key: The relevant cash flows are those that change with the replacement.

SPREADSHEET MODELING

- We can use spreadsheets (e.g., Microsoft Excel) to model the capital budgeting problem.
- Useful Excel functions:
 - Data tables
 - NPV
 - IRR
- A spreadsheet makes it easier for the user to perform sensitivity and simulation analyses.

EFFECTS OF INFLATION ON CAPITAL BUDGETING ANALYSIS

- Issue: Although the nominal required rate of return reflects inflation expectations and sales and operating expenses are affected by inflation,
 - The effect of inflation may not be the same for sales as operating expenses.
 - Depreciation is not affected by inflation.
 - The fixed cost nature of payments to bondholders may result in a benefit or a cost to the company, depending on inflation relative to expected inflation.

7. PROJECT ANALYSIS AND EVALUATION

What if we are choosing among mutually exclusive projects that have different useful lives?

What happens under capital rationing?

How do we deal with risk?

MUTUALLY EXCLUSIVE PROJECTS WITH UNEQUAL LIVES

- When comparing projects that have different useful lives, we cannot simply compare NPVs because the timing of replacing the projects would be different, and hence, the number of replacements between the projects would be different in order to accomplish the same function.
- Approaches
 1. Determine the least common life for a finite number of replacements and calculate NPV for each project.
 2. Determine the annual annuity that is equivalent to investing in each project *ad infinitum* (that is, calculate the **equivalent annual annuity, or EAA**).

EXAMPLE: UNEQUAL LIVES

Consider two projects, Project G and Project H, both with a required rate of return of 5%:

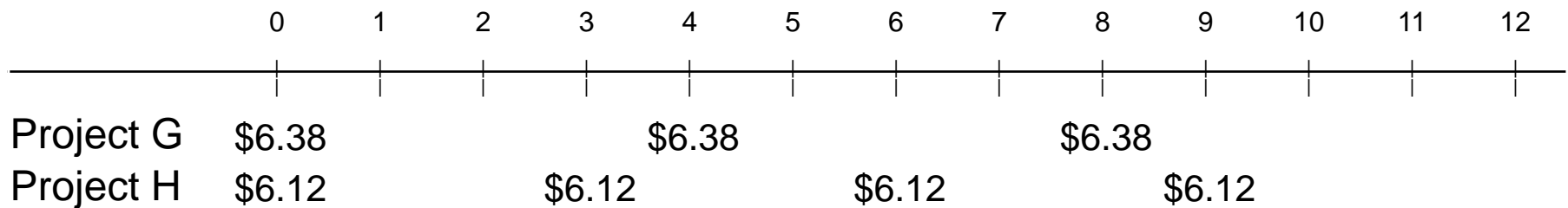
Year	End-of-Year Cash Flows	
	Project G	Project H
0	-\$100	-\$100
1	30	38
2	30	39
3	30	40
4	30	
NPV	\$6.38	\$6.12

Which project should be selected, and why?

EXAMPLE: UNEQUAL LIVES

NPV WITH A FINITE NUMBER OF REPLACEMENTS

Project G: Two replacements
Project H: Three replacements



NPV of Project G: original, plus two replacements = \$17.37

NPV of Project H: original, plus three replacements = \$21.69

EXAMPLE: UNEQUAL LIVES EQUIVALENT ANNUAL ANNUITY

Project G

$$PV = \$6.38$$

$$N = 4$$

$$I = 5\%$$

Solve for PMT

$$PMT = \$1.80$$

Project H

$$PV = \$6.12$$

$$N = 3$$

$$I = 5\%$$

Solve for PMT

$$PMT = \$2.25$$

Therefore, Project H is preferred (higher equivalent annual annuity).

DECISION MAKING UNDER CAPITAL RATIONING

- When there is capital rationing, the company may not be able to invest in all profitable projects.
- The key to decision making under capital rationing is to select those projects that maximize the total net present value given the limit on the capital budget.

EXAMPLE: CAPITAL RATIONING

- Consider the following projects, all with a required rate of return of 4%:

<i>Project</i>	<i>Initial Outlay</i>	<i>NPV</i>	<i>PI</i>	<i>IRR</i>
One	-\$100	\$20	1.20	15%
Two	-\$300	\$30	1.10	10%
Three	-\$400	\$40	1.10	8%
Four	-\$500	\$45	1.09	5%
Five	-\$200	\$15	1.08	5%

Which projects, if any, should be selected if the capital budget is:

1. \$100?
2. \$200?
3. \$300?
4. \$400?
5. \$500?

EXAMPLE: CAPITAL RATIONING

Possible decisions:

<i>Budget</i>	<u><i>Choices</i></u>	<u><i>NPV</i></u>	<u><i>Choices</i></u>	<u><i>NPV</i></u>	<u><i>Choices</i></u>	<u><i>NPV</i></u>
\$100	One	\$20				
\$200	One	\$20	Two	\$15		
\$300	One + Five	\$35	Two	\$15		
\$400	One + Two	\$50	Three	\$40		
\$500	One + Three	\$60	Four	\$45	Two + Five	\$45

Optimal choices

Key: Maximize the total net present value for any given budget.

RISK ANALYSIS: STAND-ALONE METHODS

- **Sensitivity analysis** involves examining the effect on NPV of changes in one input variable at a time.
- **Scenario analysis** involves examining the effect on NPV of a set of changes that reflect a scenario (e.g., recession, normal, or boom economic environments).
- **Simulation analysis** (Monte Carlo analysis) involves examining the effect on NPV when all uncertain inputs follow their respective probability distributions.
 - With a large number of simulations, we can determine the distribution of NPVs.

RISK ANALYSIS: MARKET RISK METHODS

The required rate of return, when using a market risk method, is the return that a diversified investor would require for the project's risk.

- Therefore, the required rate of return is a risk-adjusted rate.
- We can use models, such as the CAPM or the arbitrage pricing theory, to estimate the required return.

Using CAPM,

$$r_i = R_F + \beta_i [E(R_M) - R_F] \quad (10)$$

where

r_i = required return for project or asset i

R_F = risk-free rate of return

β_i = beta of project or asset i

$[E(R_M) - R_F]$ = market risk premium, the difference between the expected market return and the risk-free rate of return

REAL OPTIONS

- A **real option** is an option associated with a real asset that allows the company to enhance or alter the project's value with decisions some time in the future.
- Real option examples:
 - **Timing option:** Allow the company to delay the investment
 - **Sizing option:** Allow the company to expand, grow, or abandon a project
 - **Flexibility option:** Allow the company to alter operations, such as changing prices or substituting inputs
 - **Fundamental option:** Allow the company to alter its decisions based on future events (e.g., drill based on price of oil, continued R&D depending on initial results)

ALTERNATIVE TREATMENTS FOR ANALYZING PROJECTS WITH REAL OPTIONS

Use NPV without considering real options; if positive, the real options would not change the decision.

Estimate $NPV = NPV - \text{Cost of real options} + \text{Value of real options}$.

Use decision trees to value the options at different decision junctures.

Use option-pricing models, although the valuation of real options becomes complex quite easily.

COMMON CAPITAL BUDGETING PITFALLS

- Not incorporating economic responses into the investment analysis
- Misusing capital budgeting templates
- Pet projects
- Basing investment decisions on EPS, net income, or return on equity
- Using IRR to make investment decisions
- Bad accounting for cash flows
- Overhead costs
- Not using the appropriate risk-adjusted discount rate
- Spending all of the investment budget just because it is available
- Failure to consider investment alternatives
- Handling sunk costs and opportunity costs incorrectly

8. OTHER INCOME MEASURES AND VALUATION MODELS

- In the basic capital budgeting model, we estimate the incremental cash flows associated with acquiring the assets, operating the project, and terminating the project.
- Once we have the incremental cash flows for each period of the capital project's useful life, including the initial outlay, we apply the net present value or internal rate of return methods to evaluate the project.
- Other income measures are variations on the basic capital budgeting model.

ECONOMIC AND ACCOUNTING INCOME

Accounting Income

- Focus on income
- Depreciation based on original cost

Economic Income

- Focus on cash flow and change in market value
- Depreciation based on loss of market value

Cash Flows for Capital Budgeting

- Focus on cash flow
- Depreciation based on tax basis

ECONOMIC PROFIT, RESIDUAL INCOME, AND CLAIMS VALUATION

- **Economic profit (EP)** is the difference between net operating profit after tax (NOPAT) and the cost of capital (in monetary terms).

$$EP = \text{NOPAT} - \$WACC \quad (12)$$

- **Residual income (RI)** is the difference between accounting net income and an equity charge.
 - The equity charge reflects the required rate of return on equity (r_e) multiplied by the book value of equity (B_{t-1}).

$$RI_t = NI_t - r_e B_{t-1} \quad (15)$$

- **Claims valuation** is the division of the value of assets among security holders based on claims (e.g., interest and principal payments to bondholders).

EXAMPLE:

ECONOMIC VS. ACCOUNTING INCOME

Consider the Hoofdstad Project again, with the after-tax cash flows as before, plus additional information:

Year	1	2	3	4
After-tax operating cash flow	\$35.07	\$46.76	\$32.48	\$12.34
Beginning market value (project)	\$10.00	\$15.00	\$17.00	\$19.00
Ending market value (project)	\$15.00	\$17.00	\$19.00	\$20.00
Debt	\$50.00	\$50.00	\$50.00	\$50.00
Book equity	\$47.74	\$46.04	\$59.72	\$60.65
Market value of equity	\$55.00	\$49.74	\$48.04	\$60.72

What is this project's economic and accounting income?

EXAMPLE: ECONOMIC VS. ACCOUNTING INCOME

Solution:

Year	1	2	3	4
Economic income	\$40.07	\$48.76	\$34.48	\$13.34
Accounting income	-\$2.26	-\$1.69	\$13.67	\$0.93

RESIDUAL INCOME METHOD

- The residual income method requires:
 - Estimating the return on equity;
 - Estimating the equity charge, which is the product of the return on equity and the book value of equity; and
 - Subtracting the equity charge from the net income.

$$RI_t = NI_t - r_e B_{t-1} \quad (15)$$

where

RI_t = Residual income during period t

NI_t = Net income during period t

$r_e B_{t-1}$ = Equity charge for period t , which is the required rate of return on equity, r_e , times the beginning-of-period book value of equity, B_{t-1}

EXAMPLE: RESIDUAL INCOME METHOD

Suppose the Boat Company has the following estimates, in millions:

Year	1	2	3	4
Net income	\$46	\$49	\$56	\$56
Book value of equity	\$78	\$81	\$84	\$85
Required rate of return on equity	12%	12%	12%	12%

The residual income for each year, in millions:

	Year	1	2	3	4
Step 1					
<i>Start with</i>	Book value of equity	\$78	\$81	\$84	\$85
<i>Multiply by</i>	Required rate of return on equity	<u>12%</u>	<u>12%</u>	<u>12%</u>	<u>12%</u>
<i>Equals</i>	Required earnings on equity	\$9	\$10	\$10	\$10
Step 2					
<i>Start with</i>	Net income	\$46	\$49	\$56	\$56
<i>Subtract</i>	Required earnings on equity	<u>9</u>	<u>10</u>	<u>10</u>	<u>10</u>
<i>Equals</i>	Residual income	\$37	\$39	\$46	\$46

EXAMPLE: RESIDUAL METHOD

- The present value of the residual income, discounted using the 12% required rate of return, is \$126 million.
- This is an estimate of how much value a project will add (or subtract, if negative).

CLAIMS VALUATION

- The claims valuation method simply divides the “claims” of the suppliers of capital (creditors and owners) and then values the equity distributions.
 - The claims of creditors are the interest and principal payments on the debt.
 - The claims of the owners are the anticipated dividends.

EXAMPLE: CLAIMS VALUATION

Suppose the Portfolio Company has the following estimates, in millions:

Year	1	2	3	4
Cash flow before interest and taxes	\$80	\$85	\$95	\$95
Interest expense	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>
Cash flow before taxes	\$76	\$82	\$93	\$94
Taxes	<u>30</u>	<u>33</u>	<u>37</u>	<u>38</u>
Operating cash flow	\$46	\$49	\$56	\$56
Principal payments	\$11	\$12	\$13	\$14

1. What are the distributions to owners if dividends are 50% of earnings after principal payments?
2. What is the value of the distributions to owners if the required rate of return is 12% and the before-tax cost of debt is 8%?

EXAMPLE: CLAIMS VALUATION

1. Distributions to Owners:

	Year	1	2	3	4
<i>Start with</i>	Interest expense	\$4	\$3	\$2	\$1
<i>Add</i>	Principal payments	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>
<i>Equals</i>	Total payments to bondholders	\$15	\$15	\$15	\$15
<i>Start with</i>	Operating cash flow	\$46	\$49	\$56	\$56
<i>Subtract</i>	Principal payments to bondholders	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>
<i>Equals</i>	Cash flow after principal payments	\$35	\$37	\$43	\$42
<i>Multiply by</i>	Portion of cash flow distributed	<u>50%</u>	<u>50%</u>	<u>50%</u>	<u>50%</u>
<i>Equals</i>	Equity distribution	\$17	\$19	\$21	\$21

EXAMPLE: CLAIMS VALUATION

2. Value of Claims

Present value of debt claims = \$50

Present value of equity claims = \$59

Therefore, the value of the firm = \$109

COMPARISON OF METHODS

Issue	Traditional Capital Budgeting	Economic Profit	Residual Income	Claims Valuation
Uses net income or cash flow?	Cash flow	Cash flow	Net income	Cash flow
Is there an equity charge?	In the cost of capital	In the cost of capital in dollar terms	Using the required rate of return	No
Based on actual distributions to debtholders and owners?	No	No	No	Yes

9. SUMMARY

- Capital budgeting is used by most large companies to select among available long-term investments.
- The process involves generating ideas, analyzing proposed projects, planning the budget, and monitoring and evaluating the results.
- Projects may be of many different types (e.g., replacement, new product), but the principles of analysis are the same: Identify incremental cash flows for each relevant period.
- Incremental cash flows do not explicitly include financing costs, but are discounted at a risk-adjusted rate that reflects what owners require.
- Methods of evaluating a project's cash flows include the net present value, the internal rate of return, the payback period, the discounted payback period, the accounting rate of return, and the profitability index.

SUMMARY (CONTINUED)

- The preferred capital budgeting methods are the net present value, internal rate of return, and the profitability index.
 - In the case of selecting among mutually exclusive projects, analysts should use the NPV method.
 - The IRR method may be problematic when a project has a nonconventional cash flow pattern.
 - The NPV is the expected added value from a project.
- We can look at the sensitivity of the NPV of a project using the NPV profile, which illustrates the NPV for different required rates of return.
- We can identify cash flows relating to the initial outlay, operating cash flows, and terminal, nonoperating cash flows.
 - Inflation may affect the various cash flows differently, so this should be explicitly included in the analysis.

SUMMARY (CONTINUED)

- When comparing projects that have different useful lives, we can either assume a finite number of replacements of each so that the projects have a common life or we can use the equivalent annual annuity approach.
- We can use sensitivity analysis, scenario analysis, or simulation to examine a project's attractiveness under different conditions.
- The discount rate applied to cash flows or used as a hurdle in the internal rate of return method should reflect the project's risk.
 - We can use different methods, such as the capital asset pricing model, to estimate a project's required rate of return.
- Most projects have some form of real options built in, and the value of a real option may affect the project's attractiveness.
- There are valuation alternatives to traditional capital budgeting methods, including economic profit, residual income, and claims valuation.